

## Conclusion

Current stormwater quality issues for Hat Head are relatively minor in comparison to typical residential areas. The low pollutant values are due to the low density of development and the high treatment effectiveness provided by the grassed buffer strips and the high infiltration rates of the sandy soils.

Potential issues that may impact on stormwater quality are:

- future development in South Hat Head without appropriate detention and treatment measures;
- increased roof areas and paved areas from redevelopment throughout Hat Head without appropriate detention and treatment measures; and
- replacement of the existing grassed swales and buffer strips with standard kerb and gutter street drainage.

### Future Development in South Hat Head

Potential future development in South Hat Head involves:

- infill development of approximately 12 standard residential lots and 13 rural residential lots; and
- development of approximately 19ha of bushland for rural residential lots.

The impact of the infill development is relatively small due to the high treatment effectiveness of the existing swale system. The only works recommended are construction of a swale drainage system along the section of Marlin Grove that currently does not have a formed kerb and gutter system. The estimated cost of these works is approximately \$200,000.

Potential development of 19ha of bushland, which is zoned 1(d) 'rural investigation', for rural residential lots will significantly increase pollutants in the absence of any treatment measures. It is recommended that swale drainage systems, similar to existing swales, are constructed. The estimated cost of these works to adequately treat 19ha of rural residential area is approximately \$250,000.

### Redevelopment throughout Hat Head

The impact of redevelopment throughout Hat Head associated with house renovations / demolition and rebuilding will impact on stormwater quality. The impact of the increased roof and paved areas increases the pollutant load reaching Korogoro Creek by approximately 10 to 15%. This increase is not very large due to the effectiveness of the existing swale system.

The installation of rainwater tanks for stormwater detention on any redeveloped lots will reduce annual pollutant loads exiting the lots by 5% to 15% prior to treatment by the swale system. The requirement of rainwater tanks or some other form of on-site detention and treatment is recommended to assist in reducing the overall load to Korogoro Creek and reduce the reliance on the existing swale system to provide all necessary treatment. Construction cost estimates associated with the rainwater tanks are approximately \$2,000 per lot.

### Retaining Grassed Swales

The existing swale system was compared to redevelopment with a kerb and gutter system to provide a more focussed assessment of the benefit of the existing swale system in regard to stormwater pollution. MUSIC modelling indicates that replacement of the swales with a kerb and gutter system would increase the annual pollutant load to Korogoro Creek by more than 100 times. In order to mitigate this effect, a

significant area would be required for treatment on each residential lot and at the outlets. This is not considered feasible due to the location of the outlets in mangroves. These results highlight the importance of retaining the existing swale system.

### **Litter Pollution**

Gross Pollutant Traps are not considered to be an effective measure for addressing litter at Hat Head. This is due to the relatively low litter generation rates, a significant portion of the litter present in the creek may be due to individuals dropping the litter near the creek edge during recreational activities, and litter originating in the drainage system will often be 'caught' in the grassed swale systems or grated drainage inlet pits. Cost estimates for supply and installation of litter nets are approximately \$2,500 per net which are placed on the pipe outlets to the creek. If this option was pursued it is assumed that up to eight nets may be required at a cost of approximately \$20,000. This does not include maintenance costs.

An educational strategy targeting littering is considered to be a more effective measure than the installation of gross pollutant traps. The cost of an educational strategy is estimated at approximately \$50,000 which includes fees for development of a strategy, community and stakeholder consultation, and development, manufacture and installation of signage and litter bins.



# Project Team

The project team members included:

Tim Ruge  
**Environmental Engineer**

Ali McCallum  
**Environmental Scientist**

# References

- Atkinson, G. 1999a. *Soil Landscapes of the Kempsey-Korogoro Point 1:100 000 Sheet Report*, Department of Land and Water Conservation, Sydney.
- Atkinson, G. 1999b. *Soil Landscapes of the Kempsey-Korogoro Point 1:100 000 Sheet Map*, Department of Land and Water Conservation, Sydney.
- CSIRO, 1999. *Urban Stormwater: Best Practice Environmental Management Guidelines*. Prepared for the Stormwater Committee with assistance from Environment Protection Authority, Melbourne Water Corporation, Department of Natural Resources and Environment and Municipal Association of Victoria.
- De Smeth, K. *et al.* 2007. *Stormwater Management Strategy for Hat Head*. Australian National University, Fenner School of Environment and Society. De Smeth, K., Joyse, S., Read, Z., and Ritchie, J. 5 November 2007.
- Fletcher, T. *et al.* 2004. *Stormwater Flow and Quality, and the Effectiveness of Non-Proprietary Stormwater Treatment Measures – A Review and Gap Analysis*. CRC for Catchment Hydrology Report 04/8.
- GECO Environmental, 2007. *Korogoro Creek Estuary Data Compilation and Processes Study Report*. August 2007.
- Gold Coast City Council, 2006. *GCCC MUSIC Modelling Guidelines 2006 – Version 1*.
- KSC, 2004. *Kempsey Shire Urban Stormwater Management Plan 2004 - 2009*. Kempsey Shire Council.
- KSC, 2003. *Development Control Plan No. 37: Hat Head*. Adopted by Kempsey Shire Council on 8 April 2003.

