

Appendix A Darwin Port Corporation Environmental Monitoring Program



DARWIN PORT CORPORATION

Environmental Monitoring Program Outline - 2010-2013

Conducted By:



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INTRODUCTION

Coffey Environments has been engaged by the Darwin Port Corporation to undertake the environmental monitoring at its facilities in Darwin Harbour. This monitoring program commenced in September 2010.

Sampling is generally conducted on a quarterly basis, except stormwater (opportunistically), marine sediments (yearly) and air quality (monthly).

Table 1.1 Environmental monitoring summary

Sampling	Sites
Marine Water	7 sites
Marine Sediment [§]	13 sites
Drinking Water	3 sites
Wastewater	2 sites
Stormwater [#]	5 sites
Terrestrial Soil	10 sites
Noise	4 sites
Air [†]	4 sites

§ Marine sediments are sampled yearly.

Stormwater is sampled opportunistically and not all sites were sampled on each date.

† Air quality is sampled approximately monthly, commencing on the dates shown.

MARINE WATER

Marine surface water samples were collected from seven sites within Darwin Harbour. The sampling locations are described in [Table 2.1](#) and shown in [Figure 2.1](#).

Table 2.1 Marine water sampling locations

Site	Location	Latitude [†]	Longitude [†]	Depth
FHW2	Fort Hill Wharf	-12.47247	130.84625	20.0 m
SHW1	Stokes Hill Wharf	-12.47137	130.84877	19.3 m
FMW3	Fisherman's Wharf	-12.45981	130.85094	3.7 m
EAW2	East Arm Wharf - Front	-12.48958	130.87972	15.5 m
EAW4	East Arm Wharf - Back	-12.48838	130.88578	4.8 m
DHC1	Darwin Harbour Centre	-12.48478	130.83649	10.9 m
FBM2	Frances Bay Mooring Basin	-12.45415	130.84810	3.9 m

[†] Latitude and longitude are presented in decimal degrees using the datum WGS84.

Once collected, samples are placed on ice and transported to ALS Environmental laboratories in Sydney for analysis.

Samples are analysed for:

- Total suspended solids (TSS).
- Total metals.
- Dissolved metals.
- Tributyltin (TBT).
- Total petroleum hydrocarbon (TPHs).
- Chlorophyll a.
- Nutrients.

MARINE SEDIMENT

Marine sediments were collected from sites within Darwin Harbour using Diving Services.

Samples were collected by divers by inserting a polycarbonate tube into the sediment, capping the top and extracting the tube. A cap was also placed on the bottom of the tube for surfacing. The top and bottom caps were made of polycarbonate.

Upon returning to the vessel, the cores are extruded from the tube onto a clean plastic sheet for sub-sampling. The extrication of the sediments involved uncapping the tube and allowing the sediments to slide out from the effects of gravity only. The sediments at all sites are such that they are easily removed from the tube and they retained their shape upon the plastic sheet. The top 15 cm (surface horizon) and the next 15 cm (lower horizon) are sampled using a plastic spatula. Samples were homogenised prior to sub-sampling. Where there are insufficient sediment depths for a lower horizon sample, only the surface horizon is sampled.

Sediment is sampled at thirteen sites within Darwin Harbour, with locations described in [Table 3-1](#) and shown in [Figure 3-1](#).

Table 3-1 Marine sediment sampling locations

Site	Location	Water Depth	Latitude ^a	Longitude ^a
FHW1 ^b	Fort Hill Wharf - west end	19.2m	-12.47293	130.84475
FHW2	Fort Hill Wharf - middle	20.0m	-12.47249	130.84625
FHW3	Fort Hill Wharf - east end	21.2m	-12.47198	130.84728
SHW1	Stokes Hill Wharf - west end	19.3m	-12.47138	130.84877
FMW3	Fisherman's Wharf - south east	3.7m	-12.45981	130.85094
FMW4	Fisherman's Wharf - south west	3.2m	-12.45980	130.84958
FBM2	Frances Bay Marina - "Duck Pond"	3.9m	-12.45417	130.84810
FBY1	Frances Bay	3.0m	-12.45703	130.85311
EAW1	East Arm Wharf - south east	15.5m	-12.49205	130.88301
EAW2	East Arm Wharf - middle	15.5m	-12.48960	130.87971
EAW3	East Arm Wharf - north west	13.5m	-12.48867	130.87839
EAW4	East Arm Wharf - back	4.8m	-12.48838	130.88577
DHC1	Darwin Harbour Centre	10.9m	-12.48497	130.83640

a. Latitude and longitude are presented in decimal degrees using the datum WGS84.

The analysis undertaken on the marine sediment samples are:

- Moisture content.
- Particle size distribution.
- Total metals.
- Tributyltin (TBT)
- Polychlorinated biphenyls (PCBs)
- Polynuclear aromatic hydrocarbons (PAHs).
- Total petroleum hydrocarbons (TPHs)



WASTEWATER

Wastewater samples are collected at two sites. Samples are collected from within the final tank of the sewage treatment plants prior to the water being discharged. The cap is removed from the sewage treatment plant and a plastic container lowered into the wastewater. Water was then transferred into sample bottles using a plastic syringe.

