MOTT MACDONALD

Agreement No. HMWSD 1/2019 (EP) Post-Construction Monitoring of Chinese White Dolphin (Line-transect Vessel Surveys) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road at West Lantau Waters – Investigation

Monthly EM&A Report – October 2020

Highways Department

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Highways Department

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Mott MacDonald Hong Kong Limited
registered in Hong Kong no. 236497

MOTT MACDONALD

Ramboll Hong Kong Limited
21st Floor, BEA Harbour View Centre
56 Gloucester Road
Wan Chai, Hong Kong

Attention: Mr. Manson Yeung – Independent Environmental Checker

Our Reference
GC/HY/jt/411565/L051

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Monthly EM&A Report for October 2020

12 November 2020
By Email

Dear Sir,

In accordance with Condition 4.4 of the Environmental Permit (EP-352/2009/D) covering the captioned assignment, we are pleased to submit the certified Monthly EM&A Report for October 2020 for your verification.

Yours faithfully,
For Mott MacDonald Hong Kong Limited

Gary Chow
Environmental Team Leader

Encl.

cc.
Highways Department – Mr. Tommy Tse (By Email)

Ref.: HYDHZMBEEM00_0_8269L.20

12 November 2020

By Fax (3188 6614) and By Post

Highways Department
Major Works Project Management Office (Special Duties)
4th Floor, Ho Man Tin Government Offices
88 Chung Hau Street, Ho Man Tin, Kowloon

Attention: Mr David Chan

Dear Sirs,

Re: Agreement No. CE 48/2011 (EP)
Environmental Project Office for the
HZMB Hong Kong Link Road, HZMB Hong Kong Boundary Crossing Facilities, and Tuen Mun-Chek Lap Kok Link – Investigation

Agreement No. HMWSD 1/2019 (EP)
Post-Construction Monitoring of Chinese White Dolphin (Line-transect Vessel Surveys) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road at West Lantau Waters - Investigation
Monthly EM&A Report for October 2020

Reference is made to the Environmental Team's submission of the Monthly EM&A Report for October 2020 certified by the ET Leader (ET's ref.: "GC/HY/jt/411565/L051" dated 12 November 2020) and provided to us via e-mail on 12 November 2020.

We are pleased to inform you that we have no adverse comments on the captioned submission. We write to verify the captioned submission in accordance with Condition 4.4 the Environmental Permit No. EP-352/2009/D.

Thank you very much for your attention and please feel free to contact the undersigned should you require further information.

Yours faithfully,
For and on behalf of
Ramboll Hong Kong Limited

Manson Yeung
Independent Environmental Checker
HZMB HKLR

c.c.	HyD	Attn.: Ms Karen Ho	(By Fax: 3188 6614)
	MMHK	Attn.: Mr Gary Chow	(By Fax: 2827 1823)

Internal: DY, YH, ENPO Site

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This Monthly Environmental Monitoring and Audit (EM&A) Report is prepared for "Agreement No. HMWSD 1/2019 (EP) Post-Construction Monitoring of Chinese White Dolphin (Line-transect Vessel Surveys) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road at West Lantau Waters – Investigation" (hereafter referred to as "the Assignment") for the Highways Department of Hong Kong Special Administrative Region (HKSAR).

Mott MacDonald Hong Kong Limited was appointed by the Highways Department of HKSAR to undertake the Environmental Team services for this Assignment for the post-construction monitoring of Chinese White Dolphin in West Lantau waters for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road Project.

This is the Monthly EM&A Report for the 24th month of the post-construction phase of the Project which summarises findings of the post-construction EM&A activities during the reporting period from 1 to 31 October 2020, which is the final month of post-construction monitoring of Chinese White Dolphin in West Lantau waters for the Project.

Environmental Monitoring and Audit Progress

A summary of the post-construction monitoring activities during the reporting period is listed as below:

- Chinese White Dolphin Monitoring (Line-transect Vessel Surveys): 5 and 8 October 2020

1 Introduction

1.1 Background of the Project

The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) is a designated project under the Environmental Impact Assessment Ordinance (EIAO). The Environmental Impact Assessment (EIA) Report and Environmental Monitoring and Audit (EM&A) Manual (EIA Register No.: AEIAR-144/2009) for the project were approved by the Director of Environmental Protection in October 2009 and the Environmental Permit No. EP-352/2009 (EP) was issued in November 2009. The EP has been subject to several variations and the current one is EP No. EP-352/2009/D.

The HZMB HKLR was constructed under two works contracts namely Contract No. HY/2011/03 (HZMB HKLR – Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (HKBCF)) and Contract No. HY/2011/09 (HZMB HKLR – Section between HKSAR Boundary and Scenic Hill). In accordance with the EP, the Contractors of Contract No. HY/2011/03 and Contract No. HY/2011/09 have separately employed their own Environmental Team (ET) and ET Leader to conduct construction phase monitoring of Chinese White Dolphin (CWD) in the North Lantau (NL) and West Lantau (WL) waters following the requirements specified in the EM&A Manual and the relevant contract specifications of the two contracts.

In accordance with Section 10.3 of the EM&A Manual, an ecological monitoring and audit programme is needed which will monitor potential impacts through construction and operation activities, and will verify the assessments which were made in the EIA report. In particular, the programme should include dolphin monitoring at NL and WL waters to be set up in order to verify the predictions of impacts and to ensure that there are no unforeseen impacts on the dolphin population during construction phase. Such dolphin monitoring should cover the pre-construction phase, the entire period of construction phase and after the completion of construction works (i.e. post-construction phase).

The main objective of the current Assignment commissioned by the Highways Department (HyD) is to conduct Post-Construction Monitoring of CWD in WL waters in compliance with the requirements stipulated in the EM&A Manual and the EP for the HZMB HKLR Project. The post-construction monitoring of CWD should be conducted for two years upon the completion of all marine-based construction activities.

The marine-based construction activities for the Contract No. HY/2011/09 was completed in October 2018. Subsequently, 10 months of post-construction dolphin monitoring had been carried out by the Contract, while the remaining 14 months of post-construction dolphin monitoring will be completed under this Assignment, from 1 September 2019 to 31 October 2020.

In August 2019, Mott MacDonald Hong Kong Limited was appointed by the HyD to undertake the Environmental Team (ET) services for this Assignment for the post-construction monitoring of CWD in WL waters for the HZMB HKLR Project. This is the Monthly EM&A Report for the 24th month of the post-construction phase of the Project summarising the findings of the post-construction EM&A activities during the reporting period from 1 to 31 October 2020, and is submitted to fulfil Condition 4.4 of the EP.

1.2 Project Organisation

The project organisation and lines of communication with respect to the environmental management structure are shown in **Appendix A**. The key personnel contact names and numbers are summarised in **Table 1.1**.

