

CONTRACT NO. HY/2013/04

**Hong Kong-Zhuhai-Macao Bridge Hong Kong Boundary Crossing
Facilities – Infrastructure Works Stage II (Southern Portion)
Dolphin Monthly Monitoring (Operational Phase)**

10th Monthly Progress Report (December 2019)

*Submitted to Mott MacDonald Hong Kong Limited &
China State Construction Engineering (Hong Kong) Limited*

Submitted by
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1. Introduction

- 1.1. For the Hong Kong-Zhuhai-Macao Bridge (HZMB) Hong Kong Boundary Crossing Facilities (HKBCF), its operation requires the contractor (i.e. China State Construction Engineering (Hong Kong) Limited) and the associated Environmental Team, Mott MacDonald Hong Kong Limited, to implement the Environmental Monitoring and Audit (EM&A) programme during the operational phase.
- 1.2. According to the HKBCF EM&A Manual, monthly line-transect vessel surveys for Chinese White Dolphins should be conducted to cover the Northwest (NWL) and Northeast Lantau (NEL) survey areas, which should be the same as in AFCD annual marine mammal monitoring programme. However, as such monitoring surveys have been undertaken by the TMCLKL08 EM&A project (i.e. Contract No. HY/2012/08 HZMB Tuen Mun – Chek Lap Kok Link (Northern Connection Sub-sea Tunnel Section)) in the same areas (i.e. NWL and NEL), a combined monitoring approach is recommended by the Highways Department, that the HKBCF EM&A project should utilize the monitoring data collected by TMCLKL08 EM&A project to avoid any redundancy in monitoring effort.
- 1.3. In April 2019, the Director of Hong Kong Cetacean Research Project (HKCRP), Dr.

Samuel Hung, has been appointed by the ET as the dolphin specialist for the operational phase of the HKBCF EM&A project. He is responsible for the dolphin monitoring study, including the collection and collation of dolphin monitoring data from the TMCLKL08 EM&A project to examine any potential impacts of HKBCF during the operational phase on the dolphins. From the monitoring results, any changes in dolphin occurrence within the study area will be reviewed for possible causes, and appropriate actions and additional mitigation measures will be recommended as necessary.

- 1.4. This 10th monthly progress report of the HKBCF operational phase dolphin monitoring programme is submitted to the environmental team and the contractor, summarizing the results of the survey findings during the month of December 2019 by utilizing the survey data collected from the TMCLKL08 EM&A project.

2. Monitoring Methodology

2.1. Vessel-based Line-transect Survey

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

Table 1. Co-ordinates of transect lines

Line No.		Easting	Northing		Line No.		Easting	Northing
1	Start Point	804671	815456		13	Start Point	816506	819480
1	End Point	804671	831404		13	End Point	816506	824859
2	Start Point	805476	820800		14	Start Point	817537	820220
2	End Point	805476	826654		14	End Point	817537	824613
3	Start Point	806464	821150		15	Start Point	818568	820735
3	End Point	806464	822911		15	End Point	818568	824433
4	Start Point	807518	821500		16	Start Point	819532	821420
4	End Point	807518	829230		16	End Point	819532	824209
5	Start Point	808504	821850		17	Start Point	820451	822125
5	End Point	808504	828602		17	End Point	820451	823671

6	Start Point	809490	822150		18	Start Point	821504	822371
6	End Point	809490	825352		18	End Point	821504	823761
7	Start Point	810499	822000		19	Start Point	822513	823268
7	End Point	810499	824613		19	End Point	822513	824321
8	Start Point	811508	821123		20	Start Point	823477	823402
8	End Point	811508	824254		20	End Point	823477	824613
9	Start Point	812516	821303		21	Start Point	805476	827081
9	End Point	812516	824254		21	End Point	805476	830562
10	Start Point	813525	821176		22	Start Point	806464	824033
10	End Point	813525	824657		22	End Point	806464	829598
11	Start Point	814556	818853		23	Start Point	814559	821739
11	End Point	814556	820992		23	End Point	814559	824768
12	Start Point	815542	818807		24	Start Point	805476	815900
12	End Point	815542	824882		24	End Point	805476	819100

- 2.1.2. The TMCLKL08 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 last 22 years of marine mammal monitoring surveys in Hong Kong developed by HKCRP (see Hung 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.
- 2.1.3. Two experienced observers (a data recorder and a primary observer) made up the on-effort survey team, and the survey vessel transited 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 dolphins and porpoises continuously through 7 x 50 *Fujinon* marine binoculars. Both observers searched the sea ahead of the vessel, between 270° and 90° (in relation to the bow, which is defined as 0°). 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 were experienced in small cetacean survey techniques and identifying local cetacean species.
- 2.1.4. 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 Legend*).

