Marine Farming Development Plan

Storm Bay off Trumpeter Bay
North Bruny Island

July 1998

Glossary

anoxic	Limited supply of oxygen in the sediments
DELM	Department of Environment and Land Management
DPIF	Department of Primary Industry and Fisheries
GPS	Global Positioning Systems
MRLs	Maximum Residual Levels
NASAT	Navigation and Survey Authority of Tasmania
Oxic	Plentiful supply of oxygen in the sediments
Photic Depth	Depth of water to which light penetrates
ppt	Parts per thousand

Species Glossary

Atlantic Salmon	*Salmo salar*
Blue Fin Tuna	*Thunnus maccoyi*
Rainbow Trout	*Oncorhynchus mykiss*
Striped Trumpeter	*Latris lineata*

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

The coastal zone of Tasmania is recognised as a valuable environmental, social and economic resource that can cater for a wide range of activities. One important economic use of the Tasmanian coastline is marine farming. Since the establishment of shellfish farming in the 1960's and finfish farming in the 1980's, the marine farming industry has grown rapidly over the last 10 years and now contributes over $100m to the Tasmanian economy.

It is expected that the industry could double in size over the next 5 years. The salmon industry is considered to have the potential to increase production by 50% over this 5 year period. The expansion of the industry will lead to increased employment opportunities and extra export income for the State, but in doing so, will require additional coastal waters for marine farming to allow for the projected expansion.

The Tasmanian State Government recognised the need for a policy direction to guide the management of the State's coastal resources on a sustainable basis. As a result the Government initiated a number of coastal management reforms including the introduction of a *State Coastal Policy* , the *Living Marine Resources Management Act 1995* and the *Marine Farming Planning Act 1995*.

Part of the coastal management reform was an understanding that no new marine farming leases would be approved without the approval of a Marine Farming Development Plan. The State Government have prepared Marine Farming Development Plans for many of the aquaculture regions of the State including the Huon and Port Esperance, D'Entrecasteaux Channel, the Tasman Peninsula and Norfolk Bay. Draft Plans have been prepared for the Furneaux Islands, Georges Bay and Great Oyster Bay. New Plans are currently being prepared for Macquarie Harbour, Smithton, Pipeclay Lagoon and Pittwater coastal areas in the State.

The objectives for marine farming development plans are to achieve well-planned sustainable development of marine farming activities having regard to the need to:

a) integrate marine farming activities with other marine uses; and

b) minimise any adverse impact of marine farming activities; and

c) set aside areas for activities other than for marine farming activities; and

d) take account of land uses; and

e) take account of the community's right to have an interest in those activities.

Nortas Pty Ltd has been an industry leader in researching and trialing the feasibility for offshore finfish farming within the State. During 1996 the company had an exploratory licence for a site in Storm Bay off Trumpeter Bay, some 1.5 kms offshore of North Bruny Island. The results of the trial have demonstrated the feasibility for the company to proceed towards a significant investment into offshore marine finfish farming in the future. Map 1 shows the general location of proposed marine farm zone in relation to Bruny Island.

No previous Marine Farming Development Plan had been prepared for Trumpeter Bay and this Plan was commissioned by Nortas Pty Ltd in order to facilitate the approval process for establishing an offshore marine farming operation.

1.2 STRUCTURE TO THE PLAN

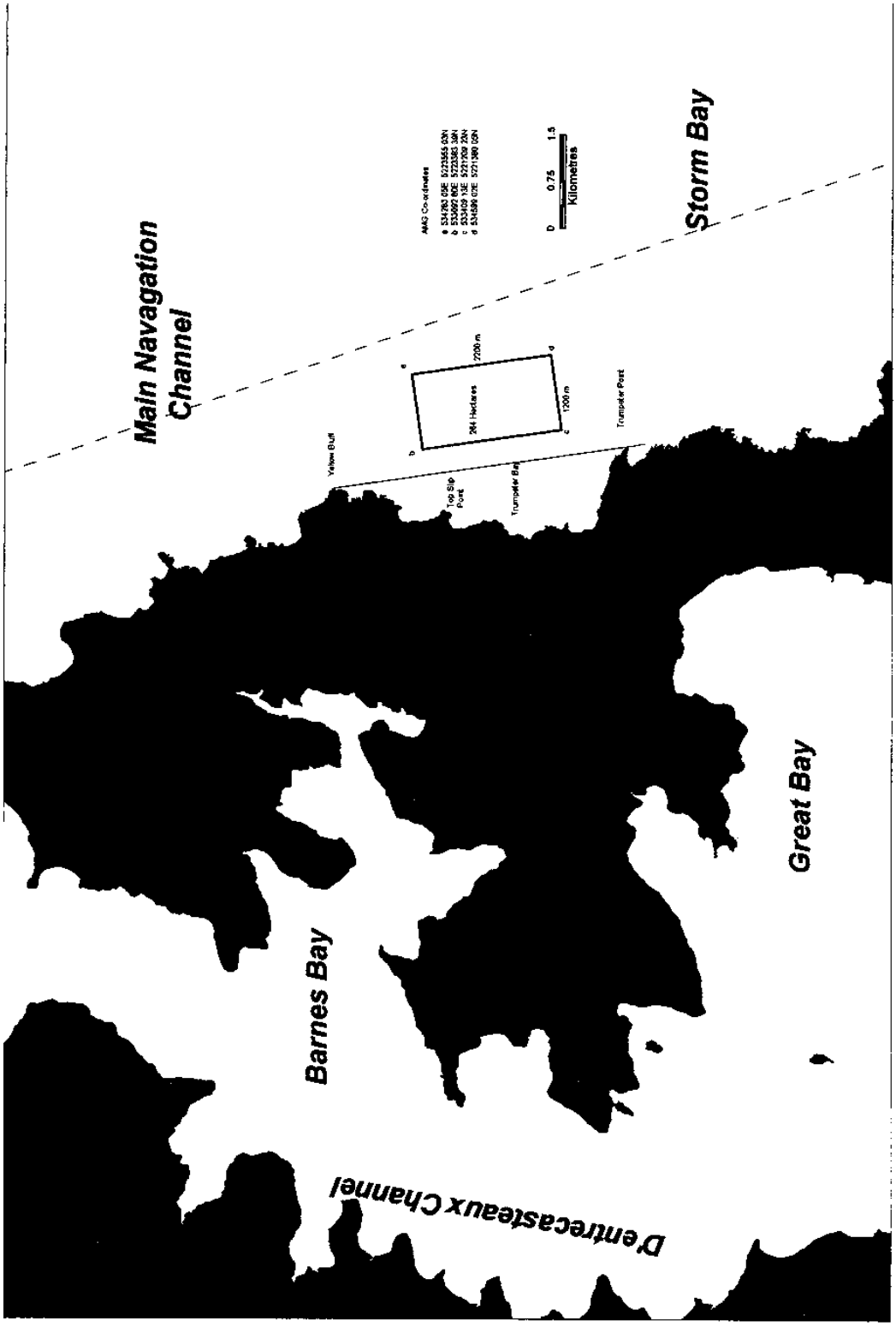
The Plan is divided into three sections.