Table 1.1: Contact Information of Key Personnel

Party	Position	Name	Telephone	Fax
Permit Holder (HyD)	Engineer	Mr. Tommy Tse	2762 4149	3188 6614
Environmental Project Office / Independent Environmental Checker (Ramboll Hong Kong Limited)	Environmental Project Office Leader	Mr. Y H Hui	3465 2888	3465 2899
	Independent Environmental Checker	Mr. Manson Yeung	3465 2836	3465 2899
Environmental Team (Mott MacDonald Hong Kong Limited)	Environmental Team Leader	Mr. Gary Chow	2828 5874	2827 1823

1.3 Environmental Status and Programme

As described in Section 1.1, the current Assignment is under the post-construction phase of the HZMB HKLR Project with all marine-based construction activities completed, thus there were no construction works involved.

The CWD monitoring programme covers all transect lines in WL survey area (refer to **Figure 1**) for twice per month throughout the entire post-construction monitoring period for two years. The current reporting period is the 24th month which is the final month of the post-construction CWD monitoring for the Project. The CWD monitoring schedule for this reporting period is provided in **Appendix C**.

2 Chinese White Dolphin Monitoring

2.1 Monitoring Requirements

According to the requirement stated in the EM&A Manual, a CWD monitoring programme was set up to conduct surveys for twice per month adopting the line-transect vessel survey method and covering the following transect lines in the West Lantau (WL) survey area as in the AFCD long-term marine mammal monitoring programme.

The CWD monitoring works were undertaken by a dedicated survey team comprising qualified dolphin specialist and experienced CWD surveyors. The qualified dolphin specialist was approved by the AFCD and EPD.

2.2 Monitoring Locations

The location of the WL survey area and all transect lines are depicted in **Figure 1**. The co-ordinates of all transect lines are shown in **Table 2.1**.

Table 2.1: Co-ordinates of Transect Lines in WL Survey Area

Line No.		Easting	Northing	Line No.		Easting	Northing
1	Start Point	803750	818500	7	Start Point	800200	810450
1	End Point	803750	815500	7	End Point	801400	810450
2	Start Point	803750	815500	8	Start Point	801300	809450
2	End Point	802940	815500	8	End Point	799750	809450
3	Start Point	802550	814500	9	Start Point	799400	808450
3	End Point	803700	814500	9	End Point	801430	808450
4	Start Point	803120	813600	10	Start Point	801500	807450
4	End Point	801640	813600	10	End Point	799600	807450
5	Start Point	801100	812450	11	Start Point	800300	806500
5	End Point	802900	812450	11	End Point	801750	806500
6	Start Point	802400	811500	12	Start Point	801760	805450
6	End Point	800660	811500	12	End Point	800700	805450

2.3 Monitoring Methodology

2.3.1 Line-transect Vessel Survey

The following monitoring protocol is consistent and compatible with the baseline and construction phase dolphin monitoring methodology, which was also designed and adopted by the Hong Kong Cetacean Research Project (HKCRP) team for the HZMB monitoring since 2011.

The survey team used standard line-transect methods (Buckland et al. 2001) to conduct the systematic vessel surveys, and followed the same technique of data collection that has been adopted over the past two decades of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2018, 2019). For each monitoring vessel survey, a 15-m inboard vessel with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area.

Two experienced observers (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited through different transect lines at a constant speed of 13-15 km per hour. The data recorder searched with unaided eyes and filled out the datasheets, while the primary observer searched for CWD continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea ahead of the vessel, between 270^{o} and 90^{o} (in relation to the bow, which is defined as 0^{o}). One to two additional experienced observers were available on the boat to work in shift (i.e. rotate every 30 minutes) in order to minimize fatigue of the survey team members. All observers are experienced in small cetacean survey techniques and identifying local cetacean species.

During on-effort survey periods, the survey team recorded effort data including time, position (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance travelled in each series (a continuous period of search effort) with the assistance of a handheld GPS (*Garmin eTrex*). Data including time, position and vessel speed were automatically and continuously logged by a handheld GPS throughout the entire survey for subsequent review.

When dolphins were sighted, the survey team would end the survey effort, and immediately record the initial sighting distance and angle of the dolphin group from the survey vessel, as well as the sighting time and position. Then, the research vessel would be diverted from its course to approach the animals for species identification, group size estimation, assessment of group composition, and behavioural observations. The perpendicular distance (PSD) of the dolphin group to the transect line would later be calculated from the initial sighting distance and angle.

Survey effort being conducted along the parallel transect lines that were perpendicular to the coastlines (as indicated in **Figure 1**) was labelled as “primary” survey effort, while the survey effort being conducted along the connecting lines between parallel lines was labelled as “secondary” survey effort. According to HKCRP long-term dolphin monitoring data, encounter rates of CWD deduced from effort and sighting data collected along primary and secondary lines have been similar in survey areas around Lantau Island. Therefore, both primary and secondary survey effort were presented as on-effort survey effort.

Encounter rates of CWD (number of on-effort sightings per 100 km of survey effort) were calculated in WL survey area in relation to the amount of survey effort conducted during each month of monitoring survey. Only data collected under Beaufort 3 or below condition would be used for encounter rate analysis. Dolphin encounter rates were calculated using primary survey effort alone, as well as the combined survey effort from both primary and secondary lines.

2.3.2 Photo-identification Work

When a group of CWD was sighted during the line-transect survey, the survey team would end effort and approach the group slowly from the side and behind to take photographs of them. Every attempt was made to photograph every dolphin in the group, and even photograph both sides of the dolphins whenever possible, since the colouration and markings on both sides may not be symmetrical.

At least one professional digital camera (Canon EOS 7D model) equipped with long telephoto lens (100-400 mm zoom) was available on board for researchers to take sharp, close-up photographs of dolphins as they surface. The images were shot at the highest available resolution and stored on Compact Flash memory cards for downloading onto a computer.

All digital images taken in the field were first examined, and those containing potentially identifiable individuals were sorted out. These photographs were then examined in greater detail, and were carefully compared to the existing CWD photo-identification catalogue maintained by HKCRP since 1995. CWDs can be identified by their natural markings, such as nicks, cuts, scars and deformities on their dorsal fin and body, and their unique spotting patterns can also be used as secondary identifying features (Jefferson 2000).

All photographs of each individual were then compiled and arranged in chronological order, with data including the date and location first identified (initial sighting), re-sightings, associated dolphins, distinctive features, and age classes entered into a computer database.

2.4 Monitoring Results

2.4.1 Line-transect Vessel Survey

Two sets of systematic line-transect vessel surveys were conducted on 5th and 8th October 2020, to cover all transect lines in WL survey area twice. The survey routes of each survey day are presented in Figures 2 to 3 of **Appendix B**.

A total of 64.62 km of survey effort was collected, with 94.9% of total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility), as detailed in **Appendix B**. Out of the 64.62 km of survey effort, the total survey effort conducted on primary lines was 42.98 km, while the effort on secondary lines was 21.64 km.

During the two sets of monitoring surveys, six groups of 27 CWDs were sighted. All six dolphin groups were sighted during on-effort search, with five of these sightings being made on primary lines (refer to sighting data presented in **Appendix B**). None of these dolphin groups were associated with operating fishing vessel.