- 2.1.5. Data including time, position and vessel speed were also automatically and continuously logged by 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 was 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 was 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 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 were similar in NEL and NWL survey areas. Therefore, both primary and secondary survey effort were presented as on-effort survey effort in this report.
- 2.1.8. Encounter rates of Chinese White Dolphins (number of on-effort sightings per 100 km of survey effort and number of dolphins from all on-effort sightings per 100 km of survey effort) were calculated in NEL and NWL survey areas 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 TMCLKL08 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, since the colouration and markings on both sides may not be symmetrical.

- 2.2.2. A professional digital camera (*Canon EOS 7D* model), 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 surfaced. 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 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 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. Under the TMCLKL08 dolphin monitoring programme, two sets of systematic line-transect vessel surveys were conducted on the 3rd, 10th, 12th and 16th of December 2019, to cover all transect lines in NWL and NEL survey areas twice during the monitoring month. The survey routes of each survey day are presented in Figures 2-5.
- 3.1.2. From the two sets of TMCLKL08 monitoring surveys conducted in December, 262.02 km of survey effort was collected, with 100% of the total survey effort being conducted under favourable weather conditions (i.e. Beaufort Sea State 3 or below with good visibility) (Appendix I).
- 3.1.3. Among the NEL and NWL survey areas, 95.80 km and 166.22 km of survey effort were conducted respectively. Moreover, the total survey effort conducted on primary and secondary lines were 189.40 km and 72.62 km respectively (Appendix I).
- 3.1.4. A total of three groups of 13 Chinese White Dolphins were sighted during the two sets of

TMCLKL08 monitoring surveys conducted in NWL in December 2019, while no dolphin was sighted at all in NEL (Appendix II). All three dolphin groups were sighted on primary lines during on-effort search, and they were not associated with any operating fishing vessel (Appendix II).

- 3.1.5. Distribution of the three dolphin sightings made during this monitoring month is shown in Figure 6. One large group of 11 dolphins was sighted along the HKLR09 alignment at the southwestern corner of NWL survey area, and the other two groups were two lone dolphins sighted to the west of Sha Chau and near Lung Kwu Tan respectively. All three sightings were located very far away from the HKBCF work site (Figure 6).
- 3.1.6. From the TMCLKL08 surveys conducted in December 2019, the 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 deduced from the two sets of TMCLKL08 surveys (two surveys in each set) conducted in December 2019 in Northeast (NEL) and Northwest Lantau (NWL)

		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
NEL	Set 1: December 3 rd / 10 th	0.0	0.0
	Set 2: December 12 th / 16 th	0.0	0.0
NWL	Set 1: December 3 rd / 10 th	0.0	0.0
	Set 2: December 12 th / 16 th	5.0	21.8

Table 3. Overall dolphin encounter rates (sightings per 100 km of survey effort) from the two sets of TMCLKL08 surveys conducted in December 2019 on primary lines only as well as both primary lines and secondary lines in Northeast (NEL) and Northwest Lantau (NWL)

	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
Northeast Lantau	0.0	0.0	0.0	0.0
Northwest Lantau	2.5	1.8	10.9	7.8

3.1.7. During the December's surveys, the average dolphin group size was 4.3 individuals per group. Two of the three groups were composed of lone animals, while the other one was a large group composed of 11 dolphins (Appendix II).

3.2. *Photo-identification Work*

3.2.1. During the two sets of TMCLKL08 monitoring surveys conducted in December 2019, a total of nine known individuals were sighted nine times (Appendix III and IV). All of them were re-sighted only once during the monthly surveys in December.

