

FINAL REPORT
20th June, 2006

**AQUATIC ECOLOGICAL ASSESSMENT FOR THE
PROPOSED DREDGING OF AN OYSTER LEASE FRINGING
OAKY ISLAND, WALLIS LAKE, N.S.W.**

**For
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Tuncurry
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Oyster Lease No. 80-178

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1. Background

Pacific Blue Design has been commissioned by Geolyse Pty Ltd on behalf of Mr Trevor Dent to conduct an Aquatic Ecology Assessment in relation to a proposed dredging operation in Wallis Lake. The proposed dredging is for the purpose of re-establishing an oyster production operation in the existing oyster lease No. 80-178, Wallis Lake, NSW (see Annex 1, Figure 1).

The lease area was originally established for oyster growing approximately 100 years ago, at which time the bed of the lease was raised to an appropriate height for rack farming by local oyster farmers, through the infilling of the area with felled cabbage tree palms and the addition of marine sand overburden. Over time, however, the action of artificially raising the bed has led to the accretion of flood tide-activated marine sands and fluvially-derived fines over the lease area. Consequently, due to the lack of maintenance dredging resulting from economic constraints on the lease owners, the bed of the lease has accreted to a height that prevents sufficient inundation of water for growing of oysters, with large areas of the bed of the lease area being sub-aerial at low tide. Subsequently, the lease has been no longer usable for the purpose of farming oysters.

1.1 Purpose of the Report

In order to resume oyster production within the lease dredging of approximately eight hectares of the existing lease is required to a depth of at least one metre. This aquatic ecological study and assessment has been requested by relevant authorities before consent can be given for the proposed dredging to proceed.

This study includes a survey of all the aquatic habitats, aquatic fauna and aquatic vegetation in the proposed dredge site and along the route of the pipeline to the proposed dredge spoil site. It also includes an assessment of the potential impacts of the proposed dredging and measures for minimising these potential impacts to aquatic habitat under the proposal.

1.2 Site Description

Incorporating oyster lease No. 80-178, the site is located 3.3 km west of the ocean entrance to Wallis Lake, within the tidal delta of the estuary (Figure 1, Site Plan). The site fringes the western side of Oaky Island, and the western, northern and eastern sides of what was once an adjacent island but which since become connected to Oaky Island due to sediment deposits and mangrove colonization.

The site covers 81,500 m² with an average depth range of 0-1m, which is comprised of sand flats, seagrass beds, old oyster cultivation areas and oyster racks, some of which border 1.5 – 2 m deep water channels. The site fringes the mangroves of the island (see Annexe, Figure 2, Map of Site showing Habitats, Sampling Locations and Distribution of Seagrass).

A secondary area included in the survey is the proposed pipeline route for the dredge spoil, which runs approximately 2 km north-west along the northern bank of the Wallamba River to the creek entrance of the spoil deposition site (See Annexe, Figure 3, Aerial Photograph of Potential Dredge Site).

1.3 Site Zonation under the NSW Safe Foods Program

The oyster lease is located in the Long Island Zone, according to the NSW Food Authority Shellfish Program. This consists of harvest leases located to the northern shoreline of the outer estuary of Wallis Lake. Under the NSW Food Authority Shellfish Program Guidelines, this oyster lease comes under the zoning of a Conditionally Restricted Harvest Area, in accordance with specifications of the Australian Shellfish Quality Assurance Program (ASQAP) Operations Manual. This requires that oysters within this area undergo depuration or relaying to approved harvest areas prior to human consumption, except in the case of closure due to conditions which exceed those specified in the environmental management plan (SQAP, 2002).

2. Methods

The following investigations and assessments have been carried out:

2.1 Background Research

Background research for the purpose of this study involved the review of aquatic surveys and assessments that have been conducted previously within Wallis Lake. This review also included but was not limited to:

- NSW Fisheries Database (DPI 2004);
- EPBC Act online database (Commonwealth Department of Environment and Heritage, <http://www.deh.gov.au/epbc/index.html>);
- Atlas of NSW Wildlife (NPWS, 2005);
- Relevant ecological studies prepared by Southern Cross University students within the study area;
- Relevant ecological literature, studies and prepared by various other authors (unpublished information); and
- Information from local commercial and recreational fishermen and oyster farmers

Preliminary consultation began with the major stakeholders including the Department of Primary Industries (Fisheries) and the Department of Lands.

Liaison was undertaken with representatives of NSW Department of Primary Industries (DPI) at Tuncurry to confirm the locations of commercial fishing operations and at Port Stephens to substantiate the legal requirements and all relevant permits. Discussions were also held with representatives of the Aquaculture, Threatened Species and Conservation Divisions of the DPI to discuss any specific requirements for the assessment of habitats and species found within the study area. Liaisons with the Department of Lands and their Native Titling Unit were held to confirm the zonation status of the oyster lease and with Council to determine any LEP zoning.

2.2 Field Investigation

Field investigations were undertaken to determine the status of the habitats and species present within the proposed dredging area and along the route of the pipeline to the spoil disposal site.

2.2.1 Site Visits

Following a preliminary team visit on November 23rd, 2005, seven visits were made to the site on December 31st, 2005, and on January 3rd, 14th, 17th, 18th, 23rd and 29th, 2006. Visits were made to coincide with a combination of low and high tides in order to survey the full range of tides, times of day and weather conditions.

2.2.2 Habitat Assessment

The study site was described and mapped in terms of the dominant habitats, aquatic vegetation and protected habitats. This included area, distribution, density and species composition of seagrasses and was conducted using combined methods of walking, wading and snorkelling using a Global Positioning System (GPS) and quadrat surveys.

2.2.3 Seagrass Assessment

An initial pilot study was conducted to assess seagrass distribution. Based on seagrass patchiness within the study site, a random stratified sampling programme was employed to differentiate the areas of highest seagrass cover, dividing the site into five zones.

A seagrass assessment was undertaken to identify species present and to provide an estimate of seagrass distribution and density within the proposed dredge area. This assessment was undertaken by randomly throwing a one quarter of a square metre wire quadrat, equally divided into 25 smaller quadrat sections. Estimates were based on percentage cover by seagrass of the substratum. The condition of the seagrasses was also assessed by examining the epiphytes present and the degree of siltation.

2.2.4 Pipeline Route Assessment

The proposed pipeline route to the dredge spoil site was examined. All aquatic vegetation was mapped along the route using a wire quadrat to estimate cover. Assessment focussed on the possible impact of the pipeline on seagrasses in the vicinity of the pipeline.

2.2.5 Fauna and Flora Assessment

A survey of the aquatic flora and fauna species was conducted, which covered the aquatic plants, marine algae, fish and macro-invertebrates. This was carried out by snorkelling or wading and yabby pumping at intervals throughout the study site and the adjacent intertidal zones. Vertebrate species were listed and abundance was estimated. Invertebrate species under the substrate and their relative abundance were investigated using both a yabby pump and a 0.25 m² wire quadrat. Limited dip netting was undertaken within the study site in order to target species not detected in the other surveys.