Distribution of the dolphin sightings made in the reporting period is shown in Figure 4 of **Appendix B**. Four of the six dolphin groups were sighted at the central portion of the WL survey area (i.e. to the east of Kai Kung Shan and Peaked Hill), while the other two were sighted at the northern end (to the north of Tai O Peninsula) and southern end (near Fan Lau) of the survey area respectively. None of these dolphin groups were sighted in the proximity of the HKLR alignment.

Encounter rates of CWD deduced from the survey effort and on-effort sighting data made under favourable conditions (Beaufort 3 or below) are shown in **Table 2.2** and **Table 2.3**.

Table 2.2: Dolphin encounter rates per set in WL survey area during the reporting period

Survey Area	Survey Set	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	Primary Lines Only
West Lantau (WL)	Set 1: October 5th, 2020	14.7	83.5
	Set 2: October 8th, 2020	4.9	34.0

Table 2.3: Overall dolphin encounter rates on primary lines only as well as both primary and secondary lines in WL survey area during the reporting period

Survey Area	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		Encounter rate (ANI) (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	Primary Lines Only	Both Primary and Secondary Lines	Primary Lines Only	Both Primary and Secondary Lines
West Lantau (WL)	9.8	8.2	58.6	40.8

The average group size of CWDs was 4.5 dolphins per group. Two of the six dolphin sightings were consisted of 1-2 animals per group, while the other four medium-sized group had 5-7 animals per group.

2.4.2 Photo-identification Work

A total of 16 different individual CWDs were identified 19 times during surveys, with details presented in **Appendix B**. Besides three individuals being re-sighted twice, the other 13 individuals were re-sighted once during this reporting period. Notably, one of the 16 individuals (i.e. WL98) was sighted with her young calf.

3 Conclusions

Post-construction phase EM&A work including the monitoring of CWD was conducted in accordance with the EM&A Manual during the reporting period. This is the final month of post-construction monitoring of Chinese White Dolphin in West Lantau waters for the Project.

In this month of post-construction monitoring of CWD in WL waters, vessel surveys were conducted on 5th and 8th October 2020 covering all transect lines in WL survey area twice. A total of 64.62 km of survey effort was collected, with six groups of 27 CWDs were sighted. All marine-based construction activities have been completed and as a result, no adverse impact on CWD was observed from the HZMB HKLR works.

Figures

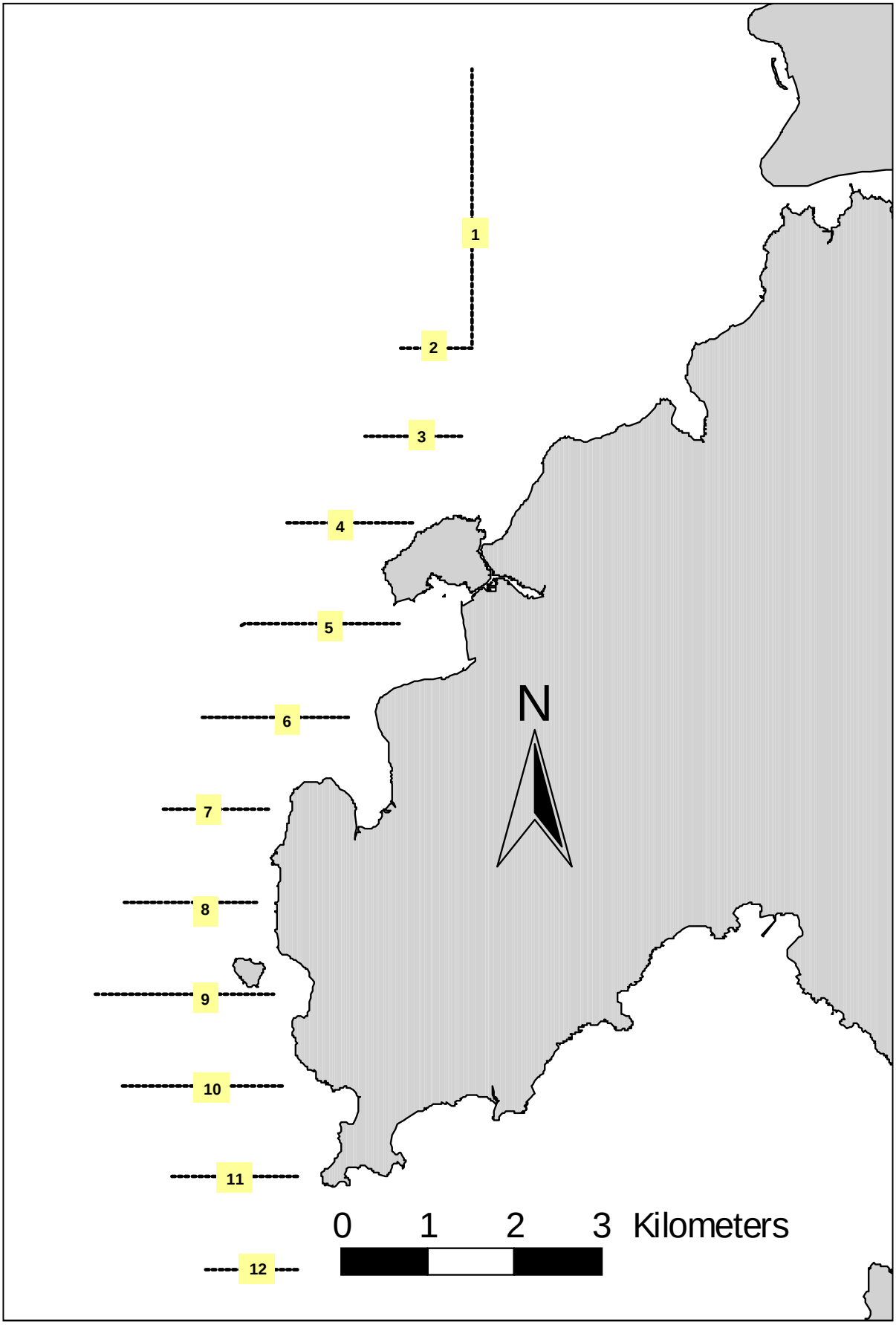
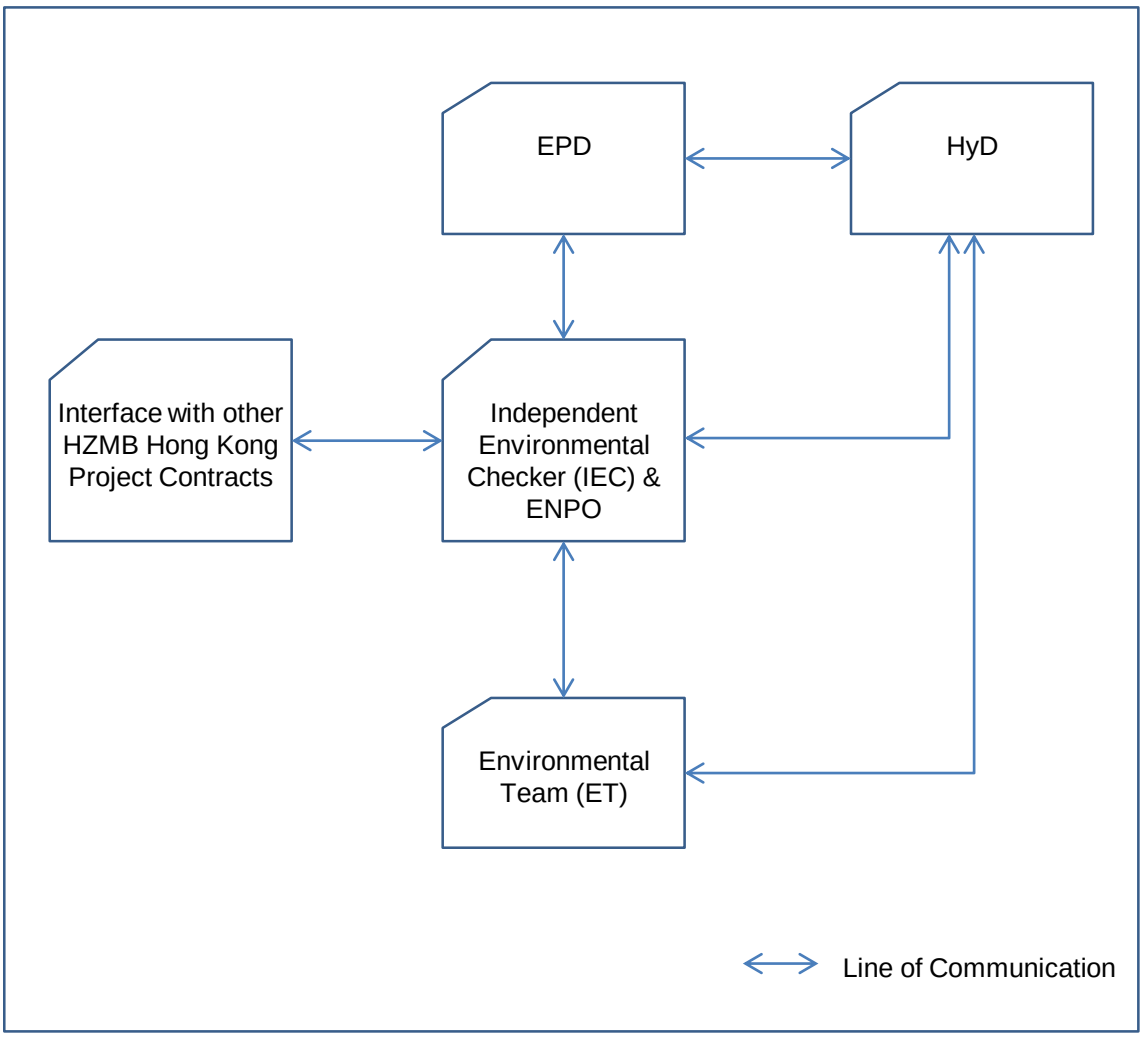


