

ENVIRONMENTAL HEALTH

One-Mile Dam, thought to be feed by a subterranean spring, has acted as a stormwater detention pond for the immediate industrial area and parts of the wider Darwin CBD for many decades. Despite this history, anecdotal evidence suggests that the lagoon supports an abundance of fish, turtles and various other aquatic flora and fauna. In keeping with environmental change experienced in waterbodies that act as sediment/debris traps elsewhere in Australia, water quality at One-Mile Dam has deteriorated over time. This deterioration is evidenced by blue-green algae blooms, accumulation of litter and rubbish. It is also to be expected that trace elements, including heavy metal and hydrocarbon, may build up over time from urban and industrial stormwater run-off carrying with it contaminants from accidental and inadvertent spills and discharges. Weed invasion and significant bank erosion at One-Mile Dam impact terrestrial native flora. Decaying flora and fauna lead to elevated pathogen levels.

Deterioration of Water Quality – Causes and Effects

- **Eutrophication** as a result of increased amounts of dissolved and particulate nutrients (phosphate, nitrogen, ammonia), organic matter and heavy metals from stormwater runoff, and erosion.
- **Blue-green algae blooms**, the direct result of the eutrophication, lead to oxygen depletion, increases in pH, release of toxins and toxic decomposition by-products (ie. Sulphides)
- **Resuspension and/or remobilisation** into the water column of anoxic toxicants previously locked up in sulphidic sediments (result of pH, salinity changes, bioturbation, rainfall)

THE ONE-MILE DAM REMEDIATION PROJECT

Stormwater management requires a coordinated partnership approach as run-off, particularly in rainfall intense tropical regions, occurs on a catchment scale where land ownership and property boundaries are of little relevance.

It is for this reason that the One-Mile Dam community, Kumbutjil Association Inc, has enlisted the assistance of Greening Australia NT, Yilli Reung Aboriginal Housing Corporation, Darwin Regional CDEP Inc, Northern Territory Government and Darwin City Council to initiate a program designed to improve the environmental health of One-Mile Dam. Measures to be implemented include:

- a spot check assessment of One-Mile Dam's water quality and sediment quality followed by the development of a formal water quality monitoring and environmental health improvement program;
- rehabilitation of the Dam's banks through erosion controlling revegetation and weed management projects;
- the installation of litter curtains to contain some run-off sediments, litter and rubbish.

The NT Government provided \$ 10,000 funding in February 2005 through the 2004/05 Environment Grants.

WATER/SEDIMENT QUALITY ASSESSMENT

Sample collection and analysis

While anecdotal evidence suggests that various NT Government departments have conducted some water quality monitoring at One-Mile Dam there appears to be no formal ongoing monitoring regime for the site. Analytical water quality data was not available for review. For this reason, and to facilitate the development of an ongoing monitoring and rehabilitation program, an initial assessment was conducted at 2 easily accessible sites (Appendix 1 – Site Map 2):

1. Sampling site 1 was located within One-Mile Dam at the mouth of the stormwater drain to Lot 5196 which flows towards Frances Bay; and
2. Sampling site 2 was located midway on the lagoon, directly opposite the Community Office

Two water and two sediment samples were taken at each site for trace element analysis by ICPMS and ICPOES. Northern Territory Environmental Laboratories Pty Ltd (NTEL) conducted analyses for trace elements. A second set of water samples, to determine pathogen levels, were taken at the same sites for analysis by DBIRD's Water Microbiology Laboratory. (Appendix 2 - Analytical results)

Trace element levels investigated are commonly associated with the land use of the area and include Aluminium (Al), Arsenic (As), Boron (B), Cadmium (Cd), Copper (Cu), Mercury (Hg), Lead (Pb), Sulphur (S) and Tin (Sn).

Pathogen analysis was restricted to water samples and consisted of the indicators faecal coliform, *Escherichia coli* (E.coli) and enterococci organisms, commonly used to assess a waters suitability for recreational use.

RESULTS

Analytical results overall are consistent with those frequently observed in urban stormwater drainage systems. While heavy metals in One-Mile Dam waters are within water quality guideline values for recreational pursuits except for Aluminium (Al), the microbiological characteristics of One-Mile Dam indicate that swimming and other recreational activities can not be recommended. The implementation of a more extensive monitoring program is highly recommended given the substantial quality differences between the 2 sites sampled during this very limited assessment. An efficient, cost effective ongoing monitoring regime should be developed as a matter of priority if One-Mile Dam is to be used for recreational activities.

Heavy Metals

Heavy metals do not degrade but are transferred or stored in bottom sediments, which act as a sink. Various reactions both microbiological and physio-chemical can transform and redistribute metals within the sediments and to the water column. The presence of sulphides, an acidic gas, may act to release heavy metals from bottom sediments. Heavy metals in larger concentrations are toxic to many marine species and can be bioaccumulated by fauna through the food chain. It is therefore in the interest of the long-term environmental health of One-Mile Dam to minimise sediment deposition into the lagoon.

Elevated levels of cadmium, lead and copper (in the water column and sediments) can be prevented over time by appropriate management initiatives such as the periodic removal of solids building up around stormwater drainage points.

Pathogens

Microbiological characteristics of One-Mile Dam show that the water was unsuitable for human interaction. Swimming and other recreational pursuits should not occur while *Escherichia coli* and enterococci organisms are at the level determined during sampling. While Faecal coliform bacteria are virtually present in all warm-blooded animals, the high level of E. coli and enterococci organisms found should give rise to an investigation of the local sewerage system to ensure its integrity is intact. Pathogen levels in excess of guideline recommendation may lead to ear, eye, nose and throat infections, skin diseases and gastrointestinal disorders. (Hart 1974, McNeill 1985)

REHABILITATION OPTION

With the decommissioning of the tank farm and after completion of land rehabilitation at the nearby fuel storage, hydrocarbon discharges into One-Mile Dam should decrease significantly. Combinations of several rehabilitation measures are available to improve the environmental health of One-Mile Dam and halt further deterioration.

