

**Emission Inventory (Marine Emission)**

Source	Source ID	Type	X (m)	Y (m)	Base Elevation (mpd)	Release Height [1] (m)	Exit Temperature [1] (K)	Exit velocity [1] (m/s)	Internal diameter [1] (m)	Emission Rate per Trip [2]					
										Departure			Arrival		
										NOx (g/s)	RSP (g/s)	FSP (g/s)	NOx (g/s)	RSP (g/s)	FSP (g/s)
Barge - Hotelling [2]	B01	POINT	838998	835474	0	11	588	8	0.2	1.39E-01	5.54E-03	5.40E-03	1.39E-01	5.54E-03	5.40E-03
Barge - Maneuvering [2]	CC01	POINT	838670	834404	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC02	POINT	838675	834423	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC03	POINT	838682	834442	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC04	POINT	838689	834461	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC05	POINT	838695	834480	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC06	POINT	838701	834499	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC07	POINT	838708	834518	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC08	POINT	838708	834538	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC09	POINT	838707	834558	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC10	POINT	838706	834578	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC11	POINT	838706	834598	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC12	POINT	838704	834618	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC13	POINT	838703	834638	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC14	POINT	838701	834658	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC15	POINT	838700	834678	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC16	POINT	838698	834698	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC17	POINT	838697	834717	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC18	POINT	838697	834737	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC19	POINT	838696	834757	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC20	POINT	838696	834777	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC21	POINT	838696	834797	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC22	POINT	838696	834817	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC23	POINT	838697	834837	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC24	POINT	838697	834857	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC25	POINT	838697	834877	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC26	POINT	838698	834897	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC27	POINT	838699	834917	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC28	POINT	838699	834937	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC29	POINT	838699	834957	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC30	POINT	838699	834977	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC31	POINT	838699	834997	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC32	POINT	838700	835017	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC33	POINT	838701	835037	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC34	POINT	838701	835057	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC35	POINT	838703	835077	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC36	POINT	838704	835097	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC37	POINT	838706	835117	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC38	POINT	838708	835137	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC39	POINT	838709	835157	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC40	POINT	838711	835177	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC41	POINT	838713	835197	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC42	POINT	838715	835217	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC43	POINT	838716	835237	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC44	POINT	838720	835256	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC45	POINT	838733	835271	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC46	POINT	838748	835285	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC47	POINT	838762	835298	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC48	POINT	838777	835312	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC49	POINT	838791	835326	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC50	POINT	838806	835340	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC51	POINT	838820	835354	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC52	POINT	838834	835368	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC53	POINT	838849	835381	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC54	POINT	838864	835395	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC55	POINT	838879	835408	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC56	POINT	838893	835422	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC57	POINT	838908	835435	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC58	POINT	838922	835449	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC59	POINT	838941	835455	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC60	POINT	838960	835461	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05
	CC61	POINT	838979	835467	0	11	588	8	0.2	1.76E-03	5.60E-05	5.42E-05	1.76E-03	5.60E-05	5.42E-05

Notes:  
 [1] No information from the operator is available. Barge information including release height, exit temperature, exit velocity and internal diameter of its chimney is referenced to another similar type of Barge presented in Appendix 5.3.15-6 of approved EIA study "Expansion of Hong Kong International Airport into a Three-Runway System (AEIAR-185/2014)" due to the similar nature and operating mode.  
 [2] Calculation of emission factor of Barge - Refer to "Emission factor for Barges of Concrete Batching Plants"

## Calculations of TIM for Barges to / from the concrete batching plants

Premise	Vessel Type	Length of Sailing Route [1]	Design Speed	Design Speed	Speed under various Mode (knots)		Speed under various Mode (m/s)		Time-In-Mode (minutes)	
		(m)	(knots)	(m/s)	Hotelling	Maneuvering	Hotelling	Maneuvering [2]	Hotelling [3]	Maneuvering [4]
K. Wah Concrete Co. Ltd. & K. Wah Materials Ltd.	Barge	1200	NA	NA	0	4.50	0.00	2.31	60	8.64

## Notes:

[1] Length of sailing route within 500m assessment area.

[2] No information is available from the operator. For the sailing pattern within 500m assessment area, the barge would be either approaching or departing from the anchor point (i.e. at the cement depot), hence they are assumed to be travelling under Maneuvering Mode for assessment purpose. With reference to EPD's study on marine vessel (2012), the speed in Maneuvering mode ranges from 1 to 8 knots (i.e. 0.51 and 4.12 m/s). The average speed in Maneuvering Mode is 4.5 knots (i.e. 2.31 m/s) is adopted in this assessment, assuming the travelling speed of the barges is the same during their journey.

