Development of an Offshore Wind Farm in Hong Kong

EM&A Manual

11 November 2014

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Document Code:
WMS_Updated EM&A Manual_v11.doc

Client:	Project No:
HK Electric	0169904
Summary: This document presents the EM&A Manual for the EIA Study for an Offshore Wind Farm in Hong Kong waters.	Date: 11 November 2014 Approved by:  *Craig A Reid* *Partner*

Revision	Description	By	Checked	Approved	Date
11	EM&A Manual_WMS	CY	JT	CAR	11/11/14
10	EM&A Manual_WMS	JT	JT	CAR	12/08/14
9	EM&A Manual_WMS	JT	JT	CAR	26/09/13
8	EM&A Manual_WMS	RC	JT	CAR	15/08/13
7	EM&A Manual_WMS	JY	JT	CAR	29/05/13
6	EM&A Manual_WMS	Various	JNG	CAR	13/07/11
4b	EM&A Manual_WMS	Various	CAR	CAR	23/06/11
4a	EM&A Manual_WMS	Various	CAR	CAR	21/06/11
4	EM&A Manual_WMS	Various	CAR	CAR	21/06/11
3	EM&A Manual_WMS	JT	CAR	CAR	20/06/11
2a	EM&A Manual_WMS	Various	CAR	RK	12/04/11

Distribution

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1 INTRODUCTION

1.1 BACKGROUND

The Hongkong Electric Company, Ltd. (hereinafter referred to as HK Electric) is developing a large-scale wind farm in Hong Kong to generate power from renewable sources (the Project). The project will produce around 100 MW of electricity, which will be supplied directly to the HK Electric grid network to help meeting the HKSAR Government commitments to renewable energy generation and reduction in greenhouse gas emissions.

The Project is designated under *Schedule 2, Part I, Item D.1. – Public Utility Electricity Power Plant* of the *Environmental Impact Assessment Ordinance* (EIAO) and as such the statutory procedures under the EIAO need to be followed and an environmental permit is required prior to the commencement of construction.

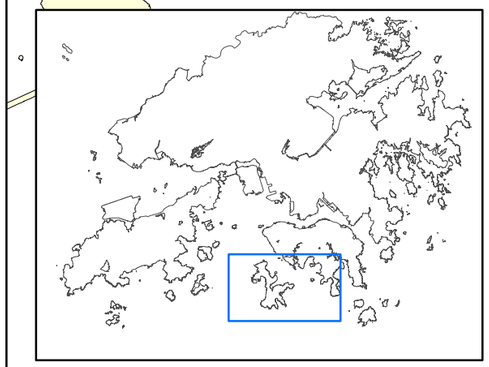
The HK Electric commissioned ERM-Hong Kong, Limited (ERM) in 2006 to provide professional environmental services in respect of assessing the Project and to proceed with obtaining an Environmental Permit (EP) based on the *EIA Study Brief No. ESB-151/2006* received from the Environmental Protection Department (EPD). An EIA of the Offshore Wind Farm at Southwest Lamma facility (*EIAO Register Number AEIAR-152/2010*), based upon the layout detailed in *Figure 1.1*, was prepared in accordance with EIA Study Brief issued by the EPD in August 2006 and submitted under the EIAO in January 2010 and subsequently Environmental Permit *EP-394/2010* was granted on the 8th June 2010.

The EIA (*EIAO Register Number AEIAR-152/2010*) for the project recommended comprehensive Environmental Monitoring and Audit requirements to be undertaken during the construction and operational stages of the project. As such an Environmental Monitoring and Audit (EM&A) Manual for the Offshore Wind Farm was prepared and submitted under the Ordinance (1).

1.2 PURPOSE OF THE MANUAL

This Environmental Monitoring and Audit (EM&A) Manual ("the Manual") has been prepared by ERM-Hong Kong, Limited (ERM) on behalf of HK Electric. The Manual is a supplementary document of the Environmental Impact Assessment (EIA) Study of the development of an offshore wind farm in the Hong Kong SAR (hereafter referred to as the Project).

(1) ERM-Hong Kong, Limited (2010) Development of an Offshore Wind Farm in Hong Kong - Environmental Monitoring and Audit (EM&A) Manual. http://www.epd.gov.hk/eia/register/report/eiareport/eia_1772009/cover.html



Key

Cable Route

Potential Development Site

Wind Monitoring Station

Lamma Island

N

Meters

0 1,000 2,000

Figure 1.1

Location of the SW Lamma Offshore Windfarm and Cable Route

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The Manual has been prepared in accordance with the *EIA Study Brief* (No. ESB-151/2006) and the *Technical Memorandum of the Environmental Impact Assessment Process* (*EIAO TM*). The purpose of the Manual is to provide information, guidance and instruction to personnel charged with environmental duties and those responsible for undertaking EM&A work during construction and operation. It provides systematic procedures for monitoring and auditing of potential environmental impacts that may arise from the works.

This Manual contains the following information:

- Responsibilities of the Contractor(s), Environmental Team (ET), and the Independent Environmental Checker (IEC) with respect to the environmental monitoring and audit requirements during the course of the project;
- Project organisation;
- Requirements with respect to the construction and operational programme schedule and the necessary environmental monitoring and audit programme to track the varying environmental impact;
- Details of the methodologies to be adopted including field, laboratory and analytical procedures, and details on quality assurance and quality control programme;
- Preliminary definition of Action and Limit levels;
- Establishment of Event and Action plans;
- Requirements for reviewing pollution sources and working procedures required in the event of exceedances of applicable criteria and/or receive of complaints;
- Requirements for presentation of environmental monitoring and audit data and appropriate reporting procedures; and
- Requirements for review of EIA predictions and the effectiveness of the mitigation measures/environmental management systems and the EM&A programme.

For the purpose of this manual, the ET Leader (ETL), who will be responsible for and in charge of the ET, will refer to the person delegated the role of executing the EM&A requirements.

This Manual is considered to be a working document and should be reviewed periodically and updated if necessary during the course of implementing the Project.

1.3 PROJECT DESCRIPTION

1.3.1 PROJECT SCOPE

The key components of the Project include the following:

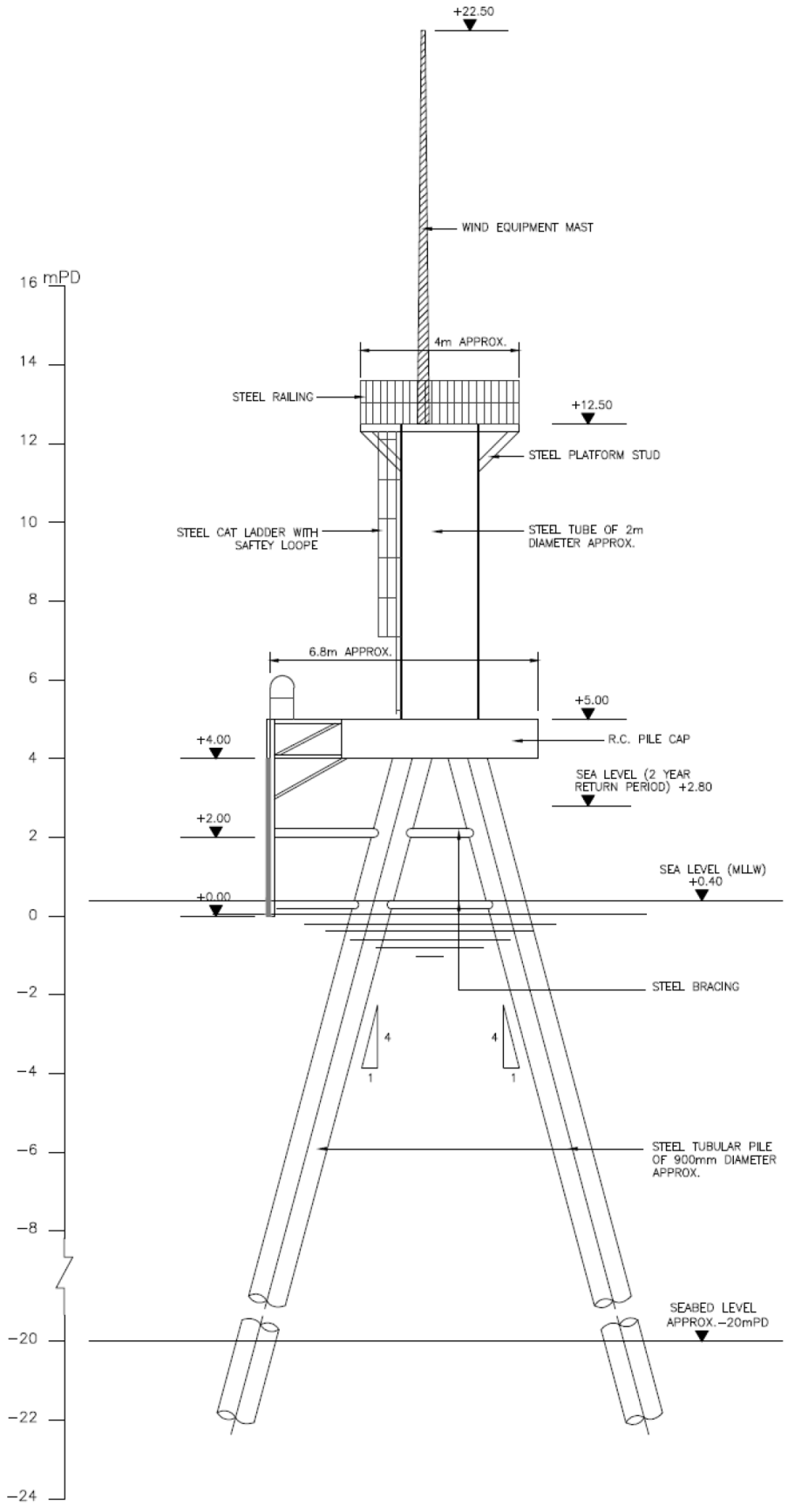
- The construction of around thirty (30) to thirty five (35) individual 3 to 3.6MW class wind turbine units, including seabed works required for foundation emplacement.
- The installation of interconnecting submarine electricity cables between turbine units, to the onshore substation and to grid.
- An onshore substation to be installed and located at Lamma Power Station Extension.
- Development of an onshore lay down area and quayside for material storage and pre-assembly works.
- Development of an offshore wind monitoring station.

1.3.2 DESIGN OF FACILITIES

Wind Monitoring Station

The offshore wind monitoring station which is required to measure the *in-situ* wind, wave and current data at the Project Site for detailed wind turbine design was installed and put into service in early March 2012. The station consists of a 4m x 4m offshore platform erected on top of a piled foundation (*Figure 1.2*). Wind monitoring equipment are installed on top of the platform comprises a Light Detection And Ranging (LIDAR) unit, data logging and transmission system and a 10m met mast completed with anemometry instruments. Operations of the station are supported by batteries powered by solar PV panels and small wind turbines with backup power from a diesel generator. An Acoustic Current Wave Profiler is deployed onto the seabed for measurement of tidal and wave conditions.

Figure 1.2 Design of the Wind Monitoring Station



Wind Turbines and other Infrastructure

At the time of this Updated EM&A Manual, the design of the wind turbines and other infrastructure is currently still under review. Details of the final design(s) will be provided prior to the installation of such facilities. In the meantime, the reader is referred to the preliminary designs presented in the EIA Report [1] and the Review of Wind Turbine Design Working Paper [2].

1.3.3 SITE LOCATION

The wind farm and cable route are located in the waters between Lamma Island and Cheung Chau lying adjacent to the Southwest Lamma Channel. The closest distance of the site to land is approximately 3.5 km to Lamma Island. The water depth at the site ranges from -18 to -23mPD. The proposed area for development has been developed to avoid main shipping routes, key nature conservation sensitivities and existing pipeline infrastructure buried in the seabed. The proposed cable route will run from the north of the site and connect to the Lamma Power Station Extension as shown in *Figure 1.1.*

1.4 OBJECTIVE OF THE EM&A

The main objectives of the EM&A programme are to:

- provide a database of environmental parameters against which to determine any short term or long term environmental impacts;
- provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- ensure the mitigation recommendations of the EIA are included in the design of the project;
- clarify and identify potential sources of pollution, impact and nuisance arising from the works for the responsible parties;
- confirm compliance with regulatory requirements, contract specifications and EIA study recommendations;
- confirm compliance of environmental designs during the design phase of the Project with the specifications stated in the EIA Report and the EP;
- monitor performance of the mitigation measures and to assess their effectiveness;

(1) ERM-Hong Kong, Limited (2010) Development of an Offshore Wind Farm in Hong Kong - Environmental Impact Assessment Report. http://www.epd.gov.hk/eia/register/report/eiareport/eia_1772009/cover.html

(2) ERM (2012) Development of an Offshore Wind Farm in Hong Kong - Review of Wind Turbine Design Working Paper. Approved by EPD on 24 December 2012.

- take remedial action if unexpected issues or unacceptable impacts arise;
- verify the environmental impacts predicted in the EIA; and
- audit environmental performance.

1.5 THE SCOPE OF THE EM&A PROGRAMME

The scope of this EM&A programme is to:

- implement monitoring, inspection and audit requirements for water quality monitoring programme;
- implement inspection and audit requirements for waste management;
- implement monitoring, inspection and audit requirements for terrestrial ecology monitoring programme;
- implement monitoring, inspection and audit requirements for marine ecology;
- implement monitoring, inspection and audit requirements for noise monitoring programme;
- implement inspection and audit requirements for landscape and visual mitigation measures;
- implement inspection and audit requirements for fisheries;
- implement inspection and audit requirements for cultural heritage;
- liaise with, and provide environmental advice (as requested or when otherwise necessary) to construction site staff on the significance and implications of the environmental monitoring data;
- identify and resolve environmental issues and other functions as they may arise from the works;
- check and advice the Contractor(s)'s overall environmental performance, implementation of Event and Action Plans (EAPs), and remedial actions taken to mitigate adverse environmental effects as they may arise from the works;
- conduct monthly reviews of monitored impact data as the basis for assessing compliance with the defined criteria and to ensure that necessary mitigation measures are identified and implemented, and to undertake additional ad hoc monitoring and auditing as required by special circumstances;

- evaluate and interpret environmental monitoring data to provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards, and to verify the environmental impacts predicted in the EIA;

- manage and liaise with other individuals or parties concerning other environmental issues deemed to be relevant to the construction process;

- conduct regular site inspections of a formal or informal nature to assess:

  - the level of the Contractor(s)'s general environmental awareness;

  - the Contractor(s)'s implementation of the recommendations in the EIA and their contractual obligations;

  - the Contractor(s)' performance as measured by the EM&A;

  - the need for specific mitigation measures to be implemented or the continued usage of those previously agreed;

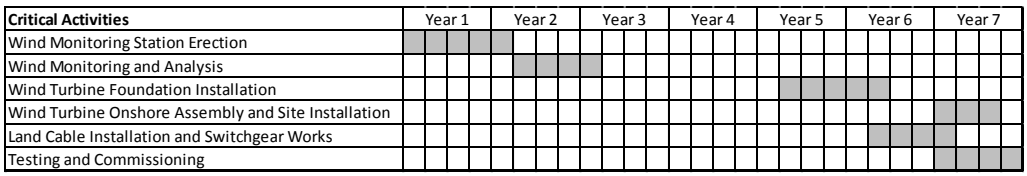
  - to advise the site staff of any identified potential environmental issues; and

- submit monthly EM&A reports which summarise project monitoring and auditing data, with full interpretation illustrating the acceptability or otherwise of any environmental impacts and identification or assessment of the implementation status of agreed mitigation measures.

1.6 WORKS PROGRAMME AND WORKS LOCATIONS

The preliminary programme for the Detailed Design and Construction Phases is presented in *Figure 1.3.*

Figure 1.3 Construction Programme



It should be noted that *Figure 1.3* provides the major construction programme for the Project while some minor works including burying of submarine cables, application of scour protection and installation of artificial reef, etc. will be carried out beyond completion of the testing and commissioning of the wind turbines in Year 7.

1.7 ORGANISATION AND STRUCTURE OF THE EM&A

1.7.1 GENERAL

HK Electric will appoint an Environmental Team (ET) to conduct the monitoring and auditing works and to provide specialist advice on undertaking and implementation of environmental responsibilities.

The ET will have previous relevant experience with managing similarly sized EM&A programmes and the Environmental Team Leader (ET Leader) will be a recognised environmental professional, preferably with a minimum of seven years relevant experience in impact assessments and impact monitoring programmes.

To maintain strict control of the EM&A process, HK Electric will appoint independent environmental consultants to act as an Independent Environmental Checker (IEC) to verify and validate the environmental performance of the Contractor(s) and his Environmental Team. The IEC will have previous relevant experience with checking and auditing similarly sized EM&A programmes and the IEC will be a recognised environmental professional, preferably with a minimum of seven years relevant experience in impact assessments and impact monitoring programmes.

1.7.2 PROJECT ORGANISATION

The roles and responsibilities of the various parties involved in the EM&A process are further expanded in the following sections and in *Figure 1.4*. The ET Leader will be responsible for, and in charge of, the Environmental Team; and will be the person responsible for executing the EM&A requirements, and to develop environmental Contract Clauses for Contractor Contract.

HK Electric

HK Electric will:

- employ an Environmental Team (ET) to undertake monitoring, laboratory analysis and reporting of environmental monitoring and audit data;
- employ an Independent Environmental Checker (IEC) to audit and verify the overall environmental performance of the works and to assess the effectiveness of the ET in their duties;
- supervise the Contractor(s)' activities and ensure that the requirements in the EM&A Manual and the Contract Document are fully complied with;
- develop appropriate contract clauses to ensure that the Contractor(s) will fulfil the EIA/EP requirements;
- inform the Contractor(s) when action is required to reduce impacts in accordance with the Event and Action Plans;

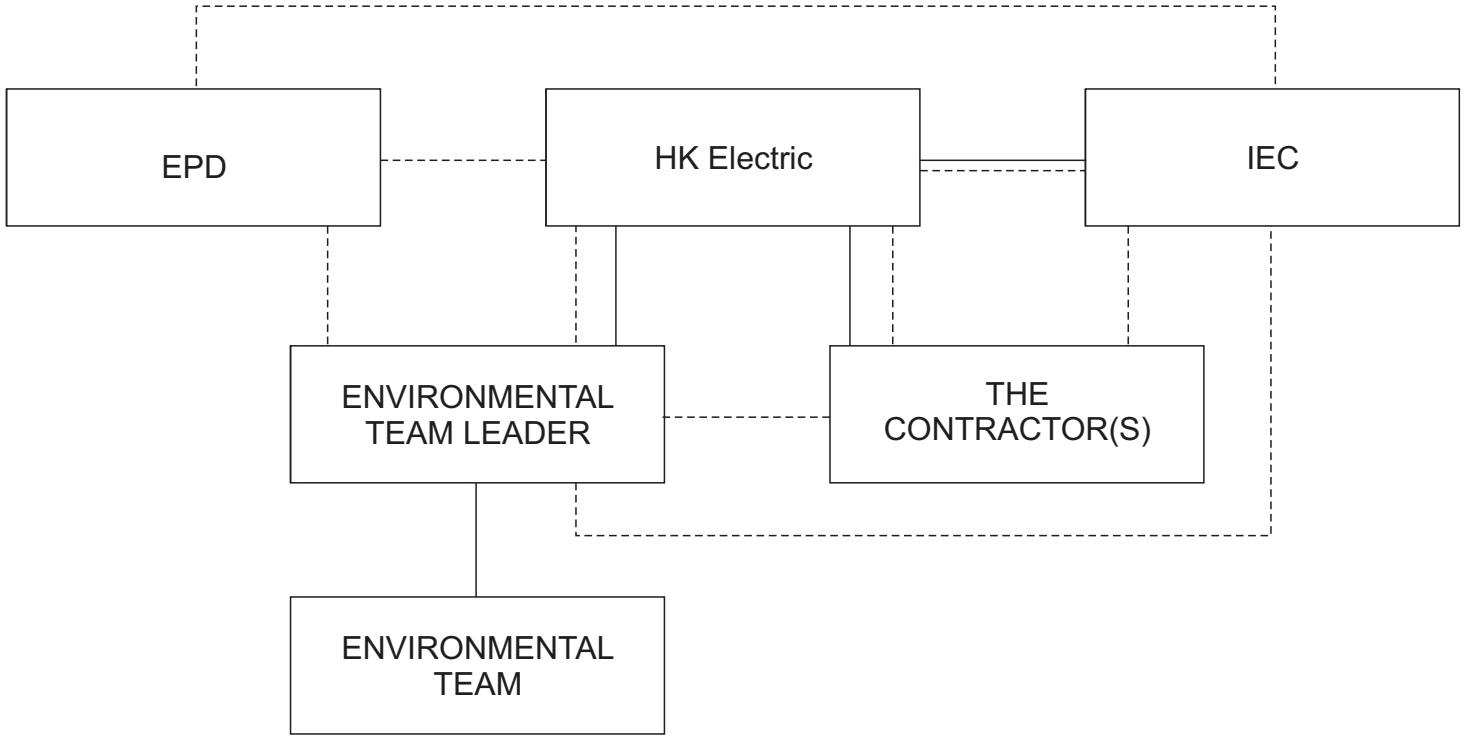


Figure 1.4

Indicative Project Organisation Chart

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DATE: 12/08/2013

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- adhere to the procedures for carrying out complaint investigation; and
- participate in joint site inspections undertaken by the ET and IEC.

The Contractor(s)

The Contractor(s) will:

- work within the scope of the construction contract and other tender conditions;
- provide assistance to the ET in carrying out monitoring;
- submit proposals on mitigation measures in case of exceedances of Action and Limit levels in accordance with the Event and Action Plans;
- implement measures to reduce impact where Action and Limit levels are exceeded;
- implement the corrective actions instructed by HK Electric/ET/IEC;
- participate in the site inspections undertaken by the ET and the IEC, as required, and undertake any corrective actions instructed by HK Electric /ET/IEC; and
- adhere to the procedures for carrying out complaint investigation.

Environmental Team

The Environmental Team (ET) will:

- monitor various environmental parameters as required in this EM&A Manual;
- analyse the EM&A data and review the success of the EM&A programme determining the adequacy of the mitigation measures implemented and the validity of the EIA predictions as well as identify any adverse environmental impacts before they arise;
- carry out regular site inspection to investigate and audit the Contractor(s)'s site practice, equipment and work methodologies with respect to pollution control and environmental mitigation, and effect proactive action to pre-empt issues;
- review the Contractor(s)'s working programme and methodology, and comment as necessary;
- review and prepare reports on the environmental monitoring data, site environmental conditions and audits;

- report on the environmental monitoring and audit results and conditions to the IEC, Contractor(s), EPD and HK Electric;

- recommend suitable mitigation measures to the Contractor(s) in the case of exceedance of Action and Limit levels in accordance with the Event and Action Plans; and

- adhere to the procedures for carrying out complaint investigation.

The ET will be led and managed by the ET Leader. The ET leader will have relevant education, training, knowledge, experience and professional qualifications and the appointment will be subject to the approval of the Director of Environmental Protection. Suitably qualified staff will be included in the ET, and ET should not be in any way an associated body of the Contractor(s).

Independent Environmental Checker

The IEC will:

- review and monitor the implementation of the EM&A programme and the overall level of environmental performance being achieved;

- arrange and conduct independent site inspections/audits of the works on an as-need basis;

- validate and confirm the accuracy of monitoring results, monitoring equipment, monitoring stations, monitoring procedures and locations of sensitive receivers;

- audit the EIA recommendations and requirements against the status of implementation of environmental protection measures on site;

- on a need basis, audit the Contractor(s)'s construction methodology and agree the appropriate, reduced impact alternative in consultation with HK Electric, the ET and the Contractor(s);

- adhere to the procedures for carrying out complaint investigation;

- review the effectiveness of environmental mitigation measures and project environmental performance including the proposed corrective measures;

- review EM&A report submitted by the ET leader and feedback audit results to ET by signing off relevant EM&A proformas; and

- report the findings of site inspections/ audits and other environmental performance reviews to HK Electric, ET, EPD and the Contractor(s).

1.7.3 KEY CONTACT INFORMATION

Key contact information will be provided in a similar format as in *Table 1.1*.

Table 1.1 Contact Information

Name	Position	Telephone	Facsimile	E-mail
HK Electric – Environmental Permit Holder				
Mr. C. K. Lau	General Manager (Projects)	3143 3882	2537 1013	cklau@hkelectric.com
Contractor(s)				
TBC	TBC	TBC	TBC	TBC
Environmental Team				
HK Electric *Attn: Mr. FUNG Kam-Fai Kenneth*	Environmental Team Leader	2843 3441	2537 1013	kfung@hkelectric.com
Independent Environmental Checker				
TBC	TBC	TBC	TBC	TBC

1.8 STRUCTURE OF THE EM&A MANUAL

The remainder of the Manual is set out as follows:

- *Section 2* sets out the EM&A general requirements and EIAO Permit Conditions;
- *Section 3* details the requirements for water quality baseline and impact monitoring, and lists relevant monitoring equipment, compliance and Event and Action Plans (EAPs);
- *Section 4* details the requirements for waste management;
- *Section 5* sets out the EM&A requirement for terrestrial ecology;
- *Section 6* details the requirements for marine ecology;
- *Section 7* details the requirements for noise impacts;
- *Section 8* sets out the EM&A requirements for landscape and visual;
- *Section 9* sets out the EM&A requirements for cultural heritage;
- *Section 10* sets out the EM&A requirements for fisheries;
- *Section 11* describes the scope and frequency of site environmental auditing;
- *Section 12* describes the overall EM&A requirements for the Project; and
- *Section 13* details the reporting requirements for the EM&A.