Section 1 provides an introduction to the basis for preparing the Marine Farming Development Plan for Trumpeter Bay, and an outline of the key aspects of the proposed development.

Section 2 provides a summary of the location, past marine farm history of the site, environmental conditions, proposed marine farm operations, assessment of potential impacts and details of the zone characteristics.

Section 3 recommends the management controls that should apply to the approval of the proposed marine farming zone at Trumpeter Bay.

Attachment 1 identifies the general impacts of finfish marine farming including ecological impacts, marine use impacts and land use impacts. This is based on a review of past research undertaken overseas and within the Tasmanian marine environment.



Map 1 : Location of Trumpeter Bay

1.3 BASIS FOR PROPOSED MARINE FARMING ZONE

The identification of the proposed marine farming zone has taken into consideration:

- the current policy framework;
- the suitability of the site conditions;
- the operational requirements for a feasible marine farm operations;
- minimising impacts on the marine environment;
- minimising potential impacts and conflicts with other marine users; and
- minimising potential impacts and conflicts with land uses.

Opportunities for consultation were arranged with representatives of DPIF, Kingborough Council, Hobart Ports Corporation, Tasmanian Fishing Industry Council, DELM (Planning, Parks and Wildlife, Environment), Tasmanian Conservation Trust, Hazell Bros Group, Tasmanian Aquaculture Council, Tasmanian Recreational Fisherman's Association and Recreational Sailing Groups. A local community meeting was organised on North Bruny Island during early October 1997 to present an outline of the proposed Marine Farm Development Plan.

The environmental conditions and operational prospects at Trumpeter Bay are considered to be highly suited to finfish farming. These aspects include:

- being reasonably well protected from prevailing westerly winds;
- the industry having the technology, skills and operating practices to handle the predicted extreme wave conditions that can arise with southeasterly storms;
- having good depths of 25-35m across the proposed site;
- consistently strong current and ideal water temperatures for finfish farming;
- having water conditions suited to low risks of disease and mortality rates;
- very low risks of algae bloom problems ever reaching the site; and
- having sediment and bethnic fauna that is characteristic of other southeastern waters, generally with low conservation value.

In addition the marine farming operation would benefit from the regional advantages of southeastern Tasmania which is well serviced by transport and processing infrastructure,

available skilled labour and having close proximity to airports for exporting of products overseas and interstate.

The proposed marine farming zone would have minimal impacts on land use activities within Trumpeter Bay given all the surrounding land is currently in one ownership, this owner is supportive of the marine farm development proposal, and that the proposed zone is located a significant distance offshore.

The proposed marine farming zone would have minimal impacts on marine use activities given the location offshore. There would be no conflict with commercial and recreational fishing that occurs closer to the coast. The zone has been positioned outside of the main navigational route for shipping routes off North Bruny Island.

1.4 POTENTIAL BENEFITS

The proposal has a number of major benefits for the State including:

- placing Tasmania at the leading edge of innovative marine farming practice in the world for offshore finfish marine farming;
- providing a catalyst for initiating major new investment in the industry associated with the potential for significant offshore marine farming ventures in the future;
- meeting demand for increased production of finfish in the industry;
- avoiding the range of conflicts which can often occur with other marine users and land activities, when marine farming occurs in sheltered inlets and waters; and
- creating a range of economic benefits to the State including new local employment opportunities on Bruny Island, increased export income and support to service industries.

SECTION 2
MARINE FARM DEVELOPMENT ZONE

This Section provides a summary of the location, environmental conditions, proposed marine farm operations, potential impacts and zone characteristics.

2.1 LOCATION

The area covered by this draft plan is located on the eastern side of North Bruny Island, approximately 1.5 kms seaward of Trumpeter Bay. The northwestern corner of the zone is about 1.4 kms southeast of Yellow Bluff and the southwest corner is about 1.3 kms to the northeast of Trumpeter Point. At a point due east of Top Slip Point the distance from the plan area to land is about 1 km. The location of the plan area is shown in Map 2.

The zone area for the draft plan is the same as the plan area as defined above.

2.2 ENVIRONMENTAL CONDITIONS

Wind and Wave Exposure

The site is reasonably well protected from the southwest - northwest winds, although strong northwest gales can provide choppy wave conditions. The site is more exposed to southeast winds and seas, but these are typically uncommon during summer periods. However a strong southeast gale can be expected every 2-3 years. Strong northeast winds would typically generate up to 3m waves at the site.

The most extreme wave conditions are from southerly seas. The CSIRO (1996) undertook a prediction of wave conditions at Trumpeter Bay based on an assessment of an eight year program of wave observations at Wedge Island[1]. The prediction of extreme wave conditions over a ten year period was for a wave height of 9.64 m with a mean event duration of 20 minutes. It was stressed that the prediction is only a tentative estimate, until such time as more detailed wave measurements can be taken. The maximum wave height observed at the site during the exploratory lease period was 6m. Discussions with local people indicated that swells were normally less than 2m and any waves greater than 4m were infrequent conditions.