2.2.6 Threatened Species Assessment

An assessment of all protected or threatened species that could potentially occur within the area was conducted within the study site and along the adjacent shoreline, based on their habitat requirements.

3. Results

In total, 66 species were recorded from the study site. These included 17 species of fish, 39 species of invertebrates and 10 species of plants. Thirteen of these were commercially-targeted fish and invertebrate species and 12 species are targeted by recreational fishers. No threatened species were recorded.

3.1 Commercial and Recreational Fisheries

3.1.1 Commercial activities occurring in the vicinity of the site

The prime activity occurring on the perimeter of the site, where depth permits, is cultivation of the Sydney Rock Oyster, *Saccostrea commercialis*, on racks. Some cultivation also occurs in shallow water in the south-western section of the site directly on the substratum.

Commercial fish meshing is conducted intermittently in the area, along the channels and within other oyster leases mostly at night. Fish and crab trapping are also conducted in the vicinity. The target fish species are mullet, bream and blackfish, and target invertebrates are the blue swimmer and mud crabs.

Set pocket prawning is conducted in the Wallamba Channel between Cockatoo and Long Islands, but not in the immediate vicinity of the site.

3.1.2 Recreational fishing activities occurring in the vicinity of the site

Recreational line fishing is conducted around the perimeter of the lease in the channels and deeper water, for baitfish as well as edible fish.

Prawning by recreational fishers is conducted in the area throughout the summer months, however, this activity is generally confined to the channels and along adjacent flats south-east of the oyster lease.

Crab traps are set in the channels and around the leases by recreational fishers targeting blue swimmer and mud crabs. The lease area is used for collection of nippers with yabby pumps from the sand flats during summer holidays, with observations indicating usage rates of 3-4 people per day (author's pers. obs.).

3.2 Habitats and Aquatic Vegetation Description

The study site comprises six dominant habitats. These consist of sand flats, silty-mud flats, seagrass beds, mangroves, oyster cultivation areas and dredged channels. The habitats are described below.

3.2.1 Sand Flats

The studies determined that sand flats comprise approximately 45% of the study site, amounting to approximately 35,000 m². A list of the 15 species found on the sand flat are presented in Tables 1 and 2.

The sediments of the sand flats within the study site consist of flood tide delta sands. The sand flats comprise an area which is devoid of vegetation, because there are few holdfasts to anchor any plants, and where very few mobile invertebrate species are seen.

Large whelks, some containing hermit crabs, are the dominant invertebrate on the surface, and in some areas aggregates of 8 to 20 per square metre. There are many entrances to burrows beneath the sand within this habitat which were found to contain ghost shrimps (*Trypaea australiensis*, formerly *Callinassa australiensis*, commonly known as nippers or yabbies). An average of four ghost shrimps were found per cubic metre of substrate although the number of entrance holes into the burrows averaged around 160 for the same area, there being multiple entrances to a single burrow. At least five species of polychaete worms (Families Sabellidae, Syllidae, Aphroditidae and Nereidae) were also found burrowing in the sand.

The dominant vertebrates identified were the common toadfish (*Tetractenos hamiltoni*), dusky flathead (*Platycephalus fuscus*), sand flathead (*P.caeruleopunctatus*), sand whiting (*Sillago ciliata*), smooth stingrays (*Dasyatis brevicaudata*) and estuary stingrays (*D. fluviorum*).

3.2.2 Soft Substrate areas and Seagrass Beds

Soft substrates, which include both the vegetated seagrass areas and non-vegetated areas, comprise approximately 47 % of the site, i.e. 38,000 m², similar to the size of the sand flats.

The seagrass beds colonise the finer-grained, silty substrata of the study site. Silty sands and sandy silts dominate more sheltered areas with reduced wave action. The areas with finer sediments occur on the western (lee) side of Oaky Island in the south of the study site and around many of the oyster racks. Fine-grained silty sediments deposit out in the depressions in the sand flats and along the edges of the oyster racks and channels within the study site and are often covered with a surface layer of cyanobacteria. The sediments bind together and form fairly stable substrata, suitable for burrowing animals and seagrasses.

Two species of seagrass were found to occur at the study site. The dominant species, eelgrass (*Zostera capricorni*), is a widespread species which is highly adaptable and can be found in low-energy areas amongst substrata ranging from sand to mud. The second

species, paddleweed (*Halophila ovalis*), is both a primary-colonising species and an opportunistic species which can appear suddenly when environmental conditions are favourable and then disappear again when environmental conditions change. It can play an important role of binding and stabilizing the sediments especially along muddy shorelines or at the edge of a channel. It can also colonise open spaces between other seagrass species. Both *Halophila* and *Zostera* can tolerate exposure at low tide and occurs at depths from 0-1m at the study site.

The dominant vertebrates found in the seagrass beds were hairy pipefish (*Urocampus carinirostris*), large-mouth gobies (*Redigobius macrostoma*), smooth stingrays (*Dasyatis brevicaudata*), estuary stingrays (*D. fluviorum*), yellowfin bream (*Acanthopagrus australis*), silver biddy (*Gerres ovatus*), sand whiting (*Sillago ciliata*), glassy perchlets (*Velambassis jacksoniensis*), dusky flathead (*Platycephalus fuscus*), sand flathead (*P. caeruleopunctatus*), large-toothed flounder (*Peudorhombus arsius*), rabbit fish (*Siganus nebulosus*) and numerous unidentified juvenile fish which were not able to be captured. These species all utilize the seagrass beds for both shelter and foraging.

The most abundant of all the species present was the carid shrimp (*Macrobrachium intermedium*), which feeds on small animals and decaying matter. The pistol prawn (*Alpheus euphrosyne*), was also found to be common. The bobtail squid (*Sepiola* sp.) was also common amongst the seagrass and numerous small crabs, amphipods, isopods and mysids were found on the leaf blades.

A list of the 29 species found among the seagrasses during the study is in Tables 1 and 2.

3.2.3 Mangroves

Approximately 3.5 % of the study area (2,800 m²) is dominated by mangrove habitats. These include the areas of mangrove trees and shoot growths fringing the island and the adjacent sheltered shoreline strip of approximately 14 metres width. The substrate within this area is made up of fine-grained silts (silty-mud). The dominant vegetation is the grey mangrove (*Avicennia marina*), with its protruding aerial roots. In some areas up to 11 young mangrove shoots were growing in the mud in a square metre area along the shoreline. The red alga (*Ceramium* sp.) was found attached to various holdfasts and small amounts of cockleweed (*Cystoseira trinodis*). In addition *Sargassum* and *Padina elegans* were present in some areas. Small fragments of kelp (*Ecklonia radiata*) were observed to float past the study site with the tide. The two seagrass species, *Halophila ovalis* and *Zostera capricorni*, also colonized this area.

