

# SOME EARLY ENVIRONMENTAL PROBLEMS AND GUIDELINES IN NEW SOUTH WALES ESTUARIES

D. J. Dunstan  
5 Hope Avenue  
North Manly, N.S.W. 2100

## INTRODUCTION

New South Wales was the first Australian state in which detailed scientific interest was taken in the problems associated with the unplanned and uncontrolled development in, and adjacent to, waterways. These investigations commenced in the 1960s when the adverse effects of many operations on the aquatic environment and on amateur and commercial fishing, became apparent. The types of activities involved range from minor foreshore structures to large scale changes associated with developments such as residential canal estates, marinas, flood mitigation works, mineral sands mining, commercial sand extraction, dredging and reclamation, garbage disposal, dams, bridges, power stations and sewage treatment works. The NSW Government interest resulted in habitat management guidelines (Dunstan 1968) which were published in *The Fisherman*, the official journal of the Division of Fisheries, then in the Chief Secretary's Department.

In 1963 the Fisheries Branch operated under the Fisheries and Oyster Farms Act 1935. Applications for developments on Crown Land (land below mean high water mark) were generally referred to Fisheries although there was no legal obligation on the Department of Lands, and objections were raised only if recognised fishermen's hauling grounds or oyster leases were adversely affected. At that time the State Planning Authority, the precursor to the Department of Environment and Planning (now separate agencies) was concerned only with planning matters, and the functions of the National Parks and Wildlife Service were the responsibility of the Fauna and Flora Protection Board consisting of three members. Other relevant authorities evinced little or no concern for possible adverse effects of developments in estuaries, whether on the productivity of such habitats or on the environment generally. Municipal and shire engineers and planners, competent in their own fields, often viewed wetlands and waterways as cheap land to be filled and reclaimed, or as a source of commercial sand. The backwaters and mangrove swamps offered the ideal location for the disposal of garbage with little thought given to the tragic effects on the natural environment. In the Municipality of Hurstville, bordering the Georges River, some 80 per cent of the present open space was obtained from reclamation of mangrove swamps, primarily using such areas for garbage disposal. When in 1969 objections were raised against further reclamation to extend a golf course, the Shire Engineer was reported in the press as saying - "Mangroves are a noxious weed and a cancerous growth". There was no public objection to this statement. The oyster farmers, dependent on the river for their livelihood, then regarded the garbage tips and resultant seepage as a source of food for the oysters extensively cultivated on leases throughout the tidal reaches. By the early 1970s the potential threat to the oyster industry was apparent (Dunstan 1974), but the now mandatory purification of oysters was not introduced until after the disastrous food poisoning episodes that occurred in 1978.

It was apparent more than 20 years ago that, based on bacterial counts, water quality was deteriorating, and that some waterways close to major population centres presented a health risk and were unsuitable for recreational activities such as swimming. In 1968, the Cabinet of the NSW State Government approved the preparation of legislation to provide for the control of water pollution, as a consequence, in 1970, the Department of Environment was established, and The State Pollution Control Commission Act, The Clean Waters Act, and The Waste Disposal Act were proclaimed. However, even in the early 1970s many highly damaging activities still did not fall within the jurisdiction of any existing legislation. The Division of Fisheries was concerned at the lack of appropriate controls and often could not reach agreement on development proposals with either other government agencies or with local councils. In such cases, it became necessary to object to the unacceptable development proposals at Land Board hearings, local government appeals tribunals, and public inquiries. In 1979, a number of amendments to fisheries legislation were proclaimed to exercise control over developments. For example, Section 90 of the amended Fisheries and Oyster Farms Act vested in the Minister major powers in relation to dredging and reclamation proposals by individuals on local government authorities. In 1987 a Regulation providing for the protection of mangroves on Crown Land was finally gazetted.

## CASE STUDIES

In the 1968 guidelines (Dunstan 1968) the first principle recommended that there be "No further destruction of healthy mangrove stands nor reclamation of intertidal flats or swamps which serve as nursery and feeding grounds for fry and fingerlings". Productive seagrass flats were then known as weed beds and their importance not fully understood. The foreshores were being reclaimed for golf courses, bowling greens, playing fields and other interests without taking into account their importance to adjacent waterways. This is illustrated in the following brief examples.