Figure 1. Transect Line Layout in West Lantau Survey Area

Appendix A Project Organisation for Environmental Works

Project Organisation for Environmental Works



Appendix B Chinese White Dolphin Monitoring Results

AGREEMENT NO. HMWSD 1/2019 (EP)
Post-Construction Monitoring of Chinese White Dolphin (Line-transect Vessel Surveys) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road at West Lantau Waters - Investigation

Monthly Progress Report (October 2020)

Submitted by
Samuel K.Y. Hung, Ph.D.
Hong Kong Cetacean Research Project

19 October 2020

1. Introduction

1.1. The Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Link Road (HKLR) is a designated project under the Environmental Impact Assessment Ordinance (EIAO). The Environmental Impact Assessment (EIA) Report and Environmental Monitoring and Audit (EM&A) Manual (EIA Register No.: AEIAR-144/2009) for the project were approved by the Director of Environmental Protection in October 2009 and the Environmental Permit No. EP-352/2009 (EP) was issued in November 2009. The EP has been subject to several variations and the current one is EP No. EP-352/2009/D.

1.2. The HZMB-HKLR was constructed under two works contracts namely Contract No. HY/2011/03 (HZMB HKLR – Section between Scenic Hill and Hong Kong Boundary Crossing Facilities (HKBCF)) and Contract No. HY/2011/09 (HZMB HKLR – Section between HKSAR Boundary and Scenic Hill). In accordance with the EP, the Contractors of Contract No. HY/2011/03 and Contract No. HY/2011/09 have separately employed their own Environmental Team (ET) and ET Leader to conduct construction phase monitoring of Chinese White Dolphin (CWD) in the North Lantau (NL) and West Lantau (WL) waters following the requirements specified in the EM&A Manual and the relevant contract specifications of the two contracts.

1.3. In accordance with Section 10.3 of the EM&A Manual, an ecological monitoring and audit programme is needed which will monitor potential impacts through construction and operation activities, and will verify the assessments which were made in the EIA report.

In particular, the programme should include dolphin monitoring at NL and WL waters to be set up in order to verify the predictions of impacts and to ensure that there are no unforeseen impacts on the dolphin population during construction phase. Such dolphin monitoring should cover the pre-construction phase, the entire period of construction phase and after the completion of construction works (i.e. post-construction phase).

1.4. The main objective of the current assignment commissioned by the Highways Department is to conduct Post-Construction Monitoring of CWD in WL waters in compliance with the requirements stipulated in the EM&A Manual and the EP for the HZMB HKLR. The post-construction monitoring should be conducted for two years upon the completion of all marine-based construction activities.

1.5. The marine-based construction activities for the Contract No. HY/2011/09 was completed in October 2018. Subsequently, 10 months of post-construction dolphin monitoring had been carried out by another contractor between late October 2018 and the end of August 2019, while the remaining 14 months of post-construction dolphin monitoring will be completed under this assignment, from 1 September 2019 to 31 October 2020.

1.6. In August 2019, Mott MacDonald Hong Kong Limited (MMHK) has been appointed as the Consultant responsible for the 14 months of post-construction monitoring of CWD in WL waters for HZMB HKLR. Subsequently, the Hong Kong Cetacean Research Project (HKCRP) has been appointed by MMHK to undertake the dolphin monitoring tasks to conduct systematic line-transect vessel surveys and the analysis of such survey data. The present report summarizes the results of post-construction monitoring survey findings during the monitoring month of October 2020.

2. Monitoring Methodology

2.1.1. According to the requirement of the updated EM&A manual, the dolphin monitoring programme should cover all transect lines in WL survey area (see Figure 1) twice per month throughout the entire post-construction period. The co-ordinates of all transect lines are shown in Table 1.

Table 1. Co-ordinates of transect lines in WL survey area

Line No.		Easting	Northing		Line No.		Easting	Northing
1	Start Point	803750	818500		7	Start Point	800200	810450
1	End Point	803750	815500		7	End Point	801400	810450

2	Start Point	803750	815500		8	Start Point	801300	809450
2	End Point	802940	815500		8	End Point	799750	809450
3	Start Point	802550	814500		9	Start Point	799400	808450
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4	Start Point	803120	813600		10	Start Point	801500	807450
4	End Point	801640	813600		10	End Point	799600	807450
5	Start Point	801100	812450		11	Start Point	800300	806500
5	End Point	802900	812450		11	End Point	801750	806500
6	Start Point	802400	811500		12	Start Point	801760	805450
6	End Point	800660	811500		12	End Point	800700	805450

2.1.2. It should be emphasized that the following monitoring protocol is consistent and completely compatible with the baseline and construction phase dolphin monitoring methodology, which was also designed and adopted by the HKCRP team for the HZMB monitoring since 2011.