The dominant vertebrates recorded included common toadfish (*Tetractenos halmiltoni*), dusky flathead (*Platycephalus fuscus*), large-mouth gobies (*Redigobius macrostoma*), and the hairy pipefish (*Urocampus carinirostris*). A diamond fish (*Monodactylus argenteus*) and a large jumping flat-tail mullet (*Liza argentea*) were observed and an oyster goby (*Cristatogobius gobioides*) was detected within an old bottle on the mud flat.

The dominant invertebrates include crustaceans such as amphipods, isopods, mysids and crabs. The largest crab was a mud crab but crabs from families Portunidae, Ocypodidae, Grapsidae, Hymenosomatidae and Paguridae were also present. Molluscs ranged from the mangrove gastropod (*Ophicardelus* sp.), conniwinks (*Bembicium melanostoma*) and limpets (*Patelloidea mimula*) on the mangrove branches to free-growing oysters (*Saccostrea commercialis*), mussels (*Mytilus edulis*), whelks (*Pyrazus ebininus* and *Velacumantus australis*), sand snails (*Polinicies* spp.), bubble shells (*Bulla ampulla*) and squid eggs (*Sepiola* sp.) around the base of the trees. Nematode worms, water striders and diatoms were also present.

A list of the 35 species found among the mangroves during the study is found in Tables 1 and 2.

3.2.4 Oyster racks and beds

The oyster racks consisted of those which were currently in use, those which had been abandoned, and beds of oysters which were growing directly on the substrate. These constitute approximately 6,000 m² or 7 % of the site.

The substrate around the oyster racks was fairly muddy, due to slow rates of current flow causing the suspended fine-grained sediments in the water to be deposited. Conditions were found to be favourable for *Zostera* and high densities of the seagrass were observed around the oyster racks and between the racks and channels.

Other dominant species included yellowfin bream (*Acanthopagrus australis*), flat-tail mullet (*Liza argentea*) and common toadfish (*Tetractenos halmiltoni*) (Table 1). Luderick (*Girella tricuspidata*) has been reported and a fisherman was observed to catch river garfish (*Hyporhamphus regularis*) around the lease during one of the site visits.

Dominant invertebrates around the oyster racks included the oyster itself, barnacles (*Balanus trigonus*) and spirorbid polychaete worms (*Spirorbis* sp.) growing on the oyster shells and the racks and mussels (*Mytilus edulis*) growing on the oyster poles (Table 2). In total 15 species were recorded in this habitat (Tables 1 and 2). Although not recorded during the surveys, both the common octopus (*Octopus cyanea*) and

the blue ringed octopus (*Hapalochlaena maculosa*) have been previously reported around or on the leases (K. Godwin, pers. comm.)

3.2.5 Channels

The channels are the deeper water areas between the oyster racks which are currently in use and also between Jonnel Park and the oyster lease. These have been dredged in the past and maintain a reasonably fast current of tidal water. The bottom of these channels is invariably sand, with some seagrass in the deeper water and fringing the edges. Only four species were recorded in the channels. The dominant vertebrate species seen during snorkelling through the channels were juvenile flat-tail mullet (*Liza argentea*), river garfish (*Hyporhamphys regularis*), silver biddy (*Gerres ovatus*) and estuary perchlets (*Velambassis jacksoniensis*) (Table 1). The only invertebrate species seen was the sea hare (*Aplysia oculifera*) (Table 2) although portunid crabs, prawns and squid would be expected to occur.

3.2.6 Pipeline Route

The pipeline route extended from the north-west corner of the oyster lease along the channel near to the northern bank of the Wallamba River to the entrance to the dredge deposit site along the Wallamba Broadwater. This covers a distance of approximately 1 km.

The substrate sediments varied from silty sands in the channel opposite Jonnel Park to silty muds with a high percentage of shell fragments at the Wallamba Broadwater. Although the water clarity was poor, observations from a seagrass survey showed low densities of *Zostera* and *Halophila* colonized the entire route of the pipeline.

3.3 Results of Surveys

Habitat surveys and species surveys showed the distribution and cover of aquatic vegetation, fish and invertebrate species occurring within the proposed dredging site.

3.3.1 Seagrass Distribution and Cover

A pilot study comparing a simple random sampling strategy with a stratified random sampling method showed that the latter method was more suitable. This stratified sampling was adopted due to the patchy distribution of seagrass. Sampling zones and locations are shown in Figure 2. A statistical data summarizing seagrass cover within the study site is shown in Table 3.

Halophila ovalis was found to occur in areas of soft sediment, often amongst oyster racks or near the silty mud flats and had large leaves in excellent condition. It constitutes only 4 % of the total seagrass cover and has a non-uniform distribution. *Zostera capricorni*, the dominant species (constituting the remainder of the total seagrass cover), was

found to have a patchy distribution, occurring in 60 % of all the sampled quadrats, although mostly at very low density. The *Zostera capricorni*'s condition was assessed as average to good, compared with other *Zostera* beds in the lake, with very little silt or sediment slime on the leaf blades and low epiphyte cover. Epiphytes were sparse (<30 %), and consisted of spirorbid worms and red algal species.

The stratified sampling method determined that a seagrass cover of nearly 14 % occurred within the proposed dredge area. This figure consists of the cover of the individual zones, as a percentage of the total area, given in Table 4 (ie. 2.81 % (Zone 1); 4.04 % (Zone 2); 3.90 % (Zone 3); 1.71 % (Zone 4); and 1.49 % (Zone 5)). Higher seagrass occurrence was found around the oyster racks and beds in the southern and south-western zone of the site (Zone 1).

Zone 1 recorded a higher concentration of seagrass than the other zones and it provides habitat for the protected hairy pipefish. Zones 2, 3, 4 and 5 have a total seagrass cover of 12.04 %.

Without the inclusion of Zone 1 in the calculations, the remaining seagrasses from Zones 2-5 would represent 11.15 % cover of the 8.5 ha site. *Halophila* constitutes 0.75 % of this and *Zostera* comprises 10.4 % or an area of approximately 800 m².

3.3.2 Pipeline Route

Of 19 samples taken along the pipeline route (Figure 3) the average cover by seagrass was 31 %. Approximately 25 % comprised *Zostera* and the remaining 6 % *Halophila*. The distribution was patchy and dependent on depth and light penetration of the water and softness and depth of substrata. The amount of seagrass varied from 100% cover in some shallow muddy parts of the Wallamba Broadwater, down to zero cover in areas of 120-130 cm depth, which had a hard substrate. The entire length of the route was quite shallow, with maximum depths of 1.3 m. Water clarity in the Wallamba Broadwater was low due to high suspended sediment loads, most likely entrained by wind-wave stirring.

Substrata consisted mainly of silty mud in the Broadwater or silty sand along the channel near the study site. Shell debris, a few crabs and ghost shrimp burrows were the only evidence of macro-invertebrate life.

3.3.3 Vertebrate Species

A total of 17 species of fish plus juveniles were sighted during the survey. An additional species (luderick) has been reported and species such as tarwhine, leatherjacket and fortescues would also be expected to occur.

