

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)**

Seventh Monthly Progress Report (September 2019)

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

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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 HKLR03 EM&A project 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 HKLR03 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 HKLR03 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 seventh 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 September 2019 by utilizing the survey data collected from the HKLR03 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 HKLR03 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 2017, 2018). 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 HKLR03 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 HKLR03 dolphin monitoring programme, two sets of systematic line-transect vessel surveys were conducted on the 4th, 11th, 17th and 23rd of September 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 HKLR03 monitoring surveys conducted in September, 267.91 km of survey effort was collected, with 98.8% 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, 99.40 km and 168.51 km of survey effort were conducted respectively. Moreover, the total survey effort conducted on primary and secondary lines were 193.93 km and 73.98 km respectively (Appendix I).
- 3.1.4. Only two groups of five Chinese White Dolphins were sighted during the two sets of HKLR03 monitoring surveys conducted in September 2019 (Appendix II). Both

dolphin groups were sighted in NWL, while no dolphin was sighted at all in NEL. Only one of the two dolphin sightings was sighted on primary line during on-effort search. Neither group was associated with any operating fishing vessel (Appendix II).

- 3.1.5. Distribution of the two dolphin sightings made in this monitoring month is shown in Figure 6. They were made near Black Point and to the west of Sha Chau respectively (Figure 6). Both sightings were located very far away from the HKBCF work site.
- 3.1.6. From the HKLR03 surveys conducted in September 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 HKLR03 surveys (two surveys in each set) conducted in September 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: September 4 th / 11 th | 0.0 | | 0.0 | |
| | Set 2: September 17 th / 23 rd | 0.0 | | 0.0 | |
| NWL | Set 1: September 4 th / 11 th | 1.6 | | 3.3 | |
| | Set 2: September 17 th / 23 rd | 0.0 | | 0.0 | |

Table 3. Overall dolphin encounter rates (sightings per 100 km of survey effort) from the two sets of HKLR03 surveys conducted in September 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 | 0.8 | 1.2 | 1.7 | 3.0 |

- 3.1.7. The average group size of dolphins sighted during September's monitoring surveys was 2.5 individuals per group, as both dolphin groups were quite small with two and three animals respectively (Appendix II).

3.2. Photo-identification Work

3.2.1. During the two sets of HKLR03 monitoring surveys conducted in September 2019, only three of the five dolphins were identified as known individual dolphin from the photo-identification catalogue (Appendices III and IV). Two of them (NL202 and NL286) were a mother-calf pair that have been sighted numerous times in previous HKLR03 monitoring surveys.

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. 2017. Monitoring of Marine Mammals in Hong Kong waters: final report (2016-17). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department, 162 pp.
- 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, 163 pp.
- Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144:1-65.