2 EM&A GENERAL REQUIREMENT

2.1 INTRODUCTION

In this section, the general requirements of the EM&A programme for the Project are presented. The scope of the programme is developed with reference to the findings and recommendations of the EIA Report.

2.2 CONSTRUCTION PHASE EM&A

2.2.1 GENERAL

The environmental issues, which were identified during the EIA process and are associated with the construction phase of the Project will be addressed through the monitoring and controls specified in this EM&A Manual and in the construction contracts.

During the construction phases of the Project (1), water quality, waste, terrestrial ecology, marine ecology, noise, fisheries, landscape and visual and cultural heritage will be subject to EM&A, with environmental monitoring being undertaken for water quality, terrestrial ecology, marine ecology and noise as determined in the EIA. Monitoring of the effectiveness of the mitigation measures will be achieved through the environmental monitoring programme as well as through site inspections. The inspections will include within their scope, mechanisms to review and assess the Contractor(s)'s environmental performance, ensuring that the recommended mitigation measures have been properly implemented, and that the timely resolution of received complaints are managed and controlled in a manner consistent with the recommendations of the EIA Report.

2.2.2 ENVIRONMENTAL MONITORING

The environmental monitoring work throughout the Project period will be carried out in accordance with this EM&A and reported by the ET. Monitoring works will comprise of quantitative assessment of physical parameters, such as water quality, which also form an important part of the whole monitoring programme. The monitoring programme will be conducted at the chosen representative sensitive receivers in the vicinity of the construction site.

(1) It is understood that site investigation works associated with the wind monitoring station and wind farm are not considered as part of the Project. Therefore, commencement of such site investigation works is not classified as "commencement of construction works" under Clause 1.13 of the EP.

2.2.3 ACTION AND LIMIT LEVELS

Action and Limit (A/L) Levels are defined levels of impact recorded by the environmental monitoring activities which represent levels at which a prescribed response is required. These Levels are quantitatively defined later in the relevant sections of this manual and described in principle below:

- *Action Levels:* beyond which there is a clear indication of a deteriorating ambient environment for which appropriate remedial actions are likely to be necessary to prevent environmental quality from falling outside the Limit Levels, which would be unacceptable; and

- *Limit Levels:* statutory and/or agreed contract limits stipulated in the relevant pollution control ordinances, HKPSG or Environmental Quality Objectives established by the EPD. If these are exceeded, works will not proceed without appropriate remedial action, including a critical review of plant and working methods.

2.2.4 EVENT AND ACTION PLANS

The purpose of the Event and Action Plans (EAPs) is to provide, in association with the monitoring and audit activities, procedures for ensuring that if any significant environmental incident occurs, the cause will be quickly identified and remediated. This also applies to the exceedances of A/L criteria identified in the EM&A programme.

2.2.5 SITE INSPECTIONS

In addition to monitoring, as a means of assessing the ongoing performance of the Contractor(s), the ET will undertake site inspections and audits of the compliance with stipulated procedures and on-site practices. The primary objective of the inspection and audit programme will be to assess the effectiveness of the environmental controls established by the Contractor(s) and the implementation of the environmental mitigation measures recommended in the EIA Report. The IEC will undertake site inspection and audit on as need basis to assess the performance of the Contractor(s).

Whilst the audit and inspection programme will complement the monitoring activity, the criteria against which the audits will be undertaken will be derived from the Clauses within the Contract Documents which seek to enforce the recommendations of the EIA Report and the EM&A Manual.

The findings of site inspections and audits will be made known to the Contractor(s) at the time of the inspection to enable the rapid resolution of identified non-conformities. Non-conformities, and the corrective actions undertaken, will also be reported in the monthly EM&A Reports.

Section 11 of this Manual presents details of the scope and frequency of on-site inspections and defines the range of issues that the audit protocols will be designed to address.

2.2.6 ENQUIRIES, COMPLAINT AND REQUESTS FOR INFORMATION

Enquiries, complaints and requests for information may occur from a wide range of individuals and organisations including members of the public, Government departments, the press and community groups.

Enquiries concerning the environmental effects of the construction works, irrespective of how they are received, will be reported to HK Electric and directed to the ET which will set up procedures for the handling, investigation and storage of such information. The following steps will then be followed:

1) The ET Leader will notify HK Electric of the nature of the enquiry.

2) An investigation will be initiated to determine the validity of the complaint and to identify the source of the issue.

3) The Contractor(s) will undertake the following steps, as necessary:

   i) Investigate and identify source of the issue;

   ii) If considered necessary by HK Electric following consultation with the IEC, undertake additional monitoring to verify the existence and severity of the alleged complaint;

   iii) Liaise with ET to identify remedial measures;

   iv) Implement the agreed mitigation measures;

   v) Repeat the monitoring to verify effectiveness of mitigation measures; and

   vi) Repeat review procedures to identify further practical areas of improvement if the repeat monitoring results continue to substantiate the complaint.

4) The outcome of the investigation and the action taken will be documented on a complaint log (*Annex B*). A formal response to each complaint received will be prepared by the Contractor(s) within five working days and submitted to HK Electric, in order to notify the concerned person(s) that action has been taken.

5) Enquires which trigger this process will be reported in the monthly reports which will include results of inspections undertaken by the Contractor(s), and details of the measures taken, and additional monitoring results (if deemed necessary). It should be noted that the

receipt of complaint or enquiry will not be, in itself, a sufficient reason to introduce additional mitigation measures.

The complainant will be notified of the findings, and audit procedures will be put in place to ensure that the issue does not recur.

2.2.7 REPORTING

Baseline, construction phase and post-construction phase monitoring, monthly and final reports will be prepared and certified by the ET Leader and verified by the IEC. The reports will be submitted to the Contractor(s), HK Electric and EPD. The monthly reports will be prepared and submitted within two weeks of the end of each calendar month**.**

2.2.8 CESSATION OF EM&A

The cessation of EM&A programme is subject to the satisfactory completion of the EM&A Final Review Report, agreement with the IEC and approval from EPD.

2.3 OPERATION PHASE EM&A

Based on the findings of the EIA, no operational phase EM&A is considered necessary. Post-construction phase (i.e. within the first year of operation following construction works for the wind turbines) are, however, considered necessary for both bird and marine mammal monitoring. Other operational licenses will require specific monitoring or audit conditions or practices, and a non EIA EM&A practice will need to be put in place.

3 WATER QUALITY

3.1 INTRODUCTION

In accordance with the recommendations of the EIA, water quality EM&A is required during dredging works in the nearshore cable landing area and jetting for cable installation construction works. In addition, baseline water quality monitoring will be required prior to the commencement of dredging works. The following Section provides details of the water quality monitoring to be undertaken by the ET. The water quality monitoring programme will be carried out to ensure that any deteriorating water quality is readily detected and timely action taken to rectify the situation. The status and locations of water quality sensitive receivers and the marine works location may change after issuing this Manual. If required, the ET in consultation with the Contractor(s) will propose updated monitoring locations and seek approval from HK Electric, the IEC and EPD.

3.2 SAMPLING METHODOLOGY

3.2.1 WATER QUALITY PARAMETERS

Measurements of Dissolved Oxygen (DO) concentration (mg L^{-1}), DO saturation (%), Salinity (mg L^{-1}), Temperature (^{o}C) and Turbidity (NTU) will be taken *in situ* by the ET at monitoring stations identified in *Section 3.2.4* below. Water samples for the measurements of SS (mg L^{-1}) will also be collected for laboratory analysis.

In addition to the water quality parameters, other relevant data will also be measured and recorded in Water Quality Monitoring Logs (*Annex C*), including the location of the sampling stations, water depth, time, weather conditions, sea conditions, tidal stage, current direction and speed, special phenomena and work activities undertaken around the monitoring and works area that may influence the monitoring results. Observations on any special phenomena and work underway at the construction site at the time of sampling will also be recorded.

3.2.2 SAMPLING PROCEDURES AND MONITORING EQUIPMENT

For water quality monitoring, the following equipment will be supplied and used by the ET. The use of similar equipment is subject to prior approval from the IEC:

- ***Dissolved Oxygen and Temperature Measuring Equipment*** - The instrument will be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and will be operable from a DC power source. It will be

capable of measuring: dissolved oxygen levels in the range of 0 - 20 mg L^{-1} and 0 - 200% saturation; and a temperature of 0 - 45 degrees Celsius. It will have a membrane electrode with automatic temperature compensation complete with a cable of not less than 35 m in length. Sufficient stocks of spare electrodes and cables will be available for replacement where necessary (e.g. YSI model 59 metre, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

- ***Turbidity Measurement Equipment*** - Turbidity within the water will be measured *in situ* by the nephelometric method. The instrument will be a portable, weatherproof turbidity-measuring unit complete with cable, sensor and comprehensive operation manuals. The equipment will be operated from a DC power source, it will have a photoelectric sensor capable of measuring turbidity between 0 - 1000 NTU and will be complete with a cable with at least 35 m in length (for example Hach 2100P or an approved similar instrument).

- ***Salinity Measurement Instrument*** - A portable salinometer capable of measuring salinity in the range of 0 - 40 ppt will be provided for measuring salinity of the water at each monitoring location.

- ***Suspended Solid Measurement Equipment*** - A water sampler (eg Kahlsico Water Sampler), which is a PVC cylinder (capacity not less than 2 litres), which can be effectively sealed with latex cups at both ends, will be used for sampling. The sampler will have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth. Water samples for suspended solids measurement will be collected in high-density polythene bottles, packed in ice (cooled to 4°C without being frozen), and delivered to the laboratory in the same day as the samples were collected.

- ***Water Depth Gauge*** - A portable, battery-operated echo sounder (Seafarer 700 or a similar approved instrument) will be used for the determination of water depth at each designated monitoring station. This unit will preferably be affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme. The echo sounder should be suitably calibrated.

- ***pH Measuring Equipment*** - A portable pH meter capable of measuring a range between 0.0 and 14.0 will be provided to measure pH under the specified conditions (eg. Orion Model 250A or an approved similar instrument).

- ***Positioning Device*** - A hand-held or boat-fixed type differential Global Positioning System (DGPS) or other equivalent instrument of similar accuracy will be used during monitoring to ensure the accurate recording of the position of the monitoring vessel before taking measurements.

The DGPS or equivalent instrument, should be suitably calibrated at appropriate checkpoint (e.g. Quarry Bay Survey Nail at Easting 840683.49), Northing 816709.55) to ensure the monitoring station is at the correct position before the water quality monitoring commence.

In-situ monitoring instruments will be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at 3 monthly intervals throughout the stages of the water quality monitoring. Responses of sensors and electrodes will be checked with certified standard solutions before each use.

For the on site calibration of field equipment, the BS 1427:1993, "*Guide to Field and on-site test methods for the analysis of waters*" will be observed.

Sufficient stocks of spare parts will be maintained for replacements when necessary. Back-up monitoring equipment will also be available so that monitoring can proceed uninterrupted even when some equipment is under maintenance, calibration, etc.

3.2.3 LABORATORY MEASUREMENT AND ANALYSIS

Analysis of suspended solids will be carried out in a HOKLAS or other international accredited laboratory. Water samples of about 500mL will be collected at the monitoring stations for carrying out the laboratory SS determination. The SS determination work will start within 24 hours after collection of the water samples. The analyses will follow the standard methods as described in APHA *Standard Methods for the Examination of Water and Wastewater*, *19th Edition*, unless otherwise specified (APHA 2540D for SS) with a detection limit of 1 mg L^{-1} or less.

The submitted information should include the chain of custody forms, pre-treatment procedures, instrument use, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per-batch etc), detection limits and accuracy. The QA/QC details will be in accordance with requirements of HOKLAS or another internationally accredited scheme that HOKLAS has an agreement with. The limits of detection for the *in-situ* and laboratory measurements that will be obtained are shown in *Table 3.1*.

Table 3.1 Detection Limits and Precision for Water Quality Parameters

Parameter	Limit of Detection
Dissolved Oxygen	0.1 mg L^{-1}
Salinity	0.01 ppt
Temperature	0.1 °C
pH	0.01 units
Turbidity (NTU)	0.1 NTU
Suspended Solids	1 mg L^{-1}

3.2.4 MONITORING LOCATIONS – MARINE WORKS

Water quality monitoring will be conducted within Hong Kong Waters during dredging and jetting construction activities.

Dredging Impact Monitoring

For the dredging activities, the monitoring locations have been determined based upon the location of the dredging activity which is required for cable landing at nearshore seawall area (*Figure 3.1*).

- D1 and D2 are Impact Stations situated within 1,000m (south/west) from the construction works at cable landing point. The 1,000m distance for the Impact stations typically represents the maximum extent of the zone of influence resulting from dredging activities and at these locations impact from the dredging activities should be at a minimum.
- SR1 is a Sensitive Receiver used to monitor the water quality conditions of the coral community recorded in the seawall area;
- SR2 is a Sensitive Receiver used to monitor the water quality conditions of the Coastal Protection Area of west Lamma;
- SR3 is a Sensitive Receiver used to monitor the water quality conditions of Hung Shing Yeh Beach;
- SR4 is a Sensitive Receiver used to monitor the water quality conditions of Lo So Shing Beach
- SR5 is a Sensitive Receiver used to monitor the water quality conditions of the coral community recorded near Pak Kok;
- SR6 is a Sensitive Receiver used to monitor the water quality conditions of the potential marine park of south Lamma;
- SR7 is a Sensitive Receiver used to monitor the water quality conditions of the green turtle nesting beach at Sham Wan;

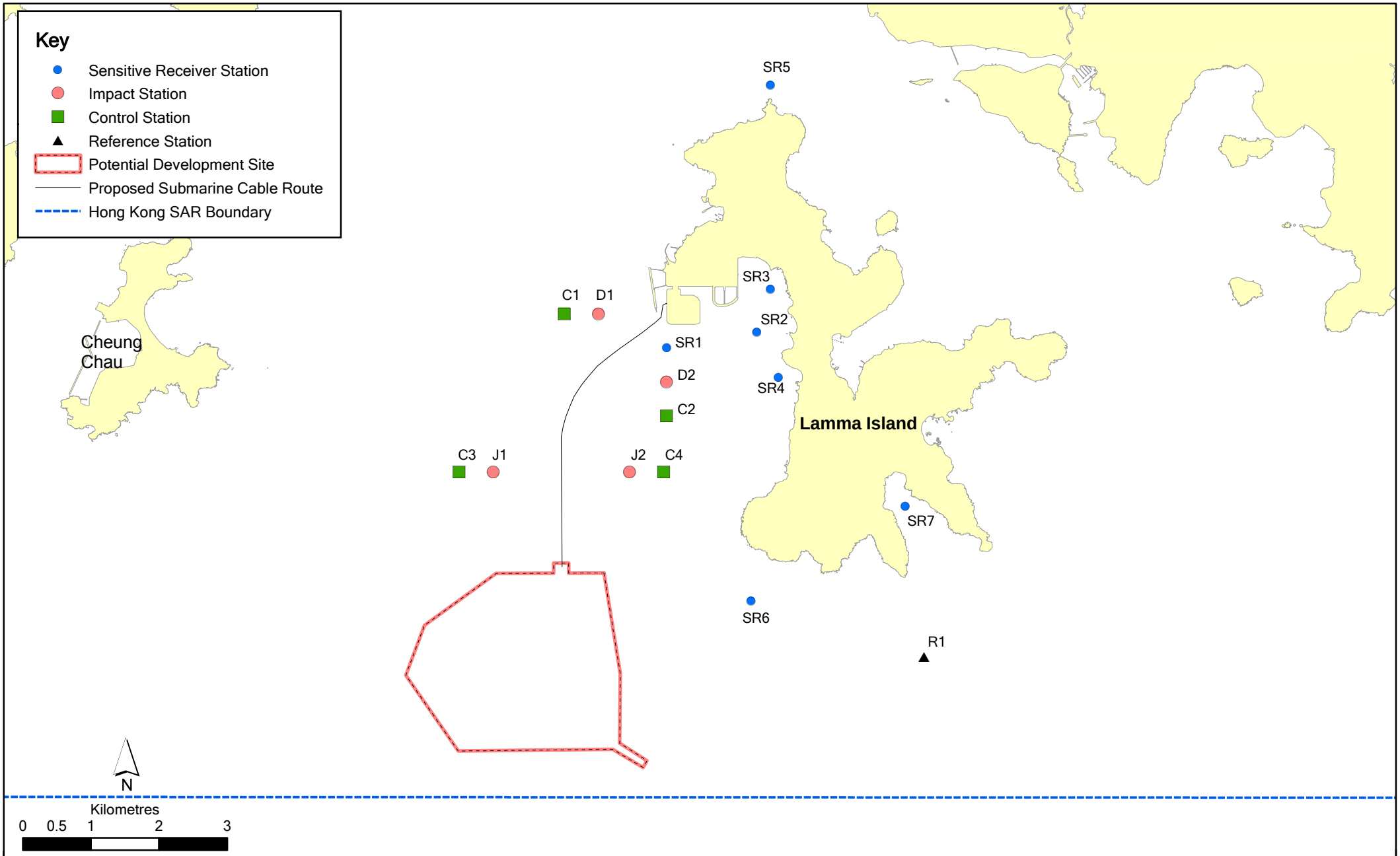

Figure 3.1

Water Quality Monitoring Locations (Indicative)

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Date: 24/11/2009

Environmental Resources Management

ERM

- C1 and C2 are Control Stations for D1 and D2 which are located approximately 1,500m from the construction works at the cable landing point and not supposed to be influenced by the construction works; and,

- R1 is a Reference Station which is not supposed to be influenced by the construction works. This Reference station has been chosen to facilitate comparison of the water quality of the Impact Stations with ambient water quality conditions. The Reference station is located to the east of the development area and in an area of open water. The Reference station is well outside the predicted influence of the construction works. Monitoring data from this Reference station could be used as upstream and downstream control for the Impact stations.

Measurements of pH, Dissolved Oxygen (DO) concentration (mg L^{-1}), DO saturation (%), Salinity (mg L^{-1}), Temperature (^{o}C) and Turbidity (NTU) will be taken *in situ* at monitoring stations. Water samples for the measurements of SS (mg L^{-1}) will also be collected for laboratory analysis.

Jetting Impact Monitoring

The monitoring locations have been determined based upon the location of the jetting activities which are required for the remainder of the cable laying works (*Figure 3.1*).

- J1 and J2 are mobile Impact Stations situated at distances of 1,000m (east/west) from the barge along the cable route.

- C3 and C4 are mobile Control Stations situated within 1,500m (east/west) from the barge along the cable route and not supposed to be influenced by the construction works.

- SR1 is a Sensitive Receiver used to monitor the water quality conditions of the coral community recorded in the seawall area;

- SR2 is a Sensitive Receiver used to monitor the water quality conditions of the Coastal Protection Area of west Lamma;

- SR3 is a Sensitive Receiver used to monitor the water quality conditions of from Hung Shing Yeh Beach;

- SR4 is a Sensitive Receiver used to monitor the water quality conditions of from Lo So Shing Beach

- SR5 is a Sensitive Receiver used to monitor the water quality conditions of the coral community recorded near Pak Kok;

- SR6 is a Sensitive Receiver used to monitor the water quality conditions of the potential marine park of South Lamma;

- SR7 is a Sensitive Receiver used to monitor the water quality conditions of the green turtle nesting beach of Sham Wan;

- R1 is a Reference Station which is not supposed to be influenced by the construction works.

Sediment laden plumes observed from the works area or elsewhere in the vicinity of the control stations during sampling will be recorded and brought to the immediate attention of the ET.

Measurements of pH, Dissolved Oxygen (DO) concentration (mg L^{-1}), DO saturation (%), Salinity (mg L^{-1}), Temperature (^{o}C) and Turbidity (NTU) will be taken *in situ* at monitoring stations. Water samples for the measurements of SS (mg L^{-1}) will also be collected for laboratory analysis.

Water quality monitoring would be undertaken by suitably qualified members of the ET. Water quality monitoring results from the Reference, Control and Impact Stations would be compared to EPD's Water Quality Objectives (WQOs), for the Southern Water Control Zone (SWCZ), as follows:

- Suspended Solids (SS): SS should not be raised above ambient levels by an excess of 30% nor cause the accumulation of SS which may adversely affect aquatic communities.

- Dissolved Oxygen (DO): DO within 2 m of the bottom should not be less than 2 mg L^{-1} for 90% of the samples; depth averaged DO should not be less than 4 mg L^{-1} for 90% of the samples during the whole year.

Prior to the commencement of the EM&A programme, the ET would seek approval of any proposed changes to the water monitoring stations from the IEC, EPD and AFCD.

3.3 BASELINE MONITORING

Baseline monitoring will be conducted to establish the ambient conditions prior to the commencement of the dredging and jetting works and to demonstrate the suitability of the proposed impact and control stations. Where necessary, the baseline monitoring data will be compared with water quality data collected during impact monitoring works.

Baseline monitoring will be conducted at Impact Stations (ie D1, D2, J1 and J2) (1), Control Stations (C1, C2, C3 and C4) (2), Sensitive Receiver Stations (SR1 to SR7), as well as Reference Station (R1) three times a week at mid-flood and mid-ebb tides for four consecutive weeks prior to the commencement of any marine works for the Project. The tidal range selected for the baseline monitoring should be 0.5m for both flood and ebb tides as far as possible.

(1) As these are mobile stations, representative locations should be selected for the baseline monitoring.

(2) As these are mobile stations, representative locations should be selected for the baseline monitoring.

There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring. The interval between 2 sets of consecutive monitoring shall not be less than 36 hours. Baseline monitoring will commence no earlier than two months before construction works are due to commence. The baseline monitoring programme should be passed to EPD at least two weeks prior to commencement of baseline monitoring.

During baseline monitoring, measurements will be taken at each station at three depths, 1 m below the sea surface, mid depth and 1 m above the seabed. Where water depth is less than 6 m the mid-depth station may be omitted. If water depth is less than 3 m, only the mid-depth station will be monitored, to avoid natural resuspension of sediments from confounding the results.

The ET will be responsible for undertaking the baseline monitoring and submitting the results within 10 working days from the completion of the baseline monitoring work to the IEC for certification prior to onward transmission to EPD.

3.4 IMPACT MONITORING

During the course of the marine works (i.e. during dredging, jetting and foundation works), impact monitoring will be undertaken at the relevant Reference, Control and Impact Stations as shown in *Figure 3.1* three times a week. Monitoring at each station will be undertaken at both mid-ebb and mid-flood tides on the same day. The tidal range selected for the impact monitoring should be at least 0.5m for both flood and ebb tides. The interval between two sets of monitoring will not be less than 36 hours. The monitoring frequency will be increased in the case of exceedances of Action/Limit Levels if considered necessary by ET and IEC. Monitoring frequency will be maintained as far as practicable. The impact monitoring schedule should be passed to EPD at least two weeks prior to commencement of impact monitoring.

Two consecutive measurements of pH, DO concentration (mgL^{-1}), DO saturation (%) and turbidity (NTU) will be taken *in-situ* according the stated sampling method. The monitoring probes would be retrieved out of water after the first measurement and then redeployed for the second measurement.

Where the difference in value between the first and second measurement of DO or turbidity parameters is more than 25% of the value of the first reading, the reading would be discarded and further readings will be taken. Water samples for SS (mgL^{-1}) measurements would be collected at the same depths and as for the *in-situ* measurements, duplicates would be taken at Impact, Control and Reference Stations.

In addition to the above *in-situ* measurements temperature and salinity will be determined at the monitoring stations at the same depths, as specified above.

Upon completion of all marine construction activities, a post-project water quality monitoring exercise will be carried out for four weeks, in the same manner as the baseline monitoring.

3.5 WATER QUALITY COMPLIANCE

Water quality monitoring will be evaluated against Action and Limit Levels. The key assessment parameters are dissolved oxygen and suspended sediment and thus Action and Limit Levels based on the assessment criteria are identified for these. However turbidity can also provide valuable instantaneous information on water quality and thus an Action Limit is also recommended for this parameter to facilitate quick responsive action in the event of any apparent unacceptable deterioration attributable to the works. The proposed Action and Limit Levels are shown in *Table 3.2*.

Action and Limit levels are used to determine whether operational modifications are necessary to mitigate impacts to water quality. In the event that the levels are exceeded, appropriate actions in Event and Action Plan (*Table 3.3)* should be undertaken and a review of works should be carried out by the Contractor(s).

Any noticeable change to water quality will be recorded in the survey reports and will be investigated and remedial actions will be undertaken to reduce impacts. Particular attention will be paid to the Contractor(s)'s implementation of the recommended mitigation measures.

It should be noted that all Action Limit levels presented in *Table 3.2* may be revised based on the baseline data to be collected in advance of construction works. If deemed necessary, the ET in consultation with the Contractor(s) will propose revised Action Limit levels and seek approval from HK Electric, the IEC and EPD.