Of the species observed yellowfin bream, dusky flathead, sand flathead, mullet, whiting, garfish and silverbiddies are commercially fished in Wallis Lake. Bream, flathead, flounder and whiting are fished recreationally, with garfish and mullet caught for bait. Other species occurring include the perchlet, large-mouth goby, oyster goby, common toadfish and hairy pipefish.

The hairy pipefish were numerous and occurred in clumps of seagrass in the mud flats close to the mangroves and in the high density areas of seagrass near the oyster beds in the southern-most section of the study site. Twelve pipefish were sampled from an area of one square metre of dense seagrasses within a time period of 20 minutes in the south-western corner by dip net.

3.3.4 Invertebrate Species

Of the 39 invertebrate species observed during the course of the study, none is listed as endangered or threatened by the FMA Act (1994). However, three are commercially valuable (the mud crab, school prawns and greasy back prawns) and it is highly likely that other portunid crabs such as the blue swimmer and commercial species of squid occur too.

Ghost shrimps or nippers are popular bait for line fishermen and the site was observed to be regularly visited by bait collectors targeting these species. Nippers have also been caught commercially, although at a low level (Tanner and Liggins 2001). Recreationally-caught invertebrate species include prawns, crabs, octopus and ghost shrimp or nippers, which are widely used for bait.

The most abundant invertebrate species recorded during the study was the nipper. Other relatively sedentary invertebrates which occur in large numbers include the whelks, hermit crabs and polychaete worms. Carid shrimps, pistol prawns and bobtail squid are numerous amongst the seagrasses. At least 11 more mollusc species and five more crab species also occur.

3.6 Threatened and Protected species

3.6.1 Threatened Species potentially occurring within the site

There were no endangered species observed during the course of the survey. A table of all threatened aquatic species listed under the Fisheries Management Act (1994) and the likelihood of their occurrence within the study area is given in Table 4 below:

TABLE 4 – LIKELIHOOD OF THREATENED AQUATIC SPECIES OCCURRENCE WITHIN THE STUDY AREA				
Common Name	Species Name	Status	Habitat	Likelihood of Occurrence within the study area
Grey Nurse Shark	<i>Carcharias taurus</i>	E	Subtropical to cool temperate coastal waters	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Murray Hardyhead	<i>Craterocephalus fluviatilis</i>	E	In still or slow flowing lowland rivers, lakes, billabongs and backwaters with thick vegetation in the Murray and Murrumbidgee river system	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Eastern Freshwater Cod	<i>Maccullochella ikei</i>	E	Occurs in clear, slow flowing rivers or creeks with abundant in-stream habitat features of the Clarence catchment.	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Trout Cod	<i>Maccullochella macquariensis</i>	E	Inland streams with relatively fast currents and a high abundance of large woody debris or snags	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Oxleyan Pygmy Perch	<i>Nannoperca oxleyana</i>	E	Restricted to small brackish creeks in Wallum Habitats from Northern NSW to Fraser Island	Considered extremely unlikely to occur within study area or adjoining aquatic environs

TABLE 4 – LIKELIHOOD OF THREATENED AQUATIC SPECIES OCCURRENCE WITHIN THE STUDY AREA				
Common Name	Species Name	Status	Habitat	Likelihood of Occurrence within the study area
Unnamed River Snail	<i>Notopala sublineata</i>	E	Only known from the Murray Darling river system but has not been recorded in the last ten years	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Green Sawfish	<i>Pristis zijsron</i>	E	Occurs in freshwater and estuarine habitats along of northern coastline extending to northern NSW	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Adams Emerald Dragonfly	<i>Archaeophya adamsi</i>	V	Small creeks with gravely or sandy bottoms, only recorded from the Sydney Basin	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Silver Perch	<i>Bidyanus bidyanus</i>	V	Fast-flowing, open waters of the Murray Darling system, especially where there are rapids and races	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Buchanans Fairy Shrimp	<i>Branchinella buchananensis</i>	V	Temporary (intermittent) Salt lakes in the West regions of NSW and Qld.	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Great White Shark	<i>Carcharodon carcharias</i>	V	Occur in inshore waters in the vicinity of rocky reefs and islands often near seal colonies	Considered extremely unlikely to occur within study area or adjoining aquatic environs

TABLE 4 – LIKELIHOOD OF THREATENED AQUATIC SPECIES OCCURRENCE WITHIN THE STUDY AREA				
Common Name	Species Name	Status	Habitat	Likelihood of Occurrence within the study area
Black Cod	<i>Epinephelus daemeli</i>	V	Occurs around rocky reefs and Bombies and in warm temperate and sub tropical parts of the south western Pacific	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Macquarie Perch	<i>Macquaria australasica</i>	V	Occurs widely in riverine and lake habitats, particularly the upstream reaches of rivers and tributaries	Considered extremely unlikely to occur within study area or adjoining aquatic environs
Southern Pygmy Perch	<i>Nannoperca australis</i>	V	Along the edges of slow flowing lowland rivers and in lakes billabongs and backwaters of the Murray and Murrumbidgee river system	Considered extremely unlikely to occur within study area or adjoining aquatic environs

Key:

E – Endangered Species- Schedule 4, Fisheries Management Act (1994)

V – Vulnerable species, Schedule 5, Fisheries Management Act (1994)

3.6.2 Protected Species potentially occurring within the site

A single protected species was observed during the course of this survey, the hairy pipefish.

The hairy pipefish was present and abundant amongst the higher density seagrasses in one area of the study site. More species of pipefish occur in other areas of Wallis Lake.

Estuary cod were not observed during the site visits.

4. Discussion

The dominant habitats within the proposed dredge area are sand flats, non-vegetated soft substrate areas and seagrass beds. Seagrass beds are considered the most important of these habitats because these support abundant and diverse communities compared to bare sand flats or non-vegetated substrate, and provide important feeding and nursery areas for juveniles of many economically important species.

The seagrasses occurring at the proposed dredging site represent less than 0.04 % of those present in the whole of Wallis Lake, which is a very small proportion of the total seagrass cover. West (1985) reports that seagrass cover in Wallis Lake totals more than 30 km² or 3,000 ha, which is the most significant area of seagrass in New South Wales.

4.1 Habitat Protection Plans

Under the NSW Fisheries Management Act 1994 (Sections 204-205) there are two plans in place to protect vulnerable fish habitat. The first relates to dredging and requires the minister's consent for the removal of seagrasses on an aquaculture lease. It also relates to protection of mangroves, of which *Avicennia marina* occurs along the shoreline of Oaky Island, adjacent to the study site. Fish Habitat Protection Plan No. 2 is designed to protect seagrasses, which give important shelter and habitat for juvenile fish. Seagrasses include *Zostera capricorni* and *Halophila ovalis*, both of which occur in the study site. Licences are required to harm or remove any of the species listed under the habitat protection zones, which include *Zostera capricorni* and *Halophila ovalis*.