3.2.2. Notably, three identified individuals (i.e. CH108, NL120 and WL214) were sighted with their young calves during their re-sightings in December 2019.

4. Conclusion

4.1. During this month of dolphin monitoring, no adverse impact from the operation of HKBCF on Chinese White Dolphins was noticeable from general observations.

4.2. Due to the monthly variation in dolphin occurrence within the study area, it would be more appropriate to draw conclusion on whether any impacts on dolphins have been detected in relation to the operation of HKBCF in the quarterly EM&A reports, where comparison on distribution, group size and encounter rates of dolphins between the quarterly operational monitoring period, impact monitoring period and baseline monitoring period will be made.

5. 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. 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 Northwest and Northeast Lantau Survey Areas

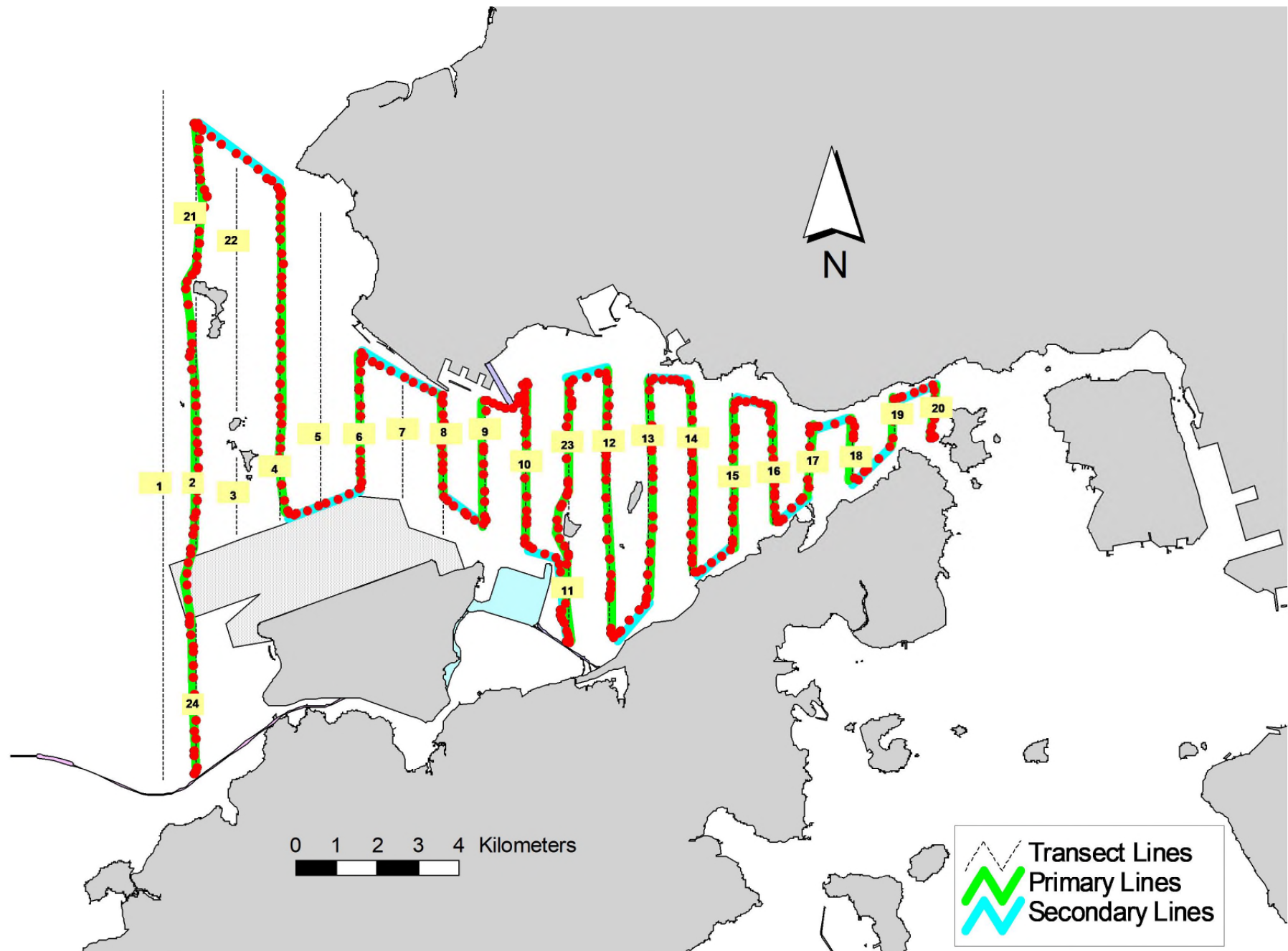


Figure 2. Survey Route on December 3rd, 2019 (from TMCLKL08 surveys)