The IEC will be empowered to audit the environmental performance of construction aspects of the EM&A programme, validate and confirm the accuracy of monitoring results, monitoring equipment, monitoring locations and procedures. If any exceedance occurs, the ET, IEC and the Contractor(s) will follow the actions stated in the Event and Action Plan (*Table 3.3).*

Table 3.2 Action and Limit Levels for Water Quality

Parameters	Action Level	Limit Level
For all marine construction works		
DO in mgL^{-1} (surface and middle)	The average of the Impact Station readings are <5%ile of baseline data and Less than the Control Stations mean DO (at the same tide of the same day)	The average of the Impact Station readings are <4mg/L or <1%ile of baseline data and Less than the Control Stations mean DO (at the same tide of the same day)
DO in mgL^{-1} (bottom)	The average of the Impact Station readings are <5%ile of baseline data and Less than the Control Stations mean DO (at the same tide of the same day)	The average of the Impact Station readings are <2mg/L or <1%ile of baseline data and Less than the Control Stations mean DO (at the same tide of the same day)
Turbidity in NTU in mg L^{-1} (depth averaged)	The depth average of the Impact Station readings are >95%ile of baseline data and 120% or more of the Control Stations turbidity (at the same tide of the same day)	The depth average of the impact station readings are >99% of baseline data and 130% or more of the Control Stations turbidity (at the same tide of the same day)
Suspended Solids in mg L^{-1} (depth averaged),	The depth average of the Impact Station readings are >95%ile of baseline data and 120% or more of the Control Stations SS (at the same tide of the same day)	The depth average of the Impact Station readings are >99%ile of baseline data and 130% or more of the Control Stations SS (at the same tide of the same day)

Notes:

- For DO, exceedance of the water quality limits occurs when monitoring result is lower than the limits.
- For SS, exceedance of the water quality limits occurs when monitoring result is higher than the limits.
- All the figures given in the table are for reference only and these may be amended with the agreement of EPD.
- "Depth Averaged" is calculated by taking the arithmetic mean of the *in-situ* parameters readings at all three depths. For suspended solids "depth averaged" is calculated by combining all three samples into one mixed sample which is analysed to produce a physical arithmetic mean.

Table 3.3 Event and Action Plan for Water Quality Monitoring during Construction Phase

EVENT	ACTION			
	ET[1]	IEC[1]	Contractor(s)	HK Electric
Action Level being exceeded by one sampling day	1. Repeat *in-situ* measurement to confirm findings; 2. Identify source(s) of impact; 3. Inform the IEC, the Contractor(s) and HK Electric; 4. Check monitoring data, plant, equipment and the Contractor(s)'s working methods; and, 5. Discuss mitigation measures with the IEC and the Contractor(s).	1. Discuss with the ET and the Contractor(s) on the mitigation measures; 2. Review proposals on mitigation measures submitted by the Contractor(s) and advise HK Electric accordingly; and 3. Assess the effectiveness of the implemented mitigation measures.	1. Inform HK Electric and confirm notification of the exceedance in writing; 2. Rectify unacceptable practice; 3. Check plant and equipment; 4. Consider changes of working methods; 5. Discuss with the ET and the IEC and propose mitigation measures to the IEC and HK Electric; and 6. Implement the agreed mitigation measures.	1. Discuss with the IEC on the proposed mitigation measures; and, 2. Make agreement on the mitigation measures to be implemented.
Action Level being exceeded by more than one consecutive sampling days	1. Repeat *in-situ* measurement to confirm findings; 2. Identify source(s) of impact; 3. Inform the IEC, the Contractor(s) and HK Electric; 4. Check monitoring data, plant, equipment and Contractor(s)'s working methods; 5. Discuss mitigation measures with the IEC and the Contractor(s); and, 6. Ensure mitigation measures are implemented.	1. Discuss the mitigation measures with the ET and the Contractor(s) ; 2. Review proposals on mitigation measures submitted by the Contractor(s) and advise HK Electric accordingly; and, 3. Assess the effectiveness of the implemented mitigation measures.	1. Inform HK Electric and confirm notification of the exceedance in writing; 2. Rectify unacceptable practice; 3. Check plant and equipment; 4. Consider changes of working methods; 5. Discuss with the ET and the IEC and propose mitigation measures to the IEC and HK Electric within 3 working days; and, 6. Implement the agreed mitigation measures.	1. Discuss the proposed mitigation measures with the IEC; 2. Make agreement on the mitigation measures to be implemented; and, 3. Assess effectiveness of the implemented mitigation measures.

EVENT	ACTION			
	ET[1]	IEC[1]	Contractor(s)	HK Electric
Limit Level being exceeded by one consecutive sampling day	1. Repeat *in-situ* measurement to confirm findings; 2. Identify source(s) of impact; 3. Inform the IEC, the Contractor(s) and EPD; 4. Check monitoring data, plant, equipment and the Contractor(s)'s working methods; 5. Discuss mitigation measures with the IEC, HK Electric and the Contractor(s); and, 6. Ensure mitigation measures are implemented.	1. Discuss the mitigation measures with the ET / Contractor(s); 2. Review proposals on mitigation measures submitted by the Contractor(s) and advise HK Electric accordingly; and, 3. Assess the effectiveness of the implemented mitigation measures.	1. Immediate stoppage of works; 2. Inform HK Electric and confirm notification of the exceedance in writing; 3. Rectify unacceptable practice; 4. Check plant and equipment; 5. Consider changes of working methods; 6. Discuss with the ET, the IEC and HK Electric and propose mitigation measures to the IEC and HK Electric within 3 working days; and, 7. Implement the agreed mitigation measures.	1. Discuss the proposed mitigation measures with the IEC, the ET and the Contractor(s); 2. Request the Contractor(s) to critically review the working methods; 3. Make agreement on the mitigation measures to be implemented; and, 4. Assess the effectiveness of the implemented mitigation measures.

EVENT	ACTION			
	ET[1]	IEC[1]	Contractor(s)	HK Electric
Limit Level being exceeded by more than one consecutive sampling days	1. Repeat *in-situ* measurement to confirm findings; 2. Identify source(s) of impact; 3. Inform the IEC, the Contractor(s) and EPD; 4. Check monitoring data, plant, equipment and Contractor(s)'s working methods; 5. Discuss mitigation measures with the IEC, HK Electric and the Contractor(s); and, 6. Ensure mitigation measures are implemented.	1. Discuss the mitigation measures with ET and Contractor(s); 2. Review proposals on mitigation measures submitted by the Contractor(s) and advise HK Electric accordingly; and, 3. Assess the effectiveness of the implemented mitigation measures.	1. Immediate stoppage of works; 2. Inform HK Electric and confirm notification of the exceedance in writing; 3. Rectify unacceptable practice; 4. Check plant and equipment; 5. Consider changes of working methods; 6. Discuss with the ET, the IEC and HK Electric and propose mitigation measures to the IEC and HK Electric within 3 working days; 7. Implement the agreed mitigation measures; and, 8. As directed by HK Electric, slow down or stop all or part of the construction activities.	1. Discuss the proposed mitigation measures with the IEC, the ET and the Contractor(s); 2. Request Contractor(s) to critically review working methods; 3. Make agreement on the mitigation measures to be implemented; 4. Assess effectiveness of the implemented mitigation measures; and, 5. Consider and instruct, if necessary, the Contractor(s) to slow down or to stop all or part of the marine work until no exceedance of Limit Level.

Note: (1) ET – Environmental Team, IEC – Independent Environmental Checker

3.6 WATER QUALITY MITIGATION MEASURES

The EIA report has outlined a variety of recommended water quality mitigation measures. These are summarised in the Implementation Schedule of Mitigation Measures (*Annex A)*.

3.7 AUDITING REQUIREMENTS

Implementation of the mitigation measures for water quality recommended by the EIA will be monitored through the site audit programme.

4 WASTE MANAGEMENT

4.1 INTRODUCTION

During the construction phase [1], waste management will be the Contractor(s)'s responsibility to ensure that wastes produced during the construction phase are managed in accordance with appropriate waste management practices and the EPD's regulations and requirements. The construction Contractor(s) will also follow a Waste Management Plan when managing the different types of wastes on site.

The Project is expected to generate the following during the construction phase:

- Dredged marine sediment;
- C&D materials; and
- Chemical waste.

Auditing of waste management practices twice per month during site inspections will ensure that these solid and liquid wastes generated during construction are not disposed of into the surrounding storm drains. The construction Contractor(s) will be responsible for the implementation of any mitigation measures to reduce waste or redress issues arising from the waste materials.

4.2 WASTE MANAGEMENT PLAN

The construction Contractor(s) will submit a Waste Management Plan (WMP) for the construction works to HK Electric before commencement of construction works. The WMP will describe arrangements for avoidance, re-use, recover and recycling, storage, collection, treatment and disposal of different categories of waste to be generated from construction activities and will include the recommended mitigation measures on waste management detailed in *Annex A* of this EM&A Manual. The WMP will indicate the disposal location(s) of all surplus excavated spoil and other waste and a Trip Ticket system will be included in the WMP. Prior to the commencement of dredging activities, the disposal strategy for the dredged sediment will be determined in accordance with the *ETWBTC No. 34/2002: Management of Dredged/Excavated Sediment* and details will be included in the WMP.

(1) Construction phase refers to the three year period including wind farm construction and pre-commissioning phase, which is the fifth to the seventh year of the construction programme as stated in *Figure 1.3*.

The WMP should be refined and updated as more detailed information is generated on the volume of dredged marine mud. Similarly, it should be regularly reviewed, and updated as appropriate, throughout the course of the construction works to ensure that it remains current with the latest detailed information and works practices.

The WMP should also outline the requirements for a waste audit program to ensure the measures outlined in the plan are effectively implemented and adhered too.

4.3 EM&A REQUIREMENTS

In order to ensure that the construction Contractor(s) has implemented the recommendations of the EIA Report, the ET will conduct regular site audits of the waste streams, to determine if wastes are being managed in accordance with the procedures in the approved WMP. The audits should look at the aspects of waste management including waste generation, storage, recycling, transport and disposal. An appropriate audit programme should be undertaken with the first audit conducted at the commencement of the construction works. The scope of the waste management audits is presented below.

4.3.1 OBJECTIVES OF WASTE AUDIT

The waste management audit programme will include, but is not limited to, the following:

- Ensuring that the wastes arising from works are handled, stored, collected, transferred and disposed of an environmentally acceptable manner and comply with the relevant requirements under the *Waste Disposal Ordinance (WDO)* and its regulations;
- Ensuring that the construction Contractor(s) properly implements the appropriate environmental protection and waste pollution control mitigation measures, as outlined in the Implementation Schedule and presented in *Annex A*, to reduce and control the potential for waste impacts;
- Ensuring the effective implementation of the Contractor(s)'s WMP; and
- Encourage the reuse and recycling of materials.

4.3.2 METHODOLOGY AND CRITERIA

The construction Contractor(s) must ensure that the necessary disposal permits or licences are obtained from appropriate authorities in accordance with the various Ordinances. In addition to the ET audits, each construction Contractor(s) will designate a member of staff as being responsible for inspecting and auditing the on-site waste management practices on a monthly

basis, with reference to the relevant legislation and guidelines as well as the recommendations given in the Implementation Schedule contained in *Annex A* of this EM&A Manual, and defined below:

General Legislation

- *Waste Disposal Ordinance* (Cap 354);
- *Waste Disposal (Chemical Waste) (General) Regulation* (Cap 354C);
- *Waste Disposal (Charges for Disposal of Construction Waste) Regulation* (Cap 354N);
- *Land (Miscellaneous Provisions) Ordinance* (Cap 28);
- *Public Health and Municipal Services Ordinance* (Cap 132) – Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws;
- *Dumping at Sea Ordinance* (1995) (Cap 466); and,
- The storage, handling and disposal of chemical waste should be audited with reference to the requirements of the *Code of Practice on the Package, Labelling and Storage of Chemical Wastes* published by the EPD.

Other Relevant Guidelines

- *Waste Disposal Plan for Hong Kong* (December 1989), Planning, Environment and Lands Branch Government Secretariat, Hong Kong Government;
- *Environmental Guidelines for Planning In Hong Kong* (1990), Hong Kong Planning and Standards Guidelines, Hong Kong Government;
- *New Disposal Arrangements for Construction Waste* (1992), Environmental Protection Department & Civil Engineering Department, Hong Kong Government;
- *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* (1992), Environmental Protection Department, Hong Kong Government;
- *Works Branch Technical Circular, 32/92, The Use of Tropical Hard Wood on Construction Site;* Works Branch, Hong Kong Government;
- *Works Branch Technical Circular No. 2/93 and 2/93B, Public Dumps*, Works Branch, Hong Kong Government;
- *Works Branch Technical Circular No. 16/96, Wet Soil in Public Dumps*; Works Branch, Hong Kong Government;

- *Works Bureau Technical Circular No. 4/98 and 4/98A, Use of Public Fill in Reclamation and Earth Filling Projects*; Works Bureau, Hong Kong SAR Government;
- *Waste Reduction Framework Plan*, 1998 to 2007, Planning, Environment and Lands Bureau, Government Secretariat, 5 November 1998;
- *Works Bureau Technical Circular No. 12/2000, Fill Management*; Works Bureau, Hong Kong Government;
- *Environmental Transport and Works Bureau Technical Circular No 31/2004, Trip-ticket System for Disposal of Construction and Demolition Material*; *Environmental Transport and Works Bureau*, Hong Kong SAR Government;
- *Works Bureau Technical Circular No. 25/99A and 25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Sub-committee Papers*; Works Bureau, Hong Kong SAR Government.
- *Works Bureau Technical Circular No. 19/2001, Metallic Site Hoardings and Signboards*, Works Bureau, Hong Kong SAR Government.
- *Environment, Transport and Works Bureau Technical Circular (Works) No. 34/2002, Management of Dredged/Excavated Material*, Environment, Transport and Works Bureau, Hong Kong SAR Government.
- *Environment, Transport and Works Bureau Technical Circular (Works) No.19 /2005, Environmental Management on Construction Sites*, Environment, Transport and Works Bureau, Hong Kong SAR Government.
- *Environment, Transport and Works Bureau Technical Circular (Works) No.33 /2002, Management of Construction and Demolition Material including Rock*, Environment, Transport and Works Bureau, Hong Kong SAR Government.

The Contractor(s)'s waste management practices will be audited with reference to the checklist detailed in *Table 4.1* below.

Table 4.1 Waste Management Checklist

Construction Activities [1]	**Timing**	**Checking Frequency**	**If non-compliance noted, Action Required**
The Contractor shall prepare a Waste Management Plan and nominate approved personnel to be responsible for implementation of the Plan.	Before the commencement of works	Once	The ET will inform the Contractor(s), HK Electric and IEC. The ET will ensure the Waste Management Plan is adequate and responsible personnel have been nominated.
Briefing will be provided to site personnel in proper waste management including chemical waste, and include the concept of waste reduction, reuse and recycling.	Before the commencement of works	Once	The ET will inform the Contractor(s), HK Electric and IEC. The ET will ensure the briefing will be provided to site personnel in proper waste management.
Necessary waste disposal permits or licences have been obtained including those for chemical waste and effluent discharges.	Before the commencement of works	Once	The ET will inform the Contractor(s), HK Electric and IEC. The Contractor(s) should apply for the necessary permits/ licences prior to disposal of the waste. The ET will ensure that corrective action has been taken.
Dredged sediments are managed and disposed of in accordance with the *ETWBTC No. 34/2002: Management of Dredged/Excavated Sediment* and under the requirements of the *Dumping at Sea Ordinance*.	Throughout the dredging works. Sediment assessment to be completed prior to dredging	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to manage and dispose the dredged materials properly. The Contractor(s) will immediately suspend dredging until the dredging materials are properly managed and disposed.
Only licensed waste hauliers are used for waste collection.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to use a licensed waste haulier. The Contractor(s) will temporarily suspend waste collection of that particular waste until a licensed waste haulier is used. Corrective action will be undertaken within 48 hours.

(1) Construction phase refers to the three year period including wind farm construction and pre-commissioning phase, which is the fifth to the seventh year of the construction programme as stated in *Figure 1.3*.

Construction Activities (1)	**Timing**	**Checking Frequency**	**If non-compliance noted, Action Required**
Records of quantities of wastes generated, recycled and disposed are properly kept. For demolition material/waste, the number of loads for each day will be recorded (quantity of waste can then be estimated based on average truck load. For landfill charges, the receipts of the charge could be used for estimating the quantity).	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. The Contractor(s) will estimate the missing data based on previous records and the activities carried out. The ET will audit the results and forward to HK Electric and IEC for approval.
Storage of material on site should be well planned and kept to a minimum	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to store materials accordingly.
Stockpiles should be located away from waterfront or storm drains and measures taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system including covering open stockpiles of more than 50m^3.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to manage stockpiles accordingly.
Wastes are removed from site by appropriate means and in a timely manner. General refuse is collected on a daily basis.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to remove waste accordingly.
Waste storage areas are enclosed, properly cleaned and do not cause windblown litter and dust nuisance.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to clean the storage area and/or cover the waste.
Different types of waste are segregated in different containers or skip to enhance recycling of material and proper disposal of waste.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to provide separate skips/ containers. The Contractor(s) will ensure the workers place the waste in the appropriate containers.
There are sufficient waste containers provided and they are fitted with lids or covers to prevent waste from escaping or ingress of water.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to provide adequate containers. The Contractor(s) will ensure containers are kept in good condition.

Construction Activities [1]	**Timing**	**Checking Frequency**	**If non-compliance noted, Action Required**
Chemical wastes are stored, handled and disposed of in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes, published by the EPD. They will be sent to the Chemical Waste Treatment Centre for proper treatment.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to rectify the issues immediately. Warning will be given to the Contractor(s) if corrective actions are not taken within 24 hrs.
Demolition materials are properly treated (eg by spraying dusty materials with water) and covered before leaving the site.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will instruct the Contractor(s) to comply. The Contractor(s) will ensure the demolition materials are properly treated and covered when transported out of the site.
Wastes are disposed of at licensed sites.	Throughout the works	Once a Month	The ET will inform the Contractor(s), HK Electric and IEC. HK Electric will warn the Contractor(s) and instruct the Contractor(s) to ensure the wastes are disposed of at the licensed sites. Should it involve chemical waste, the Waste Control Group of EPD will be notified.

Note: ET – Environmental Team, IEC – Independent Environmental Checker

4.4 *MITIGATION MEASURES*

Details of the required mitigation measures are included within the Implementation Schedule of *Annex A* of this EM&A Manual.

4.5 *AUDITING REQUIREMENTS*

Implementation of the mitigation measures for waste management recommended by the EIA will be monitored through the site audit programme.

5 TERRESTRIAL ECOLOGY

5.1 INTRODUCTION

The EIA study has assessed the potential impacts on the avifauna due to the construction and operation of the wind farm turbines. It concluded that the direct ecological impact due to the construction of the wind turbine is expected to be low. During the operation of the wind farm, the barrier effect to bird movement and bird collisions are perceived as the major ecological concern. A bird monitoring programme, which includes avifauna monitoring and bird collision monitoring, will be undertaken to confirm that the operation of the wind farm will not cause unacceptable adverse impacts to birds.

5.2 TERRESTRIAL ECOLOGY MITIGATION MEASURES

The Environmental Team will be responsible for the implementation of the mitigation measures which are presented in *Annex A*.

5.3 AVIFAUNA MONITORING

5.3.1 OBJECTIVES OF AVIFAUNA MONITORING

The purpose of the construction and operation monitoring is to investigate the temporal variation in species occurrence, abundance and distribution of birds before and after the commencement of the wind farm. Particular focus will be made on species of conservation interest (especially the Birds of Prey including White-bellied Sea Eagle and Black Kite) and migratory birds (eg White-winged Tern, Heuglin's Gull).

5.3.2 MONITORING METHODOLOGY

Traditional vessel-based survey will be applied for pre-construction, construction and operation monitoring. Line transects survey method will be used at designated sampling locations within the Project Site. Indicative locations of sampling transects are presented in *Figure 5.1* and will be finalized during the detailed design stage (after confirmation of the types and siting of the turbines).

During each survey, the vessel transited the transect lines during daylight hours at a relatively constant speed of 13-15 km/hr, observations will be made using 8x binoculars and all birds seen within 1 km both sides along the transect lines will be counted and identified to species where possible. Detailed information on bird species, sex and age where feasible, abundance, observed coordinates, bird activities/behaviour, flying height and path will be

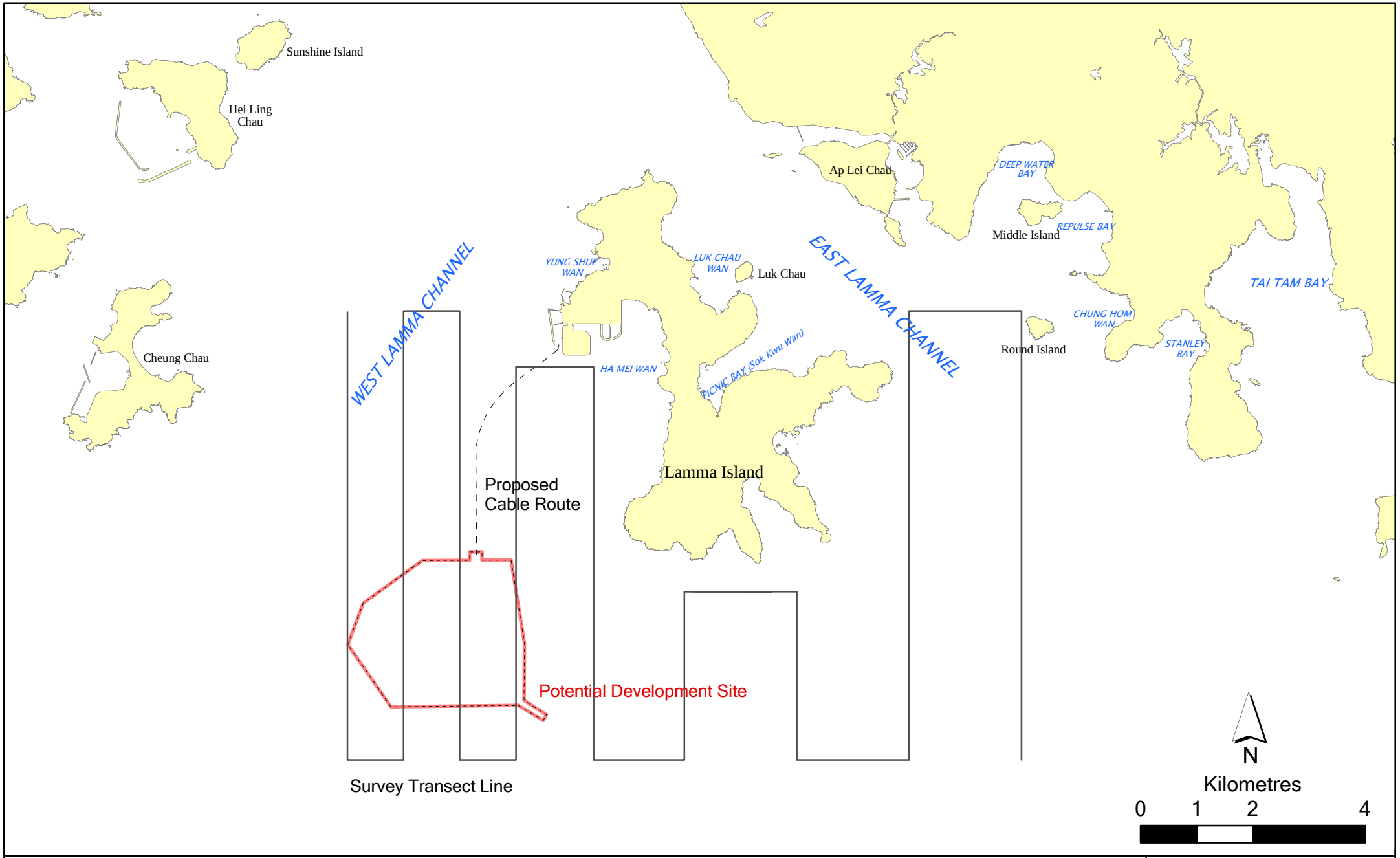

Figure 5.1

Indicative Survey Transect Location of Avifauna Vessel Survey

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recorded during the survey. Activities/behaviour of the birds will be categorised into five classes:

- Flying - Birds moving in the air following a particular direction without conducting any of the other activities as below.
- Soaring - Birds moving in the air usually making a form of circular movement.
- Resting – Birds do not move, remain in the same location in certain period of time (eg Birds of Prey perching on trees, Egrets standing on rock, Tern standing on floating objects).
- Foraging/Feeding - Birds seen attacking, collecting, pecking or carrying food with their bill or feet could be defined as foraging or feeding.
- Swimming – Birds making movements on a water surface or floating on the sea.

5.3.3 MONITORING FREQUENCY

Monitoring should be undertaken according to the following schedule:

- Baseline Period – one continuous calendar year prior to the installation of the wind turbines;
- Construction – one continuous calendar year following commencement of the installation of the wind turbines (1); and,
- Post-construction – one continuous calendar year following the commencement of operation of the offshore wind farm.

For each of the above, survey should be undertaken for one day per week during the migratory season (March to May) and one day every two weeks for the rest of the year (June to February).

A summary of Avifauna Monitoring Requirements for the Project is provided in *Table 5.1* below.