4.2 Threatened Species

4.2.1 Threatened Species Potentially Occurring Within the Site

Based on background research and habitat assessment it is likely that the black cod is the only threatened species under the Fisheries Management Act (1994) which has the potential to occur in this part of Wallis Lake during some stage of its life cycle. It is, however, considered unlikely to occur in the vicinity of the study site, due to the lack of suitable depth of water and lack of suitable habitat.

The black cod, *Epinephelus daemeli*, is listed as a vulnerable species pursuant to the FMA Act (1994). Adult black cod are found along the entire coast and are extremely territorial. They generally prefer deeper waters and rocky habitat, such as ledges, caves, gutters or bommies. Small juvenile black cod often occur in coastal rock pools and larger juveniles are found around rocky shores in estuaries.

While it is possible for juveniles to occur in seagrass beds in the Wallis Lake Estuary, it is much more likely for them to inhabit areas with more rocky structure like the coffee rock ledges and bommies which occur along Wallis Island. Adult black cod are unlikely to occur in the vicinity of the potential dredge site, although they have been sighted along the Tuncurry Breakwall.

The green turtle, *Chelonia mydas*, which is legislated an Endangered Species under the Threatened Species Conservation Act (1995) has the potential to occur as a transient species in the vicinity of the study site. None was observed during the survey although individuals are occasionally reported amongst the seagrass beds and off the coffee rock drop offs along the western edge of Wallis Island and within the Wallamba River.

4.2.2 Protected Species Known or Potentially Occurring Within the Site

One protected species, the hairy pipefish, *Urocampus carinirostris*, was recorded within the proposed dredge area. This belongs to the Family Syngnathidae, a group which includes seahorses, seadragons and pipefish. All Syngnathiformes have been afforded protected status by legislation under Section 19 of the NSW Fisheries Management Act 1994 and the Environmental Protection and Biodiversity Conservation (EPBC) Act (1999) due to their vulnerability to human impact.

Syngnathids have low reproductive and dispersal potential, relatively limited distribution and a sedentary nature, with a preference for man-made structures (such as oyster racks) and shallow habitats. Due to their low level of mobility, the proposed dredging operation has the potential to impact on numerous individuals within the proposed dredge area.

The seagrass beds provide important habitat for numerous hairy pipefish. The hairy pipefish has not been found in such abundance in other areas of the lake to date (S. Fiebig, pers. obs.). It is possible that this abundance is associated with the seagrass beds.

Estuary cod, *Epinephelus coioides*, is a protected species which was not observed however could potentially occur in this region. It is, however, more likely to inhabit areas with deeper channels, coffee rock ledges and structure, such as found around Wallis Island and the Forster-Tuncurry Breakwall. Juveniles inhabit seagrass beds as nursery grounds and could potentially occur in this area although it is more likely that they utilise areas with a more rocky structure. It is therefore unlikely that estuary cod would be affected by the proposed dredging.

4.3 Potential Impacts of Dredging

4.3.1 Potential Impacts on the Site

The following impacts on the aquatic environment could potentially occur as a result of the process of dredging an area of approximately 8 hectares:

- Change in land form, with loss of low tide sand flats and shallow soft substrate;
- Minimal removal of approximately 1.14ha of seagrasses (aggregation estimate);
- Minor loss of habitats and species, as sand flats and shallow non-vegetated soft substrate will disappear. Burrows and resident nippers and other crustaceans, less-mobile fish species (eg. gobies, pipefish, scorpaenids, some flathead and juveniles), worms and meiofauna will be removed by the dredge;
- Dredge pipe impact, as the pipe will lie on the substrate, temporarily smothering any seagrass and entrances to burrows en route to the spoil site;
- Noise and vibrations associated with the operation of the dredge and transfer of the spoil by pipe to the spoil site may cause caving in of nearby burrows; and
- Pollution or spills caused by accidental breaks in the dredge pipe, smothering flora and fauna or water contamination by oil pollution associated with the dredge. These impacts can easily be avoided and managed through the implementation of the Environmental Management Strategy.

4.3.1.1 Seagrass Beds

The removal of the seagrasses will result in the immediate loss of 1.14ha of *Zostera* and *Halophila*. It is important to note that this is an aggregated sum of mostly low density (<15 % coverage) seagrass areas. This loss will have short to medium term effects because it may take a few years for seagrass to recolonise the site. However, it is highly likely that dredging will provide an improvement in conditions and greatly increase the area available for seagrass to recolonise the lowered bed surface. At present 45 % of the area represents bare sand flats, which is unsuitable for seagrass to colonise because the area is dry at low tide.

After dredging, the whole of the lease area will be permanently inundated with water, providing opportunity for seagrass to recolonise alongside and in-between the floating oyster cultivation. Floating cultivation is more conducive to seagrass colonization compared to traditional rack cultivation, as the cultivation is relatively mobile (preventing fixed overshadowing of the bed) and is not permanent, being removed after 18 months for a period of 6 – 8 months before being re-instated.

Inspection of previously dredged areas surrounding the lease (other leases and channels) at depths similar to those proposed for the dredging indicates a higher density coverage of *Zostera* than within the majority of the existing oyster lease area. Therefore, seagrass would be expected to colonise the lowered bed surface (max. 2 m depth) of the lease area. Existing areas of seagrass from the areas peripheral to the site are likely to begin to colonise the newly dredged beds surface following dredging (depending on season). After a few seasons, the overall coverage is likely to be higher than that which currently exists, due to the permanent inundation of the site.

In terms of degree of impact, relative to the total amount of seagrass in Wallis Lake, the effect of dredging is considered to be negligible. In terms of impact to the species *Zostera* and *Halophila*, it is also considered to be negligible. Both species have a widespread distribution in Australia and within Wallis Lake. *Zostera* is known to recolonise areas quickly and is adaptable and tolerant of a wide range of conditions (including pulse turbidity events associated with river flooding). It is therefore likely to recolonise the area in the years following the dredging. *Halophila* is an opportunistic colonizer which can also tolerate a range of conditions, colonising spaces between other seagrasses.

Nearly all of the seagrass at the study site constituted sparsely distributed *Zostera*, which has re-established itself over approximately 20 years since the oyster lease was last dredged. This demonstrates the ability of the seagrass to recolonise areas following the proposed dredging and, that the long term impacts of dredging on seagrass habitat are negligible, as the proposal will result in a net increase in seagrass coverage in the lease area.

4.3.1.2 Loss of Habitat

The effects of dredging on the loss of habitat for other species may be slightly higher than the effects of dredging on the seagrass species itself. Seagrass beds within the study site show diversity typical of these environments in Wallis Lake in terms of taxonomic groups and include fish, polychaete worms, crustaceans and molluscs. Carid shrimp, perchlets, gobies and juvenile mullet were abundant. However, most benthic communities lost in the dredge footprint would be recolonised by the adjacent areas and settlement of larvae of benthic animals.

4.3.1.2 Hairy Pipefish

No detailed studies have been made of pipefish in the Wallis Lake estuary. As Syngnathids are vulnerable to the dredge process and they have low rates of reproduction, not only could their numbers diminish in this area but their ability to re-establish the population could also be

low. As this group of fishes are afforded protected status within New South Wales, management strategies should be considered to ensure their long term survival. As the majority of this species' habitat will be retained, however, the impact is not considered to be significant.