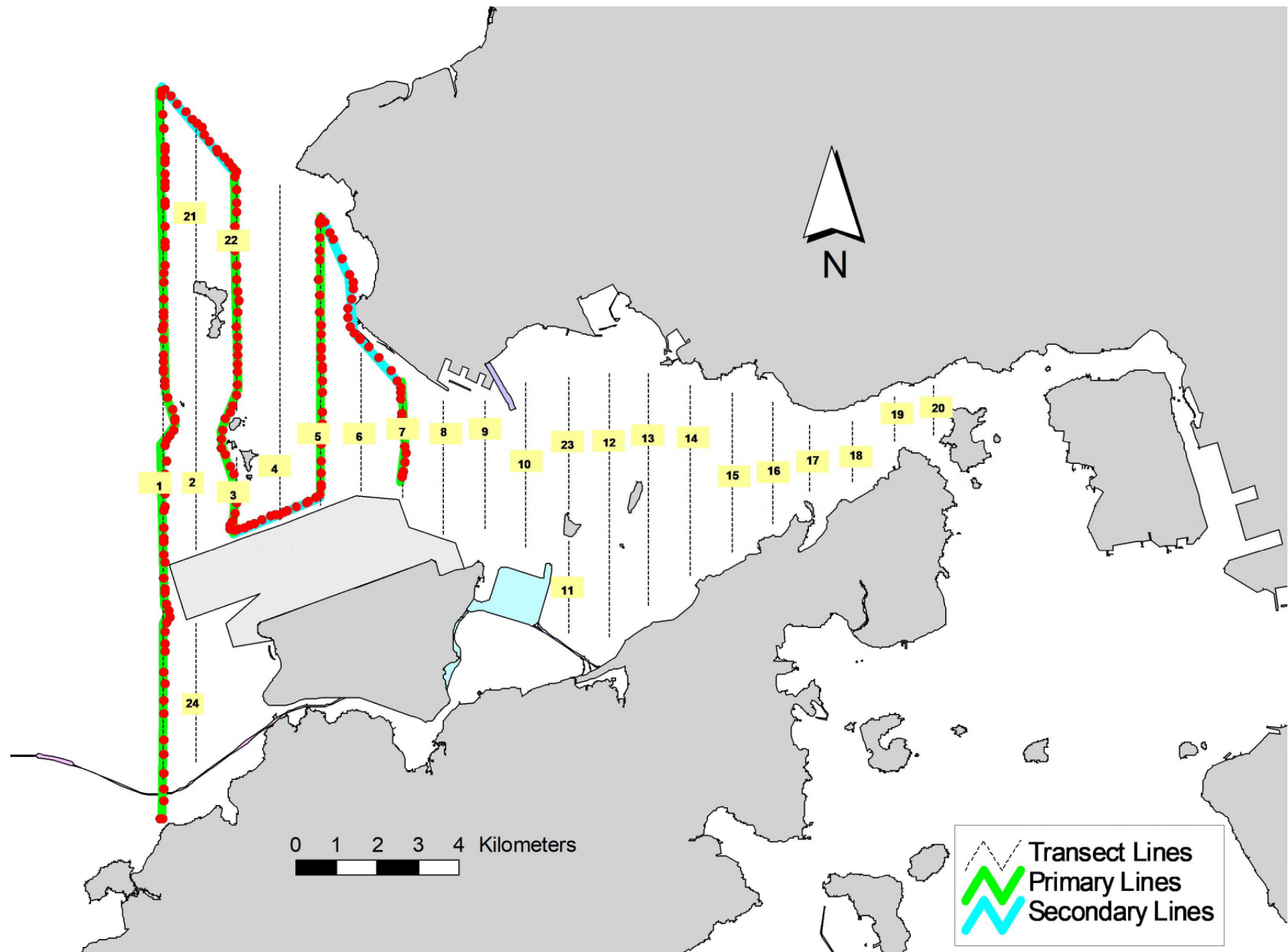


Figure 3. Survey Route on December 10th, 2019 (from TMCLKL08 surveys)