(1) It is noted that piling activities for the installation of the wind turbines will be avoided during December to May, hence monitoring activities may take place during periods when no piling works are occurring.

Table 5.1 Summary of Avifauna Monitoring Requirements for the Project

Aspect	Requirement
Method	Vessel-based Line Transect
No. of observer	One
Location	Please refer to *Figure 5.1* for monitoring location.
Monitoring duration and frequency	Baseline Period – one continuous calendar year prior to the installation of the wind turbines. Construction – one continuous calendar year following commencement of the installation of the wind turbines. Post-construction – one continuous calendar year following the commencement of operation of the offshore wind farm. Surveys should be undertaken for one day per week during the migratory season (March to May) and one day every two weeks for the rest of the year (June to February).

5.3.4 DATA ANALYSIS

Raw sightings records plotted on maps are generally not a good guide to ascertaining bird densities because different areas/seasons are not given the same amount of survey effort. In order to quantify the habitat use of bird within the monitoring areas, corrected sighting densities will be calculated in terms of number of bird individuals per effective trip per unit area (the survey area mapped using a 1 km by 1 km grid (km^2)).

All the results will be reviewed and analyzed after the operation monitoring period. Should bird abundance be significantly different (taking into account naturally occurring alterations to distribution patterns such as due to seasonal change) to the pre-construction activity (following the operation monitoring), recommendations for a further operation monitoring survey will be made. Data should then be re-assessed and the need for any further monitoring established. Significance levels will be quantitatively determined following the operation monitoring which will review up-to-date publicly available information on bird distribution to allow for typical variance levels.

If, after the first-year operation monitoring period, insignificant variation in bird abundance have been reported then the monitoring will be ceased, as it will have been confirmed that the wind turbine is not having an adverse impact on bird species, hence further operation monitoring will likely not be required.

5.4 BIRD COLLISION MONITORING

5.4.1 BACKGROUND AND OBJECTIVES

Bird collision monitoring should be undertaken during the initial operation phase of the Project in order to determine any unacceptable impact to birds as a result of collision with the operating wind turbines. The monitoring will also provide a mechanism to implement mitigation measure(s) for alleviating such impact, if any is detected.

In relation to the above, a *Bird Collision Monitoring Plan* was prepared which included details of the bird collision monitoring procedures. The feasibility of using alternative monitoring procedures, such as radar and camera surveys for the bird collision monitoring, were also investigated. Based on findings of the investigation, the bird collision monitoring procedures together with the Event and Action Plan as well as the operational remedial procedures were developed. The *Bird Collision Monitoring Plan* (1) was submitted to the Agriculture, Fisheries and Conservation Department (AFCD) in January 2013 and was subsequently approved in April 2013.

Details on the bird collision monitoring are presented below.

5.4.2 MONITORING METHODOLOGY

Avifauna monitoring using vessel-based survey will be undertaken for the initial operation phase of the wind farm to investigate the temporal variation in species occurrence, abundance and distribution of birds after commencement of the wind farm operation (please refer to *Section 5.3* above for details of the avifauna monitoring). For the purpose of bird collision monitoring, it is recommended that an additional observer be deployed onboard the survey vessel during the vessel-based avifauna monitoring. The observer will be responsible for identifying any injured bird/bird carcass within the survey area for bird collision monitoring as indicated in *Figure 5.2*. The additional observer for bird collision monitoring cannot be the same observer as that for the vessel-based avifauna monitoring since the latter should focus on and be fully occupied by collecting detailed information of birds (eg bird species, sex, age, abundance, observed coordinates, bird activities/behaviour, flying height and path) as per requirements presented in *Section 5.3* above.

Summary of the bird collision monitoring requirements are provided in *Table 5.2* while procedures to be undertaken as part of the bird collision monitoring are listed as follows:

- When travelling along the transects as indicated in *Figure 5.2,* one observer should stand on the open deck of the survey vessel which should move at a relatively constant speed of 13-15 km/hr during

(1) ERM (2013) Development of Offshore Wind Farm in Hong Kong. Bird Collision Monitoring Plan.

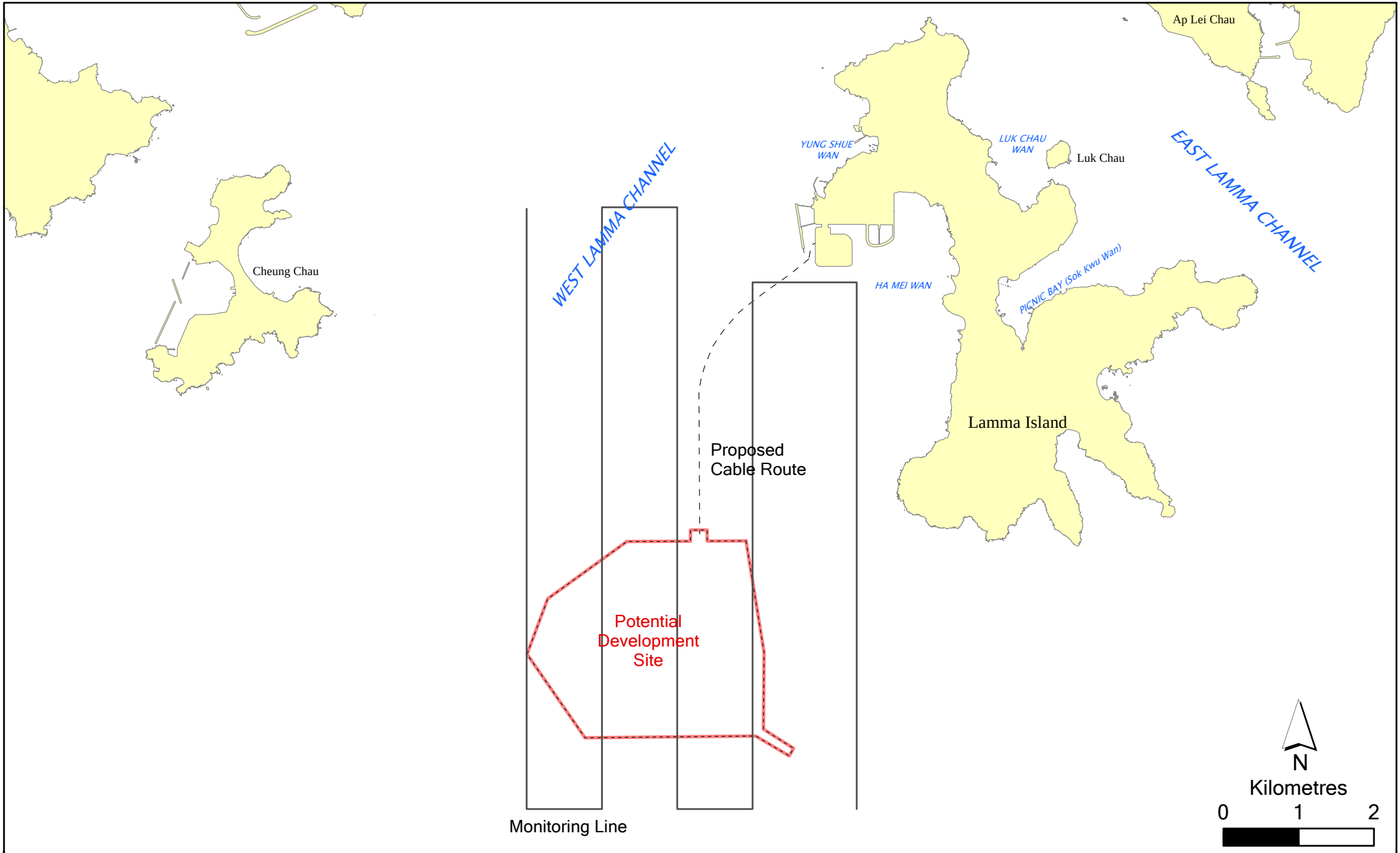

Figure 5.2

Bird Collision Monitoring Area

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daylight period, allowing for observer eye height of 4 to 5 m above water level and relatively unobstructed forward visibility between 270° and 90°.

- Vessel-based observation by the observer should be conducted by searching the 180° swath in front of the survey vessel (270° to 90°) with 8x binoculars or equivalent, scanning the same area with the naked eye and occasional binocular check.

- Observer should be alert at all times during the survey period.

- Should any injured bird/floating bird carcass be observed, check the wind farm site to identify the cause of injury/mortality.

- Further actions to be undertaken in case of recorded bird injury/mortality are presented in the Event and Action Plan (*Table 5.3*).

As for the vessel-based avifauna monitoring, bird collision monitoring should be undertaken for one year since the commencement of the operation of the wind farm. Surveys should be undertaken for one day per week during the migratory season (March to May) and one day every two weeks for the rest of the year (June to February). A summary on the bird collision monitoring requirements is provided in *Table 5.2*.

Table 5.2 *Summary of Bird Collision Monitoring Requirements for the Project*

Aspect	Requirement
Method	Vessel-based Line Transect
No. of observer	One
Location	Please refer to *Figure 5.2* for monitoring location.
Monitoring duration and frequency	For one year since the commencement of the operation of the wind farm. Surveys should be undertaken for one day per week during the migratory season (March to May) and one day every two weeks for the rest of the year (June to February).

5.4.3 EVENT AND ACTION PLAN

An Event and Action Plan (EAP) for bird collision monitoring is provided in *Table 5.3*. The EIA of the Project has provided an estimation of the potential bird collision risk, calculated based on the Collision Risk Model (CRM) developed by the Scottish National Heritage [1]. During the bird collision monitoring, the observed collision rate should be compared with the predicted risk in the EIA to determine any need to trigger specific remedial actions.

[1] Band, W. (2000). Windfarms and Birds: Calculating a theoretical collision risk assuming no avoiding action. Guidance Note Series. Scottish Natural Heritage.

Table 5.3 Event and Action Plan for Bird Collision Monitoring

Event	Action	
	Environmental Team (ET)	HK Electric
Record of bird injury or mortality by vessel-based line transect monitoring	• ET Leader (ETL) report to HK Electric within 24 hours of confirmation of record. • If injured bird/bird carcass is found, check the wind farm site to identify the cause of injury/mortality. • If there is evidence to support that bird injury/mortality is caused by collision with the wind turbines, check the cumulative bird collision rate since operation of the Project against the predicted rate in the EIA Study (if applicable). • If there is no evidence of bird collision with wind turbine, no further action is required. • If the cumulative rate is lower than that predicted in the EIA which is considered as low (equivalent to 15 birds per year) (1) (2), no remedial action is required and ET should carefully monitor any further events of bird injury or mortality. • Report investigation findings to HK Electric and AFCD.	• HK Electric report to the AFCD within 7 days of confirmation of record. • Provide wind turbine operational data to ET for investigation of the cause of bird injury or mortality.

(1) In the EIA report, the number of bird collision is presented in numbers with decimal places. In calculating the cumulative rate here the numbers are rounded to the next nearest whole number (eg 1.10 bird collision per year is rounded to 2 bird collisions per year)

(2) ERM (2012) Development of an Offshore Wind Farm in Hong Kong - Review of Wind Turbine Design Working Paper. Approved by EPD on 24 December 2012.

Event	Action	
The cumulative bird collision rate exceeded the predicted rate in the EIA Study	• ETL report to HK Electric within 24 hours of confirmation of exceedance. • Propose remedial action to be adopted for the turbine and/or time period identified with higher risk of collision with birds. Remedial actions may include but not limited installation of bird deterrent device, adjustment of turbine lighting and/or color pattern, suspended operation at wind turbine with higher risk of bird collision and/or during period when the risk of bird collision is higher, and any other measures as considered appropriate by HK Electric and AFCD. • Agree with HK Electric and AFCD on the proposed remedial action. • Undertake monitoring to determine the effectiveness of the remedial action and report findings to AFCD and HK Electric.	• HK Electric report to AFCD within 7 days of confirmation of exceedance. • Implemented the remedial actions agreed with the AFCD. • Agree with AFCD, in consultation with the ET, on the suitability to continue normal operation of the wind turbine.

5.5 MITIGATION MEASURES

The EIA report has outlined a variety of recommended terrestrial ecology mitigation measures. These are summarised in the Implementation Schedule of Mitigation Measures (*Annex A).*

5.6 AUDITING REQUIREMENTS

Implementation of the mitigation measures for terrestrial ecology recommended by the EIA will be monitored through the site audit programme.

6 MARINE ECOLOGY

6.1 INTRODUCTION

The constraints on construction works defined within the EIA will act as appropriate mitigation measures to control the environmental impacts to marine ecological resources to within acceptable levels.

The following sections provide details of the measures to be undertaken by the ET to ensure that the measures recommended in the EIA are carried out. For underwater noise monitoring requirements the readers are referred to *Section 7.3*.

6.2 MARINE MAMMAL MONITORING

In order to determine the efficacy of the recommended mitigation measures, monitoring of marine mammal abundance is required. Monitoring should cover the baseline period, the construction (1) and post-construction monitoring. Monitoring will include the following techniques:

- Vessel based surveys
- Passive acoustic monitoring
- Land-based theodolite tracking

All monitoring should be led by suitably qualified persons (degree in biology or equivalent) and should be independent of the construction contractor and should form part of the independent Environmental Team (ET). The IEC may audit the work of the ET if deemed necessary.

Details on the above monitoring are presented below. The monitoring procedures of passive acoustic monitoring and land-based theodolite tracking were developed and described in the *Passive Acoustic Monitoring and Land-based Theodolite Tracking Plan* prepared by ERM (2013). The Plan was submitted to AFCD in February 2013 and subsequently approved by AFCD in April 2013.

(1) Construction phase refers to the three year period including wind farm construction and pre-commissioning phase, which is the fifth to the seventh year of the construction programme as stated in *Figure 1.3*.

6.2.1 VESSEL BASED SURVEYS

General Approach, Schedule and Survey Area

A set of systematic standard line-transect vessel surveys (1) on the finless porpoise *Neophocaena phocaenoides* should be undertaken to examine the abundance, distribution, encounter rate and habitat use of this species in the Study Area. Surveys should be undertaken in accordance with the following schedule:

- Baseline Period – one day per month for one continuous calendar year prior to the installation of the wind turbines;
- Construction – one day per month for one continuous calendar year following commencement of the installation of the wind turbines (2); and,
- Post-construction – one day per month for one continuous calendar year following the commencement of operation of the offshore wind farm.

The survey methodology should be consistent and compatible with that adopted during the EIA and that of the long-term marine mammal monitoring programme conducted under the Hong Kong Cetacean Research Project (HKCRP) funded by AFCD since 1995 to allow potential comparisons and pooling of data for analysis.

Survey Method

Vessel surveys should be conducted from one survey vessel (ca. 12-15 m length), weather permitting (Beaufort 0-6, no heavy rain, and visibility > 1,200 m). The vessel should have an open upper deck, affording relatively unrestricted visibility. The observer team should conducted searches and observations from the flying bridge area, 4-5 m eye height above the water's surface. Two experienced observers (a data recorder and a primary observer) should make up the on-effort survey team (3).

The survey vessel should transit the transect lines at a constant speed of about 13-15 km/hour (*Figure 6.1*). The primary observer should search for porpoises continuously through 7 x 35 Brunton marine binoculars, while the data recorder should search with unaided eyes and fill out the datasheets. Both observers should search the sea ahead of the vessel, between 270° and 90° (in relation to the bow, which is defined as 0°). One to two additional

(1) BucklandST, Anderson DR, Burnham KP, Laake JL, Borchers DL, Thomas L (2001) *Introduction to distance sampling: estimating abundance of biological populations*. Oxford University Press, London

(2) It is noted that piling activities for the installation of the wind turbines will be avoided during December to May, hence monitoring activities may take place during periods when no piling works are occurring.

(3) All observers of the surveys should undergo a training program before the start of data collection. Observers should be trained and calibrated in distance estimation, by asking them to make distance estimates to various objects (e.g., other boats, specific points on shore, floating debris, etc.).

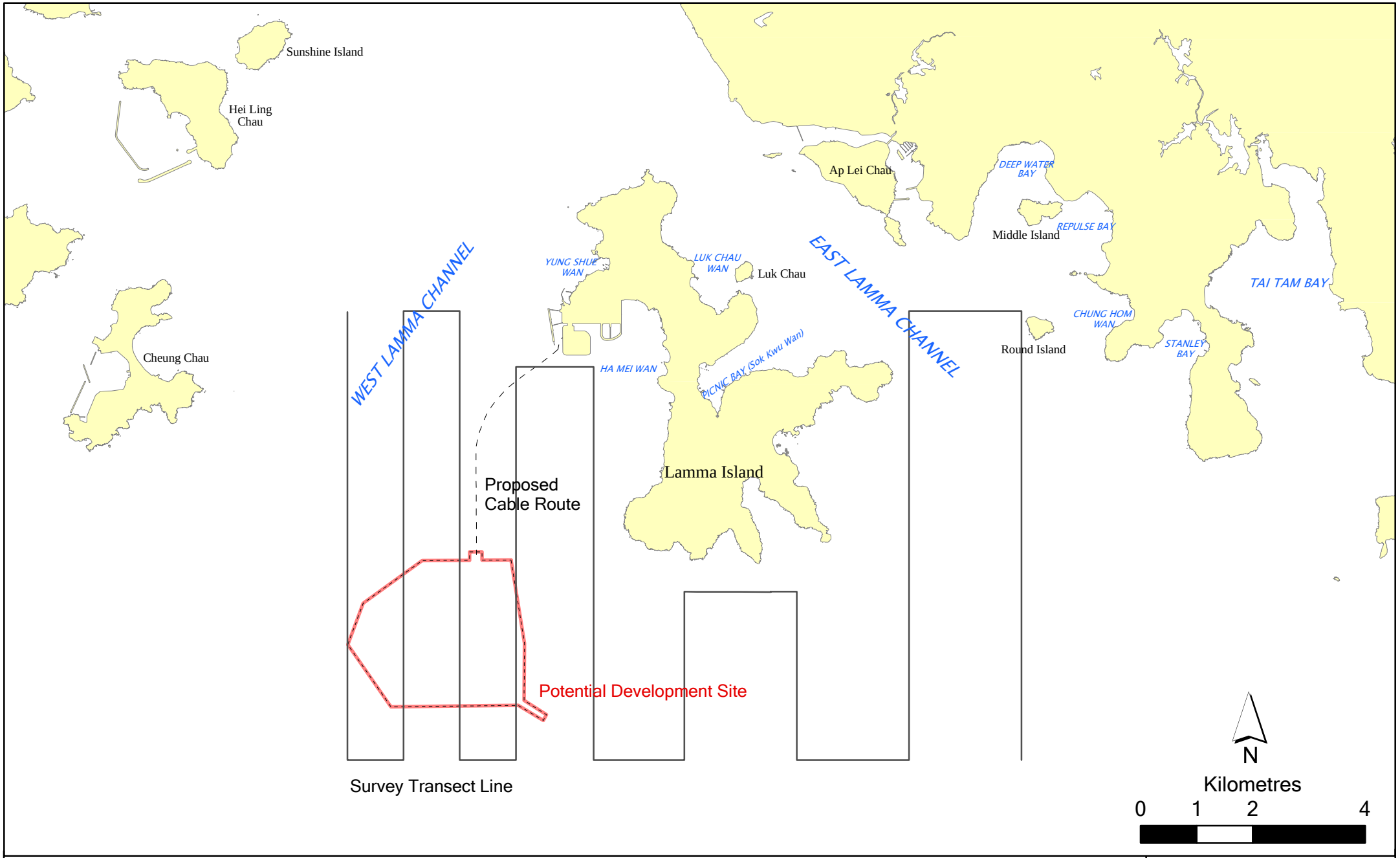

Figure 6.1

Indicative Survey Transect Location of Vessel Based Survey

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experienced observers should be available on the boat to work in shift (i.e. rotate every 30 minutes) in order to minimise fatigue of the survey team members.

Effort data to be collected during on-effort survey periods should include time and position (latitude and longitude) for the start and end of search effort, weather conditions (Beaufort sea state and visibility) and distance travelled in each series (a continuous period of search effort) with the assistance of a GPS (e.g. Garmin Geko 201). When marine mammals are sighted, the survey team should end the survey effort, be taken as off-effort, and immediately record the initial sighting distance and angle of the porpoise group from the survey vessel, as well as sighting time and position, on the sighting datasheet. The research vessel should then divert from its course to approach the marine mammal(s) for group size estimation, assessment of group composition and behavioural observations.

The perpendicular distance (PSD) of the marine mammal group to the transect line should be later calculated from the initial sighting distance and angle. The line-transect data to be collected during the present study should be compatible with the long-term databases of HKCRP/ AFCD in a way that it could be analyzed by established computer programmes (e.g. all recent versions of DISTANCE programme including version 5.0, ArcView© GIS programme) for examination of population status including trends in abundance, distribution and habitat use.

6.2.2 *PASSIVE ACOUSTIC MONITORING*

General Approach, Schedule and Survey Area

In addition to the traditional methods for marine mammal monitoring, Passive Acoustic Monitoring (PAM) is becoming a common tool used in both offshore wind farms and oil and gas exploration for detecting the high frequency clicks of marine mammals as these are easily-distinguished from sounds of other marine animals. Recent developments include specific C-POD (Cetacean Porpoise Detector) devices that more accurately records vocalizations of porpoises plus all other echolocating toothed whales and dolphins. The employment of such devices would allow the activity of finless porpoises to be monitored both day and night in all weather conditions, and are considered to be a useful addition to the marine mammal monitoring programme. As such, C-PODs should be deployed as part of the EM&A for the proposed wind farm.

As Porpoise clicks are substantially above 100 kHz in frequency, it is noted that the detection distance is likely to be on the order of low 100's of meters from bottom-mounted C-PODs (1), initially, up to twelve (12) C-PODs should

(1) Hong Kong Offshore Wind Limited (2009) Hong Kong Offshore Wind Farm in Southeastern Waters - Environmental Impact Assessment Report.

be deployed on the seabed within and directly outside the wind farm area. C-PODs should be deployed as close to the commencement of the vessel based baseline monitoring described above. C-PODs should be left in place during the entire baseline monitoring, construction of the wind farm and for a period of up to two years following the start of operation of the wind farm. Such duration should allow for a robust record of marine mammal usage of the area to be obtained and allow for the inter-seasonal and inter-year differences already known for finless porpoises. The C-PODs deployed will need to be retrieved from the seabed for services every three to four months. The services include downloading accumulated data and replacing batteries for the C-POD. The service process is relatively simple which involves opening the C-POD, removing the Secure Digital (SD) card to download data, replacing the D-cells and reassembly the device.

Specifications of the C-POD are provided in *Table 6.1* below.

Table 6.1 Specifications of C-POD (Source: Chelonia Limited) [1]

Parameters	Descriptions
Working depth	Maximum working depth > 23 m
Autonomous operation time	Maximum running times recorded are 200-212 days and depend on battery quality. Running times more than 4 months can be expected.
Dimensions	Length: 660 mm Diameter: 90 mm
Weight:	2.1 kg without batteries, 3.55 kg with batteries.
Hydrophone	20 kHz to 160 kHz, omni-directional hydrophone in a large-diameter housing to reduce surface noise.
Detection range	Maximum detection range for porpoises is approximately 400 metres.