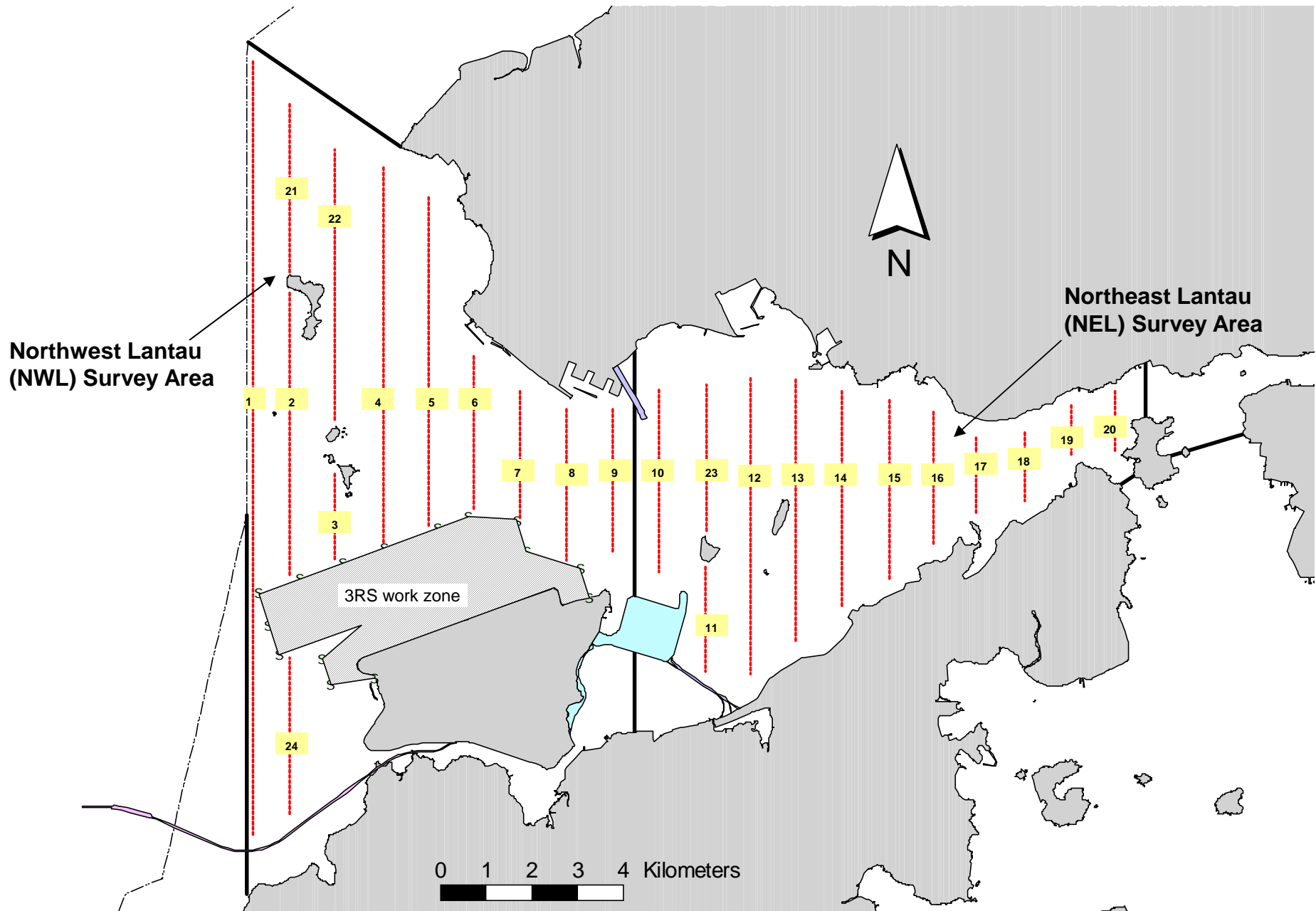


Figure 1. Transect Line Layout in Northwest and Northeast Lantau Survey Areas