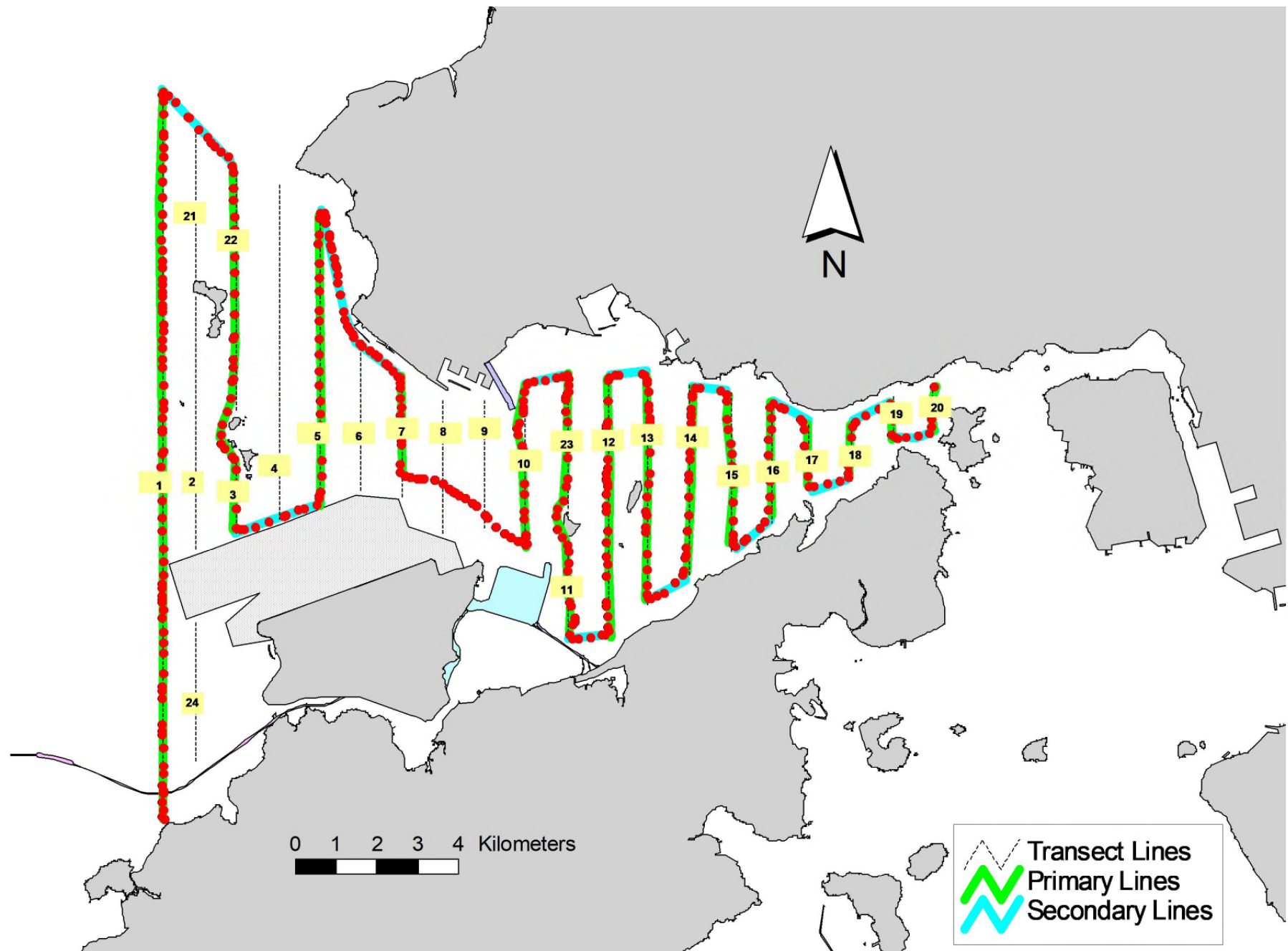


Figure 4. Survey Route on December 12th, 2019 (from TMCLKL08 surveys)