### Port Hacking

In Port Hacking, shell grit was dredged for many years until it was stopped in the mid-1960s. The creation of a large part of the existing barren sand flats on the southern side of the channel downstream of Lilli Pilli Point has been attributed to that activity (Dunstan 1968). The operator considered that there was more shell (living molluscs) in the pure stands of the eel grass, *Zostera capricorni*, than in the adjacent sand flats. No objections were raised by scientists at CSIRO Division of Fisheries and Oceanography who, from their laboratories at Hungry Point, overlooked the operation. The dredging ceased when Sutherland Council was persuaded to ban road use by shell grit laden trucks. Some 25 years later, the seagrasses have not re-established in the dredged area and only a remnant of the former extensive seagrass beds remain in that area (West *et al.* 1985). The collection of cockles as food has also played a role in destruction of *Zostera* and *Posidonia* beds. Despite rigorous policing and warning signs in several languages, this illegal activity has often continued with cockle stocks being exhausted.

In a number of areas, including the tidal reaches of Port Hacking, (but also Georges River, Pittwater, and that portion of the Hawkesbury River under the control of the Hornsby Council) local Councils, in conjunction with the Department of Lands, State Fisheries and the then State Planning Authority, have set limit lines to reclamation. Waterfront owners were permitted to reclaim land to the approved limit line but tenure is granted only by way of permissive occupancy. This scheme, first introduced in Pittwater as the Warringah Planning Scheme (Amendment No.6) Ordinance and proclaimed in Government Gazette No. 91 of 8 August 1969, restored public ownership to waterfront land. Public access was gained along the foreshore, though camping, fishing and loitering were not permitted. Natural, productive foreshores were excluded from reclamation. The established limit lines allowed for the removal of areas trapping flotsam and debris, and such areas provided an area for the disposal of dredge material where dredging for private navigation was required. The limited dredging permitted was restricted to six feet (c.2 m) depth so that the substratum was still in the euphotic zone.

### Pittwater

In Pittwater there have been several proposals which had, or had the potential to have, marked effects on the seagrass and mangrove communities.

Over the period 1962 to 1978 large scale dredging was carried out in Pittwater in Horseshoe Cove, Crystal Bay, and Crescent Bay. The bulk of the dredged material was contained behind retaining walls built to the approved limit line. Dredging in these three areas and the associated land fill provided public foreshore access, restored useable water, and resulted in the removal of mud and silt impregnated with septic wastes which had created odour problems at low tide.

Careel Bay in Pittwater was the original site planned for the Northern Peninsula sewage treatment works. The proposal involved the construction of treatment works amongst the mangroves at the head of Careel Bay, the treated effluent would then be pumped to the ocean outfall at Warriewood. At the time (1967) Warringah Shire Council was using a large area of the mangroves for garbage disposal and reclaiming the areas for playing fields but the fringing mangroves and extensive seagrass flats were in relatively pristine conditions. As a consequence of objections by the Division of Fisheries based on the loss of productivity of the wetlands which the proposal entailed, the MWS&DB decided to locate both the works and the outfall at Warriewood.

In 1968, the Royal Sydney Yacht Squadron put forward a proposal to transfer its operations from Kirribilli to the head of Careel Bay. This plan involved extensive dredging and reclamation associated with the construction of a marina and related facilities. Although this application had the full support of the Minister for Lands, and other relevant Authorities, the Fisheries Branch objected. The seagrass beds at the head of the Bay were recognised as hauling grounds as defined under Section 32 of the Fisheries and Oyster Farms Act. The placement of any structure, including a dredge would thus have constituted an offence. Marina construction did not proceed.

### Narrabeen Lagoon

The importance of legislation to control undesirable activities is shown in relation to dredging operations in Narrabeen Lagoon. The Lagoon is popular with amateur fishermen but commercial fishing is not permitted and therefore Section 32 of the Fisheries and Oyster Farms Act (used to prevent dredging in Careel Bay) is inapplicable. In 1964, the Fisheries Branch objected at Ministerial level to dredging applications in the Central Basin of the Lagoon, on the basis that this was an area of productive *Zostera* beds. These objections were rejected by both Warringah Shire Council and the Minister for Lands. Commercial sand extraction continued until 1983, when dredging was terminated following a hearing before the Land and Environment Court.