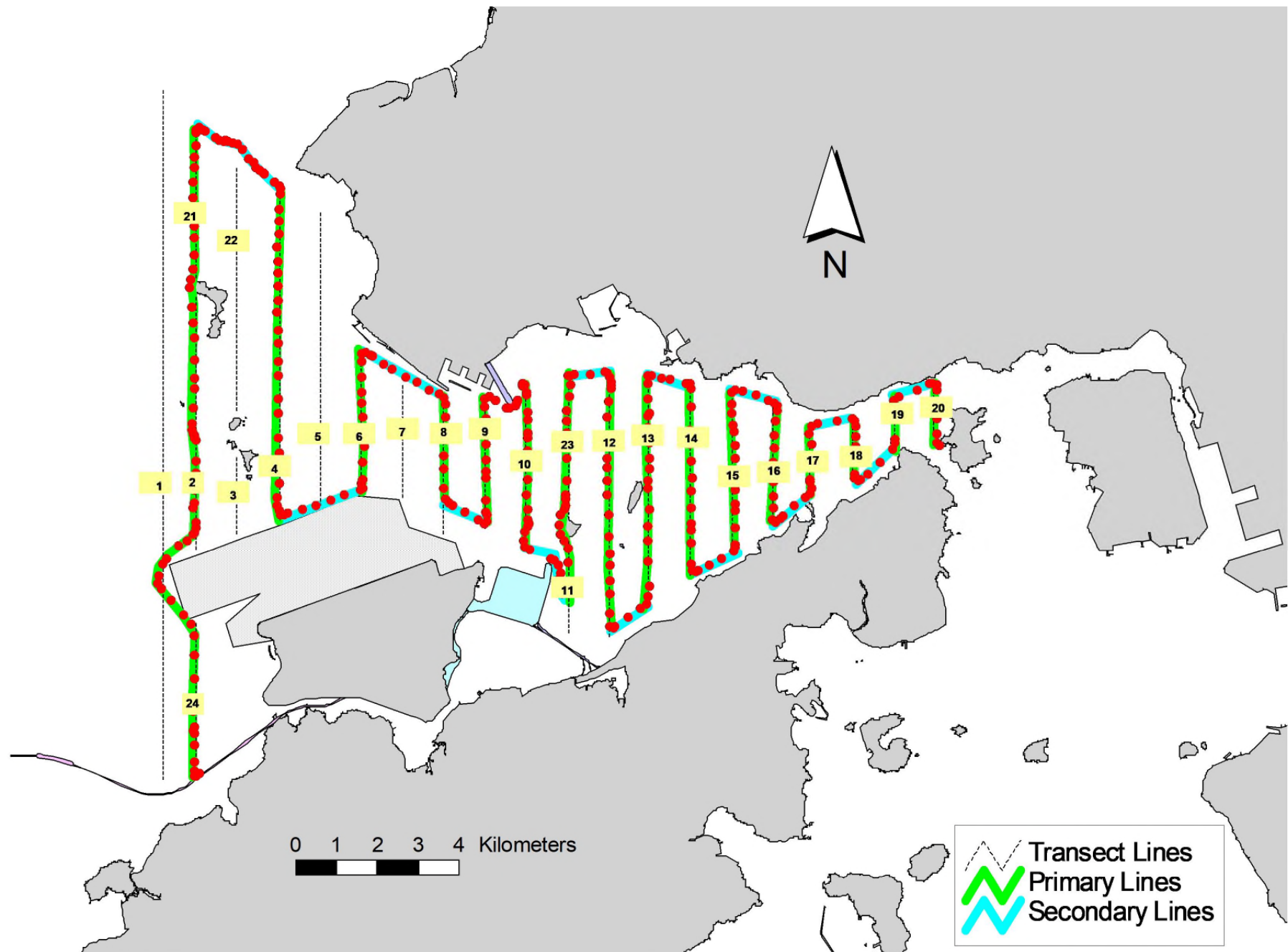


Figure 2. Survey Route on September 4th, 2019 (from HKLR03 project)