Number and Positioning of C-PODs

The proposed layout of the C-PODs to be deployed for the marine mammal monitoring of the Project is presented in *Figure 6.2* with their coordinates given in *Table 6.2*. A total of twelve (12) devices are recommended to be deployed. The number and position of deployment have been developed in consultation with a marine mammal expert with experience in PAM / C-POD application and have taken into account the potential coverage of the device as well as survey area for the monitoring programme. The proposed location also overlapped with the survey area for the vessel-based marine mammal

(1) http://www.chelonia.co.uk/cpod_specification.htm

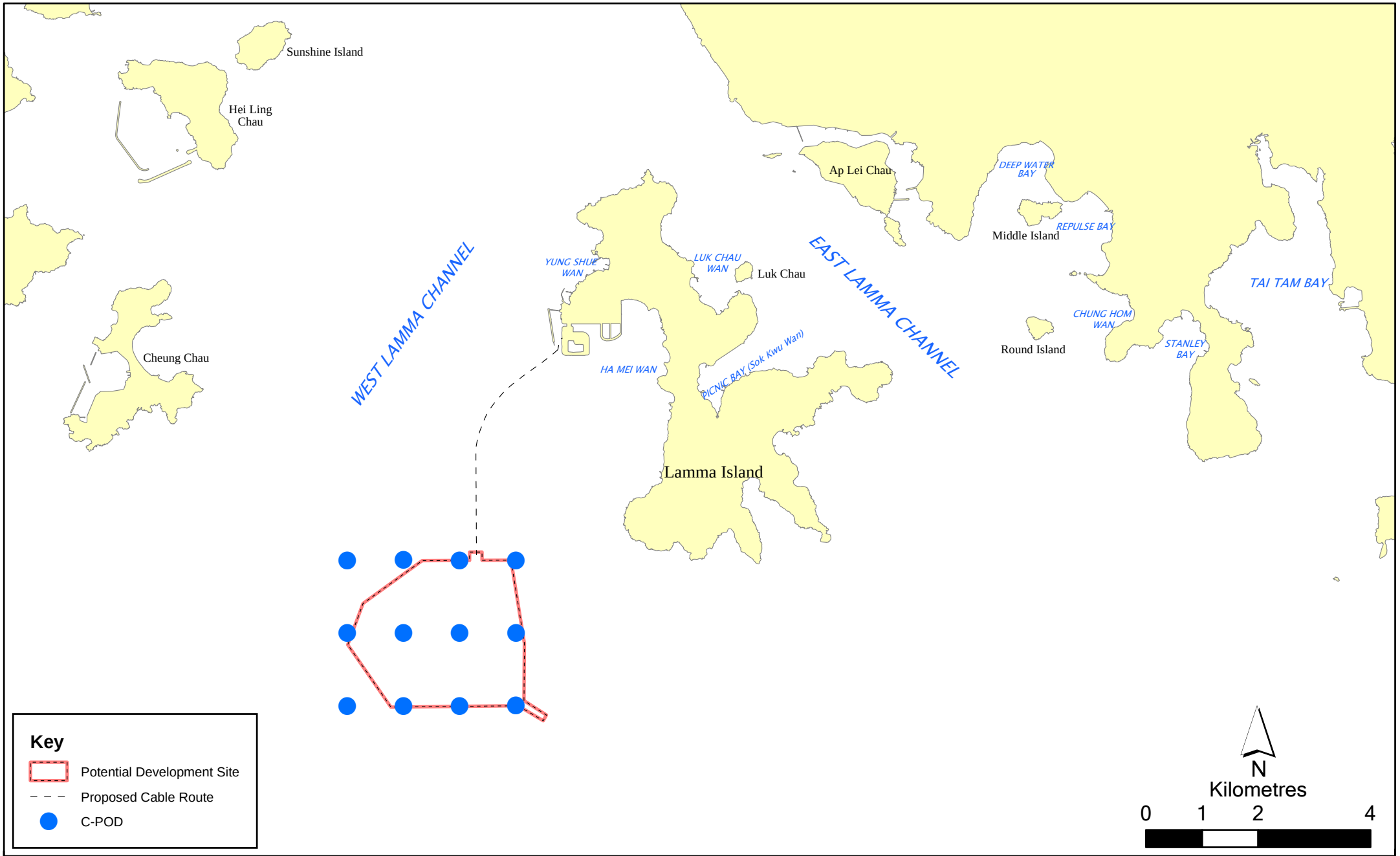

Figure 6.2

Proposed Location for Deployment of C-POD

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survey and land-based theodolite tracking in order to collect more comprehensive data for the survey area. The locations and number of C-POD deployment should be finalised and agreed with AFCD during the detailed design stage based on the final layout of the wind farm.

Table 6.2 ***Coordinates for the Proposed C-POD Deployment Locations***

Deployment Locations	Eastings	Northings
1	827852	804421
2	826852	804421
3	825852	804421
4	824852	804417
5	827860	803123
6	826852	803124
7	825852	803124
8	824852	803122
9	827852	801829
10	826852	801825
11	825852	801825
12	824852	801825

Data Analysis

The downloaded record from the C-POD should be examined to identify vocalisation of finless porpoises. Analysis should be undertaken to obtain information on porpoise positive time units which indicate the number of days in a given month (or other time unit) for which porpoise activity is recorded. Waiting time between encounters should also be calculated which can be related to density and habitat use of porpoises. Any seasonal trends in changes of the above parameter should be determined during the baseline monitoring period. Data obtained during the construction and operation monitoring should be compared to investigate any changes in usage of the wind farm site by finless porpoise during construction and operation of the Project, taking into account any temporal differences detected during the baseline period.

6.2.3 LAND-BASED THEODOLITE TRACKING

General Approach, Schedule and Survey Area

From well positioned vantage points of known height, spatial and temporal movement patterns of marine mammals should be monitored with a theodolite (Lietz/Sokkisha DT5A theodolite with 30-power monocular magnification and 5-sec precision). This technique converts horizontal and vertical angles into geographic positions (Longitude and Latitude) for each theodolite positional recording. The tracking of groups and individuals over time provides information about animal distance from shore, depth of water, distance from anthropogenic activities, and relative speeds and orientations; with measurements of leg (one point to another) speeds, re-orientations, distance made-good over time, and other movement related parameters. The location of the vantage point should have a clear and unobstructed view of the

wind farm development area and if possible be consistent with sites used for previous marine mammal observations in Hong Kong.

Surveys should be overseen by a primary operator with at least ten years of marine mammal theodolite and behavioural data gathering and analysis experience, supported by a secondary operator with at least five years' experience. The primary and secondary operators should establish the field methodology (ie including selection of survey location, orientation of theodolite unit, procedures of setting up of equipment etc) of theodolite tracking with consideration of the actual site conditions and specifications of theodolite and associated equipment selected for the surveys. The primary operator should also be responsible for training field assistants to undertake the tracking surveys.

For each survey event, a total of three field personnel are needed to undertake the survey with a single theodolite unit (1). During the theodolite tracking survey the three team members should rotate regularly to prevent fatigue which will reduce observer's ability in detecting/tracking marine mammals. As a minimum, the first survey should involve the primary and secondary operator as well as the full survey team. For all surveys following, neither the primary nor secondary operator are required to be present as these can be led by three trained field team staff. However, it is recommended that the secondary operator should audit the team on no less than three occasion.

Surveys should be undertaken in accordance with the following schedule:

- Baseline Period – one day per month for one continuous calendar year prior to the commencement of marine construction works;
- Construction – one day per month for one continuous calendar year following commencement of marine construction works (2); and,
- Post-construction – one day per month for one continuous calendar year following the commencement of operation of the offshore wind farm.

During the land-based theodolite tracking survey, observers should search for marine mammals using unaided eye and hand-held 7x50 Brunton binoculars or equivalent. When an individual/group of marine mammal is located, it

(1) In the original EM&A Manual, it was assumed that a total of two theodolite units would be deployed and each theodolite unit would be manned by a team of three personnel (ie a total of six personnel for two theodolite units). For the current plan, it is proposed to only deploy one theodolite unit at Ha Mei Tsui which is considered to be the best location for theodolite tracking as it is the nearest site to the wind farm which had been used for land-based marine mammal monitoring at SW Lamma waters (please refer to *"Position and Number of Land-based Theodolite Unit and Timing of Survey"* below for deployment location of the theodolite unit). It is noted that due to space limitation and difficulty in accessing the site it may not be possible to place two theodolite units at Ha Mei Tsui. As such, one theodolite unit which will be manned by three field personnel is now proposed. Based on a future site visit by a marine mammal expert and the final layout of the wind farm, the final number of theodolite unit(s) will be confirmed. Any changes will be reported to both the IEC and the AFCD for approval accordingly.

(2) It is noted that piling activities for the installation of the wind turbines will be avoided during December to May, hence monitoring activities may take place during periods when no piling works are occurring.

will be tracked continuously to record the position each time the marine mammal surfaced. Tracking should be continued until the individual/group is lost, travel beyond the range of reliable visibility or when environmental conditions reduce visibility (eg intense haze, high Beaufort state, or sunset).

Data acquisition should include movement and behavioural information of marine mammals as gained from a 5-sec. resolution digital theodolite with 30-power magnification, laser range-finding capability, appropriate other hand-held range finders, binoculars with distance-measuring reticles and built-in compass, recording gear of digital voice recorder, data sheets, and computer slaved to theodolites. Theodolite with similar specifications as the *Sokkia Model DT5* should be used.

Position and Number of Land-based Theodolite Unit and Timing of Survey

The potential location and number of theodolite unit as well as survey timing have been developed in consultation with a marine mammal expert with experience in theodolite tracking. One theodolite unit should be used for tracking the finless porpoises. It is proposed to deploy the theodolite at Ha Mei Tsui of Lamma Island, which is around 2-3 km from the wind farm site (*Figure 6.3*). Previous land-based marine mammal monitoring was undertaken at Ha Mei Tsui (1), however, theodolite tracking was not conducted there during that study. Theodolite tracking should be undertaken before early afternoon (ie 2 pm) as far as practicable to reduce the effect of mid-day sun streak. Exact location and number of the theodolite unit as well as the time period in a survey day during which tracking should be undertaken will be confirmed, inspected and checked by a marine mammal expert in the future through site visit before commencement of baseline monitoring.

The location and number of theodolite unit as well as survey timing should be finalised and agreed with AFCD during the detailed design stage based on the final layout of the wind farm.

Data Analysis

The theodolite-tracking data should be analysed by the secondary operator under the supervision of the primary operator. Data interpretation should be undertaken using the *Pythagoras* software, or similar, which accepts measurements of horizontal and vertical angle data from the theodolite. The software also calculates geographical position of objects in real time which allows estimation of the tracked individual's distance from the theodolite, bearing and speed information as well as mapping of the tracks for visualization. For the data analysis, porpoises' positions should be plotted and overlaid on a map in order to visualize their distribution. Data should also be analysed to obtain information on porpoise leg speed and bearing

(1) Isabel Beasley and Thomas A. Jefferson (2002) Surface and dive times of finless porpoises in Hong Kong's coastal waters. The Raffles Bulletin of Zoology 2002 Supplement No. 10:125-129.

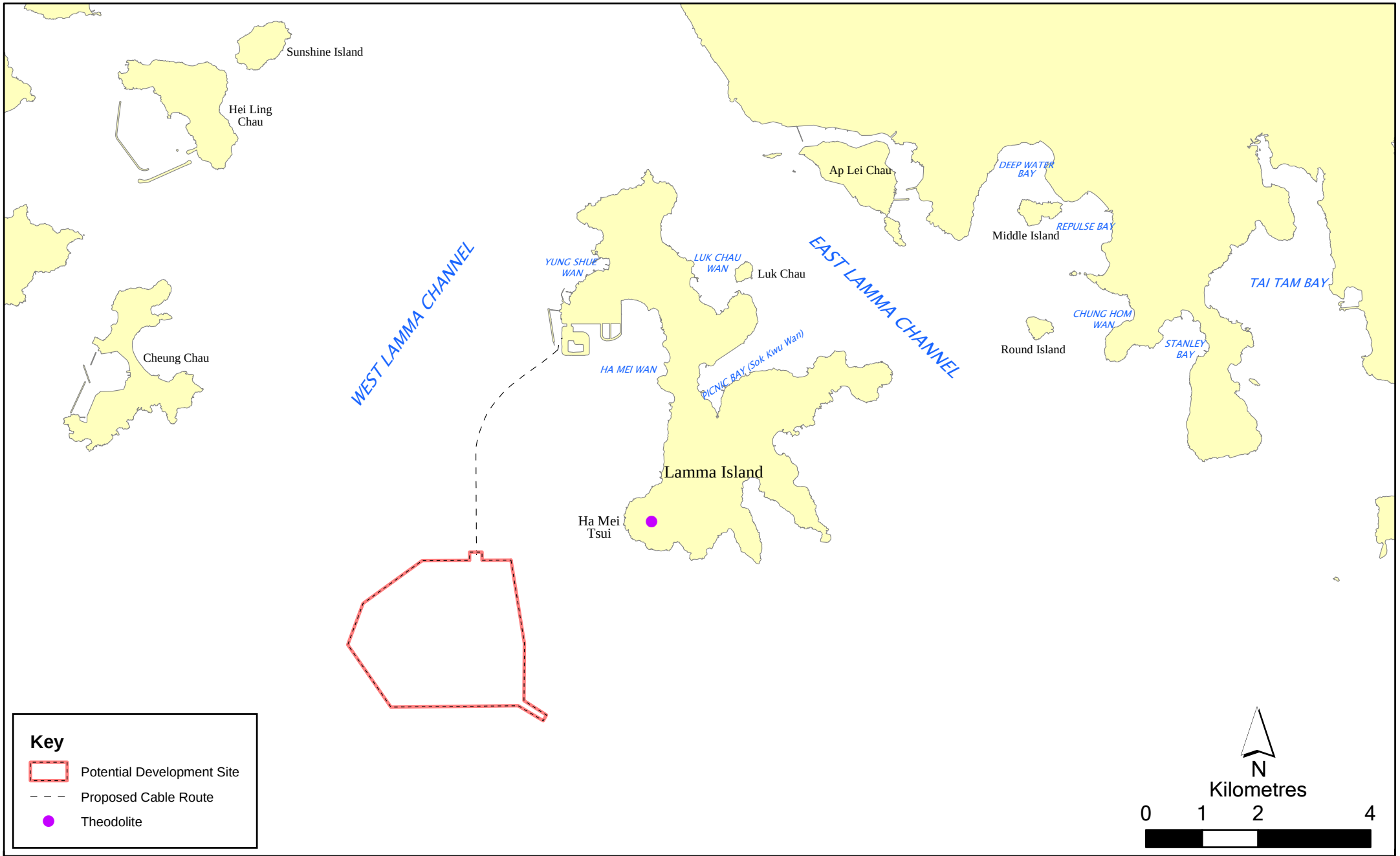

Figure 6.3

Proposed Location for Land-based Theodolite Tracking

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changes in relation to the construction and operation activities of the wind farm. The leg speed of porpoise should be calculated by dividing the distance travelled by a tracked individual by the duration between two consecutive theodolite records. Reorientation rate should be calculated by adding all bearing changes in degrees along a trackline and dividing the sum by total duration of the trackline concerned. Locations of construction and operation activities should be recorded when an individual is tracked so that relationship of leg speed, reorientation rate and distribution of porpoises with these activities can be determined. As individual tracking sessions vary in duration, one ten-minute section should be randomly selected per trackline for analysis to reduce the risk of over- and/or under-sampling.

6.2.4 MONITORING RESULTS

Information on sighting number of finless porpoises will be collected by the vessel based surveys. Data obtained from PAM should be analysed to investigate the usage of the wind farm site by finless porpoises based on parameters such as porpoise positive time units and waiting time between encounters. For theodolite-tracking, information on porpoises' movement patterns in relation to the construction and operation activities of the wind farm will be collected. Any seasonal trends in sighting number, usage of the wind farm site and movement patterns of porpoises should be determined during the baseline monitoring period. Data collected during the construction and operation monitoring should be compared to investigate any changes during construction and operation of the Project, taking into account any temporal differences detected during the baseline period. Should sighting number, site usage and movement pattern of porpoises be significantly different (taking into account naturally occurring alterations to distribution patterns such as due to seasonal change) between the baseline, construction and post-construction monitoring, recommendations for further post-construction monitoring survey will be made. Data should then be re-assessed and the need for any further monitoring established. Significance levels will be quantitatively determined following the post-construction monitoring which will include review of up-to-date publicly available information on marine mammal distribution to allow for typical variance levels.

6.3 MARINE MAMMAL / SEA TURTLE EXCLUSION ZONE

Marine mammal / sea turtle exclusion zones for various construction activities are listed in *Table 6.3*. The exclusion zone should be monitored by the qualified person(s) with an unobstructed, elevated view of the area. Activities should not begin until the qualified person certifies that the exclusion zone is continuously clear of marine mammals / sea turtle for a period of 30 minutes. Should marine mammals / sea turtle move into the exclusion zone during the activities, cessation of the activities will commence as described in *Table 6.3*.

Table 6.3 Exclusion Zone Requirement for Various Activities

Activity	Exclusion Zone	Requirement
Percussive Piling Works for Foundations of Wind Turbines and Wind Monitoring Station	500m from works area	Before piling commences, the exclusion zone must have been continuously clear of cetaceans/ sea turtles for 30 minutes. During piling, if marine mammals / sea turtles are spotted within the exclusion zone, piling works will cease and will not resume until the observer confirms that the zone has been continuously clear of marine mammals / sea turtles for a period of 30 minutes. Piling works will be restricted to a daily maximum of 12 hours with daylight operations No piling works for the wind turbines will be conducted during the finless porpoises peak season between December and May.
Marine Dredging	250m from dredging barge	Before dredging commences, the exclusion zone must have been continuously clear of marine mammals / sea turtles for 30 minutes. Should marine mammals / sea turtles move into the dredging area during dredging, it is considered that marine mammals / sea turtles will have acclimatised themselves to the works therefore cessation of dredging is not required.

Marine mammal / sea turtle observers should have a degree in biology or equivalent or have experience in marine mammal observation. Observers may be part of the ET. The IEC will be required to verify the qualification and experience of the qualified person(s).

6.4 CORAL VERIFICATION SURVEYS

6.4.1 BACKGROUND

Geophysical surveys undertaken for the EIA Study of the Project identified a number of small patches of hard substrate along the proposed cable route of the Project (1). These patches, identified as superficial dumped materials, occurred within the 150 m wide cable corridor and within -10 mCD depth or less (*Figure 6.4*). The materials were thought to be relatively mobile as displacement of the materials by trawling activity was seen on geophysical images.

(1) ERM-Hong Kong, Limited (2010) *Op. cit.*

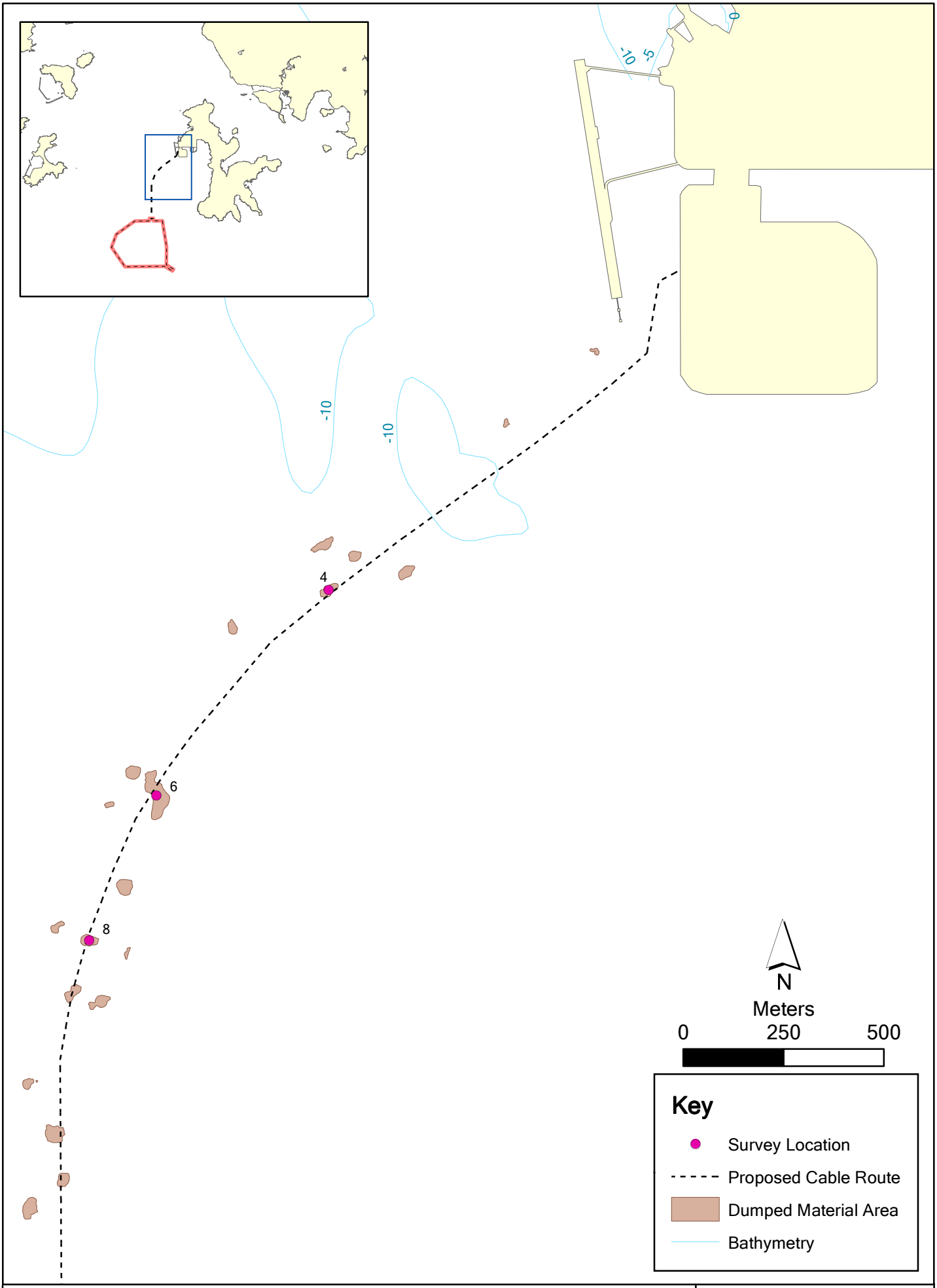

Figure 6.4

Locations of Coral Verification Survey

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Baseline coral survey by qualitative spot dive check was undertaken on the identified dumped materials during the EIA Study [(1)]. A total of three octocoral species (including one soft coral and two gorgonian species) and one black coral species were recorded on the dumped material of Patches 4, 6 and 8 (*Figure 6.4*; *Table 6.4*). The hard substrate at Patches 4, 6 and 8 were sparsely colonised with the gorgonians *Echinomuricea* sp. and *Menella* sp., and substrate at Patch 8 showed sparse colonization of soft coral *Dendronephthya* sp., *Echinomuricea* sp. and black coral *Cirripathes* sp. (*Table 6.4*). All species of octocorals and black corals recorded were considered as common and widespread species of Hong Kong. The communities identified during the baseline survey were located on the hard substrate which only formed a small percentage of the seabed as the majority of the seabed comprised soft substrate.

Since the dumped materials on which corals were recorded were relatively mobile, it is considered necessary to undertake a pre-construction coral verification survey prior to the commencement of cable laying works for the Project at the three sites where corals were found previously (ie Patches 4, 6 and 8) to confirm the coral existence if the proposed cable route is the same as that presented in the EIA Study of the Project. Locations of the three sites are detailed in *Table 6.4* and shown in *Figure 6.4*. Appropriate mitigation measures have been recommended to reduce potential marine ecological impacts to corals caused by the cable laying works which are described in the *Method Statement for the Coral Verification Survey* prepared by ERM (2012). The Method Statement was submitted to AFCD in November 2012 and subsequently approved by AFCD in January 2013.

Table 6.4 ***Coral Species Recorded at Patches 4, 6 and 8 and Coordinates of Sites***

	Patch 4	**Patch 6**	**Patch 8**
Coordinates – Latitude	22° 12' 24.60" N	22° 12' 8.01" N	22° 11' 56.24" N
Coordinates – Longitude	114° 5' 41.41" E	114° 5' 26.43" E	114° 5' 20.57" E
Octocoral Species [(a)]			
Dendronephthya sp.	0	0	1
Echinomuricea sp.	1	1	1
Menella sp.	1	1	1
Black Coral Species	0	0	1

Note: (a). 0=absent, 1=present

It is noted that the proposed cable route may be revised during the detailed design phase of the Project. Further baseline coral surveys will be conducted and the final cable route will be away from any existing coral assemblages. The survey will adopt the same methodology as the baseline coral surveys conducted during the EIA Study of the Project. As the revised cable route

(1) ERM-Hong Kong, Limited (2010) *Op. cit.*

will be away from any identified coral assemblages, it is considered not necessary to undertake any coral verification survey. However, if the cable route remained the same as that presented in the EIA Study of the Project, coral verification survey as stated in *Section 6.4.2* below will be required to be undertaken.

6.4.2 METHODOLOGY

Coral verification survey should be undertaken at Patches 4, 6 and 8 to confirm the presence of corals and coral conditions (eg percentage cover, diversity) should be recorded, if any are found. The coral verification survey should comprise the following two components:

- Qualitative spot dive survey; and
- Semi-quantitative Rapid Ecological Assessment (REA) survey.

The method of the coral verification survey is the same as that adopted for the EIA baseline survey. This would allow direct comparison of observations between the coral verification and baseline surveys. Methodology of the survey is described further below.

Qualitative Spot Dive Check

At each survey site, a spot dive reconnaissance check should be conducted by a qualified coral specialist by SCUBA to confirm the substrate type and associated sessile benthos, particularly the presence of coral communities (hard and soft corals). The qualified coral specialist should be a holder of a marine science based postgraduate degree from universities of HKSAR, or equivalent, and have at least three (3) years of experience in underwater identification of corals. During the qualitative spot dive check, the immediate seabed area around the patch (5 m radius around the centre point) should be checked by the coral specialist, and representative photographs of the seabed and associated fauna should be taken. Coral species encountered during the spot dive checks should be identified to the lowest possible taxonomic level (ie species level for hard corals and genus level for octocoral and black coral). If corals are found, semi-quantitative Rapid Ecological Assessment (REA) survey should be undertaken to record the conditions of the identified coral assemblages

Rapid Ecological Assessment (REA) Survey Method

Semi-quantitative REA survey should be undertaken at the survey site, if coral is found during the qualitative spot dive check, in order to examine the conditions of the coral assemblage. The REA technique allows semi-quantitative information on the ecological attributes of the subtidal habitat to be obtained in a relatively simple way without compromising scientific rigour. This technique is the standard practices for EIA marine baseline surveys in Hong Kong and has been modified from the standardised REA survey

technique established for the assessment of coral communities on the Great Barrier Reef [1] for marine environment of Hong Kong [2].

At each site, the REA survey should be conducted by the qualified coral specialist by SCUBA along one (1) transect of 100 m in length. Following the laying of the 100 m transect on the seabed, the coral specialist should swim along the transect slowly and conducted a REA of the seabed. The REA methodology encompasses an assessment of the benthic cover (Tier I) and taxon abundance (Tier II) undertaken in a swathe ~ 4 m wide, 2 m either side of each transect. The belt transect width should be dependent on underwater visibility and might be adjusted to a swathe ~2 m wide, 1 m either side of the each transect in case of reduced visibility. An explanation of the two assessment categories (Tiers) used in the survey is presented below.

