

## Results of the Seasonal Kendall Test for water quality trends in typhoon shelters, 1986 – 2005

Monitoring Station		NT1	ST1	WT3	WT1	VT8	VT10	VT2	VT11
Monitoring Period		1986   2005	1986   2005	1986   2005	1986   2005	1986   2005	1993   2005	1986   2005	1994   2005
Parameter	Water Depth								
Temperature (°C)	Surface	-	↗	-	-	-	-	↗	-
	Middle	NA	-	-	-	-	-	-	-
	Bottom	-	↗	-	-	-	-	-	-
	Average	-	↗	-	-	-	-	-	-
Salinity	Surface	-	-	-	-	-	-	-	-
	Middle	NA	-	-	-	-	-	-	-
	Bottom	-	-	-	-	-	-	-	-
	Average	-	-	-	-	-	-	-	-
Dissolved Oxygen (mg/L)	Surface	↗	-	-	-	↗	-	↗	↗
	Middle	NA	-	-	-	↗	↗	-	↗
	Bottom	↗	-	-	↗	↗	-	↗	↗
	Average	↗	-	-	↗	↗	-	↗	↗
Dissolved Oxygen (%)	Surface	↗	-	-	-	↗	-	↗	↗
	Middle	NA	-	-	↗	↗	-	↗	↗
	Bottom	↗	-	-	↗	↗	-	↗	↗
	Average	↗	-	-	↗	↗	-	↗	↗
pH	Surface	-	↘	↘	↘	-	-	-	-
	Middle	NA	-	↘	↘	-	-	-	↗
	Bottom	-	-	↘	↘	-	-	-	-
	Average	-	↘	↘	↘	-	-	-	-
Secchi disc depth (m)		↗	-	↗	↗	-	↗	↗	-
Turbidity (NTU)	Surface	-	-	-	-	↗	-	↗	↗
	Middle	NA	-	-	-	↗	-	-	↗
	Bottom	-	-	-	-	↗	-	↗	↗
	Average	-	-	-	-	↗	-	↗	↗
Suspended Solids (mg/L)	Surface	-	-	-	-	-	↘	-	-
	Middle	NA	-	-	-	-	↘	-	-
	Bottom	-	-	-	-	-	↘	-	-
	Average	-	-	-	-	-	↘	-	-
Total volatile solids (mg/L)	Surface	↘	-	↘	↘	-	-	↘	-
	Middle	NA	-	↘	↘	-	-	↘	-
	Bottom	-	-	↘	↘	-	-	↘	-
	Average	↘	-	↘	↘	-	-	↘	-
5-day Biochemical Oxygen Demand (mg/L)	Surface	-	↘	-	-	↘	-	↘	-
	Middle	NA	-	-	-	↘	-	↘	-
	Bottom	-	↘	-	-	↘	-	↘	-
	Average	-	↘	-	-	↘	-	↘	-
Ammonia nitrogen (mg/L)	Surface	↘	-	-	-	-	-	↘	↘
	Middle	NA	-	-	-	↘	-	↘	-
	Bottom	-	-	-	-	-	-	↘	↘
	Average	↘	-	-	-	-	-	↘	↘
Nitrite nitrogen (mg/L)	Surface	↗	-	-	-	-	-	-	-
	Middle	NA	-	-	-	↗	-	-	-
	Bottom	-	-	-	-	-	-	-	-
	Average	↗	-	-	-	-	-	-	-
Nitrate nitrogen (mg/L)	Surface	↗	↗	-	-	↗	-	↗	-
	Middle	NA	-	-	-	↗	-	↗	-
	Bottom	↗	-	-	-	↗	-	↗	-
	Average	↗	↗	-	-	↗	-	↗	-
Total inorganic nitrogen (mg/L)	Surface	-	-	-	-	-	↘	-	-
	Middle	NA	-	-	-	-	↘	-	↘
	Bottom	↗	-	-	-	-	↘	-	↘
	Average	-	-	-	-	-	↘	-	↘
Total Kjeldahl nitrogen (mg/L)	Surface	↘	-	-	-	↘	-	↘	↘
	Middle	NA	-	-	-	↘	-	↘	↘
	Bottom	-	-	-	-	↘	-	↘	↘
	Average	↘	-	-	-	↘	-	↘	↘
Total nitrogen (mg/L)	Surface	-	-	-	-	↘	-	↘	↘
	Middle	NA	-	-	-	↘	-	↘	↘
	Bottom	-	-	-	-	↘	-	↘	↘
	Average	-	-	-	-	↘	-	↘	↘
Orthophosphate phosphorus (mg/L)	Surface	↘	-	-	-	↘	-	↘	↘
	Middle	NA	-	-	-	↘	-	↘	↘
	Bottom	-	-	-	-	↘	-	↘	↘
	Average	↘	-	-	-	↘	-	↘	↘
Total phosphorus (mg/L)	Surface	↘	-	-	-	↘	-	↘	↘
	Middle	NA	-	-	-	↘	-	↘	↘
	Bottom	-	-	-	-	↘	-	↘	↘
	Average	↘	-	-	-	↘	-	↘	↘
Silica (mg/L)	Surface	-	-	-	-	-	↘	-	↘
	Middle	NA	-	-	-	-	↘	-	↘
	Bottom	-	-	-	-	-	↘	-	↘
	Average	-	-	-	-	-	↘	-	↘
Chlorophyll- <i>a</i> (µg/L)	Surface	↗	-	-	↗	-	-	-	-
	Middle	NA	-	-	-	↗	↗	-	-
	Bottom	-	-	↗	-	-	-	-	-
	Average	↗	-	-	-	-	-	-	-
<i>E. coli</i> (cfu/100mL)	Surface	↘	-	-	↘	↗	-	↘	-
	Middle	NA	-	-	↘	-	-	↘	-
	Bottom	-	-	-	-	↗	-	↘	↘
	Average	↘	-	-	↘	↗	-	↘	↘
Faecal coliforms (cfu/100mL)	Surface	-	-	-	-	↗	-	-	-
	Middle	NA	-	-	-	-	-	↘	-
	Bottom	-	-	-	-	↗	-	↘	-
	Average	-	-	-	-	↗	-	↘	-