[3] Time-In-Mode (TIM) for Hotelling - Based on site observation, the barge would travel to the concrete batching plants at least once per two days and stay at the anchoring point for at least 2 to 5 hours. Given the long duration of stay and infrequent sailing schedule of the barges, it is assumed there would be one barge hotelling continuously during the working hours as a conservative assessment.

[4] TIM for Maneuvering is estimated based on the averaged speed and the length of sailing route within 500m assessment area.

**Emission factor for Barges of Concrete Batching Plants**

**Marine Emission**

*Emission Rate = Engine Power x Loading Factor x Emission Factor x Time-in-mode*

**Given**

Premise	Vessel Type	Engine Type	Average Engine Power [1]	Loading Factor [3]		Time-In-Mode (minutes) [4]		Emission Factor (g/kWh)		
			(kW)	Hotelling	Maneuvering	Hotelling	Maneuvering	NOx [2]	RSP [2]	FSP [2]
K. Wah Concrete Co. Ltd. & K. Wah Materials Ltd.	Barge	Main Engine	727	0.00	0.30	60	8.64	10.00	0.30	0.29
		Auxiliary Engine	116	0.43	0.43	60	8.64	10.00	0.40	0.39

Note:

- [1] Engine Power for Main Engine and Auxiliary Engine - No information from operator is available. Referenced to Table 4-5 and 4-6 of the Study on Marine Vessels Emissions Inventory, February 2012, Main Engine Power and Auxiliary Engine of Barge at GRT Class >=1000 for conservative purpose.
- [2] Emission Factor for Main Engine and Auxiliary Engine - No information from operator is available. Reference to EPD's Table 4-16 of the Study on Marine Vessels Emissions Inventory, February 2012, engine type of ME(Cat.1) for main engine and AE for Auxiliary Engine.
- [3] Loading Factor for Main Engine and Auxiliary Engine - No information from operator is available. Reference to EPD's Tables 4-7 and 4-10 of the Study on Marine Vessels Emissions Inventory, February 2012, vessel type of All except tug and All RTVs respectively for conservative purpose.
- [4] Time-In-Mode (TIM) Estimation - Refer to Calculations of TIM for Barges to / from the concrete batching plants

**Detailed Emission Rate**

Premise	Vessel Type	Engine Type	Emission Rate (kg/hour)					
			Hotelling			Maneuvering		
			NOx	RSP	FSP	NOx	RSP	FSP
K. Wah Concrete Co. Ltd. & K. Wah Materials Ltd.	Barge	Main Engine	0.00E+00	0.00E+00	0.00E+00	3.14E-01	9.42E-03	9.11E-03
		Auxiliary Engine	4.99E-01	2.00E-02	1.95E-02	7.18E-02	2.87E-03	2.80E-03

Notes:

- [1] It is assumed that there would be one barge hotelling at each concrete batching plant during the working hours. See "Barges Schedule".
- [2] Emission = Engine Power (kW) x Loading Factor x Time-in-mode (hr) x Emission Factor (g/kWh)  
 e.g. RSP emission factor of auxiliary engine under hotelling mode (kg/hour) = Engine Power (kW) x Loading Factor x Emission Factor (g/kWh) x Time-in-mode (hr) / 1000  
 = (116 x 0.43 x 0.40 x 1 / 1000)  
 = 0.02 kg/hour

**Barges Schedule**

Hour		Number of Activity Adopted in this Assessment	
		K. Wah Concrete Co. Ltd. & K. Wah Materials Ltd.	
Start	End	Hotelling [1]	Maneuvering [2]
0	1	0	0
1	2	0	0
2	3	0	0
3	4	0	0
4	5	0	0
5	6	0	0
6	7	0	0
7	8	1	1
8	9	1	1
9	10	1	1
10	11	1	1
11	12	1	1
12	13	1	1
13	14	1	1
14	15	1	1
15	16	1	1
16	17	1	1
17	18	1	1
18	19	1	1
19	20	1	1
20	21	1	1
21	22	1	1
22	23	1	1
23	24	0	0