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# Stormwater Quality Analysis Results

Enquiries to: Maree Smith  
Telephone: (02) 65818810  
Fax: (02) 65818814  
Our Reference: H08 0372:1664/1667

11<sup>th</sup> August 2008

**TO:** Damon Telfer  
5 Arcadia Lane  
Grassy Head NSW 2441

### LABORATORY REPORT

Date/Time Sampled                   : 25.07.08  
Date/Time Received                 : 25.07.08, 10:45am  
Date/Time Analysed                 : 25.07.08, 1:00pm (Faecal Coliforms)  
Sample Description                 : Water

### RESULT OF ANALYSIS

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Please refer to the following pages for the results.

Please note: An invoice for these services will be forwarded to you in the near future.

Laboratory ID	Sample Description	Faecal Coliforms (cfu 100mL <sup>-1</sup> )	Total Nitrogen (mg L <sup>-1</sup> )	Total Phosphorus (mg L <sup>-1</sup> )	Total Oil and Grease (mg L <sup>-1</sup> )
<i>Method No.</i>		<i>MET 033.2</i>	<i>MET 035.1</i>	<i>MET 035.1</i>	<i>APHA (2005) 5520 D (Grease)</i>
H08 0372:1664	1. Stormwater – Sump CP L/B E22	2300	0.36	0.10	3
H08 0372:1665	2. Stormwater – Outlet CP L/B E34 SW# 17	2800	0.19	0.06	2
H08 0372:1666	3. Stormwater – Outlet U/S R/B	1500	0.8	<0.01	2
H08 0372:1667	4. Stormwater – Outlet D/S R/B	Est. 18000	0.26	0.09	<2

Est. = Estimated count.

NB. Total Oil and Grease Analysis performed by Hunter Water Laboratories, NATA accreditation number 3626.



M. Smith  
Laboratory Manager



# CHAIN OF CUSTODY, DOCUMENTATION



Environmental

CLIENT: Port Macquarie Hastings Council Environ Lab  
 POSTAL ADDRESS: PO Box 84, Port Macquarie 2444  
 SEND REPORT TO: Dr M. Smith SEND INVOICE TO: Dr M. Smith  
 DATA NEEDED BY: \_\_\_\_\_ REPORT NEEDED BY: \_\_\_\_\_  
 PROJECT ID: \_\_\_\_\_ QUOTE NO.: 54/001/08  
 P.O. NO.: \_\_\_\_\_ COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: \_\_\_\_\_  
 LABORATORY BATCH NO.: \_\_\_\_\_  
 SAMPLERS: \_\_\_\_\_  
 PHONE: \_\_\_\_\_ FAX: \_\_\_\_\_ EMAIL: \_\_\_\_\_  
 REPORT FORMAT: HARD:  FAX:  E-MAIL:   
 QC LEVEL: QCS1:  QCS2:  QCS3:  QCS4:

FOR LAB USE ONLY  
 COOLER SEAL  
 Yes  No   
 Broken  Intact   
 COOLER TEMP. 15 deg. C

SAMPLE DATA				CONTAINER DATA			ANALYSIS REQUIRED										NOTES
SAMPLE ID	MATRIX	DATE	TIME	TYPE & PRESERVATIVE	NO.	pH	Total Cu	As	Cd	Cr	Cu	Ni	Pb	Zn	Al		
1 H080317-1690		29/1/08	5:05am	None			X										
2 -1691		✓	5:10am	✓			X										
3 -1692		✓	5:20am	✓			X										
4 H080312-1664-1		25/1/08	8:30	Nitric													
5 -1665-2		✓	8:30	✓			X	X	X	X	X	X	X	X	X		
6 -1666-3		✓	9:00	✓			X	X	X	X	X	X	X	X	X		
7 -1667-4		✓	9:00	✓			X	X	X	X	X	X	X	X	X		
8 H080384-1724 KCS17		29/1/08	12:30	None													
9 -1718 KCS08		✓	9:15	✓											X		
10 -1719 KCS08		✓	9:45	✓											X		
11 -1720 KCS07		✓	9:30	✓											X		

