

DERWENT ESTUARY

Water Quality Improvement Plan for Heavy Metals

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Prepared by the Derwent Estuary Program
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Initiative, Tasmanian State Government and Derwent Estuary Program
partnership



EXECUTIVE SUMMARY

The Derwent estuary is affected by elevated levels of heavy metals in water, sediments and biota – largely the legacy of past industrial practices. While there have been significant reductions in loads and gradual improvements in estuarine condition, further action is needed to reduce loads and to manage risks associated with contaminated sediments and seafood.

In 2003, the Australian Government provided a grant through the Coastal Catchments Initiative to prepare a Water Quality Improvement Plan (WQIP) for the Derwent estuary to address heavy metal contamination. Resources were also provided by the Tasmanian State Government and the Derwent Estuary Program partnership.

This report reviews current sources and loads, sets environmental targets and recommends actions to reduce and manage heavy metals in the Derwent. Detailed estuarine models were developed to support the WQIP and extensive sediment investigations were carried out.

Environmental values, indicators and targets

Heavy metals – particularly zinc, lead, mercury and cadmium – occur in Derwent estuary waters and sediments at levels well above the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Heavy metal levels in Derwent estuary shellfish – particularly zinc in oysters and lead in mussels – are also in excess of Food and Safety Australia and New Zealand guidelines, while mercury levels in flathead are close to the recommended limit.

Protected Environmental Values were set for the Derwent estuary under the *State Policy on Water Quality Management 1997* (SPWQM) in 2004, to provide water quality sufficient for the protection of aquatic ecosystems and fish suitable for human consumption. Although the value of shellfish suitable for human consumption was not set as a PEV, this is a longer-term objective of the Derwent Estuary Program.

Zinc was selected as the indicator for this project as it is by far the most abundant heavy metal in the Derwent and can be readily measured in water, sediments and biota, thus enabling the development of calibrated estuary models. Furthermore levels of most other heavy metals show a strong correlation with zinc levels, and management actions proposed to address zinc contamination should address other metals as well. A water column target of 15 µg/L total zinc was selected, corresponding to the ANZECC trigger level to protect 95% of species (slightly- to-moderately disturbed system). This target will be refined over time, as further information becomes available.

Heavy metal sources and loads

An assessment of heavy metal loads currently discharged to the estuary was carried out, including major industries, sewage treatment plants, urban stormwater, tips and landfills and the Derwent River catchment. The single largest source was found to be the Zinifex Hobart Smelter, in particular the historic groundwater contamination at the site which accounts for the majority of the current load. The second largest source was identified as urban stormwater run-off.

In the past, heavy metal loads were much higher and were primarily associated with the zinc smelter (established in 1917) and the Boyer newsprint mill (established 1941). The wreck of the *Lake Illawarra*, which lies at the base of the Tasman Bridge

in 40 meters of water with a cargo of zinc concentrate, was not found to be a significant source of heavy metals.

Contaminated sediments and biological effects

The large area of contaminated sediments in the Derwent estuary raises a number of important questions for future management. For example, are sediments a major internal source of metals to the water column? Are there conditions under which they could become a major source? What are the ecological implications of these contaminated sediments in terms of both toxicity and bioaccumulation? Can anything be done to remediate sediments or to reduce ecological and human health risks? A series of investigations and experiments were carried out as part of this project to address these questions.

In general, heavy metals were found to be tightly bound to estuarine sediments and do not appear to leach readily to the overlying waters under current conditions. However, should the current situation change (e.g. oxygen depletion, major disturbance) sediments could potentially become a significant source of heavy metals.

Cores collected at several sites around the estuary indicate that metal levels are highest at depth of 10 to 20 centimetres, indicating that the most heavily contaminated sediments are being gradually diluted by deposition of cleaner sediments over time. Heavy metal levels in sediments collected from intertidal areas near reserves and recreational areas were generally found to be within recommended standards for human exposure.

A preliminary evaluation of the biological effects of heavy metal contamination resulted in mixed findings. Initial toxicity screening suggested that sediments and pore waters were not highly toxic, however, tests using more sensitive species indicated significant sediment toxicity in some areas.

A detailed survey of benthic invertebrate communities in the Derwent and Huon estuaries was carried out by the University of Tasmania through a Natural Heritage Trust-funded project. This survey found a surprisingly diverse and abundant fauna living in sediments throughout the Derwent. Contrary to expectations, heavy metal contamination was not determined to be the overriding factor controlling benthic community structure in the estuary as a whole. Areas with high levels of heavy metals sustained abundant but modified faunal populations, suggesting either that the bioavailability of metals was low, or that the organisms were not highly sensitive to the contaminants.

Caged oyster experiments demonstrated rapid uptake of zinc, both in surface waters and at depth. The issue of bioaccumulation (the potential for heavy metal accumulation up the food chain), rather than toxicity or direct metal fluxes, is perhaps a more significant concern in the Derwent Estuary. To assess this, a wider range of marine species will need to be collected and analysed as part of a study at a range of different trophic levels.

Environmental flows

A review and preliminary assessment of environmental flow issues and objectives was carried out as part of this project. The Derwent River is extensively regulated for hydro-power generation with ten dams and over 20 man-made storages constructed within the catchment since the 1930s.

Proposed river flow objectives include minimum flows, two higher flow components and controlled rates of water level decline. Given that our current state of knowledge regarding the river and estuarine values and their specific flow requirements is very limited, proposed management actions to address environmental flow issues focus initially on filling key information gaps, developing decision support tools and assessing operational capacity to deliver the various component of the flow regime.

Furthermore, significant changes to the existing flow regime without detailed understanding and good predictive capacity could carry significant risks. These risks could include upstream migration of the salt water wedge into the city of Hobart's drinking supply off-take, mobilisation of heavy-metal contaminated sediments and damage to tidal wetlands and seagrass beds that are in equilibrium with the current flow regime.

Management actions and implementation

A range of management actions is proposed to further reduce heavy metal loads to the Derwent, manage contaminated sediments and reduce seafood safety risks. These include:

- further capture and remediation of contaminated groundwater and stormwater at the Zinifex Hobart Smelter site;
- development of dredging guidelines and protocols to avoid disturbing contaminated sediments;
- management of nutrient loads so as to prevent low oxygen levels (which could cause sediments to release heavy metals);
- more detailed surveys of heavy metals in fish and biota;
- community information and awareness about seafood safety.

Implementation of these actions is proposed over the next five to ten year period through existing statutory and non-statutory frameworks, including the Derwent Estuary Program (DEP). In particular, a major extension of groundwater and stormwater remediation projects will be undertaken at the Zinifex Hobart Smelter (ZHS) site in 2006/7 that should result in significant further reductions in heavy metal loads at the site.

While the on-site load reductions to achieve water quality targets may be achievable within a few years, there will be a lag-time before improvements are observed in the estuary because of the time it takes groundwater to reach the estuary. Based on estimated groundwater travel times at the site, this could be in the order of 5 to >15 years.

Monitoring, reporting and review

Monitoring of heavy metal levels in water, sediments and biota will continue through the DEP monitoring program and license conditions at ZHS. Results will be reported in the DEP's Annual Report Cards and more detailed five-yearly State of the Derwent Reports. Key actions will be integrated within the DEP's Environmental Management Plan and ZHS Environmental Management Plan, both of which are reviewed annually. The full WQIP will be reviewed and revised in five years time.