2.1.3. The HKCRP survey team used standard line-transect methods (Buckland et al. 2001) to conduct the systematic vessel surveys, and followed the same technique of data collection that has been adopted over the past two decades of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 2018, 2019). For each monitoring vessel survey, a 15-m inboard vessel with an open upper deck (about 4.5 m above water surface) was used to make observations from the flying bridge area.

2.1.4. Two experienced observers (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited through different transect lines at a constant speed of 13-15 km per hour. The data recorder searched with unaided eyes and fill out the datasheets, while the primary observer searched for Chinese White Dolphins continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea ahead of the vessel, between 270^{o} and 90^{o} (in relation to the bow, which is defined as 0^{o}). One to two additional experienced observers were available on the boat to work in shift (i.e. rotate every 30 minutes) in order to minimize fatigue of the survey team members. All observers are experienced in small cetacean survey techniques and identifying local cetacean species.

2.1.5. During on-effort survey periods, the survey team recorded effort data including time, position (latitude and longitude), weather conditions (Beaufort sea state and visibility), and distance traveled in each series (a continuous period of search effort) with the assistance of a handheld GPS (*Garmin eTrex*). Data including time, position and vessel

speed were automatically and continuously logged by a handheld GPS throughout the entire survey for subsequent review.

2.1.6. When dolphins were sighted, the survey team would end the survey effort, and immediately record the initial sighting distance and angle of the dolphin group from the survey vessel, as well as the sighting time and position. Then the research vessel would then be diverted from its course to approach the animals for species identification, group size estimation, assessment of group composition, and behavioural observations. The perpendicular distance (PSD) of the dolphin group to the transect line were later calculated from the initial sighting distance and angle.

2.1.7. Survey effort being conducted along the parallel transect lines that were perpendicular to the coastlines (as indicated in Figure 1) was labeled as “primary” survey effort, while the survey effort being conducted along the connecting lines between parallel lines was labeled as “secondary” survey effort. According to HKCRP long-term dolphin monitoring data, encounter rates of Chinese White Dolphins deduced from effort and sighting data collected along primary and secondary lines have been similar in survey areas around Lantau Island. Therefore, both primary and secondary survey effort would be presented as on-effort survey effort.

2.1.8. Encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort) were calculated in WL survey area in relation to the amount of survey effort conducted during each month of monitoring survey. Only data collected under Beaufort 3 or below condition would be used for encounter rate analysis. Dolphin encounter rates were calculated using primary survey effort alone, as well as the combined survey effort from both primary and secondary lines.

2.2. Photo-identification Work

2.2.1. When a group of Chinese White Dolphins were sighted during the line-transect survey, the survey team would then end effort and approach the group slowly from the side and behind to take photographs of them. Every attempt was made to photograph every dolphin in the group, and even photograph both sides of the dolphins, since the colouration and markings on both sides may not be symmetrical.

2.2.2. One to two professional digital cameras (*Canon* EOS 7D Mark II model), each equipped with long telephoto lenses (100-400 mm zoom), were available on board for researchers to take sharp, close-up photographs of dolphins as they surface. The images were shot at the highest available resolution and stored on Compact Flash memory cards for downloading onto a computer.

2.2.3. All digital images taken in the field were first examined, and those containing potentially identifiable individuals were sorted out. These photographs would then be examined in greater detail, and were carefully compared to the existing Chinese White Dolphin photo-identification catalogue maintained by HKCRP since 1995.

2.2.4. Chinese White Dolphins were identified by their natural markings, such as nicks, cuts, scars and deformities on their dorsal fin and body, and their unique spotting patterns were also used as secondary identifying features (Jefferson 2000).

2.2.5. All photographs of each individual were then compiled and arranged in chronological order, with data including the date and location first identified (initial sighting), re-sightings, associated dolphins, distinctive features, and age classes entered into a computer database.

3. Monitoring Results

3.1. Vessel-based Line-transect Survey

3.1.1. During the monitoring month of October 2020, two complete sets of systematic line-transect vessel surveys were conducted on the 5th and 8th, to cover all transect lines in WL survey area twice. The survey routes of each survey day are presented in Figures 2-3.

3.1.2. From these surveys, a total of 64.62 km of survey effort was collected, with 94.9% of total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility) (Appendix I). The total survey effort conducted on primary lines (i.e. the horizontal lines perpendicular to the coastlines) and secondary lines (i.e. the lines connecting the primary lines) were 42.98 km and 21.64 km respectively.

3.1.3. During the monitoring surveys conducted in October 2020, six groups of 27 Chinese White Dolphins were sighted. All six dolphin groups were sighted during on-effort search, with five of these sightings being made on primary lines (Appendix II). None of these dolphin groups was associated with any operating fishing vessel during the monitoring month.

3.1.4. Distribution of the dolphin sightings made during October's surveys is shown in Figure 4. Four of the six dolphin groups were sighted at the central portion of the WL survey area

(i.e. to the east of Kai Kung Shan and Peaked Hill), while the other two were sighted at the northern end (to the north of Tai O Peninsula) and southern end (near Fan Lau) of the survey area respectively. None of these dolphin groups were sighted in the proximity of the HKLR09 alignment as in previous monitoring periods in recent months.

3.1.5. During the October's surveys, encounter rates of Chinese White Dolphins deduced from the survey effort and on-effort sighting data made under favourable conditions (Beaufort 3 or below) are shown in Tables 2 & 3.

Table 2. Dolphin encounter rates (sightings per 100 km of survey effort) per set during October's surveys in West Lantau (WL)

		Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)	**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)
		Primary Lines Only	**Primary Lines Only**
West Lantau	Set 1: October 5th	14.7	83.5
	Set 2: October 8th	4.9	34.0

Table 3. Overall dolphin encounter rates (sightings per 100 km of survey effort) in October's surveys on primary lines only as well as both primary lines and secondary lines in West Lantau (WL)

	Encounter rate (STG) (no. of on-effort dolphin sightings per 100 km of survey effort)		**Encounter rate (ANI)** (no. of dolphins from all on-effort sightings per 100 km of survey effort)	
	Primary Lines Only	**Both Primary and Secondary Lines**	**Primary Lines Only**	**Both Primary and Secondary Lines**
West Lantau	9.8	8.2	58.6	40.8

3.1.6. The average group size of Chinese White Dolphins sighted during October's surveys was 4.5 individuals per group. During this monitoring month, two of the six dolphin sightings were consisted of small groups with 1-2 animals per group, while the other four were all medium-sized groups with 5-7 animals per group (Appendix II).

3.2. Photo-identification Work

3.2.1. In October's survey, a total of 16 different individual Chinese White Dolphins were identified 19 times (Appendix III and IV). Besides three individuals being re-sighted twice, the other 13 individuals were re-sighted only once during this monitoring month.

