SPILL MANAGEMENT STRATEGIES

POTENTIAL SOURCE OF SPILL	SOURCE CONTROL
1. FUEL AND PUMP-OUT BERTHS	The fuel, bilge and sewer pump-out berths are proposed to be located at the T-head end of Arm A of the marina berths, in deep water (greater than 5 m depth). This location will minimise the impact a spill would have on the seagrass habitat located over 200 m away inshore, and mangroves and saltmarsh located over 250 m to the north-west.
2. FUEL STORAGE	Fuel storage is to be provided in two steel tanks which would have integral secondary containment in accordance with AS 1940 – 2004 (i.e. be double – skinned to prevent any leakage in the case of rupture of the primary inner tank). The tanks would be located above ground adjacent to the hardstand area. All fuel tanker unloading would be carried out under marina management supervision. A number of features which would be incorporated into the system to reduce potential hazards associated with the refuelling facilities are as follows: • portable fire extinguishers would be provided, selected from dry chemical, halogenated hydrocarbon and foam types; • drip trays would be provided under and around the bowser; • a holding tank would be provided on site to collect and retain the wastes from the drip trays that would be emptied at regular intervals and disposed of to an approved system or site; • provision would be made for regular emptying and disposal of the holding tank to an approved system or site; • an oil/fuel boom would be provided to contain any accidental fuel spillage; • an oil absorbent material would be provided to absorb petroleum products spilt on the water surface; • AS 3962-2001 also notes the need for particular precautions when supplying fuel over water, such as use of double containment lines.
3. OILY BILGE PUMP-OUT FACILITY	Marina Occupation Licence to be finalised by the marina operator would ban the direct discharge of bilge water within the berthing area. Specifically, the Rules & Regulations would require that automatic bilge pumps in vessels must be fitted with an isolation switch and that these must be left in the "off" position while the vessel is at berth. Fines would be imposed for non compliance with the above measure and the ultimate penalty for non compliance would be eviction of the craft. A drip bucket for storage of the end of the pump-out hose when not in use would be provided.
4. SEWER PUMP-OUT FACILITY	A drip bucket for storage of the end of the pump-out hose when not in use would be provided.
5. REPAIR WORKSHOP	The repair workshops and hardstands have been designed so that very little untreated run-off would enter the waterway. It is proposed that a first flush/washdown water drainage system would capture waste water from the workshop and maintenance hardstand areas. This water would be contained in a first flush collection tank. Once full this tank would pumped out to a trade waste treatment system comprising an oil separator. Oil and waste sludge would then be discharged into storage drums for disposal off-site by a waste contractor.

It is noted that the operation of the proposed development would be a 'scheduled activity' within the meaning of Schedule 1 of the Protection of the Environment Operations (*POEO*) Act 1997. As such, an Environment Protection Licence must be issued under the Act for the carrying out of the activity. The licence would be issued by DECC, being the 'appropriate regulatory authority'.

The licence would set out a range of conditions which must be complied with, including conditions related to pollution of waters. If any condition of a licence, including those related to pollution of waters, is contravened by any person, each holder of the licence is guilty of an offence and significant financial penalties apply.

5.3.4 Water Quality and Spill Management - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with water quality and spill management is considered to be moderate. Providing appropriate measures are put in place and properly maintained, it is considered that water quality and spill impacts during construction would be acceptable. For the operational phase, the proposed development is considered to have a number of positive benefits in regard to water quality, as opposed to the development of swing moorings within Lake Macquarie, provided the proposed operational procedures and mitigation measures are implemented and effectively managed.

5.4 WATER CYCLE MANAGEMENT

5.4.1 Stormwater Management

General Development Area – Stormwater Management Philosophies
Proposed stormwater control measures for both the marina, village centre and the residential mixed use developments are outlined as follows:-

Preventative Measures – The following preventative measures would be adopted as development controls to reduce the generation of pollutants under normal conditions as well as provide contingency in the event of an accidental spill of potentially polluting substances: -

- minimising areas of impervious surfaces - by reduced road widths and increased landscaping around dwellings;
- using drought tolerant native plant species for landscaping, which would reduce the need for irrigation and fertiliser application;
- establishing a fertiliser management plan which would ensure fertiliser application is undertaken only when needed and in a controlled manner using best practice methods;
- using industry best practice arrangements for the dispensing of fuel *(e.g. integral secondary containment tanks and delivery lines, provision of drip trays, provision of oil/fuel boom and oil absorbent material)*;
- providing adequate rubbish bins and waste disposal services to encourage responsible disposal of waste and rubbish;
- establishing measures to reduce pet droppings in the development area; and
- establishing a public education system, which informs residents and guests of stormwater management issues and encourages environmentally responsible behaviour.