Tier I - Categorisation of Benthic Cover

Upon the completion of each survey transect, five ecological and seven substratum attributes should be assigned to one of seven standard ranked (ordinal) categories (*Tables 6.5* and *6.6*).

Table 6.5 ***Categories used in the REA Surveys - Benthic Attributes***

Ecological	Substratum
Hard coral	Hard substrate
Dead standing coral	Continuous pavement
Soft coral	Bedrock
Black coral	Rubble
Macroalgae	Sand
Turf algae	Silt
	Large boulders (>50 cm)
	Small boulders (<50 cm)
	Rocks (<26 cm)

(1) DeVantier LM, De'Ath G, Done TJ, Turak E (1998) Ecological assessment of a complex natural system: A case study from the Great Barrier Reef. *Ecological Applications* 8: 480-496.

(2) Fabricius KE, McCorry D(2006) Changes in octcoral communities and benthic cover along a water quality gradient in reefs of Hong Kong. *Marine Pollution Bulletin* 52: 22-33

Table 6.6 Categories used in the REA Surveys - Ordinal Ranks of Percentage Cover

Rank	Percentage Cover (%)
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Tier II - Taxonomic Inventories to Define Types of Benthic Communities

An inventory of benthic taxa should be compiled for each transect. Taxa should be identified *in situ* to the following levels:

- Scleractinian (hard) corals to species wherever possible;
- Soft corals, black corals, anemones and conspicuous macroalgae recorded according to morphological features and to genus level where possible; and
- Other benthos (including sponges, zoanthids, ascidians and bryozoans) recorded to genus level wherever possible but more typically to phylum plus growth form.

Following the completion of each transect survey, each taxon in the inventory should be ranked in terms of abundance in the community (see *Table 6.7*). These broad categories rank taxa in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are subjective assessments of abundance, rather than quantitative counts of each taxon.

Table 6.7 Ordinal Ranks of Taxon Abundance

Rank	Abundance
0	Absent
1	Rare [(a)]
2	Uncommon
3	Common
4	Abundant
5	Dominant

Note:
(a) The classification of "rare" abundance refers to low abundance (small quantity) on the transect, rather than in terms of distribution in Hong Kong waters.

A set of environmental site descriptors should be recorded for each REA transect as follows:

(A) The degree of exposure to prevailing wave energy should be ranked from 1 - 4, where:

1 = sheltered (highly protected by topographic features from prevailing waves);

2 = semi-sheltered (moderately protected);

3 = semi-exposed (only partly protected); and

4 = exposed (experiences the full force of prevailing wave energy).

(B) Sediment deposition on the reef substratum (particle sizes ranging from very fine to moderately coarse) should be rated on a four point scale, from 0 – 3, where:

0 = no sediment;

1 = minor (thin layer) sediment deposition;

2 = moderate sediment deposition (thick layer), but substrate can be cleaned by fanning off the sediment; and

3 = major sediment deposition (thick, deep layer), and substrate cannot be cleaned by fanning.

A suite of representative photographs should be taken for each REA transect. All field data should be checked upon completion of each REA transect and a dive survey proforma sheet should be completed at the end of the fieldwork day. Photographs compiled for each REA transect should then be reviewed and REA data verified. Verified REA data should presented in terms of:

1. Site (transect) information (Tier I and II data), depth and environmental descriptors; and

2. Species abundance data for each transect.

Species lists, species richness and mean values for ecological and substratum types should be compiled. The rank abundance values should be converted to a mid-value percentage cover.

6.4.3 POTENTIAL MITIGATION MEASURES FOR CORALS

If the condition of corals recorded in the pre-construction verification survey is similar to that recorded during the baseline survey of the EIA (1) which is considered as of low abundance and diversity with no rare coral species recorded (please refer to *Table 9A.15* in *Annex 9A* of the EIA Report for detailed discussion of the ecological value of the corals on the dumped

(1) ERM (2010) *Op. cit.*

material patches), no mitigation measures would be deemed necessary. However, should any corals of high ecological value be found present during the pre-construction verification survey, the following mitigation measures should be adopted:

If high ecological value coral is found within the 150 m wide cable corridor

- The alignment of the proposed cable route should be revised as far as practicable so that no coral(s) will be located within the cable corridor(s); or
- Relocation of corals to a location away from the proposed cable corridor.

If no high ecological value coral is found within the 150 m wide cable corridor

- Indirect, short-term impacts to corals in the vicinity of the proposed cable route (ie outside the proposed cable corridor) as a result of sediment dispersion caused by the jetting works are expected to be acceptable as predicted in the EIA Study of the Project. As such, no further mitigation measures would be considered necessary if no coral is found within the proposed cable corridor.

6.5 MITIGATION MEASURES

The EIA has highlighted that as part of the construction procedure for dredging activities, a silt curtain will be installed to aid in reducing the levels of suspended solids generated by these works. Mitigation measures for marine ecology especially for marine mammals and marine turtles are presented in *Annex A*.

6.6 AUDITING REQUIREMENTS

Implementation of the mitigation measures for marine ecology recommended by the EIA will be monitored through the site audit programme.

7 NOISE

7.1 INTRODUCTION

The requirements, methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of noise impacts during construction of the Project are presented in this section.

7.2 AIRBORNE NOISE MONITORING

If percussive piling between 0700 and 1900 hours on any day not being a general holiday is to be undertaken, a Construction Noise Permit (CNP) will be required for the works. An application for a CNP for percussive piling is assessed in accordance with the *Technical Memorandum on Noise from Percussive Piling (PP-TM)* under the Noise Control Ordinance (NCO). The CNP may contain permitted hours of operation as a condition with reference to the predicted noise levels at noise sensitive receivers.

The Noise Control Authority (NCA) will consider a well justified CNP application, once filed, for construction works within restricted hours or percussive piling as guided by the relevant Technical Memoranda issued under the NCO. The NCA will take into account contemporary conditions/situation of adjoining land uses and any previous complaints against construction activities at the site before making his decision in granting a CNP. Any condition he thinks fit, such as noise monitoring requirements, shall be determined by EPD in the capacity of the NCA and included in the CNP when issued. Failure to comply with any such conditions will lead to cancellation of the CNP and prosecution action under the NCO.

Airborne noise monitoring is proposed during percussive piling works for the wind turbines. The following presented the proposed airborne noise monitoring under this EM&A programme. If noise monitoring requirements have been specified as a condition of a CNP, those requirements should also be followed.

7.2.1 METHODOLOGY AND CRITERIA

Noise measurements should be carried out in accordance with the guidelines given in *Annex – General Calibration and Measurement Procedures* of *Technical Memorandum on Noise from Percussive Piling* (*PP-TM*).

Whilst the *Noise Control Ordinance* (*NCO*) does not provide for the statutory control of construction activities occurring on weekdays during normal working hours (ie Monday to Saturday inclusive 0700-1900 hours), a daytime standard of $L_{eq(30min)}$ 75dB(A) as stipulated in Annex 5 of the *Technical*

Memorandum on Environmental Impact Assessment Process (*EIAO-TM*) will be adopted as the noise criterion for all residential dwellings; while a daytime standard of $L_{eq(30min)}$ 70dB(A) will be adopted for all educational institutions during normal school days and $L_{eq(30min)}$ 65dB(A) during examination periods.

The construction noise levels will be measured in terms of A-weighted equivalent continuous sound pressure level (L_{eq}) measured in decibels dB(A). $L_{eq(30min)}$ should be used as the monitoring parameter for the time period between 0700-1900 hours on normal weekdays.

Supplementary information for data auditing, two statistical sound levels L_{10} and L_{90}; the levels exceeded for 10 and 90 percent of the time respectively, should also be recorded during the monitoring for reference.

Noise measurements should generally not be made in the presence of fog, rain, wind with a steady speed exceeding 5m s^{-1} or wind with gusts exceeding 10m s^{-1}. The wind speed should be checked with a portable wind speed meter capable of measuring the wind speed in ms^{-1}.

7.2.2 *MONITORING EQUIPMENT*

As referred to the *GW-TM*, sound level meters in compliance with the *International Electrotechnical Commission Publications 651:1979 (Type 1) and 804:1985 (Type 1) Specifications* should be used for carrying out the noise monitoring. Immediately prior to and following each noise measurement the accuracy of the sound level meter should be checked using an acoustic calibrator generating a known sound pressure level at a known frequency. Measurements may be accepted as valid only if the calibration levels from before and after the noise measurement agree to within 1.0 dB.

The ET should ensure that the equipment is maintained in a good working order in accordance with the manufacturer's recommendations with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.

The ET is responsible for the provision of the monitoring equipment and will ensure that sufficient noise measuring equipment and associated instrumentation are available for carrying out the baseline monitoring and impact monitoring. All the equipment and associated instrumentation will be clearly labelled.

7.2.3 *MONITORING LOCATIONS*

Representative locations were selected to monitor the noise levels from the Project's wind turbine percussive piling activities. The noise monitoring stations are listed in *Table 7.1* and presented in *Figure 7.1*.

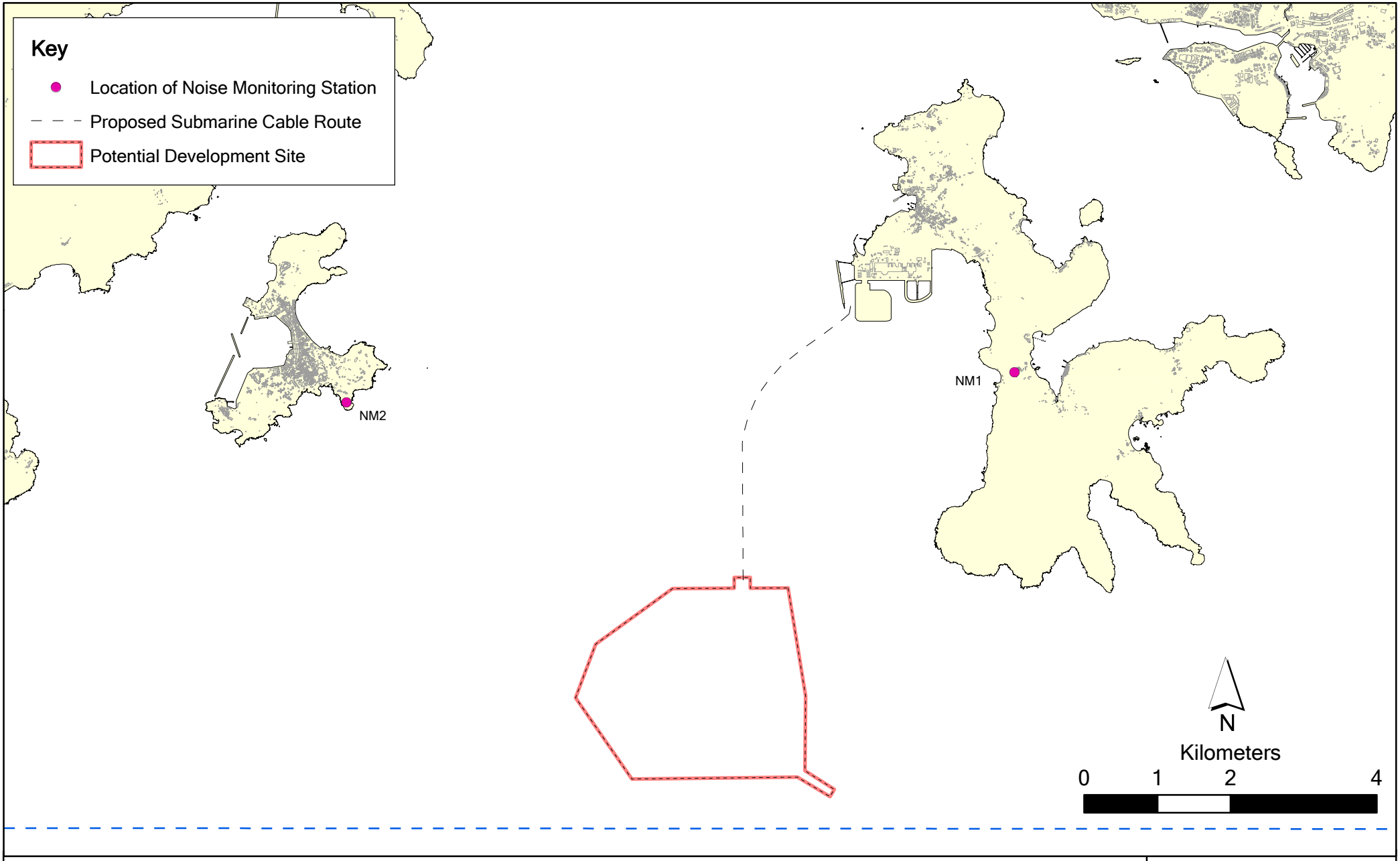

Figure 7.1

Locations of Airborne Noise Monitoring Station for Wind Turbine Percussive Piling Works

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Table 7.1 Noise Monitoring Stations for Percussive Piling Noise

Monitoring Station	Description
NM1	Lamma Island – Lo So Shing
NM2	Cheung Chau – Seascape Peninsula

The status and locations of noise sensitive receivers (NSRs) may change after issuing this Manual and the location of the noise monitoring station may need to be adjusted accordingly. If such changes occur, the ET should propose an updated monitoring location for the agreement from HK Electric, IEC and EPD.

When alternative monitoring location is proposed, the following criteria, as far as practicable, should be followed:

- At locations close to the major site activities which may have noise impacts;
- Close to the NSRs; and
- For monitoring locations located in the vicinity of the NSRs, care should be taken to minimise disturbance to the occupants during monitoring.

The monitoring station will normally be at a point 1m from the exterior of the NSR building façade and at a height of approximately 1.2m above ground or at the height that has the least obstructed view of the pile driving activities in relation to the NSR. If access to the normal monitoring position cannot be obtained, an alternative position will be chosen, and a correction to the measurements should be made, if appropriate. For instance, a correction of +3 dB(A) should be made to free-field measurements. The ET should agree with HK Electric, IEC, EPD and the owners/occupants of the premises on the monitoring position. Once the positions for the monitoring stations are chosen, the baseline monitoring and the impact monitoring should be carried out at the same positions.

7.2.4 BASELINE MONITORING

The ET should carry out baseline noise monitoring prior to the commencement of any percussive piling works for the wind turbines. The baseline monitoring shall be measured for a continuous period of at least 14 consecutive days at a minimum logging interval of 30 minutes for day-time and 15 minutes (as three consecutive $L_{eq(5min)}$ readings) for evening, holidays and night-time.

Before commencing the baseline monitoring, ET shall inform the Contractor(s), IEC, HK Electric and the EPD of the baseline monitoring schedule programme such that relevant parties could conduct on-site audit to ensure accuracy of the baseline monitoring results.

During the baseline monitoring, there should not be any construction activities in the vicinity of the monitoring stations. Any non-Project related construction activities in the vicinity of the stations during the baseline monitoring should be noted and the source(s) and location(s) be recorded.

In case the baseline monitoring could not be carried out at any of the designated monitoring locations during the baseline monitoring period, the ET shall carry out the monitoring at alternative location which could effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring locations shall be agreed with the HK Electric, Contractor(s) and IEC and approved by EPD.

In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET shall liaise with HK Electric, IEC and EPD to agree on an appropriate set of data to be used as a baseline reference.

7.2.5 IMPACT MONITORING

Monitoring of construction noise during the percussive piling works for the wind turbines shall be conducted:

- During the first pile for the wind turbine; and
- During the pile closest to the noise monitoring station, ie. piling for wind turbine no. 1 and no. 28 as per the current basis of design presented in the EIA.

Noise monitoring shall be carried out at all the designated monitoring stations. An initial guide on the monitoring is to obtain one set of 30-minute measurement at each station between 0700 and 1900 hours on normal weekdays at a frequency of three times a week for the above-mentioned period when percussive piling activities are underway.

The need for percussive piling noise monitoring should be reviewed weekly based on the previous monitoring results. If the noise levels of the first week comply with the noise criteria as stipulated in Annex 5 of the *Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)*, or are consistent with the baseline noise levels, ET may consider suspension of the noise monitoring.

7.2.6 ENVIRONMENTAL QUALITY PERFORMANCE LIMITS

A/L Levels provide an appropriate framework for the interpretation of monitoring results. Interpretation of monitoring results is undertaken through checking them against the A/L Levels defined in *Table 7.2*.

Table 7.2 ***Action and Limit Level for Construction Noise Monitoring during Percussive Piling Activities for the Wind Turbine Installation***

Time Period	Action Level	Limit Level
0700 – 1900 hours on normal weekdays	When one documented complaint is received from any one of the sensitive receivers	75 dB(A) (Note)

Notes:

(a) Limit Level is reduced to 70 dB(A) for schools and 65dB(A) during school examination periods.

To account for cases where ambient noise levels, as identified by baseline monitoring, approach or exceed the stipulated Limit Level prior to commencement of construction, a Maximum Acceptable Impact Level, which incorporates the baseline noise level and the identified construction noise Limit Level, might be defined upon agreement with the EPD. This amended level will, therefore, be greater than 75 dB(A) and will represent the maximum acceptable noise level at a specific monitoring station.

For compliance checking, after taking into account any adjustments agreed with EPD, comparison with either the Limit or the Maximum Acceptable Impact Level will represent the governing criteria for noise impact assessment during impact monitoring.

7.2.7 EVENT AND ACTION PLAN

The ET should compare the impact monitoring results with the noise criteria as defined in *Table 7.2*. In cases where exceedance of these criteria occurs, actions should be carried out in accordance with the EAP shown in *Table 7.3*.

7.3 UNDERWATER NOISE MONITORING

Underwater noise monitoring will be undertaken during percussive piling works for the wind turbines. Measurements will be undertaken as follows:

- Underwater sound measurements will be taken during the installation of the first pile for the wind turbines to be installed for the proposed wind farm;
- Measurements shall be undertaken at 250 m, 500 m and 1,000 m from the piling works, using calibrated hydrophones with calibrated precision amplifiers, analog to digital converters and a high speed data-logging system (with frequency response approximately flat from 10 Hz to 50 kHz). In view that the surface and bottom depth may be affected by potential surface or bottom reflection, the sound measurements shall be measured at a mid depth (or a minimum of 10 m);

- Measurements will record ambient noise level for one hour prior to any pile driving activities, for a minimum period of 30 pile driving blows and for a period of one hour after piling ceases;

- Piling activities must represent those for installation of all piles, such that the equipment to be used during the first pile should match closely to the equipment to be used during the remainder of construction piling; and

- Measurements should be taken at a sampling rate of 100 kHz. Both broadband and one octave bandwidth from 10Hz to 100 kHz shall be measured.

The results of the underwater sound measurements will be provided to the IEC and EPD to demonstrate that the piling activities do not exceed a Peak-to-Peak Source level of 252dB re 1 μPa at 1 metre from the pile.

7.4 MITIGATION MEASURES

The EIA report has outlined a variety of recommended noise impact mitigation measures. These are summarised in the Implementation Schedule of Mitigation Measures (*Annex A).*

7.5 AUDITING REQUIREMENTS

Implementation of the mitigation measures for noise impacts recommended by the EIA will be monitored through the site audit programme.

Table 7.3 Event and Action Plan for Construction Noise

Event	Action			
	ET	**IEC**	**HK Electric**	**Contractor**
Action Level	1. Notify IEC and Contractor; 2. Carry out investigation; 3. Report the results of investigation to the IEC, HK Electric and Contractor; 4. Discuss with the Contractor and formulate remedial measures; 5. Increase monitoring frequency to check mitigation effectiveness.	1. Review the analysed results submitted by the ET; 2. Review the proposed remedial measures by the Contractor and advise the HK Electric accordingly; 3. Supervise the implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Require Contractor to propose remedial measures for the analysed noise problem; 4. Ensure remedial measures are properly implemented.	1. Submit noise mitigation proposals to IEC; 2. Implement noise mitigation proposals.
Limit Level	1. Identify source; 2. Inform IEC and HK Electric: 3. Repeat measurements to confirm findings; 4. Increase monitoring frequency; 5. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented; 6. Inform IEC, HK Electric and EPD the causes and actions taken for the exceedances; 7. Assess effectiveness of Contractor's remedial actions and keep IEC, EPD and HK Electric informed of the results; 8. If exceedance stops, cease additional monitoring.	1. Discuss amongst HK Electric, ET, and Contractor on the potential remedial actions; 2. Review Contractors remedial actions whenever necessary to assure their effectiveness and advise the HK Electric accordingly; 3. Supervise the implementation of remedial measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Require Contractor to propose remedial measures for the analysed noise problem; 4. Ensure remedial measures properly implemented; 5. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	1. Take immediate action to avoid further exceedance; 2. Submit proposals for remedial actions to IEC within 3 working days of notification; 3. Implement the agreed proposals; 4. Resubmit proposals if problem still not under control; 5. Stop the relevant portion of works as determined by the HK Electric until the exceedance is abated.

8 LANDSCAPE AND VISUAL

8.1 INTRODUCTION

This Section defines the EM&A requirements that have been recommended to ensure that the proposed landscape and visual mitigation measures are effectively implemented.

8.2 GENERAL

The EIA has recommended that EM&A for landscape and visual resources is undertaken during the design and construction of the project. The implementation and maintenance of landscape mitigation measures (*Annex A*) should be checked to ensure that they are fully realised and that potential conflicts between the proposed landscape measures and any other project works and operational requirements are resolved at the earliest practical date and without compromise to the intention of the mitigation measures.

8.3 DESIGN PHASE AUDIT

The design phase audit should ensure the following visual mitigation measures should be incorporated into the detailed design of the Project:

- *Array Layout*: The layout of the array should be designed to reduce the number of turbines visible for the most sensitive viewpoints as far as other technical details, such as suitable sea bed and wind flow conditions, are achievable.
- *Colours Appropriate*: The colours for the wind turbines should be selected to reduce their visibility.
- *Blade Rotation*: To create a more harmonious visual pattern the blades for all turbines should rotate in the same direction.

8.4 CONSTRUCTION PHASE AUDIT

Measures undertaken by the Contractor(s) during the construction phase will be audited by the ET, ensure compliance with the intended aims of the measures. Site inspections should be undertaken at least once per month throughout the construction phase.

The visual and landscape mitigation measures recommended in the EIA should be included in the construction phase audit:

- All plant materials affected by the works relating to the submarine cable landing are to be replaced with new plantings to match the existing

situation. All planting of trees and shrubs is to be carried out in accordance with the relevant best practice guidelines. Plant densities are to be provided in future Detailed Design documents and are to be selected so as to achieve a finished landscape that matches the surrounding, undisturbed, equivalent landscape types.

- Established trees of value to be re-located where practically feasible.
- Site hoardings to be compatible with the surrounding environment. Where possible, site hoardings should be coloured to complement the surrounding areas
- Landscape resources affected by the onshore cable trench are to be reinstated to match existing conditions.

Table 8.1 Landscape and Visual Audit Checklist

Project Phases	Area of Works	Items to be Checked
Design Phase	Array Layout	Design to reduce the number of turbines visible for the most sensitive viewpoints
	Colour Appropriate	The colours for the wind turbines should be selected to reduce their visibility
	Blade Rotation	The blades for all turbines should rotate in the same direction.
Construction / Post – Construction Phase	Protection of trees to be retained	Identification and demarcation of trees / vegetation to be retained, erection of physical protection (e.g. fencing), monitoring against potential incursion, physical damage, fire, pollution, surface erosion, etc.
	Advance planting	All plant materials affected by the works relating to the submarine cable landing are to be replaced with new plantings to match the existing situation. All planting of trees and shrubs is to be carried out in accordance with the relevant best practice guidelines. Plant densities are to be provided in future Detailed Design documents and are to be selected so as to achieve a finished landscape that matches the surrounding, undisturbed, equivalent landscape types.
	Transplanting of trees	Identification and demarcation of trees / vegetation to be transplanted, monitoring of extent of pruning / lifting works to reduce damage, timing of operations, implementation of the stages of preparatory and translocation works, and maintenance of transplanted vegetation, etc.
	Decorative treatment of site hoarding	Site hoardings to be compatible with the surrounding environment. Where possible, site hoardings should be colored to complement the surrounding areas.

In the event of non-compliance from the Environmental Permit, EIA Study, EM&A Manual and Landscape Plan, the responsibilities of the relevant parties is detailed in the Event / Action plan provided on *Table 8.2.*

Table 8.2 Event and Action Plan for Landscape and Visual Monitoring during Construction Phase

EVENT	ACTION			
	ET(1)	**IEC(1)**	**Contractor(s)**	**HK Electric**
Non-compliance on one occasion	1. Identify Source 2. Inform the Contractor(s), IEC and HK Electric 3. Discuss remedial actions with the IEC, HK Electric and the Contractor(s) 4. Monitor remedial actions until rectification has been completed	1. Check report 2. Check the Contractor(s)'s working method 3. Discuss with the ET and the Contractor(s) on practical remedial measures 4. Advise HK Electric on effectiveness of proposed remedial measures. 5. Check implementation of remedial measures.	1. Amend working methods 2. Rectify damage and undertake any necessary replacement	1. Notify Contractor(s) 2. Ensure remedial measures are properly implemented
Repeated Non-compliance	1. Identify Source 2. Inform the Contractor(s), IEC and HK Electric 3. Increase monitoring frequency 4. Discuss remedial actions with the IEC, HK Electric and the Contractor(s) 5. Monitor remedial actions until rectification has been completed 6. If nonconformity stops, cease additional monitoring	1. Check monitoring report 2. Check the Contractor(s)'s working method 3. Discuss with the ET and the Contractor(s) on practical remedial measures 4. Advise HK Electric on effectiveness of proposed remedial measures 5. Supervise implementation of remedial measures.	1. Amend working methods 2. Rectify damage and undertake any necessary replacement	1. Notify the Contractor(s) 2. Ensure remedial measures are properly implemented

Note: (1) ET – Environmental Team, IEC – Independent Environmental Checker

8.5 MITIGATION MEASURES

The Landscape and Visual Assessment of the EIA recommended a series of mitigation measures for the Project design and during construction and post-construction phase to ameliorate the landscape and visual impacts of the project. Details of the recommended mitigation measures are included within the Implementation Schedule provided in *Annex A*.