3.2.2. Notably, one of the 16 individuals (i.e. WL98) was sighted with her young calf during this month's monitoring surveys.

3.3. Conclusion

3.3.1. In this month of post-construction dolphin monitoring in WL waters, marine construction activities have been completed and as a result, no adverse impact on Chinese White Dolphins from the HZMB works has been observed.

4. References

- Buckland, S. T., Anderson, D. R., Burnham, K. P., Laake, J. L., Borchers, D. L., and Thomas, L. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, London.

- Hung, S. K. 2018. Monitoring of Marine Mammals in Hong Kong waters: final report (2017-18). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 174 pp.

- Hung, S. K. 2019. Monitoring of Marine Mammals in Hong Kong waters: final report (2018-19). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 140 pp.

- Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144: 1-65.

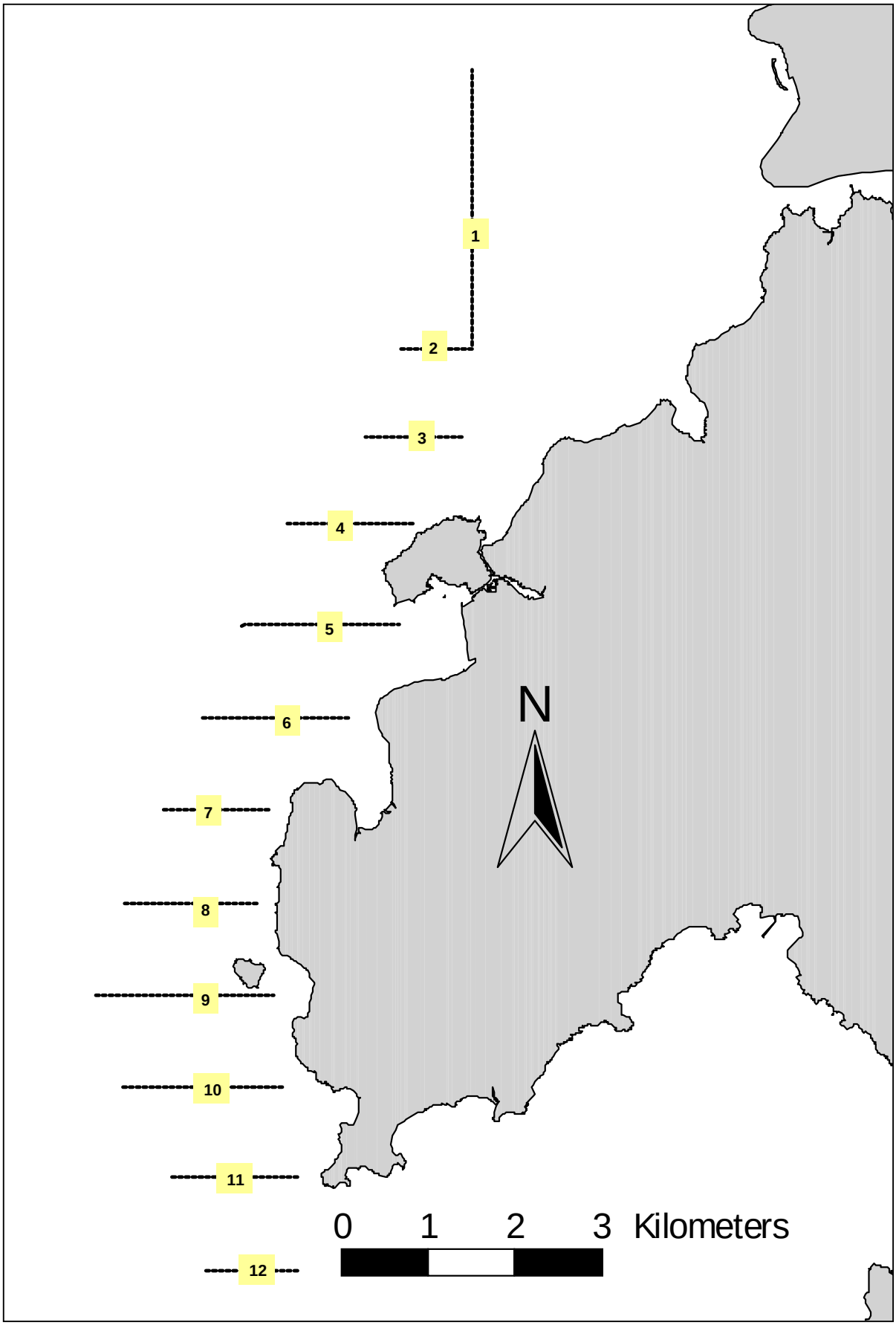

Figure 1. Transect Line Layout in West Lantau Survey Areas

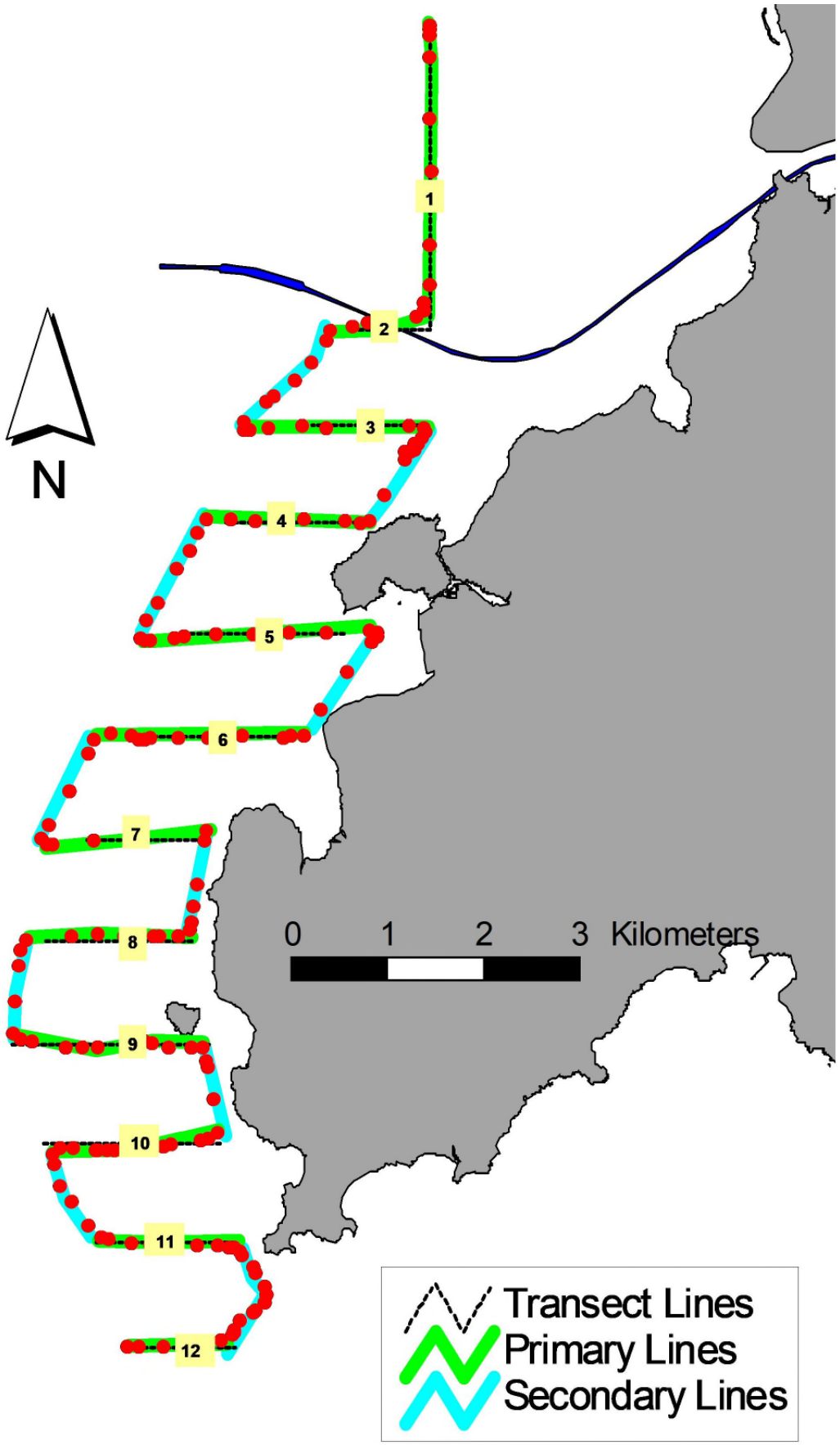

Figure 2. Survey Route on October 5th, 2020 (note: red dots represent the tracked positions of survey boat logged continuously by GPS throughout the course of the survey)

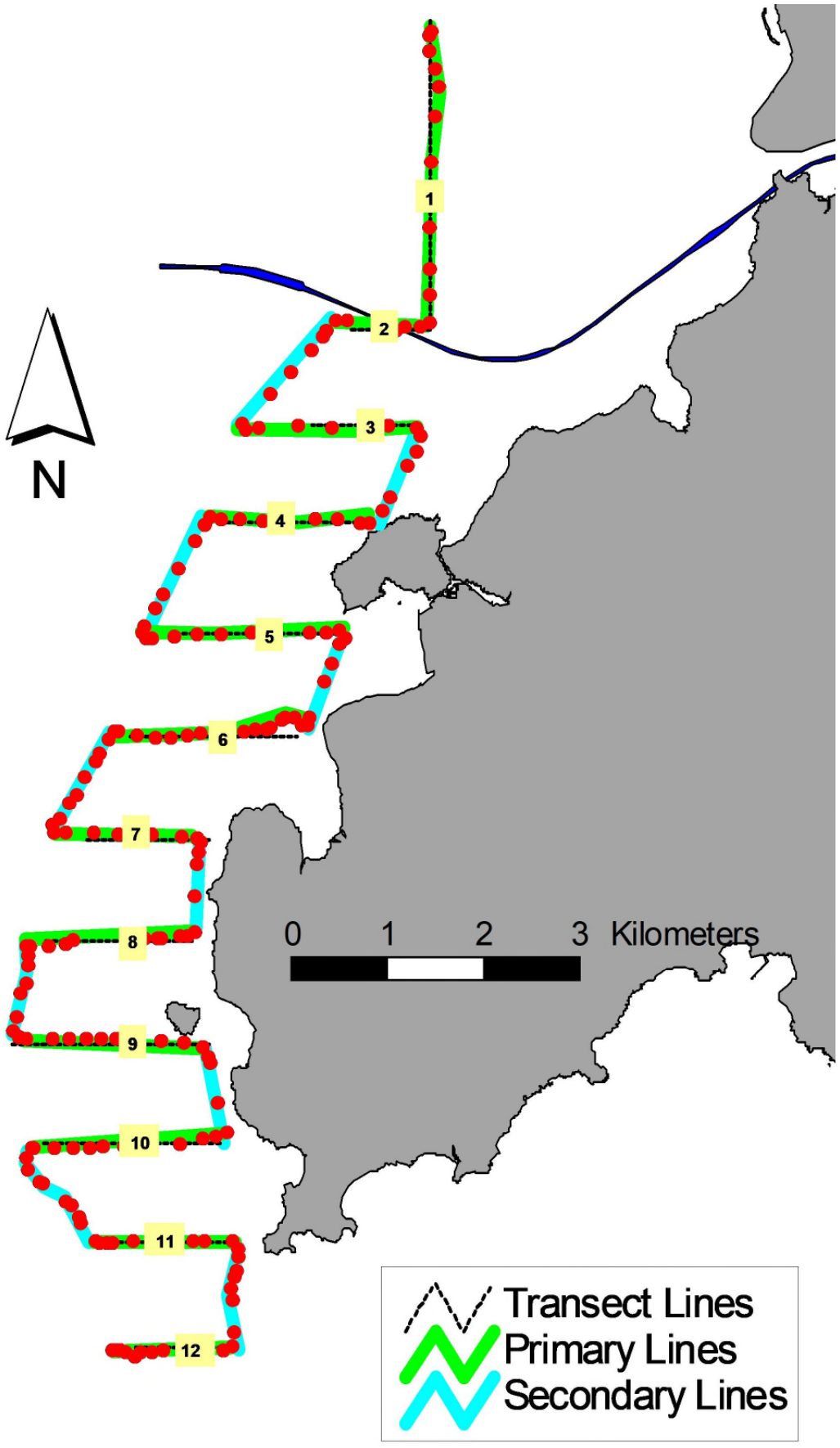

Figure 3. Survey Route on October 8th, 2020 (note: red dots represent the tracked positions of survey boat logged continuously by GPS throughout the course of the survey)