### Georges River

The extensive seagrass beds that once flourished in the estuarine reaches of the Georges River have been smothered by silt and now only isolated patches remain. Georges River was surveyed first by Bass and Flinders in 1796 and in 1810 the township of Liverpool was founded by Governor Macquarie, who considered the river banks suitable for cultivation and pasture. The Liverpool weir was constructed as a town water supply in 1836. In 1870 a proposal was put forward to dam the Georges River for Sydney's water supply. Mr John Young (the contractor for the Sydney Exhibition Building and a person with "considerable experience as an engineer in embanking navigable rivers, constructing canals, weirs etc. in England") considered that - "It is quite practicable to construct a dam at Tom Ugly's or Kangaroo Point at moderate costs, and both safe and secure. There is an absence of mudflats and swamps, cultivation or dwellings of any kind, or in fact anything to contaminate the Water" (Anon. 1870). The "absence of mudflats and swamps" suggests that mangroves were sparse or absent, although Tench (1788) had noted that they were well represented in the shallows and swamps of Botany Bay a century earlier.

Over the period 1887-1913 large quantities of mud were deposited on all the natural beds of oysters in the river killing and smothering many (Roughley 1922). This mud would have been derived from the erosion of the Wianamatta shales which occupy some 49% of the catchment area (Munro *et al.* 1967). It is probable that mangrove spread followed the record flooding at Liverpool and Milperra in the 1870s and the resultant erosion of cleared and cultivated land. Some circumstantial evidence for later increases in mangrove is available. For example, in 1968 the Oatley Flora and Fauna Conservation Society asked the Hurstville Council to preserve the mangroves at the head of Lime Kiln Bay. In reply, the Shire Engineer stated that - "The mangroves in this location are quite a new development" (Minutes of the ordinary meeting of Hurstville Council, 5 September 1968) and later minutes (6 March 1969) record - "The siltation rate in the Georges River and the bays off it is such that the mangrove swamp areas are rapidly increasing. A comparison of the mangrove area in air photos taken in 1937 and those taken in 1962 show a tremendous increase in only 24 years. It is tragic to see the waterways silting to this extent and anything that can rid the river of these unsightly mudflats and foul mangrove swamps should be applauded by everyone". A comparison of mangrove distribution computed from aerial photographs during the 1950s and the early 1960s between Caravan Head and Picnic Point indicated an average yearly increase of approximately two hectares for the decade 1970-1980 (Crooks *et al.* 1973).

### Parramatta River

During the 1960s, the mangroves around the foreshores of Homebush, Horseshoe, Yaralla and Majors Bays and in the vicinity of Hen and Chicken Bay were being reclaimed primarily through landfill by local councils. The Maritime Services Board, together with the Concord Council and the State Planning Authority approved reclamation of the magnificent stand of mangroves around Yaralla Bay. Objections at ministerial level were overruled by the Premier. Objection by staff of the Engineering Faculty of the University of New South Wales and local residents based on hydraulic considerations and aesthetic grounds were eventually heeded by Council and the stand remains.

Also in the 1960s the Maritime Services Board proposed reclamation of extensive stands of mangrove on either side of the waterway in Middle Harbour, above the Roseville Bridge. Objections were raised and in the event the Board allowed dredging and fill of the eastern stand only. This now forms a portion of the Davidson State Recreation area. At the time, the loss of the eastern mangroves was deplored but in retrospect the operation now appears to have been a reasonable compromise, especially if the reclaimed area is available should there be essential dredging operations in the future. If the mangrove area had not been available for spoil disposal, mangroves could well have colonised the whole of the waterway above the bridge, making this area inaccessible to the public and decreasing the capacity for the release of flood waters.

### Brisbane Waters

In the past, large areas of mangroves were lost to landfill but this trend has now been reversed as mangroves spread into silted up backwaters and bays. The rate of accretion is particularly marked in the main creeks (Erina, Kincumber, Narara) and is dependent on the extent of land clearing, erosion and runoff. The extent of change in Erina Creek is indicated in the local history record. In 1885, ship building was a thriving industry and there were few, if any, mangroves. In 1884 a drawbridge spanned the creek which was used by the steamer, *Lone Pine*, which operated as a supply ship until it sunk in World War II. In 1911 the vessel *Gosford II* with a draft of 7 feet 9 inches (2.36 m) was built and launched at 201 The Entrance Road. These and other similar examples led Dundon (1970) to conclude that - "Today's silted up creek is just a travesty of what it was when it was a hive of activity - ships were built, saw mills worked flat out, and numerous small vessels arrived with ballast, emptied along the creek and loaded with timber for Sydney". The 1901 hydrographic survey of Brisbane Water by the Department of Public Works, does not show mangroves along Erina Creek nor Kincumber and Narara Creeks.