Environmental Division  
 Sydney  
 Work Order  
**ES0810955**



Telephone : +61-2-8784 8555

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: <u>Lark Whittingham</u>	DATE: <u>30/1/08</u>	NAME: <u>Frank ALS</u>	DATE: <u>31/1/08</u>	CONSIGNMENT NOTE NO.
OF: <u>PHHC-EL</u>	TIME: <u>9:00</u>	OF: <u>ALS</u>	TIME: <u>13:20</u>	TRANSPORT CO. NAME
NAME:	DATE:	NAME:	DATE:	
OF:	TIME:	OF:	TIME:	

\*Container Type and Preservative Codes: P = Natural Plastic; N = Nitric Acid Preserved; C = Sodium Hydroxide Preserved; J = Solvent Washed Acid Rinsed Jar; S = Solvent Washed Acid Rinsed Glass Bottle; V = Vial;  
 VC = Hydrochloric Acid Preserved Vial; VS = Sulphuric Acid Preservative Vial; BS = Sulphuric Acid Preserved Glass Bottle; PS = Sulphuric Acid Preserved Plastic Bottle; Z = Zinc Acetate Preserved Bottle;  
 E = EDTA Preserved Bottle; H = Hydrochloric Acid Preserved Plastic Bottle; F = Formaldehyde Preserved; ST = Sterile Bottle; B = Plastic Bag; O = Other

ENFM (204/0).S

**AUSTRALIAN LABORATORY SERVICES P/L ACN 009 936 029**

77 Woodpark Road, Smithfield NSW 216 Australia  
 Tel: (02) 8784 8555 Fax: (02) 8784 8500



Environmental Division

**SAMPLE RECEIPT NOTIFICATION (SRN)**  
*Comprehensive Report*

Work Order : **ES0810955**

Client	: HASTINGS MUNICIPAL COUNCIL	Laboratory	: Environmental Division Sydney
Contact	: DR MAREE SMITH	Contact	: Victor Kedicioglu
Address	: P O BOX 84 CORNER OF OCEAN DRIVE AND KOALA STREET PORT MACQUARIE NSW, AUSTRALIA 2444	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: maree.smith@pmhc.nsw.gov.au	E-mail	: victor.kedicioglu@alsenviro.com
Telephone	: 6581 8810	Telephone	: +61-2-8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: ----	Page	: 1 of 2
Order number	: ----	Quote number	: ES2008HASMUN0199 (SY/001/08)
C-O-C number	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
Sampler	: ----		

*Dates*

Date Samples Received	: 31-JUL-2008	Issue Date	: 31-JUL-2008 13:32
Client Requested Due Date	: 08-AUG-2008	Scheduled Reporting Date	: <b>08-AUG-2008</b>

*Delivery Details*

Mode of Delivery	: Carrier	Temperature	: AMBIENT
No. of coolers/boxes	: ----	No. of samples received	: 11
Security Seal	: Intact.	No. of samples analysed	: 11

*General Comments*

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Requested Deliverables
- **Samples received in appropriately pretreated and preserved containers.**
- **Sample(s) have been received within recommended holding times.**
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Please direct any queries related to sample condition / numbering / breakages to Nanthini Coilparampil
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (14 days), Solid (90 days) from date of completion of work order.

**Environmental Division Sydney**

Part of the **ALS Laboratory Group**  
277-289 Woodpark Road Smithfield NSW Australia 2164  
Tel. +61-2-8784 8555 Fax. +61-2-8784 8500 [www.alsglobal.com](http://www.alsglobal.com)  
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Environmental Division

**CERTIFICATE OF ANALYSIS**

Work Order	: ES0810955	Page	: 1 of 5
Client	: HASTINGS MUNICIPAL COUNCIL	Laboratory	: Environmental Division Sydney
Contact	: DR MAREE SMITH	Contact	: Charlie Pierce
Address	: P O BOX 84 CORNER OF OCEAN DRIVE AND KOALA STREET PORT MACQUARIE NSW, AUSTRALIA 2444	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: maree.smith@pmhc.nsw.gov.au	E-mail	: charlie.pierce@alsenviro.com
Telephone	: 6581 8810	Telephone	: +61-2-8784 8555
Facsimile	: ---	Facsimile	: +61-2-8784 8500
Project	: ---	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ---	Date Samples Received	: 31-JUL-2008
C-O-C number	: ---	Issue Date	: 07-AUG-2008
Sampler	: ---	No. of samples received	: 11
Site	: ---	No. of samples analysed	: 11
Quote number	: SY/001/08		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results



NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025.

*Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Celine Conceicao	Spectroscopist	Inorganics

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Work Order : ES0810955  
Client : HASTINGS MUNICIPAL COUNCIL  
Project : —



### General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = Chemistry Abstract Services number

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

- LCS recovery for Arsenic and Zinc falls outside ALS Dynamic Control Limit. However, it is within the acceptance criteria based on ALS DQO. No further action is required.

Page : 3 of 5  
 Work Order : ES0810955  
 Client : HASTINGS MUNICIPAL COUNCIL  
 Project : —



### Analytical Results

Sub-Matrix: WATER				Client sample ID	H080377-1690	H080377-1691	H080377-1692	H080372-1664-1	H080372-1665-2
				Client sampling date / time	28-JUL-2008 05:05	28-JUL-2008 05:05	28-JUL-2008 05:05	25-JUL-2008 08:30	25-JUL-2008 08:30
Compound	CAS Number	LOR	Unit	ES0810955-001	ES0810955-002	ES0810955-003	ES0810955-004	ES0810955-005	
<b>EG020T: Total Metals by ICP-MS</b>									
Arsenic	7440-38-2	0.001	mg/L	—	—	—	<0.001	<0.001	
Cadmium	7440-43-9	0.0001	mg/L	—	—	—	0.0004	0.0004	
Chromium	7440-47-3	0.001	mg/L	—	—	—	0.001	<0.001	
Copper	7440-50-8	0.001	mg/L	0.045	0.036	0.089	0.003	0.001	
Lead	7439-92-1	0.001	mg/L	—	—	—	0.004	0.001	
Nickel	7440-02-0	0.001	mg/L	—	—	—	<0.001	<0.001	
Zinc	7440-66-6	0.005	mg/L	—	—	—	0.026	0.018	

Page : 4 of 5  
 Work Order : ES0810955  
 Client : HASTINGS MUNICIPAL COUNCIL  
 Project : —



**Analytical Results**

Sub-Matrix: WATER				Client sample ID	H080372-1666-3	H080372-1667-4	H080384-1724 KCS17	H080384-1718 KCS05	H080384-1719 KCS06
				Client sampling date / time	25-JUL-2008 09:00	25-JUL-2008 09:00	29-JUL-2008 15:00	29-JUL-2008 15:00	29-JUL-2008 15:00
Compound	CAS Number	LOR	Unit	ES0810955-006	ES0810955-007	ES0810955-008	ES0810955-009	ES0810955-010	
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Aluminium	7429-90-5	0.01	mg/L	—	—	0.10	0.02	0.03	
<b>EG020T: Total Metals by ICP-MS</b>									
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	—	—	—	
Cadmium	7440-43-9	0.0001	mg/L	0.0004	0.0003	—	—	—	
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	—	—	—	
Copper	7440-50-8	0.001	mg/L	0.001	0.001	—	—	—	
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	—	—	—	
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	—	—	—	
Zinc	7440-66-6	0.005	mg/L	<0.005	0.010	—	—	—	

Page : 5 of 5  
 Work Order : ES0810955  
 Client : HASTINGS MUNICIPAL COUNCIL  
 Project : ---