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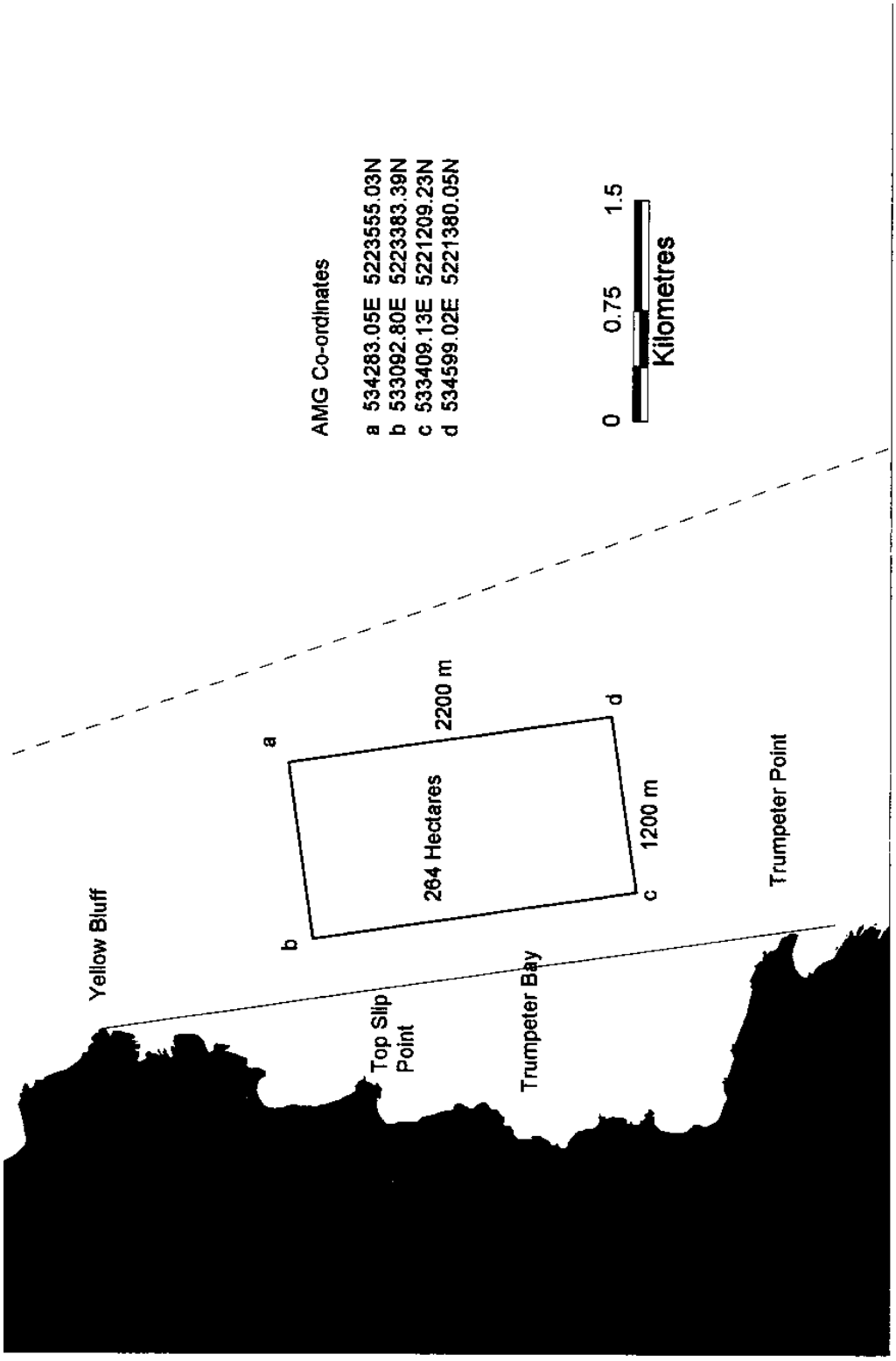
[1] Wedge Island is located some 20 kms to the east of Trumpeter Bay within Storm Bay and both sites are similarly exposed to southerly seas. The Wedge Island site is more exposed to westerly winds than the Trumpeter Bay site, but not so exposed to easterly winds. Trumpeter Bay has 30m depth of water compared with 40 m at Wedge Island, but the latter is closer to the shelf edge and it is likely to experience slightly rougher conditions than Trumpeter Bay.



Map 2 : Location of Proposed Marine Farming Zone in Trumpeter Bay

Depth and Currents

The depth of the site varies between 25-35 m. Water depths are within 20-30 m at 1km to the east of the proposed western zone boundary, and between 30-40 m at one km to the west of the proposed eastern zone boundary. By way of comparison, depths of up to 20m are still found within 200m of the shoreline.

A current meter was installed on the exploratory lease for 5.5 months during September 1996 to early February 1997. Problems with equipment failure prevented reliable data records to be gathered. However experimental work indicated a prevailing current running parallel to the shore (north west and south east) of a consistent strong flow with a minimum of 5 cms / sec. The assessment of bethnic conditions were also suggestive of very low levels of natural deposition within the site from the receiving waters.

Salinity and Water Temperatures

Salinity measurements showed about 35 ppm during September to December months with a general decline over the summer months to about 30 ppm by early February.

Temperature measurements indicated a range of 11.5 ^{0}C to 13.5 ^{0}C during the period September to December with increasing temperatures between 14 ^{0}C to 18 ^{0}C over the summer months. This suggests milder water temperatures than might have been expected over the winter months for such a location. The water temperatures over the summer months are cooler than those conditions found at inshore locations within the D'Entrecasteaux Channel where farming typically occurs in much shallower waters.

The water conditions have led to excellent fish appearance in the exploratory trial with good growth rates being recorded. It is expected that the favourable water temperatures will result in better fish health than inshore farming locations, along with lower mortality rates. Due to the consistent water flow at the site and favourable water temperatures, it is also expected that the bathing of fish will be less often than inshore farm sites. The water conditions and low nutrient waters are unlikely to cause algae bloom problems at the site.

Sediment and Biological Quality

Aquahealth et al (1996) assessed sediment and biological quality at two sites within the exploratory lease (100m apart) and two control sites off the lease site (1.4 km apart), prior to placement of the exploratory fish cage.

The bottom was found to be typically sand with minor corrugations. Across all four sites the sediment profile was typically yellow sand to a depth of 3-4 cm, and then becoming a yellow-brown sand at further depths. The sediments had a clayey nature and gritty content (mainly due to fine shell fragments). Rocks and boulders were not observed.

The pH values of sediments ranged between 7.79 and 8.18, reflecting the marine conditions. Temperature values ranged between 9.8^{0}C and 12.5 ^{0}C, reflecting the winter sampling period. The Eh values ranged between 303 and 310 mV and this indicated that the water column was well oxygenated at the surface, with the Eh value decreasing with increasing sediment depth. The % Loss-On-Ignition values ranged between 2.6% and 3.7%, indicating a low to moderate level of organic enrichment.

The density of invertebrates (average density of 1340 individuals per m^2) was within the range for those found in other South East Tasmanian sites (eg. Nubeena, South Roaring Beach and Great Taylors Bay). However the average richness of the Trumpeter Bay site was lower than these other South East Tasmanian sites. The number of individuals and taxa were also much lower than those recorded for shallow inshore habitats by Moverley and Jordon (1996).

Crustaceans accounted for 50% of the 55 taxa identified at the sites. The dominant biomass was the New Zealand screwshells. Small pipis and hermit crabs were occasionally present at all the sites.

2.3 FUTURE POTENTIAL

The environmental conditions at Trumpeter Bay are considered to be highly suited to finfish farming. These aspects include:

- being reasonably well protected from prevailing westerly winds;
- the industry having the technology, skills and operating practices to handle the predicted extreme wave conditions that can arise with southeasterly storms;
- having good depths of 25-35m across the proposed site;
- consistently strong current and ideal water temperatures for finfish farming;
- having water conditions suited to low risks of disease and mortality rates;
- very low risks of algae bloom problems ever reaching the site; and
- having sediment and bethnic fauna that is characteristic of other southeastern waters, generally with low conservation value.

The zone does not require land based processing or servicing facilities to be located within Trumpeter Bay as marine farming operations can be serviced by a large vessel from existing shore-based facilities in the D'Entrecasteaux Channel area. However the future marine farm operator may require arrangements with the Hazell Bros Group for access to the small boat

ramp at Trumpeter Bay for emergency situations where staff were required to be transferred to shore for safety or other reasons. The ramp may also allow night security staff to be onshore, if the sea conditions were adverse. The Kingborough Council does not support any further developments onshore at Trumpeter Bay, other than those previously outlined.

Given the off shore location and deeper water, the cages will need to be individually moored. With water depths of 25-35 m across the proposed site, the mooring lines will need to be about 100m - 120m. Assessment of development potential indicates the need for a zone of about 264 ha. A 2.2km by 1.2km zone is proposed with the longest section being parallel to the coast, so as to minimise extension of the zone towards the shipping route for vessels proceeding around southern Tasmanian waters to Hobart, or vice versa.