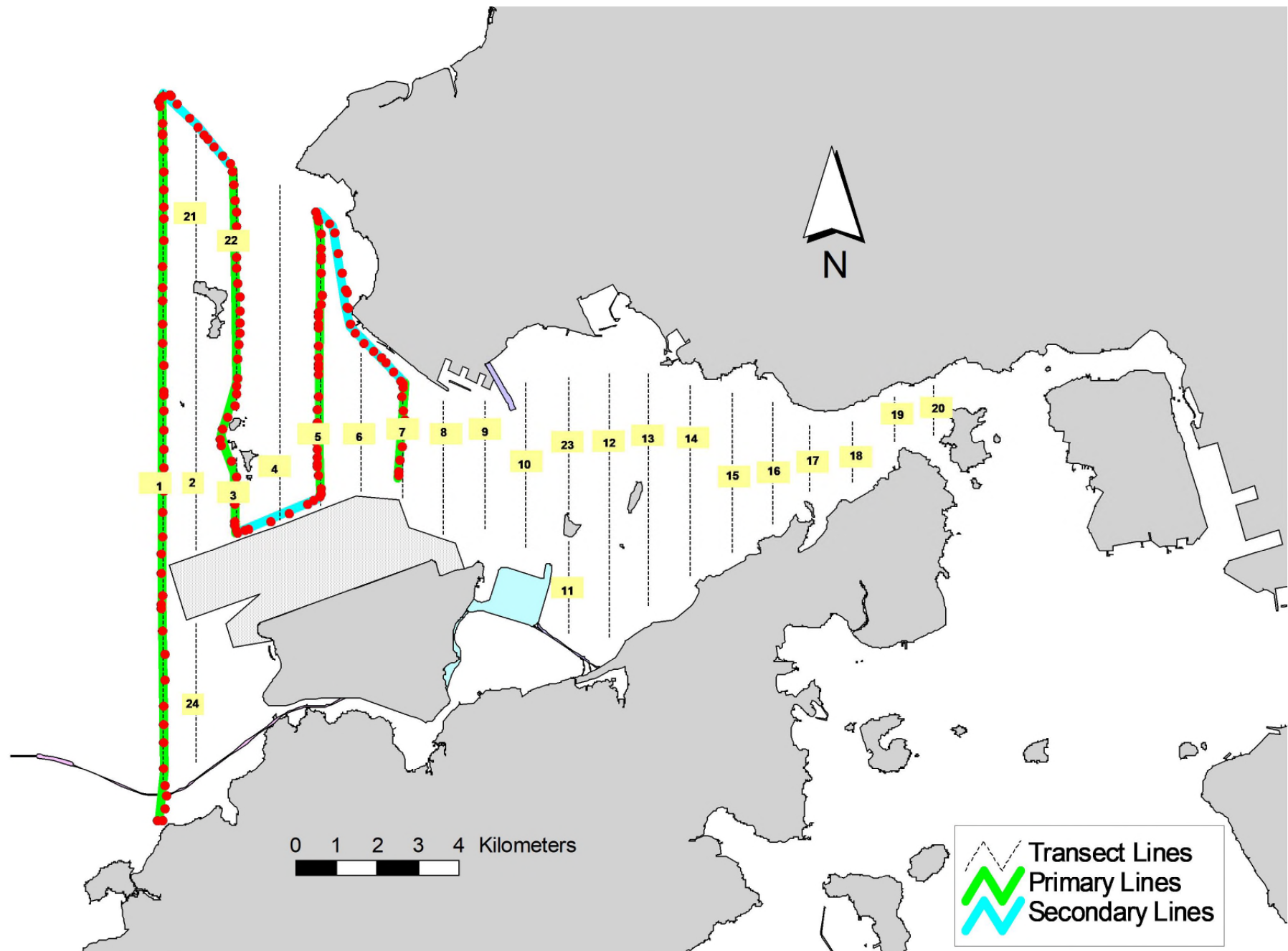


Figure 3. Survey Route on September 11th, 2019 (from HKLR03 project)