8.6 AUDITING REQUIREMENTS

Implementation of the mitigation measures for landscape and visual resources recommended by the EIA will be monitored through the site audit programme.

As it is concluded that no archaeological material will be impacted by this Project no further marine archaeological investigation is required. The avoidance of direct impacts to the shipwreck identified during the geophysical survey will be verified by the Environmental Team and the Independent Environmental Checker through review of the final design prior to the installation of turbines and submarine cable. Designs and subsequent construction works will be checked to ensure that no works will occur within 50 m of the shipwreck.

When carrying out marine works of the construction phase, the boundary of the marine works area(s), within which non-Project vessels (including fish vessels) may not be allowed to enter, will have to be approved by Marine Department. In addition, site audit will be undertaken twice per month during the construction phase which will involve checking of mitigation measures related to fisheries aspects (*Annex A*).

11 SITE ENVIRONMENTAL AUDIT

11.1 SITE INSPECTIONS

Site inspections provide a direct means to assess and ensure the Contractor(s)'s environmental protection and pollution control measures are in compliance with the contract specifications. The site inspection will be undertaken routinely by the ET to ensure that appropriate environmental protection and pollution control mitigation measures are properly implemented in accordance with the EIA. In addition, the ET will be responsible for defining the scope of the inspections, detailing any deficiencies that are identified, and reporting any necessary action or additional mitigation measures that were implemented as a result of the inspection.

Regular site inspections will be carried out twice per month during the construction phase. The areas of inspection will not be limited to the site area and should also include the environmental conditions outside the site which are likely to be affected, directly or indirectly, by the site activities. The ET will make reference to the following information while conducting the inspections:

- the EIA and EM&A recommendations on environmental protection and pollution control mitigation measures;
- ongoing results of the EM&A programme;
- work progress and programme;
- individual works methodology proposals;
- the contract specifications on environmental protection;
- the relevant environmental protection and pollution control laws; and
- previous site inspection results.

A monthly waste management audit will be carried out as part of the site audit programme.

The Contractor(s) will update the ET with relevant information on the construction works prior to carrying out the site inspections. The site inspection results will be submitted to the IEC, HK Electric and the Contractor(s) within 2 working days. Should actions be necessary, the ET will follow up with recommendations on improvements to the environmental protection and pollution control works and will submit these recommendations in a timely manner to the IEC, HK Electric and the Contractor(s). They will also be presented, along with the remedial actions

taken, in the monthly EM&A report. The Contractor(s) will follow the procedures and time frame stipulated in the environmental site inspection for the implementation of mitigation proposal and the resolution of deficiencies in the Contractor(s)' EMS. An action reporting system will be formulated and implemented to report on any remedial measures implemented subsequent to the site inspections.

Ad hoc site inspections will also be carried out by the ET and IEC if significant environmental issues are identified. Inspections may also be required subsequent to receipt of an environmental complaint or as part of the investigation work as specified in the Action Plan for environmental monitoring and audit.

11.2 COMPLIANCE WITH LEGAL AND CONTRACTUAL REQUIREMENTS

There are contractual environmental protection and pollution control requirements as well as environmental protection and pollution control laws in Hong Kong with which the construction activities will comply.

In order that the works are in compliance with the contractual requirements, the works method statements submitted by the Contractor(s) to HK Electric for approval will be sent to the ET for review.

The ET will also review the progress and programme of the works to check the regulatory compliance.

The Contractor(s) will regularly copy relevant documents to the ET so that the checking and auditing work can be carried out. The relevant documents are expected to include at a minimum the updated Work Progress Reports, the updated Works Programme, the application letters for different licence/permits under the environmental protection laws and all valid licences/permits. The site diary will also be available for the ET inspection upon request.

After reviewing the document, the ET will advise the IEC, HK Electric and the Contractor(s) of any non-compliance from the contractual and legislative requirements on environmental protection and pollution control for follow-up actions. The ET will also advise the IEC, the Contractor(s) and HK Electric on the current status on licence/permit applications and any environmental protection and pollution control preparation works that may not be suitable for the works programme or may result in potential nonconformity of environmental protection and pollution control requirements.

Upon receipt of the advice, the Contractor(s) will undertake immediate action to remedy the situation. The ET, IEC and HK Electric will follow up to ensure that appropriate action will be taken by the Contractor(s) in order that the environmental protection and pollution control requirements are fulfilled.

11.3 *ENVIRONMENTAL COMPLAINTS*

The complaints handling procedure will be as follows:

The ET will undertake the following procedures upon receipt of a complaint:

(i) log complaint and date of receipt into the complaint database;

(ii) investigate the complaint and discuss with the Contractor(s) and HK Electric to determine its validity and to assess whether the source of the issue is due to works activities;

(iii) if a complaint is considered valid due to the works , the ET will identify mitigation measures in consultation with the Contractor(s), HK Electric and IEC;

(iv) if mitigation measures are required, the ET will advise the Contractor(s) accordingly;

(v) review the Contractor(s)'s response on the identified mitigation measures and the updated situation;

(vi) if the complaint is transferred from EPD, an interim report will be submitted to EPD on the status of the complaint investigation and follow-up action within the time frame assigned by EPD;

(vii) undertake additional monitoring and audit to verify the situation if necessary and ensure that any valid reason for complaint does not recur;

(viii) report the investigation results and the subsequent actions on the source of the complaint for responding to complainant. If the source of complaint is EPD, the results should be reported within the time frame assigned by EPD; and

(ix) record the complaint, investigation, the subsequent actions and the results in the monthly EM&A reports.

During the complaint investigation work, the Contractor(s) will cooperate with the ET, HK Electric and the IEC in providing the necessary information and assistance for completion of the investigation. If mitigation measures are identified in the investigation, the Contractor(s) will promptly carry out the mitigation measures. HK Electric will approve the proposed mitigation measures and the ET and IEC will check that the measures have been carried out by the Contractor(s).

11.4 *LOG-BOOK*

The ET Leader will keep a contemporaneous log-book of each and every instance or circumstance or change of circumstances which may affect the

environmental impact assessment and every non-compliance from the recommendations of the EIA Reports or the Environmental Permit. The ET Leader will notify the IEC within two working days of the occurrence of any such instance or circumstance or change of circumstance. The ET Leader's log-book will be kept readily available for inspection by persons assisting in supervision of the implementation of the EIA Reports recommendations (such as HK Electric, IEC and Contractor(s)) and the EPs or by EPD or his authorised officers.

EM&A procedures are required during the design, construction and post-construction of the project implementation and a summary of the requirements for each of the environmental parameters is detailed in *Table 12.1* below. For ease of implementation, these are presented in terms of those required for the Wind Monitoring Station (WMS) and separately for the Wind Turbines (WTs) associated with the project.

Table 12.1 Summary of EM&A Requirements

Parameters	Wind Monitoring Station			Wind Turbines		
	Design Phase [2]	Construction Phase	Post-Construction Phase	Design Phase [2]	Construction Phase	Post-Construction Phase
Water Quality						
Water Quality Monitoring				✓	✓	✓
Audit		✓			✓	
Waste						
Audit		✓			✓	
Terrestrial Ecology						
Avifauna Monitoring				✓[1]	✓	✓
Bird Collision Monitoring						✓
Audit					✓	
Marine Ecology						
Coral Survey / Relocation				✓		
Marine Mammal Monitoring		✓		✓	✓	✓
Audit		✓			✓	
Noise						
Airborne Noise Monitoring [3]					✓	
Underwater Noise Monitoring [3]					✓	
Audit		✓			✓	
Fisheries						
Safety / Exclusion Zone (500m)		✓			✓	
Audit		✓			✓	
Landscape and Visual						
Audit	✓			✓	✓	
Cultural Heritage						
Audit				✓	✓	

Note:
[1] Although pre- construction monitoring may overlap the design phase, the focus of this monitoring will be to provide additional information on which to assess potential impacts through construction.
[2] EM&A requirements in the design phase shall include confirmation on the compliance for environmental designs which were specified in the EIA Report and the EP for all parameters.

Parameters	Wind Monitoring Station			Wind Turbines		
	Design Phase [2]	Construction Phase	Post-Construction Phase	Design Phase [2]	Construction Phase	Post-Construction Phase
[3] Due to concerns about noise emissions during piling works for the wind turbines based on the size of the proposed piles, airborne and underwater noise monitoring has been committed during percussive piling works. Further details can be found in the Report on the 112th Environmental Impact Assessment Subcommittee Meeting (ACE Paper 7/2010 – Annex C). http://www.epd.gov.hk/epd/english/boards/advisory_council/files/ACE_Paper_7_2010_Annex_C.pdf						

13 REPORT

13.1 GENERAL

Reports can be provided in an electronic medium upon agreeing the format with HK Electric and EPD. The monitoring data (baseline and impact) will also be made available through a dedicated internet website that would be agreed with relevant authority.

Types of reports that the ET Leader will prepare and submit include baseline monitoring report, monthly EM&A report and final EM&A review report. In accordance with *Annex 21* of the *EIAO-TM*, a copy of the monthly, summary and final review EM&A reports will be made available to the Director of Environmental Protection.

13.2 BASELINE WATER QUALITY MONITORING REPORT

In respect of the construction phase EM&A works, the ET will prepare and submit a Baseline Water Quality Monitoring Report at least 2 weeks before commencement of the wind turbines construction works for the Project. Copies of the Baseline Water Quality Monitoring Report will be submitted to the following: the Contractor(s), the IEC, HK Electric, the EPD and the AFCD as appropriate. The ET will liaise with the relevant parties on the exact number of copies required.

The Baseline Water Quality Monitoring Report for the construction phase will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the baseline monitoring stations.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. name of laboratory and types of equipment used and calibration details;

c. parameters monitored;

d. monitoring locations (and depth);

e. monitoring date, time, frequency and duration; and

f. quality assurance (QA)/quality control (QC) results and detection limits.

(v) Details on influencing factors, including:

a. major activities, if any, being carried out on the site during the period;

b. weather conditions during the period; and

c. other factors which might affect the results.

(vi) Determination of the Action and Limit Levels for each monitoring parameter and statistical analysis of the baseline data, the analysis will conclude if there is any significant difference between control and impact stations for the parameters monitored;

(vii) Revisions for inclusion in the EM&A Manual; and

(viii) Comments, recommendations and conclusions.

13.3 POST-CONSTRUCTION WATER QUALITY MONITORING REPORT

The ET will prepare and submit a Post-Construction Monitoring Report at least six weeks following the completion of the wind turbines construction works for the Project. Copies of the Post-Construction Water Quality Monitoring Report will be submitted to the following: the Contractor(s), the IEC, HK Electric, the EPD and the AFCD as appropriate. The ET will liaise with the relevant parties on the exact number of copies required.

The Post-Construction Water Quality Monitoring Report will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the monitoring stations.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. name of laboratory and types of equipment used and calibration details;

c. parameters monitored;

d. monitoring locations (and depth);

e. monitoring date, time, frequency and duration;

f. environmental quality performance limits (Action and Limit levels);

g. Event-Action Plans;

h. environmental mitigation measures, as recommended in the Project EIA study final report;

i. environmental requirements in contract documents;

j. graphical plots of trends of monitored parameters at key stations over the monitoring; and

k. quality assurance (QA)/quality control (QC) results and detection limits.

(v) Details on influencing factors, including:

l. major activities, if any, being carried out on the site during the period;

m. weather conditions during the period; and

n. other factors which might affect the results.

(vi) comments, recommendations and conclusions.

13.4 MONTHLY EM&A REPORTS

The results and findings of the EM&A work required in this Manual will be recorded in the monthly EM&A reports prepared by the ET Leader. The EM&A report will be prepared and submitted within 2 weeks of the end of each reporting month, with the first report due the month after construction commences. Each monthly EM&A report will be submitted to the following parties: the Contractor(s), the IEC, HK Electric and the EPD, as well as to other relevant departments as required. Before submission of the first EM&A Report, the ET will liaise with the parties on the exact number of copies and format of the reports in both hard copy and electronic medium.

13.4.1 CONTENTS OF FIRST MONTHLY EM&A REPORT

(i) 1-2 pages executive summary, comprising:

- breaches of AL levels;
- complaint Log;
- notifications of any summons and successful prosecutions;

- reporting changes; and

- forecast of impact predictions.

(ii) Basic project information including a synopsis of the project organisation, programme and management structure, and a drawing of the Project area showing the environmentally sensitive receivers and the locations of monitoring and control stations, programme, management structure and the work undertaken during the month.

(iii) Environmental Status, comprising:

- works undertaken during the month with illustrations (such as location of works, daily dredging rates); and

- drawing showing the project area, any environmental sensitive receivers and the locations of the monitoring and control stations.

(iv) A brief summary of EM&A requirements including:

- monitoring parameters;

- environmental quality performance limits (Action and Limit levels);

- Event-Action Plans;

- environmental mitigation measures, as recommended in the Project EIA study final report; and

- environmental requirements in contract documents.

(v) Advice on the implementation of environmental protection, mitigation and pollution control measures as recommended in the Project EIA study report and summarised in the updated implementation schedule.

(vi) Monitoring results (in both hard and diskette copies) together with the following information:

- monitoring methodology;

- name of laboratory and equipment used and calibration details;

- parameters monitored;

- monitoring locations (and depth);

- monitoring date, time, frequency, and duration; and

(vii) Graphical plots of trends of monitored parameters for representative monitoring stations annotated against the following:

- major activities being carried out on site during the period;
- weather conditions during the period; and
- any other factors which might affect the monitoring results;

(viii) Advice on the solid and liquid waste management.

(ix) A summary of non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels).

(x) A review of the reasons for and the implications of non-compliance including a review of pollution sources and working procedures.

(xi) A description of the actions taken in the event of non-compliance and deficiency reporting and any follow-up procedures related to earlier non-compliance.

(xii) A summary record of complaints received (written or verbal) for each media, including locations and nature of complaints, liaison and consultation undertaken, actions and follow-up procedures taken and summary of complaints.

(xiii) A summary record of notifications of summons, successful prosecutions for breaches of environmental protection/pollution control legislation and actions to rectify such breaches.

(xiv) A forecast of the works programme, impact predictions and monitoring schedule for the next one month; and

(xv) Comments, recommendations and conclusions for the monitoring period.

13.4.2 CONTENTS OF THE SUBSEQUENT MONTHLY EM&A REPORTS

(i) Title page.

(ii) Executive summary (1-2 pages), including:

- breaches of Action and Limit levels;
- complaint log;
- notifications of any summons and successful prosecutions;
- reporting changes; and
- forecast of impact predictions.

(iii) Contents page.

(iv) Environmental status, comprising:

- drawing showing the Project area, any environmental sensitive receivers and the locations of the monitoring and control stations;
- summary of non-compliance with the environmental quality performance limits; and
- summary of complaints.

(v) Environmental issues and actions, comprising:

- review issues carried forward and any follow-up procedures related to earlier non-compliance (complaints and deficiencies);
- description of the actions taken in the event of noncompliance and deficiency reporting;
- recommendations (should be specific and target the appropriate party for action); and
- implementation status of the mitigation measures and the corresponding effectiveness of the measures.

(vii) Appendices, including:

- action and limit levels;
- graphical plots of trends of monitored parameters at key stations over the past four reporting periods for representative monitoring stations annotated against the following: major activities being carried out on site during the period; weather conditions during the period; and any other factors which might affect the monitoring results;
- monitoring schedule for the present and next reporting period;
- cumulative complaints statistics; and
- details of complaints, outstanding issues and deficiencies.

13.5 AVIFAUNA MONITORING REPORT

After undertaking the baseline pre-construction monitoring, the ET will prepare and submit a Baseline Avifauna Monitoring Report at least 2 weeks before commencement of the wind turbines installation works for the Project. Copies of the Baseline Avifauna Monitoring Report will be submitted to the following: the Contractor(s), the IEC, HK Electric, the EPD and the AFCD as appropriate. The ET will liaise with the relevant parties on the exact number of copies required.

The Baseline Avifauna Monitoring Report for the construction phase will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the baseline monitoring transect.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. types of equipment used;

c. parameters monitored;

d. monitoring locations;

e. monitoring date, time, frequency and duration; and

(v) Details on influencing factors, including:

a. major activities, if any, being carried out on the site during the period;

b. weather conditions during the period; and

c. other factors which might affect the results.

(vi) Statistical analysis of the baseline data to determine if there is any significant spatial and temporal difference for the parameters monitored;

(vii) Revisions for inclusion in the EM&A Manual; and

(viii) Comments, recommendations and conclusions.

Monitoring results collected during the construction phase monitoring will be presented in the respective Monthly EM&A reports.

13.6 OPERATION AVIFAUNA MONITORING REPORT

After the commission of the wind farm, avifauna monitoring and bird collision monitoring will be conducted for a period of one year and the ET will prepare an Operation Avifauna Monitoring Reports at least six weeks following the completion of the monitoring works. The reports will be submitted to the Contractor(s), the IEC, HK Electric, EPD and AFCD. Should any bird mortality or injury be confirmed as being due to the operation of the

wind turbine, relevant government departments (ie EPD and AFCD) will be notified.

The Operation Avifauna Monitoring Report will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the monitoring transect.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. types of equipment used;

c. parameters monitored;

d. monitoring location;

e. monitoring date, time, frequency and duration;

f. results of data analysis;

g. Event-Action Plans;

h. environmental mitigation measures, as recommended in the Project EIA study final report;

i. environmental requirements in contract documents;

j. graphical plots of trends of monitored parameters at key stations over the monitoring; and

(v) Details on influencing factors, including:

a. major activities, if any, being carried out on the site during the period;

b. weather conditions during the period; and

c. other factors which might affect the results.

(vi) comments, recommendations and conclusions.

13.7 MARINE MAMMAL MONITORING REPORT

After undertaking the baseline pre-construction monitoring, the ET will prepare and submit a Baseline Marine Mammal Monitoring Report at least 2

weeks before commencement of the wind turbines installation works for the Project. Copies of the Baseline Marine Mammal Monitoring Report will be submitted to the following: the Contractor(s), the IEC, HK Electric, the EPD and the AFCD as appropriate. The ET will liaise with the relevant parties on the exact number of copies required.

The Baseline Marine Mammal Monitoring Report for the construction phase will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the baseline monitoring transect.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. types of equipment used;

c. parameters monitored;

d. monitoring locations;

e. monitoring date, time, frequency and duration; and

(v) Details on influencing factors, including:

a. major activities, if any, being carried out on the site during the period;

b. weather conditions during the period; and

c. other factors which might affect the results.

(vi) Statistical analysis of the baseline data to determine if there is any significant spatial and temporal difference for the parameters monitored;

(vii) Revisions for inclusion in the EM&A Manual; and

(viii) Comments, recommendations and conclusions.

Monitoring results collected during the construction phase monitoring will be presented in the respective Monthly EM&A reports.

13.8 OPERATION MARINE MAMMAL MONITORING REPORT

After the commission of the wind farm, marine mammal monitoring programme will be conducted for a period of one year, except for PAM for which the C-PODs will be left in place for a period of up to two years following the start of operation of the wind farm. The ET will prepare an Operation Marine Mammal Monitoring Reports at least six weeks following the completion of the monitoring works. The reports will be submitted to the Contractor(s), the IEC, HK Electric, EPD and AFCD.

The Operation Marine Mammal Monitoring Report will include at least the following:

(i) Up to half a page executive summary.

(ii) Brief project background information.

(iii) Drawings showing locations of the monitoring transect.

(iv) Monitoring results (in both hard and diskette copies) together with the following information:

a. monitoring methodology;

b. types of equipment used;

c. parameters monitored;

d. monitoring location;

e. monitoring date, time, frequency and duration;

f. environmental mitigation measures, as recommended in the Project EIA study final report;

g. environmental requirements in contract documents;

h. graphical plots of trends of monitored parameters at key stations over the monitoring; and

(v) Details on influencing factors, including:

a. major activities, if any, being carried out on the site during the period;

b. weather conditions during the period; and

c. other factors which might affect the results.

(vi) comments, recommendations and conclusions.

13.9 ANNUAL / FINAL EM&A REVIEW REPORTS

An annual EM&A report will be prepared by the ET at the end of each construction year during the course of the project. A final EM&A report will be prepared by the ET at the end of the construction phase EM&A works. The annual/final EM&A reports will contain at least the following information:

(i) Executive Summary (1-2 pages).

(ii) Drawings showing the project area any environmental sensitive receivers and the locations of the monitoring and control stations.

(iii) Basic project information including a synopsis of the project organization, contacts for key management staff and a synopsis of work undertaken during the course of the project or past twelve months.

(iv) A brief summary of EM&A requirements including:

- environmental mitigation measures as recommended in the project EIA study final report;
- environmental impact hypotheses tested;
- environmental quality performance limits (Action and Limit Levels);
- monitoring parameters; and
- Event-Action Plans.

(v) A summary of the implementation status of environmental protection and pollution control/mitigation measures as recommended in the project EIA study report and summarised in the updated implementation schedule.

(vi) Graphical plots and the statistical analysis of the trends of monitored parameters over the course of the projects including the post-project monitoring (or the past twelve months for annual reports) for monitoring stations annotated against the following:

- the major activities being carried out on site during the period;
- weather conditions during the period;
- any other factors which might affect the monitoring results; and

(vii) a summary of non-compliance (exceedances) of the environmental quality performance limits (Action and Limit levels).

(viii) a review of the reasons for and the implications of non-compliance including review of pollution sources and working procedures as appropriate.

(ix) a description of the actions taken in the event of non-compliance.

(x) a summary record of complaints received (written or verbal) for each media, liaison and consultation undertaken, actions and follow-up procedures taken.

(xi) a summary record of notifications of summonses and successful prosecutions for breaches of the current environmental protection/pollution control legislations, locations and nature of the breaches investigation, follow-up actions taken and results.

(xii) a comparison of the EM&A data with the EIA predictions with annotations and explanations for any discrepancies, including a review of the validity of EIA predictions and identification of shortcomings in the EIA recommendations.

(xiii) A review of the monitoring methodology adopted and with the benefit of hindsight, comment on its effectiveness, including cost effectiveness;

(xiv) A review of the success of the EM&A programme, including a review of the effectiveness and efficiency of the mitigation measures, and recommendations for any improvements in the EM&A programme.

(xv) A clear cut statement on the environmental acceptability of the project with reference to specific impact hypotheses and a conclusion to state the return to ambient and/or the predicted scenario as the EIA findings.

13.10 DATA KEEPING

The site documents such as the monitoring field records, laboratory analysis records, site inspection forms, etc. are not required to be included in the EM&A Reports for submission. However, the documents will be kept by the ET Leader and be ready for inspection upon request. Relevant information will be clearly and systematically recorded in the documents. The monitoring data will also be recorded in magnetic media, and the software copy will be available upon request. The documents and data will be kept for at least one year after the completion of the operational phase EM&A works.

13.11 ELECTRONIC REPORTING OF EM&A INFORMATION

To enable the public inspection of the Baseline Monitoring Report and monthly EM&A Reports via the EIAO Internet Website and at the EIAO Register Office, electronic copies of monthly EM&A Reports will be prepared

in Hyper Text Markup Language (HTML) (version 4.0 or later) and in Portable Document Format (PDF, version 4.0 or later), unless otherwise agreed by EPD and will be submitted at the same time as the hard copies. For the HTML version, a content page capable of providing hyperlink to each section and sub-section of the EM&A Reports will be included in the beginning of the document. Hyperlinks to figures, drawings and tables in the EM&A Reports will be provided in the main text where the respective references are made. Graphics in the reports will be in interlaced GIF format unless otherwise agreed by EPD. The content of the electronic copies of the monthly EM&A Reports must be the same as the hard copies.

Environmental monitoring data will be made available to the public via the internet access in the form of a website, in the shortest practical time and in no event later 2 weeks after the relevant environmental monitoring data are analysed and validated. The internet address and the environmental monitoring data will be made available to the public via the EIAO Internet Website and the EIAO Register Office.

The internet website as described above will enable user friendly public access to the monitoring data and with features capable of:

- providing access to environmental monitoring data collected since the commencement of works;
- searching by data;
- searching by types of monitoring data (water quality);
- hyperlinks to relevant monitoring data after searching; and
- or otherwise as agreed by EPD.