It is recommended that the maximum leasable area be 200 ha as there is unlikely to be any need for fallowing of the site given the water depths, current flow and spacing of cages within the zone.

The stocking densities are likely to be 10-15 kg / M^3 due to rougher water conditions.

2.4 IMPACT ASSESSMENT

2.4.1 Environmental Impacts

Appendix 1 (Section 1.1) provides an outline of the potential ecological impacts of finfish farms based on a review of Australian and overseas research. It refers to the potential impacts associated with:

- fish and fish food;
- use of chemicals;
- operational wastes;
- diseases;
- species escapes; and
- predator control.

Impacts on the water quality and seabed in the vicinity of marine farms are not obvious, and some coastal communities are concerned that long-term ecological damage may be occurring within coastal waters. They are concerned that there is insufficient environmental investigations into the long term impacts of nutrients within coastal waters and the lack of baseline monitoring of water quality generally outside of the marine farms. They are also concerned that farming an introduced species of fish in unnaturally high densities could result in disease outbreaks affecting native fish stocks, or that an introduced species could become established in the wild as a pest.

These issues have been identified with marine farming in general and will need to be addressed through an extensive research and monitoring program undertaken by the Government in partnership with the industry. In the interim, the Marine Farming Development Plans are requiring marine farmers to meet a range of environmental management controls relating to carrying capacity, monitoring and other operational aspects (as outlined in Section 3).

Discussions with Parks and Wildlife (DELM) indicated that whales, mainly the migrating humpback and southern right whale, are using both the D'Entrecasteaux Channel and offshore waters for migrating along the coast. The main concern raised was with the possibility of cage layout 'entrapping' whales making it too narrow for manoeuvring. However given the water depths there will be considerable distance between cages (a minimum of about 200-240m between cages) and this limits any such problems arising. Similarly the mooring lines are substantial anchors and unlike pot ropes, would not become entangled with the whales.

2.4.2 Land Uses Impacts

Appendix 1 (Section 1.2) provides an outline of the potential impacts of marine farming on land use including:

- visual impacts with farming equipment, floating structures, lighting, debris and general layout of the farm;
- noise levels; and
- perceived loss of property values.

The immediate coastline is contained within the Murrayfield farm property which is owned and managed by the Hazell Bros Group. The land holding extends at least 3kms to both the north and south of the northern and southern boundaries of the proposed zone. Some 1200-1800 ha of the farm are worked as a cattle property with the remaining land being managed as bushland. Hazell Bros are managing the property to meet ISO 9002 quality standards and have taken a number of measures to sustainably manage the land resources (eg. fencing the coast to prevent stock access, identification of land hazards, incorporating landcare practices).

A number of farm facilities are located at Trumpeter Bay, some 2.5 kms from the southwestern corner of the proposed marine farming zone. These facilities include farmhouses, shearing shed, feeder and barn. A small boat ramp exists on the foreshore. A public access road exists to the three shacks, located some 400m in from the foreshore. There is no public access beyond this point to the coast. There are no coastal reserves along the immediate coastline between Yellow Bluff and Trumpeter Point.

There are no sewer outlets, stormwater outlets, jetties or other public facilities within Trumpeter Bay. There are five small creeks that flow into Trumpeter Bay, none of which are longer than 1km or flow all year round.

The existing land use activities at Trumpeter Bay will have minimal impact on the marine farming operation, as the activities do not cause any adverse impacts on the water quality in Trumpeter Bay.

The proposed marine farm will also have minimal impact on the land activities given the distance offshore and proposed means of operating the marine farm. The marine farm will have some visual impact given the necessity for the siting of cages, night lights, navigation lights and mooring of vessels at the site. The marine farm site represents about 35^{o} of a total 100^{o} water view from the land. It will be seen in the 'mid ground' of the extensive view to the horizon but will not block any of the panoramic views as seen from the land. The distance of the proposed farm from the shore and orderly layout of the farm will also minimise the visual impact. Noise and perceived loss of property values are not considered to be significant or relevant issues with the proposed marine farm.

2.4.3 Marine Use Impacts

Appendix 1 (Section 1.3) provides an outline of the potential impacts of marine farming on other marine uses including:

- navigation; and
- loss of public access to some areas for recreational, commercial or other interests.

Consultation with the Hobart Ports Corporation indicated that the main navigation consideration on the eastern side of Bruny Island is for ships coming around the southern coast of Tasmania heading for the Port of Hobart (or possibly Port of Electrona in future years) or for ships leaving these ports and heading south. The navigation route bearing was a 164^{o} course from 2.5 nautical miles seaward of Cape Queen Elizabeth to the Port Huon / Electrona marker (refer to maritime charts) at the mouth of the Derwent River. The navigation route is shown in Map 2 and indicates a course that is 1.4 nautical miles seaward of Trumpeter Point and 1.0 nautical mile seaward of Yellow Bluff. Allowing a minimum 500m navigation 'buffer' to western side of this navigation line, helps sets up the outer zone boundary for the proposed marine farm zone. This would allow the northwest seaward marker to be about 1km off Top Slip Point and the southwest seaward marker being about 1.1 kms to the northeast of Trumpeter Point.

Commercial fishing for crayfish is known to occur along the reefs close to the coastline within Trumpeter Bay. Some recreational fishing and diving may also occur close to the coast, especially over the summer period when there are favourable weather conditions. No commercial or recreational fishing is known to occur within the proposed marine farm zone. The distance of the marine farm off-shore would not cause any significant conflicts with continued access and use by commercial or recreational fishing users within Trumpeter Bay. Discussions with the Tasmanian Fishing Industry indicated the need to inform all licensed fishing operators within the State about the zone, preferably by direct mail to each operator. A Notice to Mariners would also need to be issued.

Depending on weather conditions, some boats may occasionally anchor in the southern part of Trumpeter Bay or possibly within some of the small bays either side of Top Slip Point. The proposed marine farming zone would not interfere with access to these locations, nor occupy any other known anchorage points along the coast.

Yachts using the waters on the eastern side of Bruny Island would have sufficient waters to navigate around the proposed marine farm, including between the coast and the western edge of the proposed zone (distance varies between 1km - 1.6kms). The requirement for approved navigational lights to mark the lease boundaries, alterations to maritime maps and the overall size of the lease would also alert sailors to the existence of the operation. This can also be beneficial to mariners in emergency mooring situations, break-downs and as a refuge for damaged vessels.

2.5 RECOMMENDED ZONE

The recommended marine farming zone is shown in Map 2. The co-ordinates of the proposed zone are:

Point	Easting	Northing
a	534283.05E	5223555.03N
b	533092.80E	5223383.39N
c	533409.13E	5221209.23N
d	534599.02E	5221380.05N

The zone is 264 ha with a maximum leasable area of 200 ha, which allows for the future development potential of the zone. The species allowed to be farmed would be finfish

SECTION 3
MANAGEMENT CONTROLS

This Section recommends the management controls that should apply to the approval of the proposed marine farming zone at Storm Bay off Trumpeter Bay.