Source Controls - The following source control measures have been considered for the Trinity Point Development: -

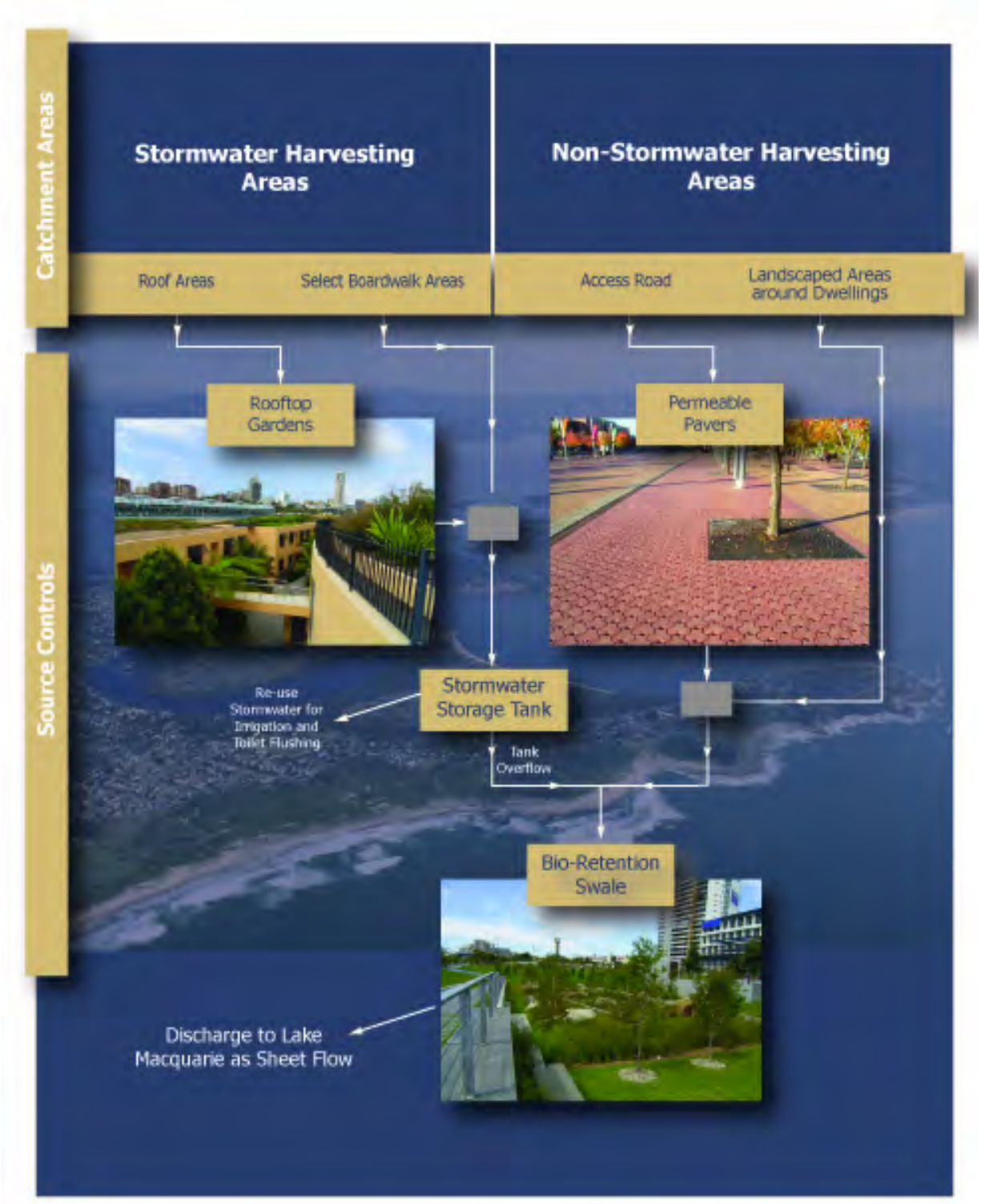
- rooftop gardens - rooftop gardens could be used to achieve a reduction in runoff volume and treatment of runoff by infiltration into the soil media. Should 'green roofs' be

implemented, they would be predominantly drought tolerant, non-fertilised gardens, which would provide benefits relating to water quality, thermal efficiency and visual amenity. An alternative to green roofs would be to harvest rainwater directly from the impervious roof surface, and to increase the downstream bio-retention area;