Note: 1. Results of the Seasonal Kendall Test statistically significant at  $p < 0.05$

2. - indicates no significant trend

3. NA (Not Applicable) indicates the measurement was not made due to shallow water

4. Test applied to past 20 years' data from each station unless stated otherwise

5. VT12 has six years' data only, which is insufficient to perform Seasonal Kendall Test

6. ↗ significant increase

7. ↘ significant decrease

Results of the Seasonal Kendall Test for water quality trends in typhoon shelters, 1986 – 2005 (continued)									
Monitoring Station		VT4	VT3	ET2	ET1	PT4	PT2	PT3	TT1
Monitoring Period		1987	1986	1993	1986	1986	1986	1986	1986
Parameter	Water Depth	2005	2005	2005	2005	2005	2005	2005	2005
Temperature (°C)	Surface	-	↗	-	↗	↗	↗	↗	↗
	Middle	-	-	-	↗	NA	NA	↗	-
	Bottom	-	↗	-	↗	↗	↗	↗	-
	Average	-	↗	-	↗	↗	↗	↗	↗
Salinity	Surface	-	-	-	-	-	-	-	-
	Middle	-	-	-	-	NA	NA	-	-
	Bottom	-	-	-	-	-	-	-	-
	Average	-	-	-	-	-	-	-	-
Dissolved Oxygen (mg/L)	Surface	↗	↗	-	-	↘	↗	-	↘
	Middle	↗	↗	↗	-	NA	NA	-	-
	Bottom	↗	↗	↗	-	-	-	-	-
	Average	↗	↗	↗	-	-	↗	-	-
Dissolved Oxygen (%)	Surface	↗	↗	-	-	↘	↗	-	↘
	Middle	↗	↗	↗	-	NA	NA	-	-
	Bottom	↗	↗	↗	-	-	-	-	-
	Average	↗	↗	↗	-	-	↗	-	-
pH	Surface	-	-	-	-	↘	-	↘	↘
	Middle	↗	-	-	-	NA	NA	-	-
	Bottom	-	-	-	-	↘	-	-	↘
	Average	↗	-	-	-	↘	-	-	↘
Secchi disc depth (m)	↗	-	↗	-	-	↗	-	-	
Turbidity (NTU)	Surface	-	↗	↗	-	↗	-	-	-
	Middle	-	↗	↗	-	NA	NA	↗	↗
	Bottom	↗	↗	↗	-	↗	-	-	↗
	Average	-	↗	↗	-	↗	-	-	-
Suspended Solids (mg/L)	Surface	↘	↘	↘	-	-	-	-	↘
	Middle	↘	-	↘	-	NA	NA	↗	↘
	Bottom	↘	↘	↘	-	-	↘	-	-
	Average	↘	↘	↘	-	-	↘	-	-
Total volatile solids (mg/L)	Surface	↘	-	↘	↘	↘	↘	-	↘
	Middle	↘	↘	↘	-	NA	NA	-	↘
	Bottom	↘	↘	↘	-	↘	-	-	-
	Average	↘	↘	↘	-	↘	-	-	-