Appropriate measures are also required to satisfactorily manage and mitigate any negative effects which the draft plan might have. These measures are included in the requirements set out below.

3.1 GENERAL CONTROLS

The lessee shall comply with the environmental controls relating to:

- general environmental impacts (Section 3.1.1);
- carrying capacity (Section 3.1.2);
- site monitoring (Section 3.1.3);
- use of chemicals (Section 3.1.4);
- waste (Section 3.1.5);
- management of disease risk (Section 3.1.6);
- visual impacts (Section 3.1.7); and
- access and safety (Section 3.1.8).

3.1.1 General Environmental Impacts

(i) There must be no unacceptable environmental impact 35m outside the boundary of the marine farming lease area. Relevant environmental parameters must be monitored in the lease area, 35m from the boundary of the marine farm lease and at any control site(s) in accordance with the requirements specified in the relevant marine farming licence.

3.1.2 Carrying Capacity Controls

(i) The maximum stocking density of salmonid fish is 25 kg / m^3.

(ii) The lessee must ensure that farmed areas are fallowed as soon as practicable after bubbles of hydrogen sulphide and methane gases form in the sediment and rise to the surface.

(iii) Salmonid finfish nets must be at least 1m clear of the seabed at low tide under normal growing conditions.

3.1.3 Monitoring Controls

(i) The lessee for the finfish farm must comply with the Environmental Monitoring Program for finfish as specified in the relevant marine farming licence. The lessee must provide the following information on an annual basis to the Marine Resources Division (DPIF):

a) total quantity of fish feed used on the lease area per year;

b) a list specifying the quantities of therapeutic treatments, pesticides, anaesthetics, antibiotics, hormones, pigments, antifoulants, disinfectants, cleansers and any other potentially harmful materials which may have been release in the lease area to the marine environment; and

c) location and size of stocked cages on the lease area and areas being fallowed.

(ii) Environmental data is to be collected and analysed to specified standards at the finfish lease area by persons approved and authorised by the Marine Resources Division (DPIF). The monitoring requirements for collection, reporting and analysis are detailed in the relevant marine farming licence.

(iii) The lessee is required to ensure that an annual underwater survey to assess the extent of marine farming-derived organic sedimentation and the degree of impact on the benthic community is conducted as specified in the relevant marine farming licence.

(iv) For all new lease areas being established, and for all expansions greater than 10% to the existing marine farming lease area, a baseline survey is required before the marine farming operations commence. Data to be collected may include but is not limited to sediment particle size analysis, organic carbon content of the sediment, redox potentials, water flow rates, current flows and composition of the benthic

community. Assessment of baseline environmental data will be used to determine future management and monitoring requirements of the lease area.

(v) For all new lease areas being established, and for all expansions greater than 10% to the existing marine farming lease area the composition of benthic communities will be assessed to determine whether the area to be farmed contains any rare and endangered species or any unusual habitat.

3.1.4 Chemical Controls

(i) All chemical use must comply with the requirements of the *Agricultural and Veterinary Chemicals (Control of Use) Act 1995*.

3.1.5 Waste Controls

(i) Wastes from harvesting or processing of produce from the marine lease area and from the removal of fouling organisms from marine farming structures and equipment, such as nets, must be disposed of in a manner that does not affect the ecology of the marine environment or nearby shorelines.

3.1.6 Disease Controls

(i) Any suspected disease must be notified to the Department of Primary Industry and Fisheries in accordance with the *Animal Health Act 1995*.

(ii) The lessee shall comply with the appropriate industry health surveillance programs and health control measures.

3.1.7 Visual Controls

(i) Given the offshore location of the marine farming lease, the lessee should take measures which improve the visibility of the marine farming structures and equipment on the marine farming lease area to other marine users. All buoys and other floating marine farming structures and equipment on the sea must be of bright colours (eg. yellow, blue), or be any other colour that is specified in the marine farming licence;

(ii) Regardless of satisfying (i) above, the lessee should aim to reduce the overall visual impacts of the marine farming lease through such measures as:

(a) keeping the lease area neat and tidy in a manner required by the Secretary (DPIF);

(b) taking care with the aiming and brightness of security and spot lights so as not to cause unnecessarily adverse effects on the amenity of residential properties;

(c) ensuring, where possible, that lights are shielded from all but essential directions (spot lights must be positioned as high above the water as practicable to maximise penetration and minimise reflection) and not to cause any interference with navigation;

(d) ensuring, wherever possible, that marine farming structures and equipment be low in profile and be of a uniform size and shape;

(e) removing redundant or dilapidated marine farming structures and equipment from the lease area at the request of the Secretary (DPIF);

(f) preventing floating storage huts, grading facilities and shelters from being located within the lease area unless authorised under the relevant marine farming licence.

3.1.7 Access and Safety Controls

(i) The lessee must identify the lease area in a manner specified by the Secretary (DPIF).

(ii) The lessee must mark the external boundaries of the lease area in whatever manner is required by the Secretary (DPIF) and by the relevant authority under the provisions of the *Marine Act 1976.*

(iii) Anchors and mooring lines that extend outside the lease area must be at least 5 m below the surface at the boundary of the lease area.

(iv) If any part or parts of marine farming structures or equipment break away from the lease area, the lessee must take action as soon as reasonably possible to return the marine farming structures and equipment to the lease area, to secure the marine farming structures and equipment and to tidy up any area affected by the debris.

3.2 OTHER CONTROLS

(i) The lessee must comply with any other Act or regulations that may affect the lease area or the marine farming operations in that lease area.

(ii) The lessee must ensure that marine farming operations meet the Department of Environment and Land Management guidelines on noise levels, as required under the *Environmental Management and Pollution Control Act 1994.*

(iii) Lessees must ensure any predator control of protected species is conducted with the approval of the Parks and Wildlife Service of the Department of Environment and Land Management.

(iv) The lessee must permit the Minister, or persons authorised by the Minister, to enter into and inspect the lease area at all reasonable times.

(v) The lessee must comply with all lawful written requirements of the Minister.

REFERENCES

Aquahealth and Seatech Australia Pty Ltd, 1996. Sediment and Biological Quality at Trumpeter Bay, Bruny Island, Report prepared as part of the environmental data requirements for the NORTAS Exploratory Marine Farm Licence.

Davies, J B, 1988 Land Systems of Tasmania Region 6: South East and Midlands - A Resource Classification System. Department of Agriculture, Tasmania.

CSIRO Division of Oceanography, 1996. Prediction of Extreme Wave Conditions at Trumpeter Bay, Report OMR - 83/93.

Gowen, R J, 1991. Aquaculture and the Environment. N De Pauw and J Joyce (eds), European Aquaculture Society Special Pub

Gowen, R J and Rosenthal, H, 1993. The environmental consequences of intensive coastal marine farming in developed countries: what lessons can be learnt, p 102-115. In R S V Pullin, H Rosenthal and J L Maclean (eds) Environment and Marine Farming in Developing Countries; ICLARM Conf. Proc. 31, 359 p.