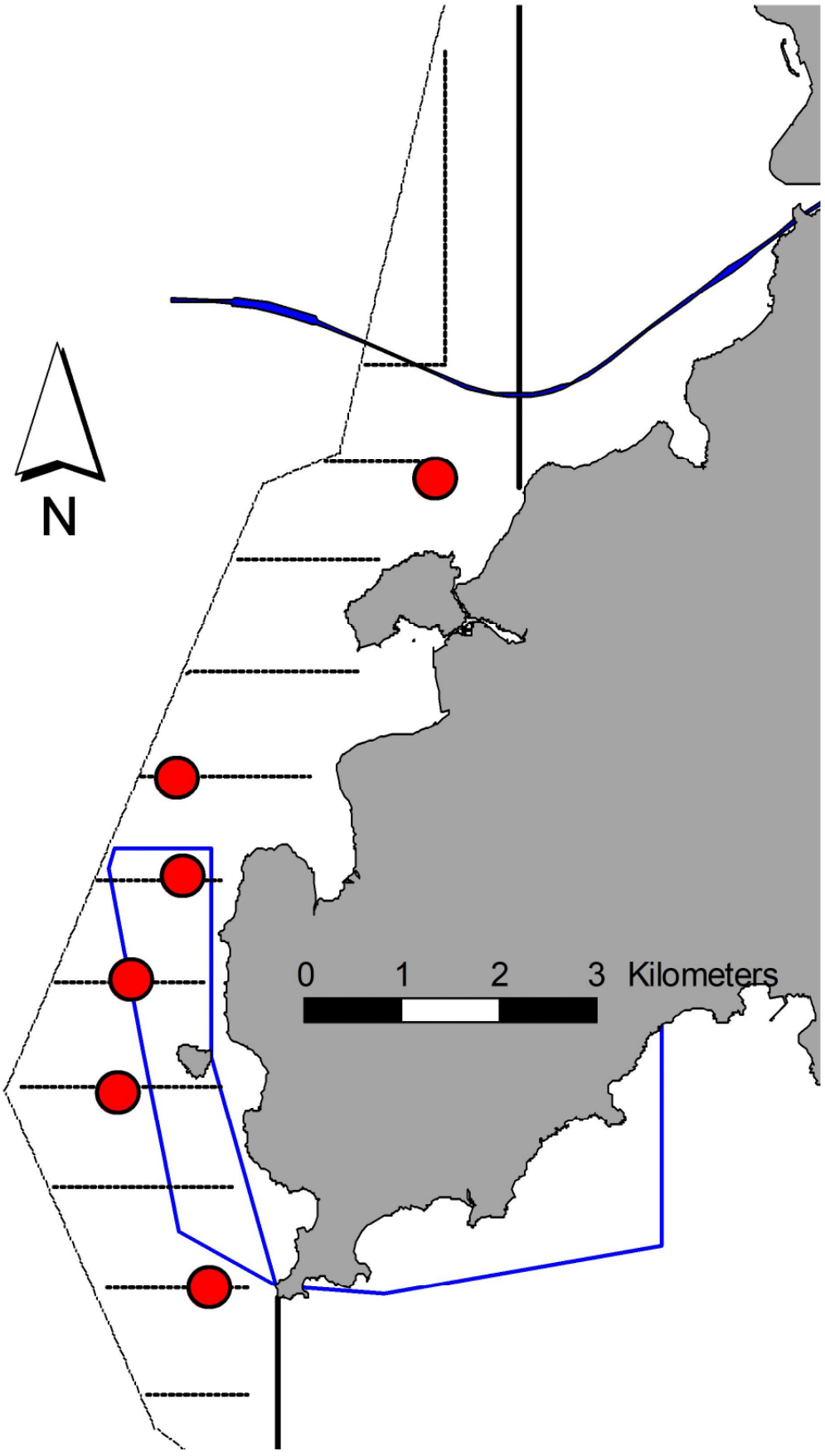

Figure 4. Distribution of Chinese White Dolphin sightings during the monitoring surveys conducted in October 2020

Appendix I. Survey Effort Database for HZMB Post-construction Monitoring in West Lantau Waters (October 2020)

(Abbreviations: BEAU = Beaufort Sea State; P = Primary Line Effort; S = Secondary Line Effort)

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
5-Oct-20	W LANTAU	2	10.75	AUTUMN	STANDARD36826	HYD-HZMB	P
5-Oct-20	W LANTAU	3	9.61	AUTUMN	STANDARD36826	HYD-HZMB	P
5-Oct-20	W LANTAU	4	1.08	AUTUMN	STANDARD36826	HYD-HZMB	P
5-Oct-20	W LANTAU	2	7.12	AUTUMN	STANDARD36826	HYD-HZMB	S
5-Oct-20	W LANTAU	3	3.14	AUTUMN	STANDARD36826	HYD-HZMB	S
8-Oct-20	W LANTAU	2	1.10	AUTUMN	STANDARD36826	HYD-HZMB	P
8-Oct-20	W LANTAU	3	19.51	AUTUMN	STANDARD36826	HYD-HZMB	P
8-Oct-20	W LANTAU	4	0.93	AUTUMN	STANDARD36826	HYD-HZMB	P
8-Oct-20	W LANTAU	2	1.40	AUTUMN	STANDARD36826	HYD-HZMB	S
8-Oct-20	W LANTAU	3	8.68	AUTUMN	STANDARD36826	HYD-HZMB	S
8-Oct-20	W LANTAU	4	1.30	AUTUMN	STANDARD36826	HYD-HZMB	S

Appendix II. Chinese White Dolphin Sighting Database for HZMB Post-construction Monitoring in West Lantau Waters (October 2020)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; ND = Not Determined; BOAT ASSOC. = Fishing Boat Association; P/S: Sighting Made on Primary/Secondary Lines)

DATE	STG #	TIME	HRD SZ	AREA	BEAU	PSD	EFFORT	TYPE	NORTHING	EASTING	SEASON	BOAT ASSOC.	P/S
5-Oct-20	1	1105	1	W LANTAU	3	45	ON	HYD-HZMB	814331	803659	AUTUMN	NONE	S
5-Oct-20	2	1150	7	W LANTAU	2	331	ON	HYD-HZMB	811424	800993	AUTUMN	NONE	P
5-Oct-20	3	1220	5	W LANTAU	2	101	ON	HYD-HZMB	810483	801053	AUTUMN	NONE	P
5-Oct-20	4	1251	5	W LANTAU	2	131	ON	HYD-HZMB	808369	800388	AUTUMN	NONE	P
8-Oct-20	1	1141	7	W LANTAU	3	325	ON	HYD-HZMB	809454	800535	AUTUMN	NONE	P
8-Oct-20	2	1239	2	W LANTAU	4	171	ON	HYD-HZMB	806474	801333	AUTUMN	NONE	P

Appendix III. Individual dolphins identified during HZMB post-construction monitoring in West Lantau waters (October 2020)

ID#	DATE	STG#	AREA
CH112	08/10/20	1	W LANTAU
NL49	05/10/20	2	W LANTAU
NL242	05/10/20	2	W LANTAU
	08/10/20	2	W LANTAU
NL321	05/10/20	4	W LANTAU
NL322	05/10/20	4	W LANTAU
WL11	08/10/20	2	W LANTAU
WL98	05/10/20	3	W LANTAU
WL168	05/10/20	1	W LANTAU
	08/10/20	1	W LANTAU
WL179	08/10/20	1	W LANTAU
WL180	05/10/20	3	W LANTAU
WL206	08/10/20	1	W LANTAU
WL251	05/10/20	2	W LANTAU
WL281	05/10/20	2	W LANTAU
WL286	05/10/20	4	W LANTAU
WL304	05/10/20	2	W LANTAU
	05/10/20	3	W LANTAU
WL305	05/10/20	4	W LANTAU

Appendix IV. Photographs of Identified Individual Dolphins from October 2020

Appendix IV. (cont'd)

Appendix IV. (cont'd)

Appendix C Monitoring Schedule

Agreement No. HMWSD 1/2019 (EP) Post-Construction Monitoring of Chinese White Dolphin (Line-transect Vessel Surveys) for the Hong Kong-Zhuhai-Macao Bridge Hong Kong Link Road at West Lantau Waters – Investigation

2020 OCTOBER

Monitoring Schedule

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	01	02	03
04	05 Post-construction phase CWD monitoring (vessel survey)	06	07	08 Post-construction phase CWD monitoring (vessel survey)	09	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31