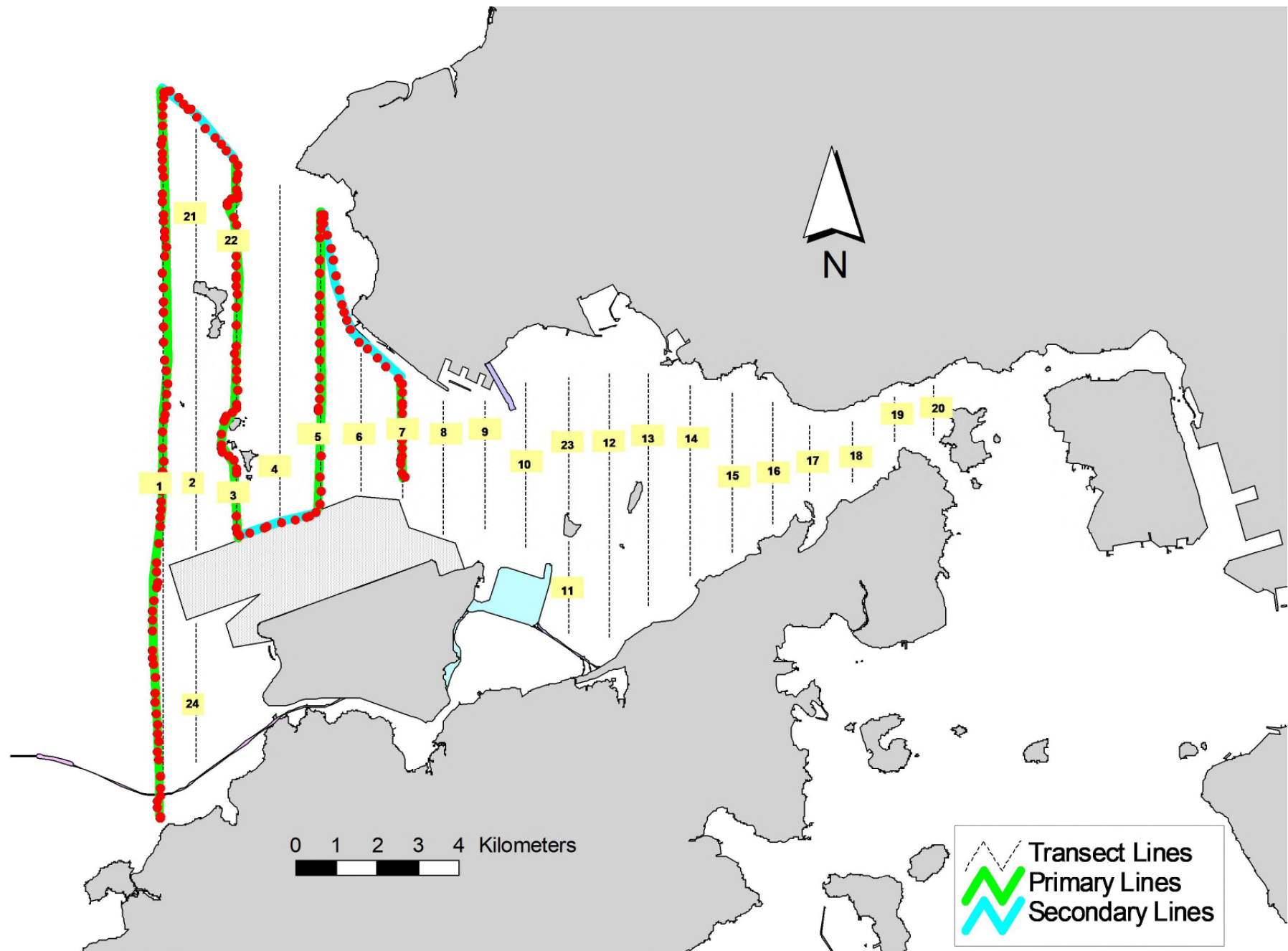


Figure 4. Survey Route on September 17th, 2019 (from HKLR03 project)