Two sites were sampled for wastewater at two package sewage treatment plants at East Arm Wharf. These locations are described in [Table 5-1](#) and shown in [Figure 5-1](#).

Table 5-1 Waste Water sample details

Site	Location	Latitude	Longitude
EAW9	East Arm Wharf, adjacent to MARPOL tanks	-12.49236	130.88608
EAW10	East Arm Wharf workshop	-12.48990	130.88857

Latitude and longitude are presented in decimal degrees using the datum WGS84.

Samples are analysed for:

- pH and conductivity.
- Total nitrogen and phosphorus.
- Total metals.
- Chemical and biological oxygen demand.
- Total petroleum hydrocarbons (TPHs).
- E.Coli.



STORMWATER

Stormwater sampling is undertaken opportunistically following rainfall. The samples are collected from sites where the runoff enters the harbour (or into the stormwater over pond for EAW8). A bulk sample is collected on each occasion by holding a 1000 mL LDPE bottle under the runoff flow and transferring to individual sample bottles. A new LDPE bottle is used for each sample. Nutrient samples are frozen after collection, while all other samples were placed on ice prior to transport to the laboratory.

Stormwater is sampled at four sites at East Arm Wharf with locations described in [Table 6-1](#) and shown in [Figure 6-1](#).

Table 6-1 Stormwater sample details

Site	Location	Latitude	Longitude
EAW8	East Arm Wharf – “Pond F”	-12.49082	130.88280
		-12.49082	130.88280
EAW7	East Arm Wharf – Front edge	-12.49240	130.88365
EAW9	East Arm Wharf – Storage tanks	-12.49272	130.88604
EAW13	East Arm Wharf – Incinerator	-12.49295	130.88743

Latitude and longitude are presented in decimal degrees using the datum WGS84.

All analyses for stormwaters are performed by ALS laboratories in Sydney. Samples are analysed for:

- Total suspended solids.
- Total metals.
- Total nitrogen and phosphorus.
- Total petroleum hydrocarbons (TPHs).



TERRESTRIAL SOIL

Terrestrial soils are sampled from sites around Darwin Harbour. The surface soils are collected using a plastic trowel and transferring the soil into sample jars (wide mouth glass) and bags (resealable plastic). Only the top one to two cm of soil is collected at each site.

Terrestrial soils were sampled at ten sites around Darwin Harbour with locations described in [Table 7-1](#) and shown in [Figure 7-1](#).

Table 7-1 Terrestrial soil sampling locations

Site	Location	Latitude	Longitude
EAS1	East side of iron ore stockpile	-12.48369	130.89948
EAS2	Northern corner of stockpile, behind conveyor	-12.48112	130.89497
EAS3	West side of stockpile area	-12.48458	130.89213
EAS4	South side of causeway	-12.49028	130.89500
EAS5	Middle of stockpile	-12.48614	130.89607
EAS6	Outside stockpile, beside VOPAK	-12.47828	130.89627
EAW9	Near MARPOL tanks	-12.49236	130.88608
EAW11	In triangle, east of Pond F	-12.49065	130.88453
EAW12	North point of P&O container yard	-12.48756	130.88077
FMW2	Hornibrooks boat ramp.	-12.45977	130.84795

Latitude and longitude are presented in decimal degrees using the datum WGS84.

All analyses for terrestrial soils were performed by ALS laboratories in Sydney. Samples were analysed for:

- Particle size distribution.
- pH.
- Metals.
- Polychlorinated biphenyls (PCBs).



Noise

Noise is logged at three sites using an EL-315 Noise Logger. At each site the logger is deployed for at least 24 hours.