4.3.2 Impacts of Dredging on Commercial and Recreational Fishing

Commercial fishing pursuits other than oyster farming in the vicinity of the site are either seasonal or occasional (set pocket prawning, trapping, meshing) and not likely to be adversely affected by the dredging of the site. Rather, the increase in depth across the site will significantly enlarge the existing area and make available up to an additional 8 ha for netting during all phases of the tidal cycle.

In terms of recreational fishing, the impact of dredging will result in a reduction of the nipper population due to the loss of intertidal habitat. The author's observations indicate relatively low usage during holiday periods in summer months. In light of the extensive areas of low tide flats available for bait collection by recreational fishers in Wallis Lake, however, the impact of the loss of this area is considered negligible. The creation by dredging of a permanently inundated water area will also make available for recreational fishers, 8 ha of previously non-existent fish habitat in and around the floating oyster cultivation.

It is unlikely that the proposed dredging will have any negative impact on line fishing and crab trapping. New habitat provided by floating oyster cultivation may have a positive effect by providing more shelter to juveniles and attracting greater numbers of fish and invertebrates to the site.

4.3.3 Cumulative Impacts of Dredging

There are no cumulative impacts on seagrasses in Wallis Lake envisaged as a result of this proposal due to the relative abundance of higher density seagrass beds in other areas of Wallis Lake and the relatively very minor area (< 0.04 %) of seagrass compared to the total area of seagrass in Wallis Lake. Dredging of navigational channels within Wallis Lake may be required in the future but there are no proposals lodged at present.

5. Evaluation and Mitigation Measures

Based on the findings discussed, there are no threatened species likely to occur in the study area. The aim of dredging is to make the site deeper for oyster culture. The effect would create more channels for the passage of fish and would not create barriers to fish movement. Oyster leases, like many other anthropogenic structures, act as fish aggregating devices, and would increase important refuge, foraging and nursery habitats for a number of species in the long term.

The species which could potentially be affected by the dredging are the seagrass, *Zostera*, and the hairy pipefish, *Urocampus carinirostris*. Both are afforded protected status. As discussed previously, the ability of seagrass to recolonise the area is demonstrated by its presence in the lease area after previous dredging for oyster cultivation, and therefore will eventually create more suitable habitat for the pipefish, through increased seagrass coverage and density. Overall, impacts on the seagrass are therefore considered negligible and short term in nature. However, as *Zostera* provides habitat for the hairy pipefish, consideration should be given to ensure that the lifecycle of the pipefish is not disrupted during dredging.

The following points should be considered in order to minimize the impact of dredging to the environment:

- Dredging along the south-western edge of Zone 1 should be kept to a minimum. If deemed appropriate, any seagrass located in this area that would otherwise be removed by dredging could be transplanted on a clump to clump basis at a ratio of 2:1. The replanting of seagrass is, however, not considered essential due to the high likelihood of recolonisation following dredging as a result of more favourable conditions for seagrass growth and the known recolonising attributes of *Zostera* and *Halophilla*;
- Part of the area already designated as Zone 1A should be left in its present state and not dredged. This is located along the south-western corner of the oyster lease site and contains the highest cover of seagrass and the highest numbers of pipefish;
- Prior to dredging all other seagrass areas to be dredged should be searched for presence of pipefish and if found, pipefish should be collected with a fine-mesh scoop net and relocated to other areas of seagrass within the lease and surrounding areas;
- Avoid dredging within 10m of the mangroves on Oaky Island to ensure stability of the shoreline and protection of the mangroves;
- Lay the dredge pipe to the spoil site only on high tide to minimize the possibility of the watercraft damaging seagrass and the substrate;

- Devise a dredge plan to minimize mechanical failures, spills and leakages, and to deal with any breaks or blockages in the pipeline during the dredge process; and
- Remove and dispose of all waste appropriately.

6. Conclusion

The oyster lease site does not provide habitat for any threatened species, although one small area (Zone 1) was identified as a habitat area for protected pipefish. The seagrasses consist of *Zostera* and *Halophila*, which, apart from Zone 1, are sparse and patchily distributed and not likely to be of significance in terms of larval recruitment for Wallis Lake, nor habitat for the Hairy Pipefish.

The likely adverse impact of the dredging proposal on commercial and recreational fisheries is considered negligible. Rather, deepening of the waterway in this area will create up to 8 ha of permanently inundated habitat and is likely to therefore increase recreational and commercial fishing opportunities in the area.

The amount of habitat for fish and invertebrates will increase due to the presence of floating oyster cultivation and the recolonised (increased coverage and density) seagrass coverage.

As the seagrass beds within the proposed dredge area are an example of regrowth following previous dredging operations for oyster cultivation, the impacts of the proposed dredging on seagrass is considered negligible and short term in nature. It is recommended, therefore, that maintenance dredging to return the site to its previous condition in order to culture oysters be permitted.

With reference to the proposed management measures, the proposal is considered unlikely to result in serious or irreversible impacts on threatened or protected aquatic species or recreational and commercial fisheries within the locality.

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ANNEXE

Table 1
Fish Species and their Habitat Preferences at the Tuncurry Oyster Lease

Common Name	Species	Habitat where observed				
		Seagrass Bed	Sand Flat	Mangrove	Oyster Lease	Channel
Hairy Pipefish	<i>Urocampus carinirostris</i>	P		P		
Smooth Stingray	<i>Dasyatis brevicaudata</i>	P	P	P		
Estuary Stingray	<i>D. fluviorum</i>	P	P	P		
Yellowfin Bream	<i>Acanthopagrus australis</i>	P			P	P
Silverbiddy	<i>Gerres ovatus</i>	P				P
Flat Tail Mullet	<i>Liza argentea</i>			P	P	P
River Garfish	<i>Hyporhamphus regularis</i>					P
Sand Whiting	<i>Sillago ciliata</i>	P	P			
Common Toadfish	<i>Tetractenos hamiltoni</i>		P	P	P	
Oyster Goby	<i>Cristatogobius gobioides</i>			P		
Large Mouth Goby	<i>Redigobius macrostoma</i>	P		P	P	
Perchlets	<i>Velambassis jacksoniensis</i>	P		P	P	
Dusky flathead	<i>Platycephalus fuscus</i>	P	P			
Sand flathead	<i>Platycephalus arenarius</i>	P	P			
Flounder	<i>Pseudorhombus arsius</i>	P				
Rabbit fish	<i>Siganus nebulosus</i>	P				
Diamond fish	<i>Mondodactylus argenteus</i>			P		
Juvenile fish		P		P		

