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

by

GRAHAM JAMES GREEN B.Sc. (Hons.)

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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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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.

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