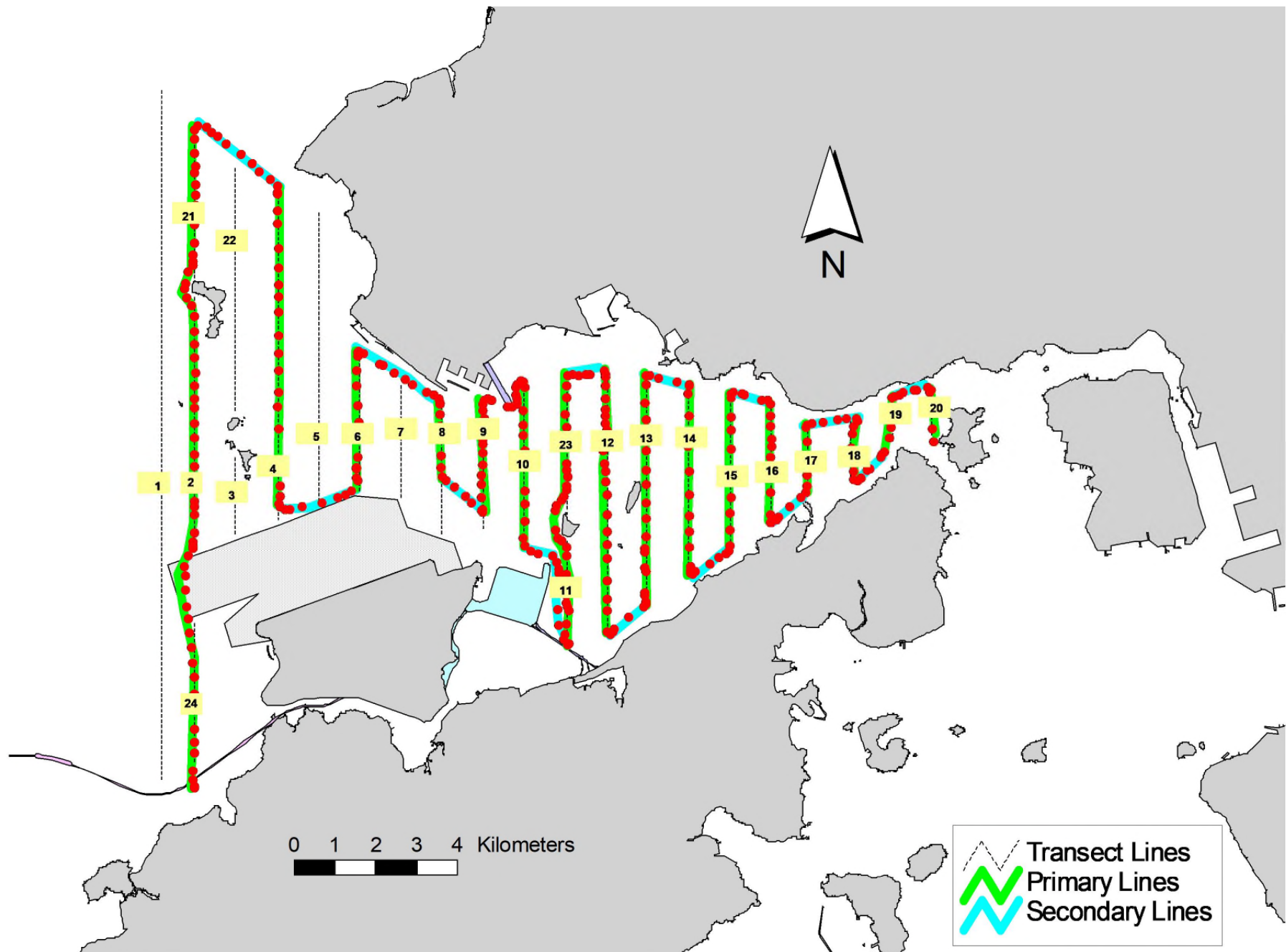


Figure 5. Survey Route on September 23rd, 2019 (from HKLR03 project)