Harris G P, Griffiths F B, Clementson L A, Lyne V and Van der Doe H 199 Seasonal and interannual variability in physical processes, nutrient cycling and the structure of the food chain in Tasmanian shelf waters: Journal of Plankton Research Vol 13 pp 109-131.

Harris G P , Griffiths F B and Clementson L A; 1992, Climate and the Fisheries of Tasmania- Interactions of Physics, Food Chains and Fish; S. Afr. J mar Sci. 12: 585-597

Harris G P , Nilsson C, Clementson L A and Thomas D; 1987; The Water Masses of the East Coast of Tasmania: Seasonal and Interannual Variability and the Influence on Phytoplankton Biomass and Productivity; Aust. J Mar. Freshw. Res., 38: 569-590.

Hecht, T and Britz, P J, 1992. The current status, future prospects and environmental implications of mariculture in South Africa. Suid-Afrikaanse Tydskrif vir Wetenskap 88, 335-342.

Horwitz, P and Blake1 G, 1992. The benthic macrofauna of sludge-affected sediments in the Derwent estuary, southern Tasmania. Pap. Proc. R. Soc. Tasm. 126, 67-72.

Johannessen, P J, Botnen, H B and ÿ F Tvedten, 1994. Macrobenthos: before, during and after a fish farm, Aquaculture Fish. Manage. 25, 55-66.

MacLeod, C, 1996. Environmental Monitoring - Marine Benthos, SALTAS R & D Report, 193-211.

Moverley J and Jordon A, 1996. Biological Surveys of Inshore Soft-bottom Communities in Tasmania. Final report to the Australian Nature Conservation Agency- Ocean Rescue 2000, DPIF.

Pearson, T H and Stanley, S O, 1979. Comparative measurement of the redox potential of marine sediments as a means of assessing the effect of organic pollution. Mar. Biol. 53, 371-379.

RAC Coastal Zone Study Enquiry: Tasmanian Case Study, 1991.

Ritz, D A, Lewis, M E and Ma Shen, 1989. Response to organic enrichment of infaunal macrobenthic communities under salmonid cages. Mar. Biol. 103, 211-214.

Smith, H and Haig, J N, 1991. The development of a control policy for fish farming. J Inst. Wat. Environ. Manage. 5, 641-648.

Warwick, R M, 1986. A new method for detecting pollution effects on marine macrobenthic communities. Mar. Biol. 92, 557-562.

Woodward, I O, Gallagher, J B, Rushton, M J, Machin, P J and Mihialenko, S, 1992. Salmon Farming and the Environment of the Huon Estuary, Tasmania. Technical Report No. 45, Division of Sea Fisheries, Tasmania.

Ye, Li-Zun, Ritz, D, Fenton, G and Lewis, M, 1991. Tracing the influence on sediments of organic waste from a salmonid farm using stable isotope analysis. J Exp. Mar. Biol. Ecol. 145, 161-174.

APPENDIX 1
ECOLOGICAL, MARINE USE AND LAND USE IMPACTS OF MARINE FARMING

Ecological impacts within the marine environment can relate to the farmed fish species and food sources, use of chemicals, management of wastes, risk of disease, escape of introduced species and the control of predators. Whilst many of these impacts have been researched and operational practices changed to minimise possible impacts, there are still shortfalls in the data about the marine environment and the impacts of marine farming activities. For instance the long term impacts on water quality and seabed outside the marine farms are not well researched, and some coastal communities are concerned that long-term ecological damage may be occurring. There is also some concern that farming an introduced species of fish in unnaturally high densities could result in disease outbreaks affecting native fish stocks, or that an introduced species could become established in the wild as a pest.

The potential impacts on human use and values of the coast are more readily identified and can often be addressed through the siting, design and operational practices used within marine farming zones. The potential impacts can include visual, noise, perceived loss of amenity values and restricted access by others to the coastal waters being farmed.

In general terms the main impacts of marine farming have been well documented overseas, and there has been some limited research on the local environment (Gowen & Rosenthal 1993, Ritz et al. 1989). The following sections provide an overview of :

- ecological impacts (Section 1.1);
- land use impacts (Section 1.2); and
- marine use impacts (Section 1.3).

1.1 ECOLOGICAL IMPACTS

1.1.1 Fish and Fish Food

At present finfish farming has a greater impact on the environment than shellfish farming because of the addition of organic material, fish feed, which results in nutrients in the form of surplus food and excretory products being released to the sediments and waters. The impacts and possible detrimental effects of finfish farms on the environment are illustrated in Figure 1 (Smith and Haig, 1991). Solid wastes may accumulate on the sea bed, especially in areas of poor current flow, causing a change in the benthic community structure, while soluble nutrients released to the water column can increase the risk of toxic algal blooms.

In Tasmania the salmonid farming industry has a continuing investment in research on methods to improve its efficiency, which has also reduced the ecological impact of the farms. Less food but of better quality, is now given. The food conversion ratio (ratio of weight of dried food fed to the gain in wet fish weight) dropped from 1.8-2.0 to 1.2-1.4 in ten years. The constant improvement in feed quality and form means that the amount of food being deposited on the bottom has been substantially reduced and this reduction continues.

Changes to the substrate ecosystem under a finfish farm have been documented in several studies, including some in Tasmania (Ritz et al. 1989). The changes are similar to, and consistent with, those caused by other forms of organic enrichment, such as wood pulp and domestic sewage. The increase in organic matter in the sediment leads to an increase in chemical oxygen demand and microbial activity, which can deplete the oxygen in the water overlying the sediment. There may also be a reduction of the oxygen in the sediment. This can be measured by the redox potential, the relative balance between oxidation and reduction in the sediments. Large reductions can result in sulphate reduction, producing hydrogen sulphide bubbles; methanogenic bacteria can cause these bubbles to also contain methane. This is commonly known as "outgassing".

Outgassing has not been a major problem in Tasmanian finfish farms, as it is controlled by feeding regimes and fallowing of the areas under cages. Experience with local conditions has enabled operators to establish the best feeding regimes for different localities and stock densities. However, the relationship between organic enrichment of the sediments and fish health is unclear (Gowen and Rosenthal 1993). Improved management strategies in Tasmania seek to ensure that organic loading in the sediment does not reach the level that can result in lower oxygen levels in the sediments and water column (T Dix, pers. comm.).

