Hydrocarbons and faecal material in urban stormwater and estuarine sediments: source characterisation and quantification

by

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Submitted in fulfilment of the requirements for admittance to the degree of:

DOCTOR OF PHILOSOPHY

Institute of Antarctic and Southern Ocean Studies,
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March 1997

1998
For my parents
The saying that a little knowledge is a dangerous thing is, to my mind, a very dangerous adage. If knowledge is real and genuine, I do not believe that it is other than a very valuable possession however infinitesimal its quantity may be. Indeed, if a little knowledge is dangerous, where is the man who has so much as to be out of danger?

Thomas Huxley, 1877
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G.J. Green
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ABSTRACT

Hydrocarbons from road runoff and faecal matter from sewage overflows have previously been implicated as major contributors to urban stormwater contamination, but little source identification or quantitative data exist. In this study chemical marker techniques were utilised to identify specific sources of these contaminants in selected stormwater catchments of Hobart, Tasmania. The mean concentration of hydrocarbons in stormwater during this study was found to be 2.88 mg/l with an estimated total annual discharge to the Derwent Estuary in the order of 164,000 kg/year. Assessment of the major hydrocarbon inputs to the Derwent estuary demonstrated that stormwater is the largest single contributor. Source elucidation of hydrocarbons demonstrated inputs to stormwater from automotive oils, diesel fuel, and plant waxes. Analysis of polycyclic aromatic hydrocarbon (PAH) profiles by gas chromatography-mass spectrometry and multivariate analysis confirmed, in most cases, that automobile sump oil, rather than unused lubricating oils were the major component of oil in stormwater. Cluster analysis, based on PAH composition, was used for grouping stormwater samples relative to potential source materials. Other techniques such as the use of PAH isomer pair ratios proved useful for determining the input of combustion derived PAH. In sheltered embayments of the Derwent Estuary a clear link was demonstrated between urban stormwater and the build-up of hydrocarbon contaminants in sediments. Localised extreme hydrocarbon concentrations were found associated with stormwater discharge and boat mooring areas. Aliphatic hydrocarbons (10,100 μg/g) and PAHs (27μg/g) in sediments at Prince of Wales Bay were the highest yet recorded levels for estuarine sediments in Australia. Stormwater in Hobart was found to
be highly contaminated with faecal pollution. Sterol and bacterial analysis of stormwater samples showed that dog faeces is potentially the most significant contributor to the faecal contamination. This finding was demonstrated primarily by the similarity between sterol profiles of dog faeces and stormwater samples and the low levels or absence of sterol markers for other sources of faeces. Human faecal material was detected in urban stormwater by tracing the faecal sterol coprostanol. During flood conditions, human faeces, attributed to cross contamination from the sewerage system, became a major contaminant in stormwater. During dry weather, urban runoff contained low levels of human faecal material possibly derived from illegal sewer connections. On an annual basis in Hobart, stormwater was calculated to represent an estimated 80-91% of faecal input to the Derwent estuary. A study of hydrocarbons and sterols in marine and shoreline sediments undertaken at Davis Station in Antarctica has been included in this project. This comparatively simple system, largely devoid of external pollution influences, provided an ideal test case for the determination of hydrocarbon and sewage impacts from a known human population.
ACKNOWLEDGEMENTS

I acknowledge my four supervisors; Peter Franzmann, Peter Nichols, Peter Sedwick and Andy Revill who were invaluable in providing assistance, direction, motivation, encouragement, and constructive criticism throughout the course of this project.

I offer my sincere appreciation to Peter Nichols, who, despite only being an official supervisor for the first year of this project, remained available beyond the call of duty to read draft material and to help with reference material and key contacts. I particularly thank Peter for his overall positive attitude, particularly in reinforcing the need for and importance of this project. I also thank Peter for demonstrating a great deal of faith in my ability to undertake, stay with, and complete a PhD project, despite my own personal reservations. I thank Peter for his encouragement and support at a time when I felt the need for a change in direction with this project.

I acknowledge Peter Sedwick who, after the departure of Peter Franzmann, took on the role as supervisor despite not having a direct academic connection to the content of the project. Peter is thanked for efficiently dealing with many of the tedious ‘behind the scene’ aspects of conducting a PhD project. This involved signing forms assessing direction and progress, encouraging departmental talks, attending to scholarship matters and dealing with paperwork both within IASOS and from the Office for Research. I really appreciated Peter’s input and assessment of appropriate content, aims and direction for this project.

Thanks to Andy for providing many valid suggestions on the framework and direction of the project. Thanks also for enduring the endless requests for advice for reference material, to read draft material, to help with statistical analysis, to help with figures and to sign the many forms. Andy was always very supportive in my requests to attend conferences and meetings and with provision of computer equipment.

Particular thanks are extended to Kurt Hammerschmid who was an encouraging and positive influence in the early stages of this project. Kurt is also thanked for his
enthusiastic guidance in writing a successful funding grant application and for providing access to stormwater flow recording equipment. Thanks to Tony Dix for his support during the project and for providing an important communication link with DELM.

Staff at the CSIRO Division of Marine Research are thanked for provision of laboratory and office space, use of laboratory equipment, instrumentation and consumables, administration of grant funds, use of library services and other facilities, use of information technology services, and for willingly sharing knowledge and expertise. Particular thanks to Danny Holdsworth for a great deal of assistance on the GC-MS, Rhys Leeming for advice on faecal biomarkers and draft material, Ed Butler for passing on relevant papers, John Volkman for advice and information. Thanks also to my roommates Ruth, Jenny, Patti, Ben and Mina for friendship, chats, laughs, encouragement and cakes, and to workmates Val, Mark, Graeme and Stephanie. An extra thank you to Patti for eleventh hour support and kindness.

This project would not have been possible without the support and funding from the following organisations. The University of Tasmania, Cooperative Research Centre for the Antarctic and Southern Ocean Environment (Antarctic CRC), Institute of Antarctic and Southern Ocean Studies (IASOS), CSIRO Division of Marine Research, Tasmanian Department of Environment and Land Management (DELM) and the Glenorchy City Council.

The Antarctic component of this study was supported by the Antarctic Scientific Advisory Council (ASAC). Jennifer Skerratt, David Nichols and Jo-Anne Cavanagh are thanked for help and support with field work; fellow ANARE personnel for their assistance at sea and on base; Andrew Revill, Liz Sikes and Patrick Deprez for comments during manuscript preparation.