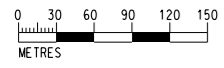
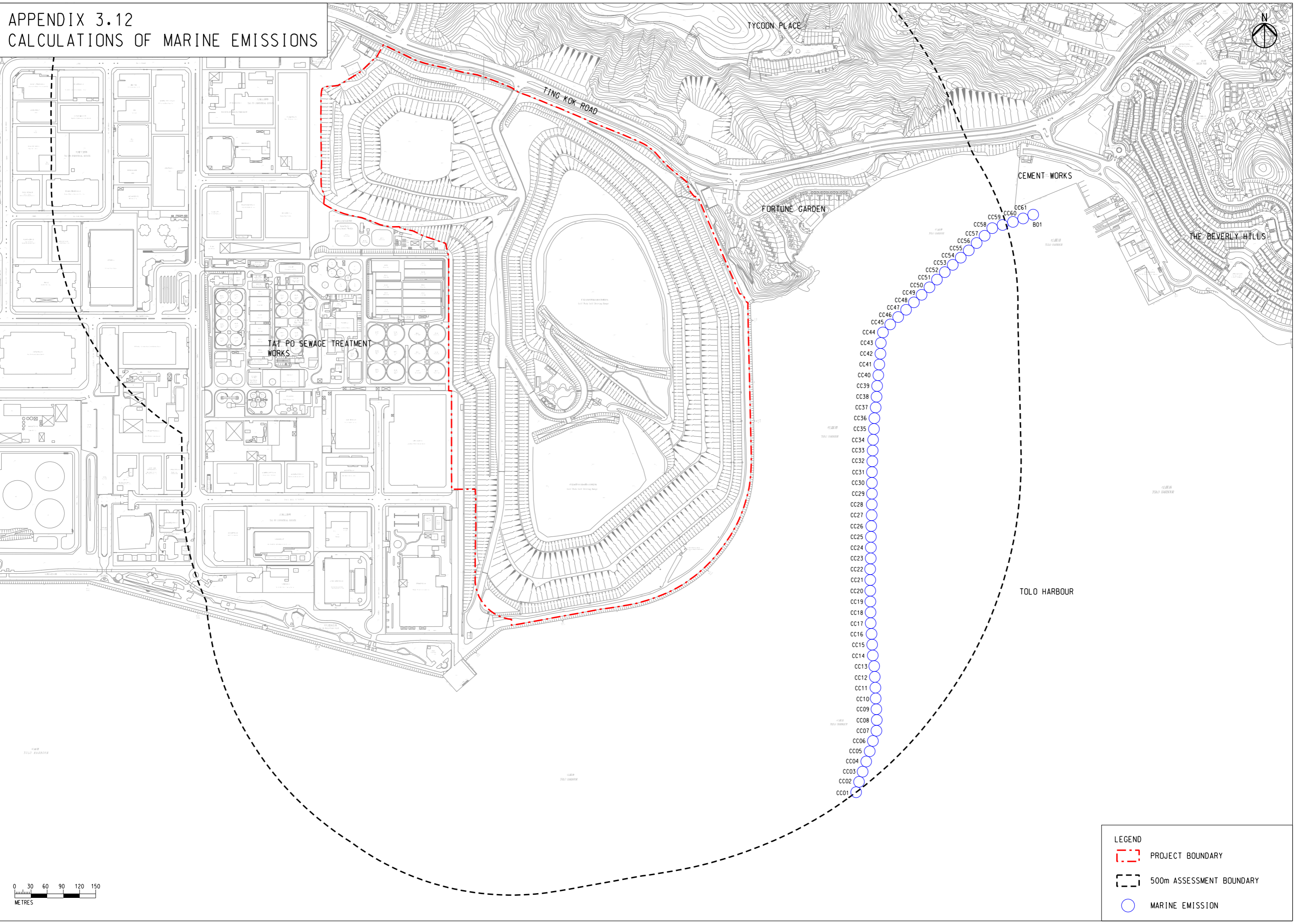
Note:

[1] Based on site observation, the barge would travel to the concrete batching plants at least once per two days and stay at the anchoring point for at least 2 to 5 hours. Given the long duration of stay and infrequent sailing schedule of the barges, it is assumed there would be one barge hotelling continuously during the working hours as a conservative assessment.

[2] As the arrival and departure time of the barges are not available from the operator, it is assumed there would be one barge arriving / departing at each cement depot cum concrete batching

# APPENDIX 3.12 CALCULATIONS OF MARINE EMISSIONS

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**LEGEND**

- - - PROJECT BOUNDARY
- - - 500m ASSESSMENT BOUNDARY
- MARINE EMISSION