13.12 INTERIM NOTIFICATIONS OF ENVIRONMENTAL QUALITY LIMIT EXCEEDANCES

With reference to Event/Action Plans, when the environmental quality limits are exceeded, the ET will notify the Contractor(s), HK Electric, EPD and the AFCD as appropriate within 2 working days of the identification of the exceedance, unless otherwise stated in relevant sections of the EM&A Manual. The notification will be followed up with each party on the results of the investigation, proposed action and success of the action taken, with any necessary follow-up proposals. A sample template for the interim notifications is shown in *Annex B*.

Annex A1

Implementation Schedule for Construction and Operation of Wind Monitoring Station

Table A.1: Implementation Schedule for Construction and Operation of Wind Monitoring Station

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
1. Water Quality								
S 6.8 and EM&A Manual	The contractor(s) will ensure that the works cause no visible foam, oil, grease, litter or other objectionable matter to be present in the water within and adjacent to the area of marine works.	During Construction	Contractor(s)		✓			-
S 6.8	Control and monitoring systems will be used to alert the crew to leaks or any other potential risks.	During Construction	Contractor(s)		✓			-
S 6.8	All plant will be fully serviced and inspected before use to limit any potential discharges to the marine environment	During Construction	Contractor(s)		✓			-
S 6.8	Avoid spillage of oil, fuel and chemicals from structures by adopting appropriate good site practices	During Construction	Contractor(s)		✓			Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 6.8	The storage areas of oil fuel and chemical will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters	During Construction & operation	Contractor(s)		✓			Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 6.8	The Contractors will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals	During Construction & operation	Contractor(s)		✓			-
S 6.8	Any grout used would conform to the relevant environmental standards. In addition, the adoption of appropriate operational management by the contractor should lead to low potential for leakage during the pumping phase.	During Construction	Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 6.8	No debris shall be willingly discharged to sea. However, should debris be placed on the seabed, this will be removed (wherever practicable)	During Construction	Contractor(s)		✓			-
2. Waste Management								
S 7.6	The Contractor shall prepare and implement a Waste Management Plan which incorporates site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.	Contract mobilisation / During Construction	Contractor(s)		✓			-
S 7.6	The Contractor shall ensure only licensed waste collectors are used to collect chemical waste for delivery to a licensed treatment facility	Contract mobilisation / During Construction	Contractor(s)		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 7.6	The Contractor shall apply for and obtain the appropriate licenses/permits for the disposal public fill and chemical waste.	Contract mobilisation / During Construction	Contractor(s)		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes Waste Disposal (Charges for Disposal of Construction Waste) Regulation

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 7.6	EM&A of waste handling, storage, transportation, disposal procedures and documentation through the site audit programme shall be undertaken.	During Construction	ET		✓			-
3. Marine Ecology								
S 9.12.2	The vessel operators will be required to control and manage all effluent from vessels.	During Construction / Marine works	Contractor(s)		✓			-
S 9.12.2	A policy of no dumping of rubbish, food, oil, or chemicals will be strictly enforced. This will also be covered in the contractor briefings.	During Construction / Marine works	Contractor(s)		✓			-
S 9.12.3	Vessel operators working on the Project construction or operation will be given a briefing, alerting them to the possible presence of marine mammals in the area, and guidelines for safe vessel operations in the presence of cetaceans. If high speed vessels are used, they will be required to slow to 10 knots when passing through a high density dolphin area.	During Construction / Marine works	ET & Contractor(s)		✓			-
S 9.12.3	The vessel operators will be required to use predefined and regular routes, as these will become known to porpoise using these waters. This measure will further serve to minimise disturbance to marine mammals due to vessel movements	During Construction / Marine works	ET & Contractor(s)		✓			-
S 9.12.4	To reduce underwater sound levels associated with percussive piling, the following steps will be taken: - Quieter hydraulic hammers should be used instead of the noisier diesel hammers; - Acoustic decoupling of noisy equipment on work barges should be undertaken.	During Construction / Marine works	Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 9.12.4	Best practices are recommended to reduce the impacts to marine mammals: - Instigate 'ramping-up' of the piling hammer to provide an advance warning system to marine mammals in the vicinity; - Activities will be continuous without short-breaks and avoiding sudden random loud sound emissions	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			-
S 9.12.4	An exclusion zone of 500 m radius will be scanned around the work area for at least 30 minutes prior to the start of percussive piling. If marine mammals/sea turtles are observed in the exclusion zone, piling will be delayed until they have left the area.	During Percussive Piling works for Foundation Construction	ET		✓			
S 9.12.4	No piling works for the wind monitoring station will be conducted during the finless porpoise peak seasons between December and May.	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			
S 9.15.1	Marine percussive piling works to be restricted to a daily maximum of 12 hours within daylight operations.	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			
4. Fisheries								

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 10.7	The impacts to fisheries resources will be minimised by adopting the following measures: - The use of competent and experienced contractors and vessels operators; - Good planning of the installation sequence to avoid possible clashes; - Good promulgation of information relating to construction activities; - Thorough auditing of all vessels; - Observing good industry construction practices by the Contractors; and,	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	Inform fishermen of possible developments of the Project in advance	Marine Works / During Construction	Contractor(s) / Operator		✓			-
S 10.7	Using good engineering practice, including the use of appropriately sized piles (smaller piles generate lower levels of underwater sound) and piling equipment.	Marine Works / During Construction	Contractor(s)	✓	✓			-
S 10.7	Using ramp-up piling procedures. Blow frequency during this ramping up period should replicate the intensity that would be undertaken during full piling (e.g. one blow every two seconds) to provide cues for fish to localize the sound source. Pile blow energy should be ramped up gradually over the 'soft start' period.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	The relevant authorities will be notified of activities in the wind monitoring station area during construction activities, including dates of any works. In addition, the Marine Department will be notified of the final location of the wind monitoring station structures so that these can be updated on marine charts.	Marine Works / During Construction	Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 10.7	All vessels engaged in construction activities will be equipped with a Maritime VHF radio and an agreed frequency channel maintained. All vessels involved in the construction works will show the correct lights and shapes and ensure that all movements are promulgated through the Marine Department	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	Consider the use of Guard Ship during the construction phase, particularly in periods of high activity.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	A safety / exclusion zone of 500 m from any area of construction works will be established for all non-Project vessels subject to approval of Marine Department.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	Temporary lighting should be provided for incomplete structures during construction	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	The wind monitoring station should be marked according to the requirements of the Marine Department. The precise marking arrangement will be agreed during the Detailed Design Phase.	Detail Design	Designer	✓				
5. Landscape and Visual								
S 11.7	Appropriate colours for the wind monitoring station should be selected to reduce their visibility	Detail Design	Designer	✓				-

Annex A2

Implementation Schedule for Construction and Operation of Wind Turbines and Transmission Cable

Table A2: Implementation Schedule for Construction and Operation of Wind Turbines and Transmission Cable

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
1. Water Quality								
S 6.8 and EM&A Manual	Implement water quality monitoring programme prior and during construction phase for the following activities: • Dredging works in the nearshore cable landing area (2,500m^3 day^{-1}); and, • Jetting for cable installation (360m hr^{-1})	Relevant works areas / During Construction	ET		✓			-
S 6.8 and Annex 6C	Dredging and jetting plant will be required to comply with the rates modelled in the EIA report (*S6 Annex*) for the various activities assessed.	Dredged areas / During Construction	Contractor(s)		✓			-
S 6.8	Silt curtains will be deployed for dredging works at the seawall of the Lamma Extension Seawall to reduce the elevation of suspended solids to nearby sensitive receivers. Details of silt curtain installation should be proposed by the contractor prior to the commencement of construction works and submitted to the IEC for approval.	Dredged areas at the landing point of the Lamma Extension seawall/ During Construction	Contractor(s)		✓			
S 6.8	Dredged marine mud will be disposed of in a gazetted marine disposal area in accordance with the *Dumping at Sea Ordinance* (*DASO*) permit conditions.	Dredged areas / During Construction	Contractor(s)		✓			Dumping at Sea Ordinance
S 6.8	Closed grab dredgers should be used to reduce the potential for leakage of sediments	Dredged areas/ During Construction	Contractor(s)		✓			Dumping at Sea Ordinance
S 6.8	Disposal vessels will be fitted with tight bottom seals in order to prevent leakage of material during transport.	Dredged areas/ During Construction	Contractor(s)		✓			Dumping at Sea Ordinance

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 6.8	Barges will be filled to a level, which ensures that material does not spill over during transport to the disposal site and that adequate freeboard is maintained to ensure that the decks are not washed by wave action.	Dredged areas/ During Construction	Contractor(s)		✓			Dumping at Sea Ordinance
S 6.8	After dredging, any excess materials will be cleaned from decks and exposed fittings before the vessel is moved from the dredging area.	Dredged areas/ During Construction			✓			Dumping at Sea Ordinance
S 6.8	When the dredged material has been unloaded at the disposal areas, remove any material that has accumulated on the deck or other exposed parts of the vessel and place in the hold or a hopper. Do not wash decks clean in a way that permits material to be released overboard.	Dredged areas/ During Construction	Contractor(s)		✓			Dumping at Sea Ordinance
S 6.8	The Contractor(s) will ensure that the works cause no visible foam, oil, grease, litter or other objectionable matter to be present in the water within and adjacent to the area of marine works.	Dredged areas/ During Construction	Contractor(s)		✓			-
S 6.8	Control and monitoring systems will be used to alert the crew to leaks or any other potential risks.	Dredged areas/ During Construction	Contractor(s)		✓			-
S 6.8	All plant will be fully serviced and inspected before use to limit any potential discharges to the marine environment	Quayside / During Construction	Contractor(s)		✓			-
S 6.8	Avoid spillage of oil, fuel and chemicals from structures by adopting appropriate good site practices	Wind farm area / During Construction	Contractor(s)		✓			Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 6.8	Any grout used would conform to the relevant environmental standards. In addition, the adoption of appropriate operational management by the contractor should lead to low potential for leakage during the pumping phase.	Wind farm area / During Construction	Contractor(s)		✓			-
S 6.8	No debris shall be willingly discharged to sea. However, should debris be placed on the seabed, this will be removed (wherever practicable)	Wind farm area / During Construction	Contractor(s)		✓			-
S 6.8	Construction site runoff at the Laydown area should be prevented or minimised in accordance with the guidelines stipulated in the EPD's Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94).	Land Site / During Construction	Contractor(s)		✓			ProPECC PN 1/94
S 6.8	The permanent storage areas of oil fuel and chemical will be surrounded by bunds or other containment device to prevent spilled oil, fuel and chemicals from reaching the receiving waters	Land Site / During Construction	Contractor(s)		✓			Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 6.8	The Contractors will prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals	Land Site / During Construction	Contractor(s)		✓			-
S 6.8	Surface run-off from bunded areas will pass through oil/water separators prior to discharge to the stormwater system	Land Site / During Construction	Contractor(s)		✓			ProPECC PN 1/94

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
2. Waste Management								
S 7.6	The Contractor shall prepare and implement a Waste Management Plan which incorporates site-specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.	Contract mobilisation / During Construction	Contractor(s)		✓			-
S 7.6	The Contractor shall ensure only licensed waste collectors are used to collect chemical waste for delivery to a licensed treatment facility	Contract mobilisation / During Construction	Contractor(s)		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes
S 7.6	The Contractor shall apply for and obtain the appropriate licenses/permits for the disposal public fill and chemical waste.	Contract mobilisation / During Construction	Contractor(s)		✓			Waste Disposal (Chemical Waste) (General) Regulation Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes Waste Disposal (Charges for Disposal of Construction Waste) Regulation
S 7.6	Separation of chemical wastes for special storage and handling and appropriate treatment in accordance with the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes	Land Site / During Construction	Contractor(s)		✓			Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S7.6	A record system for the amount of wastes generated / recycled and disposal sites.	Land Site / During Construction	Contractor(s)		✓			-
S 7.6	All excavated materials shall be reused on site to the extent practical.	Land Site / During Construction	Contractor(s)		✓			-
S 7.6	Dredged marine mud shall be disposed of in a gazetted marine disposal ground under the requirements of the Dumping at Seas Ordinance. Marine mud shall be assessed in accordance with the ETWBTC No. 34/2002 prior to the dredging to identify the suitable disposal ground.	Dredging / During Construction	Contractor(s)		✓			Dumping at Sea Ordinance ETWBTC No. 34/2002, Management of Dredged/Excavated Sediment; Environment, Transport and Works Bureau, Hong Kong SAR Government
S 7.6	EM&A of waste handling, storage, transportation, disposal procedures and documentation through the site audit programme shall be undertaken.	All facilities / During Construction	ET		✓			-
3. Terrestrial Ecology								
S 8.11.2	Extreme level of lighting should be avoided as to minimise the numbers of birds attracted to the wind turbine at night. Lighting should be of low intensity.	Wind Farm/ During Construction and Operation	Contractor(s) & Operator		✓		✓	
S 8.11.2	The construction should adopt good construction/operation practices to minimise the impact of construction/operation on marine water habitat (such as no dumping of rubbish or chemicals).	Wind Farm/ During Construction and Operation	Contractor(s) & Operator		✓		✓	

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 8.13.2	Although no adverse residual impacts are envisaged based on the results of impact assessment, monitoring for bird abundance and distribution will be undertaken for one year during the pre-construction phase, one year during the construction phase for the wind turbines and the first year of the operation of the turbines.	Wind Farm/ Pre-Construction, During Construction and First year of Operation	ET	✓	✓	✓		-
-	Bird Collision Monitoring to be undertaken during the first year of the operation of the turbines.	First-year Operation	ET			✓		-
4. Marine Ecology								
S 9.12.2	The vessel operators will be required to control and manage all effluent from vessels.	During Construction / Marine works	Contractor(s)		✓			-
S 9.12.2	A policy of no dumping of rubbish, food, oil, or chemicals will be strictly enforced. This will also be covered in the contractor briefings.	During Construction / Marine works	Contractor(s)		✓			-
S 9.12.2	Vessel operators working on the Project construction or operation will be given a briefing, alerting them to the possible presence of marine mammals in the area, and guidelines for safe vessel operations in the presence of cetaceans. If high speed vessels are used, they will be required to slow to 10 knots when passing through a high density dolphin area.	During Construction / Marine works	ET & Contractor(s)		✓			-
S 9.12.2	The vessel operators will be required to use predefined and regular routes, as these will become known to porpoise using these waters. This measure will further serve to minimise disturbance to marine mammals due to vessel movements	During Construction / Marine works	ET & Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 9.12.3	A pre-construction dive survey will be undertaken at the sites where isolated corals were identified along the cable route to confirm their existence. Should these corals be found present, mitigation will be applied, such as potential relocation away from the proposed area of works	Pre-Construction	ET & Contractor(s)	✓				
S 9.12.4	To reduce underwater sound levels associated with percussive piling, the following steps will be taken: - Quieter hydraulic hammers should be used instead of the noisier diesel hammers; - Acoustic decoupling of noisy equipment on work barges should be undertaken.	During Construction / Marine works	Contractor(s)		✓			-
S 9.12.4	Best practices are recommended to reduce the impacts to marine mammals: - Instigate 'ramping-up' of the piling hammer to provide an advance warning system to marine mammals in the vicinity; - Activities will be continuous without short-breaks and avoiding sudden random loud sound emissions	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			-
S 9.12.4	No piling works for the wind turbines will be conducted during the finless porpoise peak seasons between December and May.	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			
S 9.12.4	An exclusion zone of 500 m radius will be scanned around the work area for at least 30 minutes prior to the start of percussive piling works. For dredging works, an exclusion zone of 250m radius shall apply. If marine mammals/green turtles are observed in the exclusion zone, piling will be delayed until they have left the area.	During Percussive Piling works for Foundation Construction / Dredging Works for Cable Installation	ET		✓			

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 9.15.1	Marine percussive piling works to be restricted to a daily maximum of 12 hours within daylight operations.	During Percussive Piling works for Foundation Construction	Contractor(s)		✓			
-	Long-term monitoring will be conducted for the distribution and abundance of marine mammals during the construction and post-construction phase of the project. Baseline marine mammal monitoring will also be conducted. Monitoring will include: • Vessel based surveys • Passive acoustic monitoring • Land-based theodolite tracking The protocols for this will be agreed with AFCD in advance.	Major marine works areas / Pre-construction, during construction and post-construction	ET	✓	✓	✓		
5. Noise								
-	Airborne noise monitoring will be undertaken during percussive piling works for the wind turbines.	During Construction Phase	ET		✓			Noise Control Ordinance

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
-	Underwater noise monitoring, will be undertaken during percussive piling works for the wind turbines.	During Construction Phase	ET		✓			
6. Fisheries								
S 10.7	The impacts to fisheries resources will be minimised by adopting the following measures: - The use of competent and experienced contractors and vessels operators; - Good planning of the installation sequence to avoid possible clashes; - Good promulgation of information relating to construction activities; - Thorough auditing of all vessels; - Observing good industry construction practices by the Contractors; and, - Surveying of the 'as-laid' cable positions and having good quality position fixing/surveying systems available	Marine Works / During Construction	Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 10.7	Inform fishermen of possible developments of the Project in advance	Marine Works / During Construction	Contractor(s) / Operator		✓			-
S 10.7	Using good engineering practice, including the use of appropriately sized piles (smaller piles generate lower levels of underwater sound) and piling equipment.	Marine Works / During Detailed Design and Construction	Contractor(s)	✓	✓			-
S 10.7	Using ramp-up piling procedures. Blow frequency during this ramping up period should replicate the intensity that would be undertaken during full piling (e.g. one blow every two seconds) to provide cues for fish to localize the sound source. Pile blow energy should be ramped up gradually over the 'soft start' period.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	A geometric layout design should been adopted to eases navigation between structures and reduces collision risk in times of low visibility.	Wind Farm / During Detailed Design and Construction	Contractor(s)	✓	✓			-
S 10.7	The relevant authorities will be notified of activities in the wind farm area during construction activities, including dates of any works. In addition, the Marine Department will be notified of the final location of the wind farm structures so that these can be updated on marine charts.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	All vessels engaged in construction activities will be equipped with a Maritime VHF radio and an agreed frequency channel maintained. All vessels involved in the construction works will show the correct lights and shapes and ensure that all movements are promulgated through the Marine Department	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	Consider the use of Guard Ship during the construction phase, particularly in periods of high activity.	Marine Works / During Construction	Contractor(s)		✓			-

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 10.7	A safety / exclusion zone of 500 m from any area of construction works will be established for all non-Project vessels subject to approval of Marine Department.	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	Temporary lighting should be provided for incomplete structures during construction	Marine Works / During Construction	Contractor(s)		✓			-
S 10.7	The wind farm should be marked according to the requirements of the Marine Department. The precise marking arrangement will be agreed during the Detailed Design Phase.	Ward Farm / Detail Design	Designer	✓				
S 10.7	The markings of wind turbines will need to be maintained at all times and should failure occur, the Marine Department should be notified immediately and repairs undertaken as soon as possible.	Wind Farm / Operation	Operator				✓	-
7. Landscape and Visual								
S 11.6	All plant materials affected by the works relating to the submarine cable landing are to be replaced with new plantings to match the existing situation. All planting of trees and shrubs is to be carried out in accordance with the relevant best practice guidelines. Plant densities are to be provided in future Detailed Design documents and are to be selected so as to achieve a finished landscape that matches the surrounding, undisturbed, equivalent landscape types.	Land site / Pre-Construction (Detail Design)	Designer	✓				-
S 11.6	Established trees of value to be re-located where practically feasible.	Land site / Pre-Construction (Detail Design)	Contractor(s)		✓			
S 11.6	Site hoardings to be compatible with the surrounding environment. Where possible, site hoardings should be colored to complement the surrounding areas	Land site / During Detailed Design and Construction	Contractor(s)	✓	✓			

EIA Ref.	Environmental Protection Measures	Location/Duration of Measures/Timing of Completion of Measures	Implementation Agent	Implementation Stage				Relevant Legislation & Guidelines
				Des	C	Post-C	O	
S 11.6	Landscape resources affected by the onshore cable trench are to be reinstated to match existing conditions.	Land site / Post-Construction	Contractor(s)			✓		
S 11.7	The layout of the wind farm array shall be designed to reduce the number of turbines visible for the most sensitive viewpoints	Wind Farm/ Detail Design	Designer	✓				-
S 11.7	Appropriate colours for the wind turbines should be selected to reduce their visibility	Wind Farm/ Detail Design	Designer	✓				-
S 11.7	The blades for all turbines should rotate in the same direction to create a more harmonious visual pattern	Ward Farm / Detail Design / Operation	Designer / ET	✓		✓		-
8. Cultural Heritage								
S 12.8	To verify the avoidance of direct impact to the shipwreck identified during the geophysical survey, the Environmental Team and the Independent Environmental Checker will be required to monitor the installation of turbines and submarine cable during the construction stage.	Detail Design / Construction	ET/IEC	✓	✓			-

Annex **B**

Indicative Proforma for EM&A Programme

Indicative Proforma for Construction Phase EM&A Programme

IMPLEMENTATION SCHEDULE

Ref: _____

EIA Ref*	EM&A Log Ref	Environmental Protection Measures*	Location/ Timing	Implementation Agent	Implementation Stages**			
					Des	C	O	Dec

* *All recommendations and requirements resulted during the Course of EIA/EA Process, including ACE and / or accepted public comment to the proposed project*

** *Des- Design, C-Construction,O-Operation, Dec- Decommissioning*

Signed by Project Proponent: Date: _____

IMPLEMENTATION STATUS PROFORMA

Ref**	Environmental Protection Measures*	Implementation Status

* *All recommendations and requirements resulted during the Course of EIA/EA Process, including ACE and / or accepted public comment to the proposed project*

** *EIA Ref / EM&A Log Ref / Design Document Ref*

Signed by Environmental Team Leader: Date: _____

Audited by Independent Environmental Checker: Date: _____

SITE INSPECTION PROFORMA **Ref:** _____

Date	Location	Req. Ref.*	Observation / Deficiency	Mitigation Action** (Responsible Agency)	Date*** of Confirmation

* *EIA Ref / EM&A Log Ref / Design Document Ref / Environmental Protection Contract Clause*
** *Specific Environmental Mitigation Measures should be stated, such as, equipment, processes, systems, practices or technologies*
*** *The required completion date to confirm the specified Environmental Protection Action*

This Proforma is an Environmental Protection Instruction for:

Signed by Environmental Team Leader: Date: _____

Copy to Independent Environmental Checker Date: _____

REGULATORY COMPLIANCE PROFORMA

Ref: _____

Ref*	Environmental License / Permit*	Control Area / Facility / Location	Effective Date

* *Name of Applicant, Business Corporation, relevant regulation and remark of license / permit conditions*

** *File reference of the licensee / permittee*

Recorded by Environmental Team Leader: Date: _____

Signed by Independent Environmental Checker : Date: _____

COMPLAINT LOG **Ref: _____**

Log Ref.	Date / Location	Complainant/ Date of Contract	Details of Complaint	Investigation / Mitigation Action	File Closed

Filed by Environmental Team Leader: Date: _____

Proforma for Operational Phase EM&A Programme

IMPLEMENTATION STATUS PROFORMA

EIA Ref*	EM&A Log Ref	Environmental Protection Measures*	Location/ Timing	Implementation Agent	Implementation Stages**			
					Des	C	O	Dec

* *All recommendations and requirements resulted during the Course of EIA/EA Process, including ACE and / or accepted public comment to the proposed project*

** *Des- Design, C-Construction,O-Operation, Dec- Decommissioning*

Signed by Project Proponent: Date: _____

IMPLEMENTATION STATUS PROFORMA **Ref:** _____

Ref**	Environmental Protection Measures*	Implementation Status

* *All recommendations and requirements resulted during the Course of EIA/EA Process, including ACE and / or accepted public comment to the proposed project*

** *EIA Ref / EM&A Log Ref / Design Document Ref*

Signed by Environmental Team Leader: Date: _____

Audited by Independent Environmental Checker : Date: _____

REGULATORY COMPLIANCE PROFORMA

Ref*	Environmental License / Permit*	Control Area / Facility / Location	Effective Date

* *Name of Applicant, Business Corporation, relevant regulation and remark of license / permit conditions*

** *File reference of the licensee / permittee*

Recorded by Environmental Team Leader: Date: _____

Signed by Independent Environmental Checker: Date: _____

Sample Template for Interim Notifications of Environmental Quality Limits Exceedances

Incident Report on Action Level or Limit Level Non-compliance

Project	
Date	
Time	
Monitoring Location	
Parameter	
Action & Limit Levels	
Measured Level	
Possible reason for Action or Limit Level Non-compliance	
Actions taken / to be taken	
Remarks	

Prepared by : _____

Designation : _____

Signature : _____

Date: _____

Annex C

Indicative Water Quality Monitoring Log

Indicative Water Quality Monitoring Log

Location				
Date				
Start Time (hh:mm)				
Weather				
Sea Conditions				
Tidal Mode				
Water Depth (m)				
Monitoring Depth		Surface	Middle	Bottom
Salinity				
Temperature (^{0}C)				
Current Speed (ms^{-1})				
Current Direction (degree)				
DO Saturation (%)				
DO (mg/l)				
Turbidity (NTU)				
SS Sample Identification				
SS (mg/l)				
Observed Construction Activities	<100m from location			
	>100m from location			
Other Observations				

	Name & Designation	Signature	Date
Recorded by:			
Checked by:			

Note: The SS results are to be filled in once they are available from the laboratory.