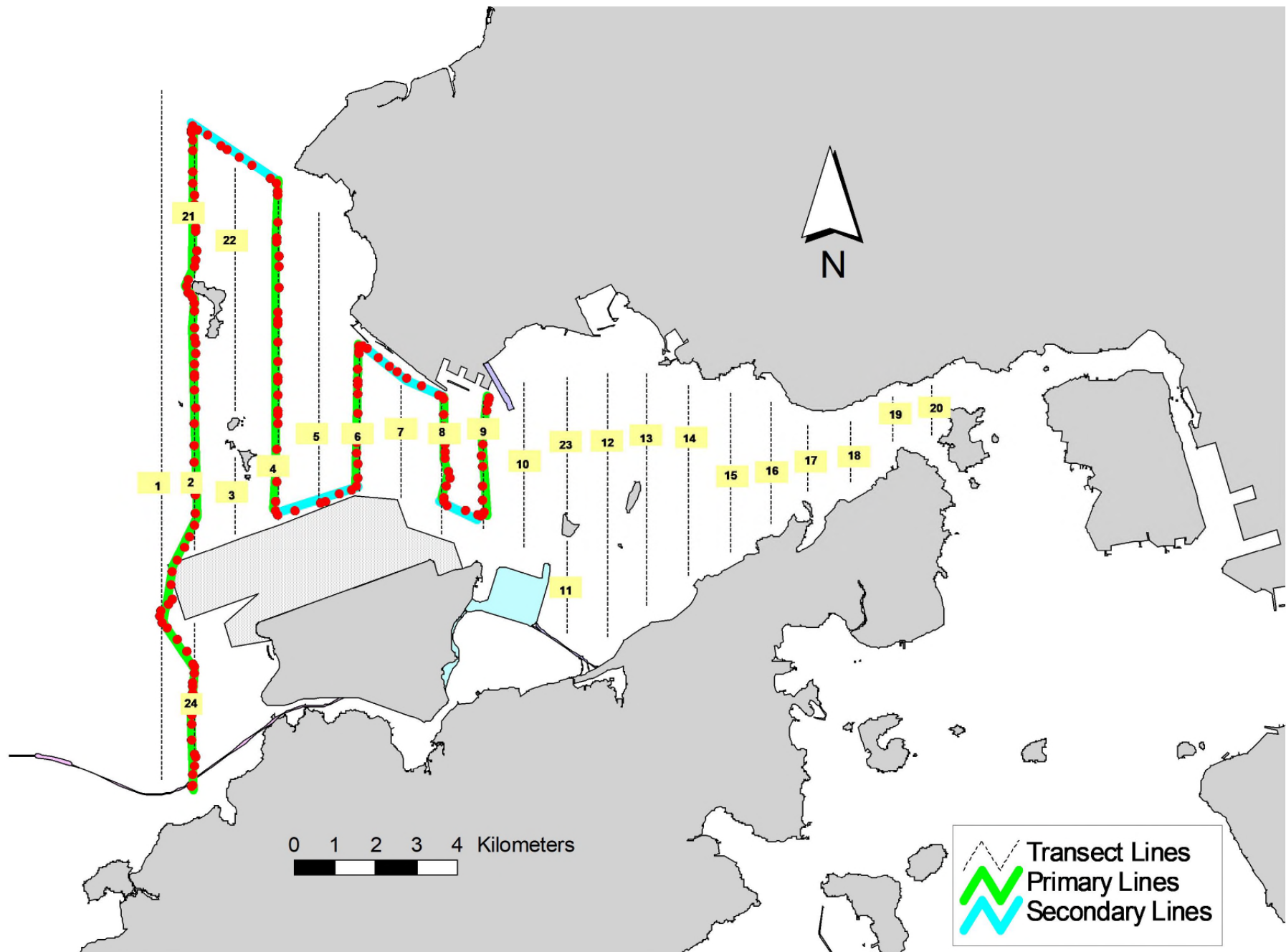


Figure 5. Survey Route on December 16th, 2019 (from TMCLKL08 surveys)