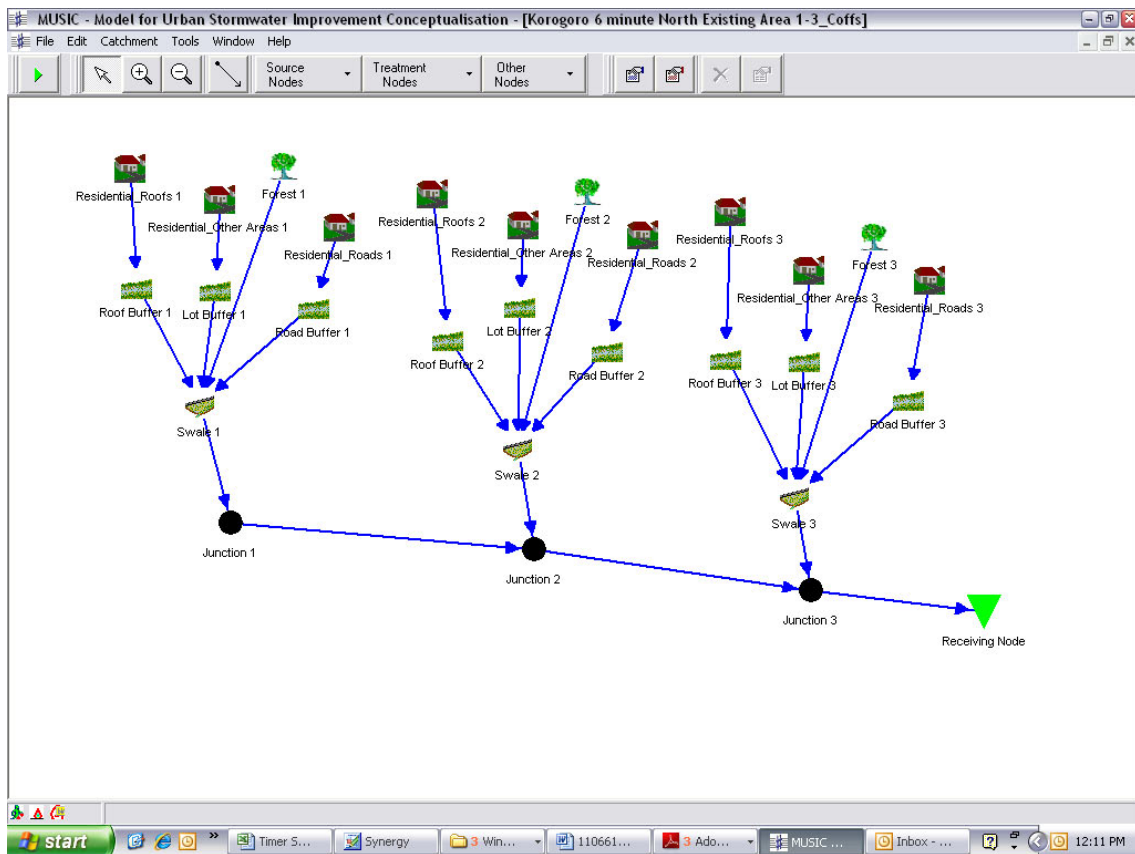
**Analytical Results**

Sub-Matrix: WATER

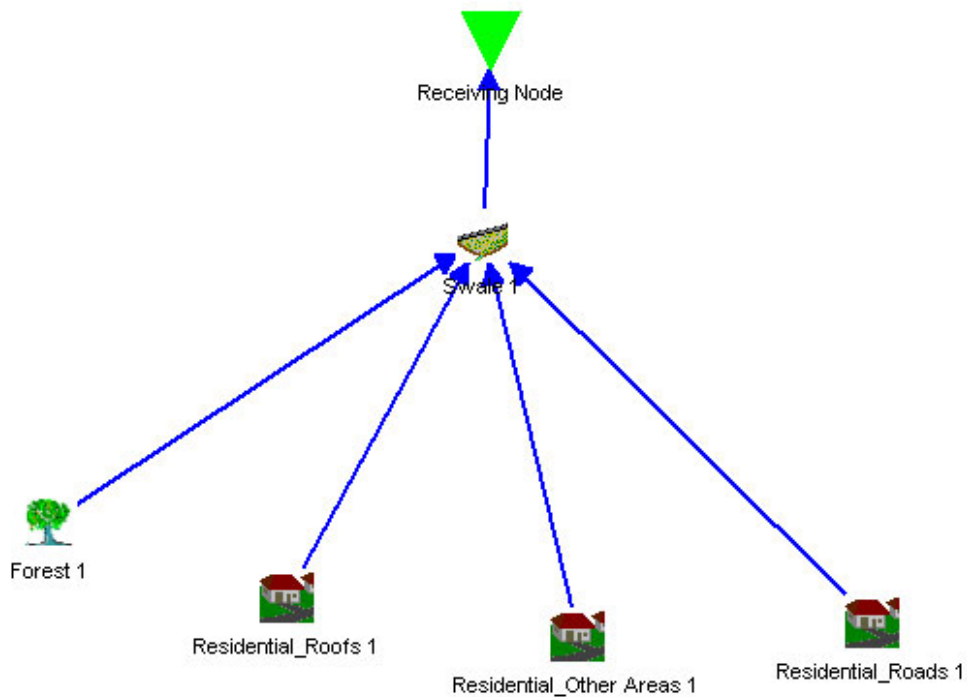
				Client sample ID	H080384-1720 KCS07	---	---	---	---
				Client sampling date / time	29-JUL-2008 15:00	---	---	---	---
Compound	CAS Number	LOR	Unit	ES0810955-011	---	---	---	---	---
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Aluminium	7429-90-5	0.01	mg/L	<0.01	---	---	---	---	---

## MUSIC Model Layouts





MUSIC layout of three sub-catchments in North Hat Head



MUSIC Layout for South Hat Head – Sub-Catchment S1