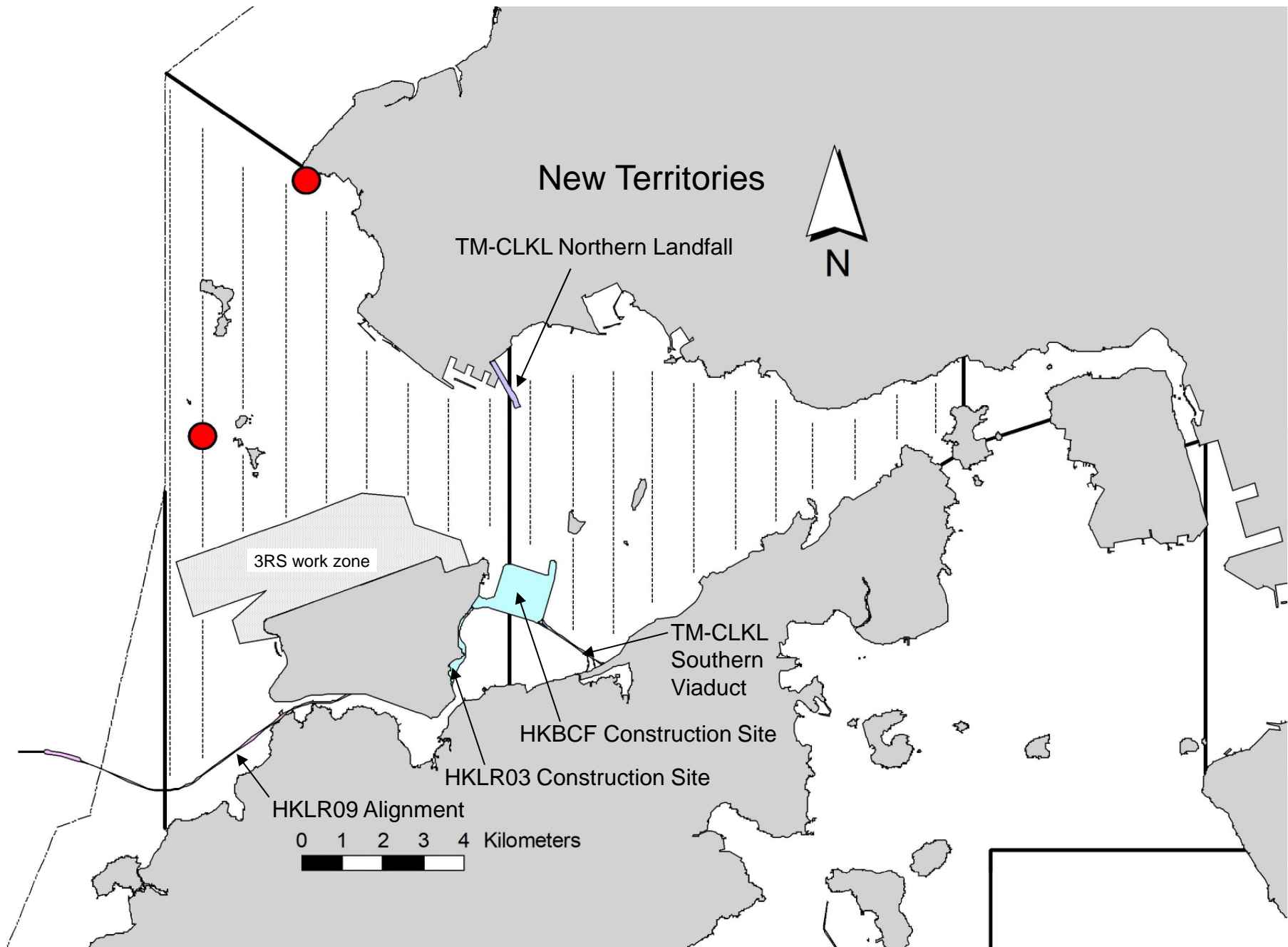


Figure 6. Distribution of Chinese White Dolphin Sightings during September 2019 HKLR03 Monitoring Surveys

Appendix I. HKLR03 Survey Effort Database (September 2019)