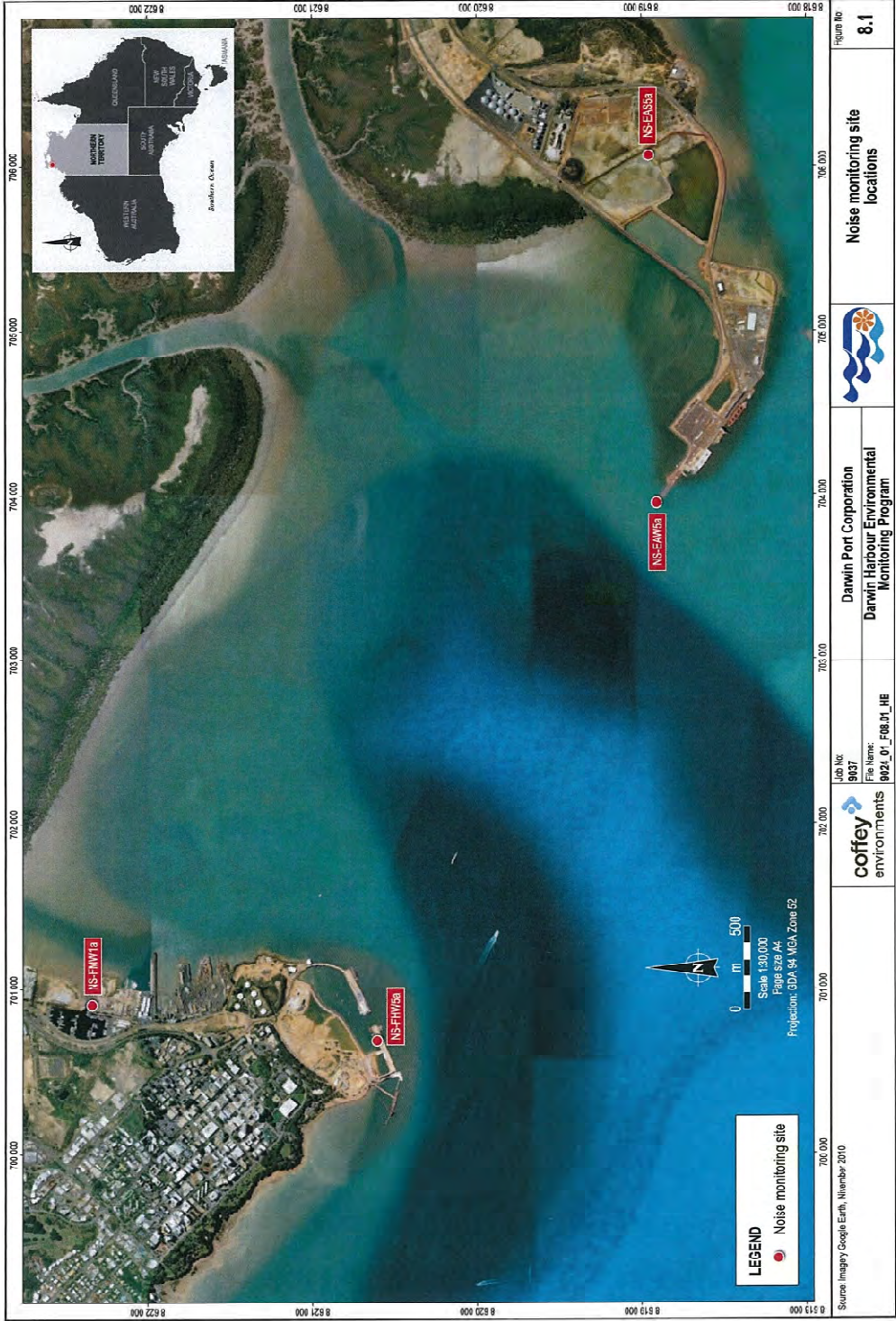
Noise quality is logged at four sites around Darwin Harbour, with locations described in [Table 8-1](#) and shown in [Figure 8-1](#).

Table 8-1 Noise quality monitoring locations

Site	Location	Latitude	Longitude
EAW5	East Arm Wharf	-12.48671	130.87667
EAS5	East Arm Stockpile	-12.48614	130.89607
FHW5	Fort Hill Wharf	-12.47154	130.84650
FMW1	France Bay Marina	-12.45479	130.84667

Latitude and longitude are presented in decimal degrees using the datum WGS84.

The location of the noise sampling site on East Arm Wharf (EAW5) was the end of the 'groin'.



AIR

Air samples are collected at locations around Darwin Harbour. Samples were collected using a high volume air sampler (HVAS) mounted on a trailer to enable it to be moved between sites. Where possible Australia/New Zealand Standards are used to locate (AS/NZS 3580.1.1:2007) and operate (AS/NZS 3580.9.3:2003) the HVAS.

The HVAS is calibrated prior to each new sampling using a top-loading orifice calibration plate and digital monometer and correcting flow rates for temperature and pressure. Pre-weighed filters are then placed into the HVAS and samples collected over a 24 hour period. Filters are handled only when wearing latex gloves to ensure no contamination of the sample. Filters are placed into paper bags then into zip-lock bags for transport to the laboratory.

Air is sampled at four sites, with locations described in [Table 9-1](#) and shown in [Figure 9-1](#).

Table 9-1 Air monitoring locations

Site	Location	Latitude	Longitude
EA6a	East Arm Wharf	-12.49014	130.88118
FMW1a	France Bay Marina	-12.45589	130.84841
FHW5a	Fort Hill Wharf	-12.47154	130.84650
EAS2a	East Arm Stockpile	-12.48112	130.89497

Latitude and longitude are presented in decimal degrees using the datum WGS84.

All analyses for air quality were performed by ALS laboratories in Sydney. Samples are analysed for:

- Total suspended particulates (not done for this sampling period).
- Particulate base metals.