5-day Biochemical Oxygen Demand (mg/L)	Surface	↘	↘	-	-	↘	↘	-	↘
	Middle	↘	↘	-	-	NA	NA	-	↘
	Bottom	↘	↘	↘	-	↘	↘	-	↘
	Average	↘	↘	↘	-	↘	↘	-	↘
Ammonia nitrogen (mg/L)	Surface	↘	↘	↘	-	-	↘	-	-
	Middle	↘	↘	↘	-	NA	NA	-	-
	Bottom	↘	↘	↘	-	-	-	-	-
	Average	↘	↘	↘	-	↘	↘	-	-
Nitrite nitrogen (mg/L)	Surface	↗	-	-	-	-	↘	-	-
	Middle	↗	-	-	-	NA	NA	-	-
	Bottom	↗	-	↘	-	-	-	-	-
	Average	↗	-	↘	-	-	↘	-	-
Nitrate nitrogen (mg/L)	Surface	↗	-	-	-	-	↘	-	-
	Middle	↗	-	-	-	NA	NA	-	-
	Bottom	↗	-	↘	-	-	↘	-	-
	Average	↗	-	↘	-	-	↘	-	-
Total inorganic nitrogen (mg/L)	Surface	-	↘	↘	-	-	↘	-	-
	Middle	↘	↘	↘	-	NA	NA	-	-
	Bottom	↘	↘	↘	-	-	-	-	-
	Average	↘	↘	↘	-	-	↘	-	-
Total Kjeldahl nitrogen (mg/L)	Surface	↘	↘	↘	-	↘	↘	-	-
	Middle	↘	↘	↘	-	NA	NA	-	-
	Bottom	↘	↘	↘	-	↘	-	-	-
	Average	↘	↘	↘	-	↘	-	-	-
Total nitrogen (mg/L)	Surface	-	↘	↘	-	↘	↘	-	-
	Middle	↘	↘	↘	-	NA	NA	-	-
	Bottom	↘	↘	↘	-	-	-	-	-
	Average	↘	↘	↘	-	↘	-	-	-
Orthophosphate phosphorus (mg/L)	Surface	↗	↘	↘	-	-	-	-	↘
	Middle	↘	↘	↘	-	NA	NA	-	↘
	Bottom	↘	↘	↘	-	-	-	↘	↘
	Average	-	↘	↘	-	-	-	↘	↘
Total phosphorus (mg/L)	Surface	-	↘	↘	-	↘	↘	-	↘
	Middle	↘	↘	↘	-	NA	NA	-	↘
	Bottom	↘	↘	↘	-	-	-	-	↘
	Average	↘	↘	↘	-	↘	-	↘	↘
Silica (mg/L)	Surface	-	↘	↘	-	-	-	-	-
	Middle	↘	-	↘	-	NA	NA	-	-
	Bottom	↘	↘	↘	-	-	-	-	-
	Average	-	↘	↘	-	-	-	-	-
Chlorophyll- <i>a</i> (µg/L)	Surface	↗	↗	-	-	-	-	-	-
	Middle	↗	↗	-	-	NA	NA	-	-
	Bottom	↗	↗	-	-	-	-	-	-
	Average	↗	↗	-	-	-	-	-	-
<i>E. coli</i> (cfu/100mL)	Surface	↘	↘	↘	-	↘	↘	-	↘
	Middle	↘	↘	↘	-	NA	NA	-	↘
	Bottom	↘	↘	↘	-	↘	↘	-	↘
	Average	↘	↘	↘	-	↘	↘	-	↘
Faecal coliforms (cfu/100mL)	Surface	-	-	-	-	↘	↘	-	-
	Middle	↘	-	↘	-	NA	NA	-	↘
	Bottom	↘	-	↘	-	↘	↘	-	↘
	Average	↘	-	↘	-	↘	↘	-	↘

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