- rainwater harvesting – runoff would be captured from roofs and boardwalks for reuse within the development for non-potable purposes. This would result in a reduction in mains water demand, as well as reducing the runoff volume from the site;
- permeable pavement – this could be used on any uncovered walkways or parking bays - the pavement would allow stormwater to infiltrate into the sub-base, where stormwater retention and treatment is provided; and
- bio-filtration swales - all site runoff would be treated by bio-retention areas which are to be integrated into the lakeside walkway. Bio-filtration swales would consist of vegetated areas with an enhanced filtration media. Stormwater attenuation is provided within the filter media as well as ponding within the swale. Runoff is slowly infiltrated through the enhanced filter media, where physical and bio-chemical processes provide removal of suspended sediments and nutrients. Filtered stormwater would be collected in an underlying subsurface drainage system and discharged into the lake via a “low impact” distribution system.

Maintenance of Public Access - Figure 4 of **Appendix W** shows the Interaction between the Boardwalk and the Bio-retention system. As shown, the bio-retention system is not intended to limit interaction between the public and private space. The bio-retention system will be tucked beneath and adjacent to the Boardwalk, with a number of access locations between the public open space and the boardwalk. The Boardwalk is not concrete but timber boards in the majority of these locations, such that water and flow between the boards down into the bio-retention swale. Parts of the bio-retention swale could be turfed as a grassed swale, which could allow additional access over the swale area. The plans shown to date are sufficient for a Concept Plan Application, more detail to the satisfaction of Council could be provided at the Development Application stage.

The proposed treatment train philosophy for the general development area is demonstrated in the following schematic.


Catchment Areas
Stormwater Harvesting Areas
Non-Stormwater Harvesting Areas
Roof Areas
Select Boardwalk Areas
Access Road
Landscaped Areas around Dwellings
Source Controls
Rooftop Gardens
Permeable Pavers
Re-use Stormwater for Irrigation and Toilet Flushing
Stormwater Storage Tank
Tank Overflow
Bio-Retention Swale
Discharge to Lake Macquarie as Sheet Flow

Hardstand Area – Stormwater Management Philosophies

The workshop/hardstand area is a potential source of pollutants toxic to marine life. Hence, strict stormwater controls would be required, these are outlined as follows:-

Preventative Measures - The following preventative measures would be adopted to minimise generation of pollutants from the vessel repair operations:

- mist shrouds would be used in the wash down bay to minimise the migration of any wash down waters outside the hardstand area;
- abrasive blasting and painting would be undertaken within tarp or workshop enclosures and would be closely monitored on windy days to prevent drifting dust;
- where practical, vacuum sanders would be used to remove paint from hulls and collect paint dust;
- sacrificial anodes would be removed or covered before water blasting;
- the majority of solid contaminants *(e.g. paint shavings, marine growths, etc)* which can accumulate on the hardstand would be regularly swept up in the dry *(rather than wash down)* and stored in solid waste bins for collection by a commercial waste contractor;
- tributyltin *(an antifouling paint which is highly toxic to marine life)* would not be used onsite; and
- the hardstand area would be set above the 5 year ARI Lake Macquarie still water flood level to prevent frequent inundation.

Containment and Treatment Controls - A first flush tank would be provided to capture the initial 15mm of runoff from the hardstand/workshop area (*as well as any water used for vessel wash down*). Captured stormwater would be treated using a proprietary treatment package and reused for vessel repair/wash down purposes. Excess water would be discharged to the sewer under a trade waste agreement.

5.4.2 Stormwater Harvesting

A preliminary assessment of a rainwater harvesting scheme has been undertaken based on the demand analysis and water balance modelling conducted in **Appendix W**. A rainwater harvesting system is proposed incorporating catchment areas consisting of roof and selected areas of boardwalk, underground storage tanks and a reticulation network.

The rainwater system would only partially meet the non-potable water demand for irrigation, resulting in an average 10 to 12% reduction in total mains water demand. Hence, mains water top-up would be required to guarantee supply. Appropriate backflow prevention measures would be required to meet Department of Health requirements. Further mains water savings would be made by using water efficient appliances throughout the development (*e.g. AAA rated shower head, toilet and laundry facilities etc. to meet BASIX requirements*). Full details of the conceptual rainwater harvesting arrangement is shown in **Appendix W**.

Operational Requirements

The proposed Trinity Point Marina development is to be run under a strata title. Hence, all maintenance of the rainwater harvesting system would be the responsibility of the Trinity Point Marina management. Routine maintenance tasks required to maintain an acceptable level of water quality would include:

- cleaning debris from roof and gutter areas as required;
- removing captured debris from pollution traps as required; and
- cleaning storage tanks as required.