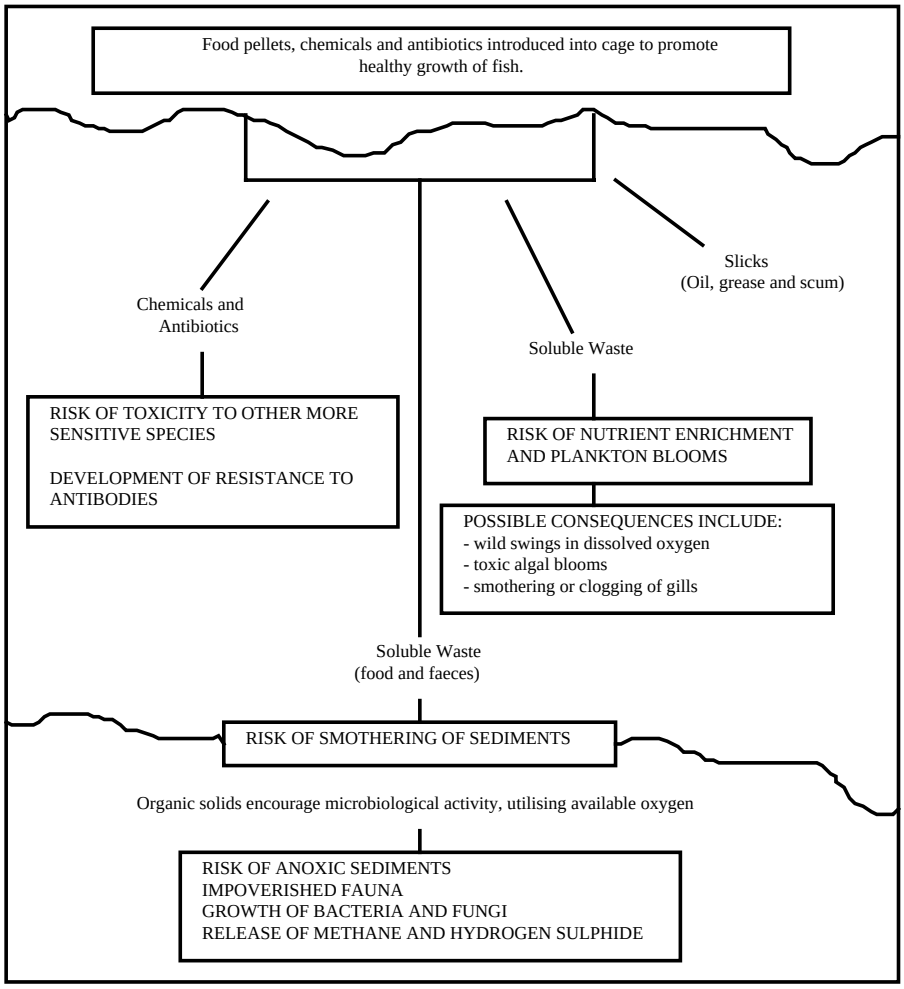


Figure 1 - Potential Routes to Environmental Impacts Associated With Cage Fish Farming (Smith and Haig, 1991)

In a study of the organic loading in and around a small finfish farm in the Huon estuary, a significant organic loading was found in the sediments outside the farm. The relatively high organic loading, and consequently higher than expected respiration rates, suggests that the source in this area is other than fish farms (Woodward et al. 1992). The changes in the organic loading in the sediment around the farm were confined to an area less than 40 to 50 m from the centre of the cage (Woodward et al. 1992), which correlates with data from overseas work on finfish farms. Further studies on sediments under finfish farms at Nubeena confirm that the changes in the local marine environment are also confined to the proximity of the farmed area (Ritz et al. 1989). This supports the evidence that the impacts from finfish farming are confined to local changes in the physical characteristics of the sediments (Johannessen et al. 1994, Ye et al. 1991), which are reflected in changes in macrobenthic communities.

The macrobenthic fauna of the sediment changes in relation to the increased organic enrichment; this has been well documented in overseas and local studies (Pearson & Stanley

1979, Horwitz and Blake 1992, Johannessen et al. 1994, Ritz et al. 1989). A study has been undertaken through SALTAS to relate the redox potential and the macrofauna of the sediments under several finfish farms in Tasmania. This study should clearly indicate the importance of the relationship between sediment structure, redox levels and changes in community structure. Sediment redox readings were observed to respond rapidly to changing levels of feed input (MacLeod 1996).

The health of the macrobenthic community under finfish cages can be monitored by a method developed by Ritz et al. (1989), based on Warwick (1986). The "ABC" (abundance, biomass comparison) method relies on the relationship between changes in species diversity and population numbers, and the degree of disturbance of the environment. As the degree of disturbance increases, species diversity begins to decrease, while the numbers and biomass of opportunistic species increase. The biomass and abundance are plotted on a k-dominance curve for the communities under the finfish cages and the position and shape of the curve can be related directly to the degree of disturbance (Ritz et al. 1989).

This method enables the collection of a single sample to be used to judge whether a site is considered undisturbed, moderately disturbed or grossly disturbed and does not rely upon a baseline or control value. This method is particularly useful in estimating the health of the sediments at sites where there is no existing background data collected prior to the establishment of the marine farm. It can also be used to establish the degree of disturbance of a site prior to the establishment of a new marine farm.

Changes to the water column will result from the increases in soluble nutrients released from sediments, deposited faecal matter, uneaten food particles and excretory products from the fish. The changes in nutrient levels in waters can in turn cause changes in phytoplankton populations, not only in density but also in species composition.

Nutrient levels in the Huon River were also measured during the 1992 study already cited (Woodward et al. 1992). The results indicated that at most stations in the river, nitrate and nitrite concentrations limited phytoplankton production in the waters. Phosphates were the limiting nutrient in the upstream stations of the study where surface waters were fresh to brackish. Changes in nutrient concentrations near the farm reflected changes in the other sampling stations and did not appear to be related to the farm. It was concluded that, at the production level in the river as at 1992, the farms were making no significant contribution to the nutrient loading in the estuarine waters.

However, the overseas experience is that, at the current level of farming in coastal waters in most countries, large-scale hypernutrification is unlikely (Gowen and Rosenthal 1993), although there may be local increases in ammonia concentrations in some embayments. Generally, it was concluded that in coastal areas where phytoplankton growth is limited by light, or biomass is reduced by dilution, eutrophication is unlikely (Gowen and Rosenthal 1993).

Research conducted both overseas and in Tasmania on the effects of salmonid farming on the seabed has generally shown that organic build-up is greatest directly underneath a stocked cage and rapidly decreases with distance from the cage. In most studies, the seabed remained at normal conditions at a distance of 30 m from the edge of the cage. Studies have also shown that most previously farmed areas will approach normal conditions if left fallow for 3 to 6 months (Ritz et al. 1989; Gowan 1991).

1.1.2 Chemicals

Chemicals used in farming finfish (for example, to treat diseases and net fouling) may have a substantial impact on the environment. Intertidal shellfish farms generally use wooden racks treated with preservatives, although these preservatives have not been found to accumulate in shellfish.

The use of chemicals has declined on Tasmanian salmonid farms. Copper-based net antifoulants were not cost-effective and have been replaced by regular manual changing and washing of nets. Very few chemicals or therapeutic substances are used because virtually none of the major salmonid diseases occur in Tasmania. In recent years antibiotics have been used irregularly in very small quantities and not at all on some farms. The requirement for use of chemicals in offshore marine farming operations is unknown and although this is not envisaged at this stage, it may need to be reviewed in the future.

1.1.3 Operational Wastes

Some aspects of the farming operations may affect water quality, such as fouling organisms from nets and other in-water equipment being disposed of, and decomposing, in the water. Similarly, wastes from harvesting and processing operations could result in substantial organic build-up if they are thrown back into the water.

