

**Table 24** Pollution sources and pollutants - qualitative assessment of inputs

Source	TSS	BOD	Nutrients	Bacteria	Metals	HC
STPs	M	M	L	L	S	?
Industry - metals	S	S	S	S	L	?
Industry - pulp	L	L	S	S	S	?
Derwent River	L	M/L?	M	S	S	?
Urban air pollution	S	S	S/M?	na	S/M	?
Estuarine sediments	?	?	?	?	?	?
Urban Runoff	L	S	S	L	S	L

L Large  
 M Medium  
 S Small

On the basis of this initial review, it is recommended that all input estimates be progressively reviewed and refined. Monitoring programs may need to be upgraded and expanded - at least for a short time - to better quantify inputs.

## 5 Previous studies and monitoring programs

Environmental quality monitoring has been carried out intermittently in the Derwent by a variety of organisations and individuals since the early 1970s, when the well-publicised illness caused by eating oysters from Ralphs Bay raised awareness about the contaminated status of the estuary. The earliest studies focused primarily on heavy metal concentrations in waters, sediments and biota. In the late 1980s, a serious episode of sludge rafting in the upper estuary spawned further investigations, this time relating to the characteristics and distribution of paper mill sludge in the upper reaches of the estuary. Over the past 5 years, monitoring programs have looked more closely at bacteriological levels near bathing beaches, nutrients, chlorophyll *a* and phytoplankton, and heavy metals in sediments and biota.

Only two relatively consistent long-term monitoring programs have been maintained: semi-annual water quality surveys carried out by Department of the Environment (now E&P/DELM) from 1971 - 1988 and 1993 to present, and annual surveys of heavy metal concentrations in fish and shellfish conducted by Pasminco Hobart (1972 to present). CSIRO has also recently studied and modelled the circulation of the Derwent Estuary. The most pertinent studies of environmental quality in the Derwent are identified below:

- Department of the Environment, 1972 - 1988: semi-annual surveys (2 - 5/yr) of surface water quality throughout the Derwent. Monitored 14 sites for physical parameters, heavy metals and faecal indicator bacteria;
- Pasminco Hobart, 1972 - present: annual survey of heavy metal concentrations in oysters, mussels and flathead from 25 sites;
- Bloom, 1975: snapshot survey of entire estuary for heavy metals in waters, sediments and biota (50-140 sites);
- Local councils/DCHS/DELM, 1987 to present: bacteriological surveys of bathing beaches at 30 sites (weekly during summer months);
- ANM, 1988 - present: fortnightly water quality surveys at 12 sites in upper estuary;

- Davies and Kalish, 1989: water quality survey of upper estuary. Monitored physico-chemical parameters at 12 sites on a monthly basis. Also surveyed fish populations, tested fish for metals;
- TasUni/Aquahealth/HECEC, 1989 - 1995: series of sediment and macroinvertebrate surveys of the upper estuary on characteristics and distribution of paper mill sludge;
- CSIRO, 1992 - 1994: as part of CSIRO Coastal Zone Program, conducted a series of physical oceanography and water quality surveys (nutrients, metals, other hydrochemical data). Some circulation modelling also completed;
- Dincen and Noller (DELM), 1995: snapshot survey of entire estuary for heavy metals in biota (10 -30 sites); fieldwork carried out in 1990;
- Coughanowr (DELM), 1995: Derwent Estuary Nutrient Program. Fortnightly surveys of nutrients, TSS and physico-chemical parameters at 51 sites over a 1-year period (1993/1994);
- Pirzl, 1996: snapshot survey of sediments at 40 sites throughout estuary (texture, % LOI, heavy metals);
- DELM, 1994 - present: bimonthly monitoring of physical parameters, nutrients, chl *a*, phytoplankton at 20 - 25 sites throughout estuary.

## 6 Environmental quality of the Derwent Estuary

### 6.1 Suspended particulate matter

Suspended particulate matter (also termed non-filterable residues or total suspended solids) consists of silt and clay, phytoplankton, decaying organic matter and other particles derived from both natural and anthropogenic sources. Suspended particulate matter (SPM) levels in estuaries often vary widely in response to river discharges, wind and tidal mixing, phytoplankton blooms and other factors. Typically, SPM tends to accumulate and thus is highest at the interface between salt and freshwater. In the Derwent, the turbidity maximum is generally found at the toe of the salt wedge between New Norfolk and Bridgewater.

High levels of SPM may adversely affect aquatic ecosystems both when in suspension and during settling. In suspension, high SPM levels may reduce light penetration, affecting primary production. As particulate matter settles out, it may also smother sessile organisms and change the nature of the substrata. ANZECC guidelines for the protection of aquatic ecosystems recommend that increases in SPM should be limited such that optical guidelines are maintained and the seasonal mean nephelometric turbidity does not change by more than 10%. Aquaculture guidelines recommend that SPM levels in marine waters should not exceed 10 - 25 mg/L (depending on the species), while previous US and European guidelines recommended acceptable SPM levels of 25 mg/L (ANZECC, 1992).

The largest external source of suspended particulate matter to the estuary is the Derwent River, while urban run-off probably contributes the largest anthropogenic/natural load, followed by ANM and sewage treatment plants. Internal and oceanic sources also undoubtedly contribute to SPM levels within the estuary via phytoplankton production and sediment resuspension.