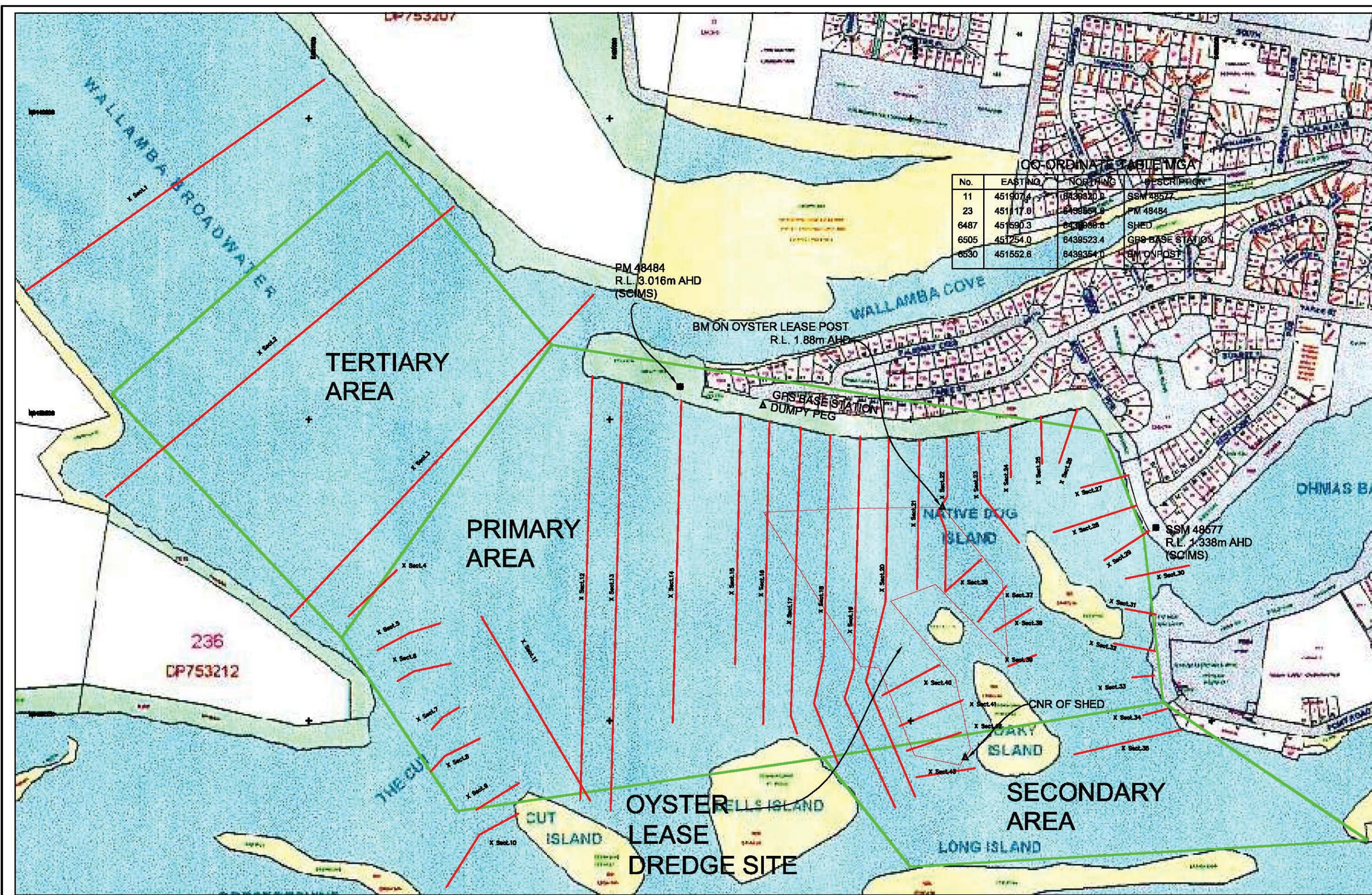
Table 2
Invertebrate and Plant Species List

Common Name	Species	Habitat where observed				
		Seagrass Bed	Sand Flats	Mangroves	Channels	Oyster leases
Crustaceans						
Ghost shrimp, yabby or nipper	<i>Trypaea (Callinassa) australiensis</i>	P	P			
Pistol prawn	<i>Alpheus euprosyne</i>	P				
Carid shrimp	<i>Macrobrachium intermedium</i>	P		P		P
School prawn	<i>Metapenaeus macleayi</i>	P		P	E	
Greasyback prawn	<i>M. benettiae</i>	P		P	E	
Mud crab	<i>Scylla serrata</i>	E		P		
Portunid Blue swimmer crab	<i>Portunus pelagicus</i>	E	E	E		
Family Portunidae	<i>Thalamita stimpsoni</i>			P		
Fam. Ocypodidae	<i>cf. Ocypode cordimana</i>			P		
Fam. Ocypodidae	<i>Macrophthalmus crassipes</i>			P		
Fam. Hymenosomatidae	<i>Trigonoplax spathulifera</i>			P		
Fam. Grapsidae	Family Grapsidae			P		
Pagurid Hermit crab	Family Paguridae	P	P	P		P
Amphipods		P				P
Isopods		P		P		P
Barnacles	<i>Balanus trigonus</i>			P		P
Mysids		P		P		P
Sea Hare	<i>Aplysia oculifera</i>	P	P		P	
Sydney Rock Oyster	<i>Saccostrea commercialis</i>			P		P
Large whelks	<i>Pyrazus ebininus</i>	P	P	P		
Small whelks	<i>Velacumantus australis</i>	P		P		
Limpet	<i>Patelloidea mimula</i>			P		P
Mangrove gastropod	<i>Ophicardelus sp.</i>	P		P		
	<i>Bembicium melanostoma/auratum</i>					
	<i>cf. Nerita undata</i>			P		
Bobtail squid	<i>Sepiola sp.</i>	P		P		P
Littorinids				P		
Sand Snail	<i>Polinices spp.</i>	P		P		
Moon Snail	<i>Bulla quoyii</i>	P		P		
Mussel	<i>Mytilus edulis</i>			P		P
Polychaete worms						
Sabellidae (tube worms)	Family Sabellidae		P			
Tube worm sp.2	Family Sabellidae		P			
Syllidae	Family Syllidae		P			
Aphroditidae	Family Aphroditidae		P			
Nereidae	Family Nereidae		P			
Sipunculid worms	Family Sipuncula			P		
Other						
Water striders	Family Gerridae			P		
Nematode worms				P		
Flora						
Diatoms				P		
Algae						
Red algae, Rhodophyta	<i>Ceramium sp.</i>			P		
Brown algae, Phaeophyta	<i>Ecklonia radiata</i>			P		
	<i>Cystoseira trinodis</i>			P		
	<i>Padina elegans</i>			P		
	<i>Sargassum sp.</i>			P	P	
Seagrass - eelgrass	<i>Zostera capricornia</i>	P		P	P	P
- paddleweed	<i>Halophila ovalis</i>	P		P		
Grey mangrove	<i>Avicennia marina</i>			P		
Saltmarsh species	<i>Sarcocornia</i>					
	<i>Sueda</i>					