1.1.4 Diseases

The likelihood of disease outbreak increases when marine organisms are cultured at densities higher than normal in the wild. Often these diseases are naturally occurring and only manifest themselves when the fish are stressed and contained at high densities, but there is also the possibility of spreading exotic diseases to native fish stocks. Also, the transfer of farmed stock to various growing areas around the coast has the potential to spread diseases further afield.

Because of the number of debilitating diseases in salmonid-producing areas overseas, and the research on the spread of diseases and salmonid parasites, most farmers have accepted that salmonid farms must be separated by at least 1 km, but preferably more.

Fortunately, most of the major diseases and parasites of salmonids do not occur in Tasmania, possibly as a result of the relatively low stocking densities in the State. It has also been established that good management practices tend to limit the risk of diseases on marine farms. Due to the potentially large losses industry could sustain from disease, the industry is very conscious of the need for disease prevention. The Government through quarantine controls assists in this regard.

1.1.5 Species Escapes

Any species escaping from a marine farm will have some impact on the environment, such as the settlement of oyster spat on the foreshore from an oyster farm or fish releases from a fish farm.

Little is known about the impact of marine farms on the recreational fish populations in Tasmania. Anecdotal evidence suggests that marine farms possibly increase habitat sites for recreational fish species, with excess food from finfish farms another attraction. Mussel longlines provide shelter for smaller fish and flounder are reported in intertidal oyster farms.

Recreational fishers surveyed in 1994 (G Double, pers. comm.) expressed the opinion that fewer recreational fish were being caught. However, this was happening not only in areas where there are marine farms. There is likely to be a number of causes, including overfishing and destruction or alteration of breeding habitat.

The impact of finfish that escape from marine farms has attracted little research. A study by the DPIF on salmon caught after an escape found the escaped salmon either had empty guts or soft material, such as pellets, and many of the fish were in poor condition (H Williams pers. comm.). An article in a sport fishing magazine described the excitement of catching salmon in the Huon River; the fish had empty guts but some were in breeding condition (Abbot, 1994).

Overseas evidence suggests that most escapees have few skills for survival in the wild: escaped fish in Canada have ignored schools of pile perch, anchovies and herrings, and just cruised around waiting for pellets (Anon. 1989).

1.1.6 Predator Control

The control of predators on oyster farms is usually limited to netting of baskets or relocating native starfish. The main potential predators of finfish farms are seals. However, currently they rarely cause problems because heavy nets are used to exclude them from the cages. In some areas, seals are trapped and released to other waters. Fish cages for smolt are usually netted to exclude birds.

1.2 LAND USE IMPACTS

1.2.1 Visual Impacts

Farming Equipment

Marine farming equipment in coastal waters, as with any structures on the water, will have some visual impact on residents and other users of an area. This equipment will generally consist of fish cages, buoys, feeding equipment, seal nets and so on. The siting, layout, colour and general appearance will affect their visibility and acceptability.

On-land developments associated with marine farming will also have a visual impact - these developments are under the control of DELM or the Kingborough Council.

On-water Sheds

The mooring of floating structures such as storage facilities, shelters and grading facilities will not be allowed within a lease area except in accordance with licence conditions. However, these structures can also reduce environmental impact. For example, if used to store feed, they reduce marine traffic. If floating structures are approved in a lease area, the visual impact may be similar to a permanently moored vessel, provided activities on the structure produce minimal noise.

Lighting

The impact of lighting used on a marine farm will vary with the type of farm and the marking requirements of the relevant Marine Authority. There may be navigation lights on the corners of the lease or spotlights for security.

Poor placement of high-intensity lights could have a considerable impact on the amenity of nearby residents, or even on residents a considerable distance away. Flashing navigation lights are required to be visible from considerable distances under maritime laws, and may be intrusive to some people. The reflective surface of calm waters could exacerbate light problems.

Debris

There is a possibility, usually during extreme weather conditions, of structures breaking away from marine farms and littering the surrounding foreshore.

General Appearance

The general appearance of marine farms will vary with the species farmed and the management strategies of the operator. Intertidal shellfish farms will typically not be highly visible, except at low to medium tides when racks become visible. Deep-water shellfish leases will usually consist of parallel rows of buoys within a marked lease area. Finfish farms will generally be visible from the shoreline. They will include fish cages of different sizes and placement patterns. The development of off-shore finfish farming may change the appearance of areas of coastline previously dominated by such a farm.

1.2.2 Noise Impacts

Several uses of coastal waters create noise and marine farming is one. The impact of that noise will depend on weather conditions, coastal topography, distance from the noise source, nature of the noise, hours of noise generation and background noise levels. Noise impacts from marine farming operations will usually be caused by such things as movement of boats, feeding and processing equipment, generators, human activity and telephones / PA systems.

1.2.3 Amenity and Property Values

Some people consider that the location of marine farms close to their land or residence, or within viewing from these places, may cause some loss of amenity values and subsequently property values. It is perceived that the potential for visual impacts, increased noise and possible loss of recreational access to parts of the coast may reduce the overall amenity values and the attraction for people to live or invest on surrounding lands.

1.3 MARINE USE IMPACTS

1.3.1 Access Restrictions

Navigation

Marine farming equipment on the water, as with any floating structures, will have some impact on the navigation of vessels (mainly fishing and recreational) in an area.

Other Restrictions

An access restriction that will impact on the public is that marine farmers are granted exclusive rights to the lease area, which prohibits the public from passing through or using

that area. This could conceivably restrict the rights of recreational fishers, sailors, divers and swimmers who may have previously used the area.

1.4 MANAGEMENT OF IMPACTS

The information base for existing marine farms in Tasmania is limited with few systematic baseline measurements made prior to marine farming. Some basic environmental data was available through the exploratory lease and these results have been included in Section 2.

Ecological changes that may take place as a result of increased marine farming are difficult to predict accurately, however, the large volumes and unrestricted water movement should be sufficient to minimise any impacts. Changes to the physical characteristics of sediments due to increased marine farming should remain local. The time taken for sediments to return to unfarmed conditions under finfish farms is expected to be similar to local and overseas experience. The monitoring program to be initiated by the DPIF should give a clearer indication of the impact of the existing industry and of changes that can be expected after an increase in production on new lease sites.

As with the prediction of any impact on the environment, there are limited guarantees. To mitigate or ameliorate the predicted impacts there is a recommended range of management controls for marine farming (as set out in Section 3.0). Included in the management controls are:

- provisions for collecting baseline environmental data;
- setting of carrying capacity limits for stocking density;
- implementing on-going monitoring programs within and outside the marine farm zone;
- meeting various operational requirements under Acts; and
- meeting health surveillance and health control measures.

The proposed management controls should help detect changes to the marine environment as a result of marine farming in sufficient time for management to be effective. However, it is also in the interests of the marine farmer, given the investment made, to achieve best management practice, as the quality of the fish will be placed at risk with any adverse management practices.

Impacts on other marine users and land use activities as a result of the proposed marine farm in Trumpeter Bay are considered to be minimal. Any potential impacts have been dealt with through the siting of the marine farming zone. The management controls recommended in Section 3.0 will help reduce any possible impact, and in particular the visual and navigational aspects.