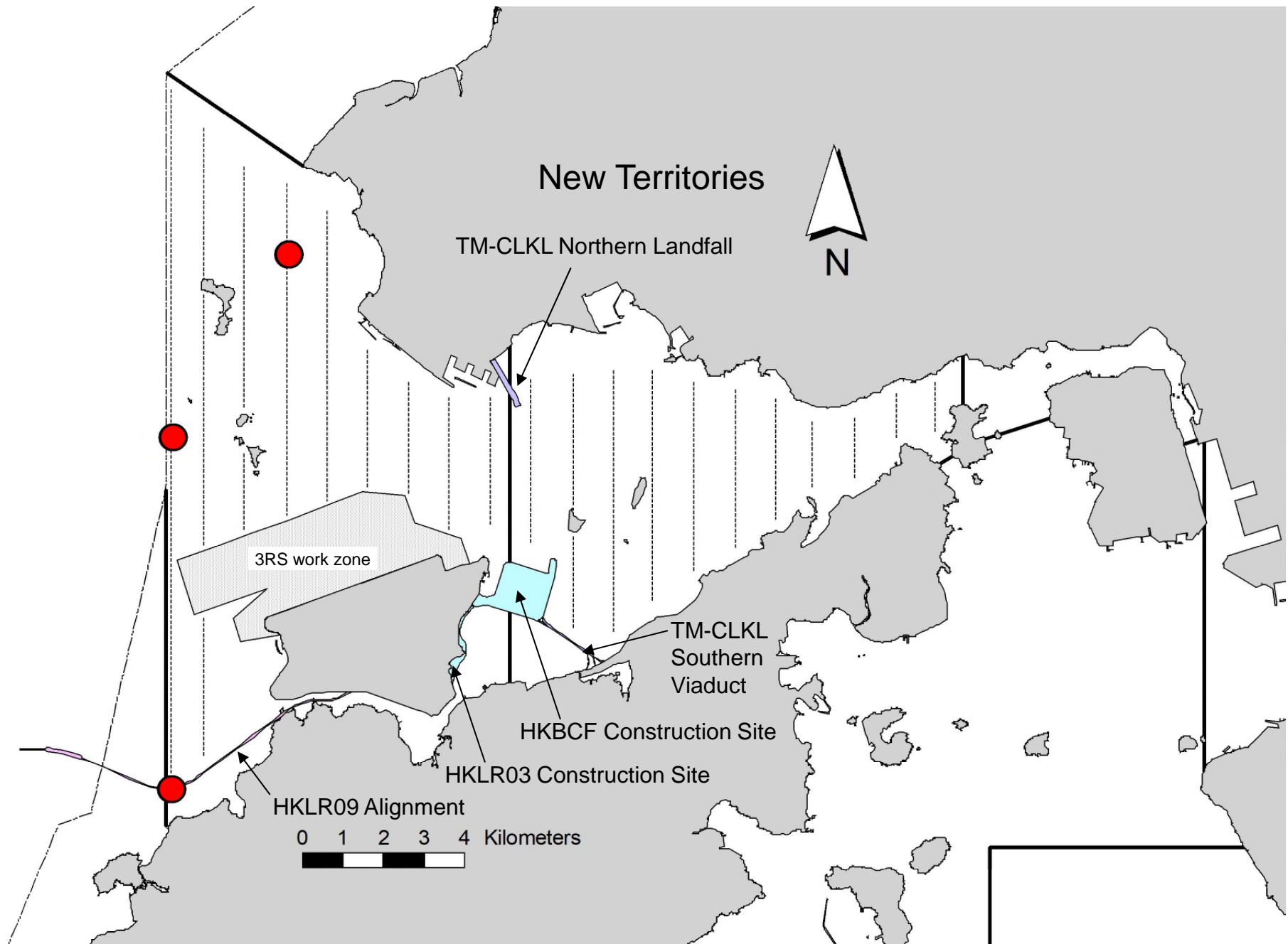


Figure 6. Distribution of Chinese White Dolphin Sightings during December 2019 TMCLKL08 Monitoring Surveys