### Tuggerah Lakes

Until the 1960s, the two most popular amateur prawning sites in New South Wales were Long Jetty and Canton Beach, in the Tuggerah Lakes, where the substratum was a firm white sand. Now the sand has been covered by a thick layer of black organic ooze supporting dense growths of undesirable weed (*Ruppia*) and macroalgae. In an effort to rid portion of the Lake of accumulated silt, Wyong Council has undertaken an extensive program of shallow water dredging and restoration of a sandy substratum.

## MANAGEMENT

The examples given above outline some of the changes that are occurring in estuaries throughout the State. Sedimentation, siltation and shallowing, and the replacement of sand by silt demand appropriate controls and restoration and rehabilitation works.

In assessing the relative importance of seagrass beds and mangroves, their location is of prime importance. Practically all important fish and prawn species spawn in outside ocean waters. The seagrass beds and mangroves of the estuaries provide the essential feeding grounds and shelter for the young of these species which are most vulnerable to predators at the mouths of rivers and in the entrance channels to coastal lakes and lagoons. Further, the fingerlings of recently spawned fish follow shorelines and if the inter-tidal shallows, mangroves and backwaters adjacent to the entrance are reclaimed, they may fall easy prey to carnivores.

### Mangroves

The historical loss of mangroves can be largely attributed to direct human action; the present rapid spread in some areas is due to past activities within the catchment areas and cannot be immediately remedied.

Up to 1969 an estimated 6.47 km<sup>2</sup> of mangroves had been estimated as lost (West 1985). While some losses continue, mangroves have also increased in area in some locations due to siltation. An example is provided by the colonisation and relatively rapid spread of mangroves from 1964 to 1986 in Wollie Creek, the principle tributary of the Cooks River (Brown *et al.* 1988). A study of the historical distribution of mangroves along the Lane Cove River recorded a dramatic increase in area and distribution extent which was attributed to sedimentation and possible increase in nutrient levels (McLoughlin 1987). Further examples are given by Pelican Island, Port Macquarie which in the early 1960s comprised a few scattered mangroves but is now overgrown as is the remainder of the intertidal shallows of the lower Hastings River and by Cudgera Creek in the Tweed Shire. In 1957, Cudgera Creek was broad and deep with sandy substratum but the sand is now covered with silt and rapidly being colonised with mangroves.

In areas of rapid mangrove expansion, sympathetic consideration should be given to control measures. Appropriate dredging is essential to prevent the eventual loss of open, productive, useable water and to eliminate claims for accreted Crown Lands under the concept of riparian rights (Crown Lands Consolidation Act, 1913). The dredging of channels encircling mangrove stands will provide full tidal ventilation, eliminate dieback, result in island formation and act as a buffer between the land and the mangroves. If mangroves threaten or eliminate waterviews or access to water, it is exceedingly difficult to prevent their destruction particularly if the mangroves were not present when the waterfront block was first purchased. The owner could reasonably claim that he is paying waterfront rates and is therefore entitled to views of, and access to, the waterway. Selective pruning should be encouraged thereby permitting some waterviews whilst preserving the major portion of the mangrove stand. A similar approach could be adopted where rapidly growing mangroves endanger estuarine waterviews from public roads, reserves and foreshore scenic drives.

Whilst it is important to preserve an adequate depth of foreshore mangroves, their productivity is not directly related to area. Investigations indicate the midstream water movement appears to be a significant source of aeration and there could be a significant reduction in productivity from the front to the back of the mangrove stand (Burchett *et al.* 1984). In areas of rapid siltation and mangrove expansion it may be necessary to accept some loss of inshore mangrove for spoil disposal sites with dredging of deposited material fronting mangroves so that mangroves will not establish at the forward or outer margin. The destruction of such areas would be more readily acceptable where popular recreational waters are threatened, and a biting mite or mosquito problem exists.

### Seagrasses

Except for essential public needs, dredging in productive seagrass beds is objectionable. This comment applied to *Zostera capricorni* and *Posidonia australis* but not to *Ruppia*, which often occurs in hyposaline waters of coastal lagoons and lakes. Whilst *Ruppia* provides protection for fish, its prolific growth restricts the use of waterways, especially the operations of watercraft and both amateur and commercial angling. It is apparently not a major source of food for fish, and the *Ruppia* community does not support a rich benthic fauna. Its dense growth also restricts water circulation. Fortunately, its small rhizome system makes it susceptible to major storms and flooding and, at these times, it is dislodged and swept to sea.