Table 3
Percentage Cover of Seagrass for the total Lease

Zone	n	Area (sqm)	Total area (%)	Cover of total area (%)
1	78	6,178	7.58	2.81
2	200	22,456	27.55	4.05
3	101	17,453	21.41	1.71
4	111	13,637	16.73	1.49
5	163	21,776	26.72	3.9
Total	653	81,500	100	13.96

Figure 1: Site Plan



PLAN
 SHOWING OYSTER LEASE DREDGE SITE AND
 SURROUNDS
 WALLIS LAKE, TUNCURRY



McGLASHAN & CRISP Pty Ltd
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SCALE: 1:8000
 DRAWN: NG
 DATE: 13 JAN '06

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GEOLYSE Pty Ltd
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 GREAT LAKES

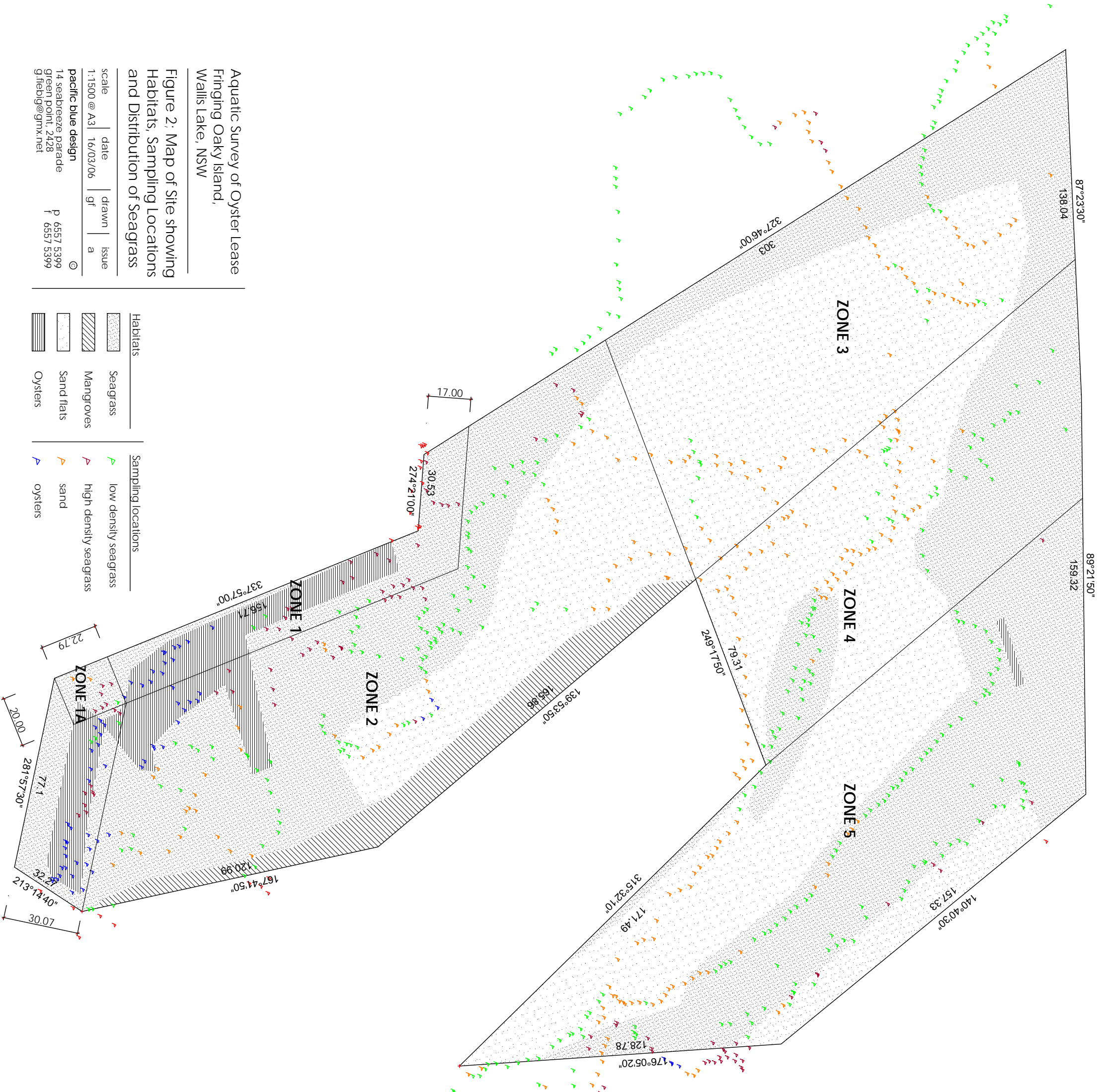
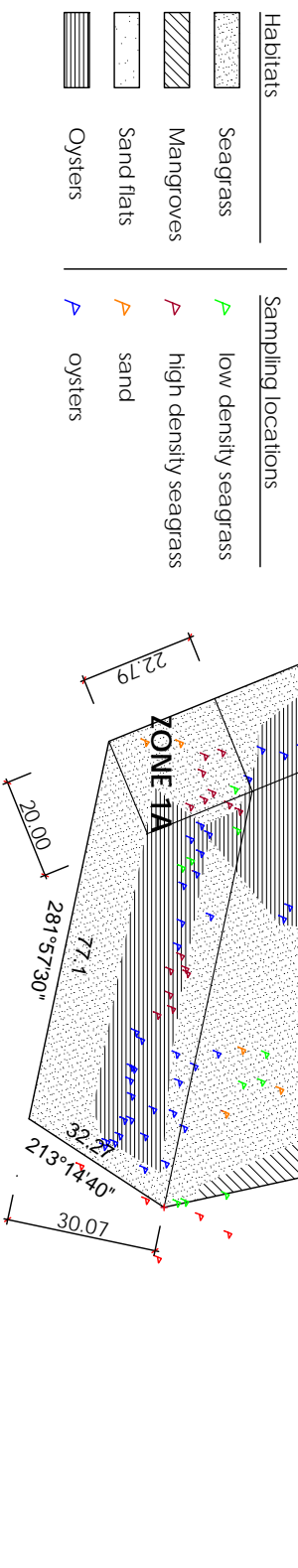
PARISH
 TUNCURRY

REFERENCE
 F920\16805
 COMPUTER FILE

Aquatic Survey of Oyster Lease
 Fringing Oaky Island,
 Wallis Lake, NSW

Figure 2: Map of Site showing
 Habitats, Sampling Locations
 and Distribution of Seagrass

scale	date	drawn	issue
1:1500 @ A3	16/03/06	gf	a
Pacific blue design			
14 seabreeze parade		P 6557 5399	
green point, 2428		F 6557 5399	
g.flebig@gmx.net			





Aquatic Survey of Oyster Lease
 Fringing Oaky Island,
 Wallis Lake, NSW

Figure 3: Random Sampling
 Sites along proposed
 Dredge Pipeline Route

scale	date	drawn	issue
	31/05/06	gf	a

pacific blue design ©
 14 seabreeze parade p 6557 5399
 green point, 2428 f 6557 5399
 g.fiebig@gmx.net