Appendix I. TMCLKL Survey Effort Database (December 2019)

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

DATE	AREA	BEAU	EFFORT	SEASON	VESSEL	TYPE	P/S
3-Dec-19	NW LANTAU	2	12.20	WINTER	STANDARD36826	TMCLKL	P
3-Dec-19	NW LANTAU	3	14.35	WINTER	STANDARD36826	TMCLKL	P
3-Dec-19	NW LANTAU	2	2.10	WINTER	STANDARD36826	TMCLKL	S
3-Dec-19	NW LANTAU	3	10.85	WINTER	STANDARD36826	TMCLKL	S
3-Dec-19	NE LANTAU	2	35.34	WINTER	STANDARD36826	TMCLKL	P
3-Dec-19	NE LANTAU	2	13.06	WINTER	STANDARD36826	TMCLKL	S
3-Dec-19	NE LANTAU	3	1.20	WINTER	STANDARD36826	TMCLKL	S
10-Dec-19	NW LANTAU	1	2.21	WINTER	STANDARD36826	TMCLKL	P
10-Dec-19	NW LANTAU	2	30.56	WINTER	STANDARD36826	TMCLKL	P
10-Dec-19	NW LANTAU	1	1.72	WINTER	STANDARD36826	TMCLKL	S
10-Dec-19	NW LANTAU	2	9.41	WINTER	STANDARD36826	TMCLKL	S
12-Dec-19	NW LANTAU	1	1.88	WINTER	STANDARD36826	TMCLKL	P
12-Dec-19	NW LANTAU	2	20.64	WINTER	STANDARD36826	TMCLKL	P
12-Dec-19	NW LANTAU	3	9.32	WINTER	STANDARD36826	TMCLKL	P
12-Dec-19	NW LANTAU	2	9.59	WINTER	STANDARD36826	TMCLKL	S
12-Dec-19	NW LANTAU	3	1.29	WINTER	STANDARD36826	TMCLKL	S
12-Dec-19	NE LANTAU	2	35.13	WINTER	STANDARD36826	TMCLKL	P
12-Dec-19	NE LANTAU	2	11.07	WINTER	STANDARD36826	TMCLKL	S
16-Dec-19	NW LANTAU	0	1.25	WINTER	STANDARD36826	TMCLKL	P
16-Dec-19	NW LANTAU	1	7.14	WINTER	STANDARD36826	TMCLKL	P
16-Dec-19	NW LANTAU	2	19.38	WINTER	STANDARD36826	TMCLKL	P
16-Dec-19	NW LANTAU	1	1.60	WINTER	STANDARD36826	TMCLKL	S
16-Dec-19	NW LANTAU	2	10.73	WINTER	STANDARD36826	TMCLKL	S

Appendix II. TMCLKL Chinese White Dolphin Sighting Database (December 2019)

(Abberviations: STG# = Sighting Number; HRD SZ = Dolphin Herd Size; BEAU = Beaufort Sea State; PSD = Perpendicular Distance; 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
12-Dec-19	1	1016	11	NW LANTAU	2	55	ON	TMCLKL	815115	804650	WINTER	NONE	P
12-Dec-19	2	1112	1	NW LANTAU	3	36	ON	TMCLKL	823299	804678	WINTER	NONE	P
16-Dec-19	1	1126	1	NW LANTAU	2	674	ON	TMCLKL	827556	807529	WINTER	NONE	P

Appendix III. Individual dolphins identified during TMCLKL monitoring surveys in (December 2019)

ID#	DATE	STG#	AREA
CH108	12/12/19	1	NW LANTAU
NL33	12/12/19	1	NW LANTAU
NL120	12/12/19	1	NW LANTAU
NL123	16/12/19	1	NW LANTAU
WL100	12/12/19	1	NW LANTAU
WL145	12/12/19	1	NW LANTAU
WL214	12/12/19	1	NW LANTAU
WL268	12/12/19	2	NW LANTAU
WL284	12/12/19	1	NW LANTAU



Appendix IV. Photographs of Identified Individual Dolphins in December 2019 (TMCLKL)