Many of the coastal lagoons and lakes have extensive shallow seagrass flats in close proximity to the shoreline. Dense mats of filamentous algae can be trapped with these seagrasses resulting in water stagnation, restricted use of the waterway and difficult access to the foreshore. The deposition, by wind and wave action, of decaying seagrasses and algae along the shoreline results in major odour problems. In these areas the dredging or swamp dozing of open-ended foreshore channels with direct connection to the deeper water should be encouraged. Channel formation will permit underwater decay and eventual flushing of some of the entrapped weeds and also provide better circulation and ventilation for the offshore seagrass flats.

## DEVELOPMENT GUIDELINES

Some suggestions are offered here for guidelines in relation to specific types of development. In addition to changes occurring in the tidal waterways themselves there are potential impacts in the adjacent areas where appropriate policies have been required.

### Canal Developments

Gawley Bay in the Georges River was the site of the first artificial canal development (Sylvania Waters) in New South Wales. The Bay was privately owned (title acquired by the Hon. T. Holt, MLA in 1866) and therefore development did not require the consent of Government Authorities. However, at the time of construction of the estate in the 1960s, a number of applications were received for this type of development, adjacent to non-tidal waters or waters with limited tidal range. It seemed obvious that inadequate water circulation and hence stagnation and pollution would result if such developments proceeded. Estuaries then proposed for canal type development included Lake Illawarra, Narrabeen Lagoon and Budgewoi Lake (Tuggerah Lakes). To preclude further applications in similar waterways, a policy was adopted requiring the parent estuary to have a mean tidal range of not less than one foot (0.3 m) before the proposal would be considered. The canal depth was restricted to 6 feet (now 2 m) at mean low water to keep the substratum within the euphotic zone and thus permit photosynthesis and the potential colonisation of the canal bed by seagrasses. The limits were based on "best judgement" at that time and not on any scientific studies. The one foot (0.3 m) minimum tidal range was introduced as a guide only for both sewered and non-sewered areas, and has no direct relationship to flushing rates. With the passage of time, these general guidelines have become specific conditions for canal developments.



Mangrove destruction prior to reclamation, Canada Bay, Paramatta River, New South Wales. Late 1960's.



Sylvania Waters, Gawley Bay, Georges River, 1968. The first canal type development in New South Wales. Note vertical walls.

### Mineral Sands Mining

Until late 1960s, mineral sand mining was permitted to the edge of the waterway and, in some cases, into the estuary itself. Mining resulted in wind-blown sand and tailings smothering aquatic fauna and flora, erosion of the natural foreshore, rapid siltation and shallowing, and reduction in water surface area. The adverse effects were particularly marked in parts of New South Wales in such areas as Jerusalem Bay, Womin Lake and Lagoon, and Cudgen and Mooball Creeks. A policy was then adopted requiring a buffer strip of vegetated land at least 100 feet (30 m) wide between the area approved for mining and the adjacent waterway.

### Structural Flood Mitigation Operations

State Fisheries had been concerned since the early 1960s with the effects of flood mitigation operations on the aquatic environment but then there was little liaison between the responsible Government Authorities. Until 1969, the controlling Authority was the Department of Public Works.

In 1969, following representations by State Fisheries, it became necessary for County Councils to carry out cost/benefit studies and obtain the approval of both Fisheries and the National Parks and Wildlife Service before flood mitigation works commenced.

Flood mitigation works damaging to the aquatic environment did continue after 1969 but Councils justified these activities on the grounds that approval had been given prior to this date, or that the works involved the replacement or ungrading of existing structures only.

### CONCLUSIONS

In the 1960s and 1970s, development proposals in estuaries were largely uncontrolled, and this resulted in many conflicts and ultimately in new legislation. This legislation proved inadequate which led to the Division of Fisheries to change its Act, and eventually resulted in the State Environmental Planning Policy on Coastal Wetlands. Some people may feel that now there are perhaps too many controls, not allowing estuaries to be cleared of the silt (and resulting mangroves) which has accumulated from bad land management. There is, therefore, the need to rethink policies and adopt a compromise approach. Mangrove productivity is important in estuaries but management must balance expansion of mangrove areas due to accretion against other values of the estuaries. Consideration should be given to controlled dredging and reclamation to remove accreted mudflats resulting from erosion within the catchment, to restore the tidal prism and dilute pollutants, to restrict the spread of mangroves and to provide accessible waterways. Selective pruning, lopping and hedge formation of mangroves may be appropriate.

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