RECOMMENDATIONS

1. Examination of the local sewerage system should be undertaken to ensure leakage and overflows into the Dam do not occur.
2. The biologically activated carbon **PICABOL**, known to absorb a range of organic and inorganic pollutants (blue-green algae toxins, hydrocarbons and heavy metals), can be floated in the Dam to remove contaminants from the water column over time. Floating geotextile bags filed with **PICABOL** are capable to remove contaminants for up to 2 years as water filters through the activated carbon.
3. Floating litter curtains should be installed at each of the drainage out and inlets to contain litter and gross pollutants for periodic removal and disposal to landfill.
4. The current fencing, installed by Yilli Rreung Aboriginal Housing Corporation, should be retained and supplemented with No Swimming/No Fishing signage until otherwise indicated by water quality monitoring results.
5. A Weed management and revegetation program should be implemented to halt erosion and improve visual amenity at the site.
6. A monthly Water Quality and 6-monthly sediment and biological tissue monitoring program should be developed and implemented at representative sites to monitor environmental health changes (improvements and deteriorations) at One-Mile Dam. The sampling program should also include Hydrocarbon analysis given the areas land use history
7. If future sediment monitoring indicates that heavy metals and/or hydrocarbons are present in excess concentrations, application of **Phoslock™**, a modified bentonite product which seals bottom sediments preventing release of contaminants should be considered. CSIRO Land and Water and the Western Australian Water and Rivers Commission developed Phoslock™, a modified bentonite, in the mid 1990s. Extensive laboratory and field trials have shown that it is effective in removing filterable reactive phosphorous (FRP). Furthermore, the thin layer of Phoslock™, which settles on the bottom sediments of water bodies, has also been demonstrated to be effective in prohibiting the release of FRP from the sediments

ANGELIKA HESSE
ENVIRONMENT MANAGER
DARWIN CITY COUNCIL

Note: Recommendations in this report are based on a very preliminary environmental quality assessment. Further environmental monitoring of One-Mile Dam may lead to a re-evaluation of conclusions and recommendations made.

Except as otherwise stated in this report, Darwin City Council has not undertaken further verification regarding the accuracy or completeness of information sources that maybe available for One-Mile Dam.

Table 1 – Analytical Results: Elements Water Quality

SITE & SAMPLE ID	SAMPLE TYPE	ELEMENT in ug/l in ug/l, unless otherwise stated										ANZECC Guidelines for Fresh and Marine Water Quality 2000 Recreational purposes – in ug/l, unless otherwise stated									
		Al	As	B	Cd	Cr	Cu	Hg	Pb	S	Sn	Al	As	B	Cd	Cr	Cu	Pb	Hg	S	Sn
1A – 8.3.05	Water	42.22	N/A	14.0	<0.02	0.2	3.05	<0.02	0.65	0.94	<0.1	200	50	1000	5	50	1000	50	1	50	N/A
1B – 8.3.05	Water	18.4	N/A	14.5	<0.02	0.1	1.98	<0.02	0.30	1.04	<0.1										
2A – 8.3.05	Water	822	N/A	15.5	0.2	2.9	23.8	<0.02	27.4	1.58	0.2										
2B – 8.3.05	Water	1.04 mg/l	N/A	15.5	0.1	2.3	18.0	<0.02	17.3	1.56	0.1										

Table 2 – Analytical Results: Elements Sediment Quality

SITE & SAMPLE ID	SAMPLE TYPE	ELEMENT in mg/kg										ANZECC Guidelines for Fresh and Marine Water Quality 2000 Effects-based ANZECC/ARMCANZ range median (ERM) in mg/kg									
		Al	As	B	Cd	Cr	Cu	Hg	Pb	S	Sn	Al	As	B	Cd	Cr	Cu	Pb	Hg	S	Sn
S1A – 8.3.05	Sediment	3300	10.0	<10	0.20	40	19.0	<20	27.8	700	1	N/A	70	N/A	9.6	370	270	218	0.71	N/A	N/A
S2B – 8.3.05	Sediment	2950	8.5	<10	0.15	50	10.6	<20	32.6	620	<1										
S2A – 8.3.05	Sediment	4800	7.5	<10	0.25	50	24.0	<20	41.6	1740	<1										
S2B – 8.3.05	Sediment	9800	18.0	<10	0.25	110	26.6	<20	54.2	1240	2										

Table 3 – Analytical Results: Pathogens

SITE & SAMPLE ID	SAMPLE TYPE	Faecal Coliforms per 100 ml	E.Coli per 100 ml	Enterococci per 100 ml	ANZECC Guidelines for Fresh and Marine Water Quality 2000					
					Primary Contact (i.e swimming)			Secondary Contact (i.e. boating, fishing)		
					Faecal Coliforms per 100 ml	E.Coli per 100 ml	Enterococci per 100 ml	Faecal Coliforms per 100 ml	E.Coli per 100 ml	Enterococci per 100 ml
S1 – 8.3.05	Water	2000	2000	15000	150/100 ml (4 of 5 monthly samples should not exceed 600/100ml)	126/10 ml	35/100 ml (max of anyone sample 600/ 100ml)	1000/100 ml (4 of 5 monthly samples should not exceed 4000/100ml)	N/A	230/100 ml (max of anyone sample 450-700/ 100ml)
S2A – 8.3.05	Water	3000	3000	910						
S2B – 8.3.05	Water	4000	4000	1200						