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

| DATE | AREA | BEAU | EFFORT | SEASON | VESSEL | TYPE | P/S |
|-----------|-----------|------|--------|--------|---------------|------|-----|
| 4-Sep-19 | NW LANTAU | 2 | 21.38 | AUTUMN | STANDARD36826 | HKLR | P |
| 4-Sep-19 | NW LANTAU | 3 | 6.40 | AUTUMN | STANDARD36826 | HKLR | P |
| 4-Sep-19 | NW LANTAU | 2 | 9.12 | AUTUMN | STANDARD36826 | HKLR | S |
| 4-Sep-19 | NW LANTAU | 3 | 2.52 | AUTUMN | STANDARD36826 | HKLR | S |
| 4-Sep-19 | NE LANTAU | 2 | 16.70 | AUTUMN | STANDARD36826 | HKLR | P |
| 4-Sep-19 | NE LANTAU | 3 | 18.83 | AUTUMN | STANDARD36826 | HKLR | P |
| 4-Sep-19 | NE LANTAU | 2 | 7.75 | AUTUMN | STANDARD36826 | HKLR | S |
| 4-Sep-19 | NE LANTAU | 3 | 5.12 | AUTUMN | STANDARD36826 | HKLR | S |
| 11-Sep-19 | NW LANTAU | 1 | 1.60 | AUTUMN | STANDARD36826 | HKLR | P |
| 11-Sep-19 | NW LANTAU | 2 | 29.50 | AUTUMN | STANDARD36826 | HKLR | P |
| 11-Sep-19 | NW LANTAU | 3 | 2.10 | AUTUMN | STANDARD36826 | HKLR | P |
| 11-Sep-19 | NW LANTAU | 1 | 1.40 | AUTUMN | STANDARD36826 | HKLR | S |
| 11-Sep-19 | NW LANTAU | 2 | 8.99 | AUTUMN | STANDARD36826 | HKLR | S |
| 17-Sep-19 | NW LANTAU | 2 | 8.96 | AUTUMN | STANDARD36826 | HKLR | P |
| 17-Sep-19 | NW LANTAU | 3 | 22.90 | AUTUMN | STANDARD36826 | HKLR | P |
| 17-Sep-19 | NW LANTAU | 4 | 1.90 | AUTUMN | STANDARD36826 | HKLR | P |
| 17-Sep-19 | NW LANTAU | 2 | 4.54 | AUTUMN | STANDARD36826 | HKLR | S |
| 17-Sep-19 | NW LANTAU | 3 | 4.90 | AUTUMN | STANDARD36826 | HKLR | S |
| 17-Sep-19 | NW LANTAU | 4 | 1.20 | AUTUMN | STANDARD36826 | HKLR | S |
| 23-Sep-19 | NW LANTAU | 2 | 19.22 | AUTUMN | STANDARD36826 | HKLR | P |
| 23-Sep-19 | NW LANTAU | 3 | 7.79 | AUTUMN | STANDARD36826 | HKLR | P |
| 23-Sep-19 | NW LANTAU | 2 | 9.84 | AUTUMN | STANDARD36826 | HKLR | S |
| 23-Sep-19 | NW LANTAU | 3 | 4.25 | AUTUMN | STANDARD36826 | HKLR | S |
| 23-Sep-19 | NE LANTAU | 1 | 11.30 | AUTUMN | STANDARD36826 | HKLR | P |
| 23-Sep-19 | NE LANTAU | 2 | 25.35 | AUTUMN | STANDARD36826 | HKLR | P |
| 23-Sep-19 | NE LANTAU | 1 | 3.61 | AUTUMN | STANDARD36826 | HKLR | S |
| 23-Sep-19 | NE LANTAU | 2 | 10.74 | AUTUMN | STANDARD36826 | HKLR | S |

Appendix II. HKLR03 Chinese White Dolphin Sighting Database (September 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 |
|-----------|-------|------|--------|-----------|------|-----|--------|------|----------|---------|--------|-------------|-----|
| 4-Sep-19 | 1 | 1046 | 2 | NW LANTAU | 2 | 311 | ON | HKLR | 823375 | 805440 | AUTUMN | NONE | P |
| 11-Sep-19 | 1 | 1058 | 3 | NW LANTAU | 2 | 430 | ON | HKLR | 829316 | 807975 | AUTUMN | NONE | S |

Appendix III. Individual dolphins identified during HKLR03 monitoring surveys in (September 2019)

| ID# | DATE | STG# | AREA |
|------------|-------------|-------------|-------------|
| NL136 | 11/09/19 | 1 | NW LANTAU |
| NL202 | 11/09/19 | 1 | NW LANTAU |
| NL286 | 11/09/19 | 1 | NW LANTAU |



Appendix IV. Photographs of Identified Individual Dolphins in September 2019 (HKLR03)