5.4.3 Changes to Flow Regimes

As discussed in Section 2.1 and 3.1 of **Appendix W**, the key focus of the stormwater management strategy is the highly sensitive aquatic ecosystems in the immediate receiving waters adjacent to the development. Given the close proximity of the development immediately on the shore of Lake Macquarie, and considering that there are no major contributing catchments or streams feeding through the subject site to the lake, it is considered that changes to the hydrological regime would have negligible impact on the receiving waters.

In addition, the approach adopted for the stormwater management strategy is for prevention, and source controls over "end of pipe" type controls, such that the expected hydrological changes, particularly during more frequent storm events would be negligible. Measures proposed include restriction on the directly connected impervious areas, use of native plants, rooftop gardens, rainwater harvesting, permeable pavements and bio-filtration swales.

Any impact to the hydrological regime would have no impact beyond the development itself, given it is located on the Lake's edge.

5.4.4 Disturbance to Groundwater

Dependant Ecosystems
Harper Somers O'Sullivan (**Appendix S**) outline that in terms of impacts upon groundwater-dependent ecosystems, no significant long-term impacts are considered likely to occur since the groundwater-related ecosystems are primarily aquatic (*such as Mangroves and Saltmarsh*) with water sources from Lake Macquarie. **Section 5.6.2** outlines any potential impacts on emergent or riparian vegetation, while **Section 5.3** outlines potential impacts on water quality in the lake.

Groundwater Resource
The proposed excavations at the site are to occur to depths of approximately 3 - 4m on the side of a hill, some 30 - 40m from the Lakes edge, with no significant upstream recharge area. No water would be alienated from downstream users as the site is at the bottom of the catchment adjacent to the receiving waters.

Therefore, the potential volume and extent of groundwater resource available at the site is not considered to be of significant size to warrant protection as a resource.

Notwithstanding, the majority of proposed site practices are expected to result in no significant permanent alteration of the groundwater table, or groundwater quality. Should, for whatever reason, the groundwater resource be utilised in future, it is expected that it would be of sufficient quality *(due to the high level of proposed stormwater management controls proposed on the site)* to be re-used for non-potable uses such as garden irrigation.

5.4.5 Construction and Operational Requirements

During construction, sediment and erosion control structures would be designed and installed in accordance with the NSW Department of Housing "*Managing Urban Stormwater – Soils and Construction*" (*Blue Book*) and Lake Macquarie City Council guidelines (*namely Councils DCP 1*). These controls would ensure that there are no significant adverse impacts on receiving water quality during the construction stage. An erosion and sediment control plan would accompany a Construction Certificate application for the development.

The only disturbance to groundwater will likely be caused by the proposed excavations to form the carparks within the residential area of the site as discussed in **Section 5.3.2**

Water quality monitoring would be undertaken to provide a more detailed assessment of the existing water quality conditions and observe water quality parameters during both construction and operational stages of the proposed development. Water quality monitoring would be used to assess the impact of the development and would provide a framework for ongoing assessment of the effectiveness of the water quality management plan proposed for the site, allowing for remedial action to be taken if required.

The key objectives of the water quality monitoring program are as follows:

- establish existing water quality;
- monitor water quality during construction periods and operation, allowing for any adverse impacts on water quality to be identified;
- monitor quality of harvested rainwater as well as treated hardstand area runoff to ensure recycled water does not pose a risk to employees, residence and guests of the development through exposure; and
- create a water quality data base which would benefit future environmental management decision making for the development site.

The proposed surface water quality monitoring programme is outlined in detail in **Appendix W**.
A water quality monitoring program would be developed for the construction phase in consultation with the consent authorities as discussed in **Section 5.3.2**.

5.4.6 Water Cycle Management - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with water cycle management is considered to be low. A suite of best practice “water sensitive” stormwater and water cycle management measures are proposed for the site, which would mitigate any impacts, and minimise the environmental footprint of the proposed development in terms of changes to flow regimes, downstream water quality and potable water demand.

5.5 WASTE MANAGEMENT

5.5.1 General

Issues associated with waste management can be conveniently discussed in terms of the construction phase of the marina and the operational phase.

5.5.2 Construction Phase

Waste generated during the construction phase would be limited to building materials such as concrete, timber, masonry material, pipes and excavated spoil. Careful planning of construction activities would ensure that the volume of surplus materials was minimised.

If suitable, excavated soil would be used for filling. If acid sulfate soils are excavated they would need to be adequately treated and then disposed of according to the Acid Sulfate Soils Management Plan prepared by Douglas Partners.

General waste from packaging, off-cuts from construction works and site amenities would also be generated on site.

Typical measures to be included in the Construction Waste Management Plan developed for the site to mitigate potential impacts include:

- segregation of wastes and waste minimisation;

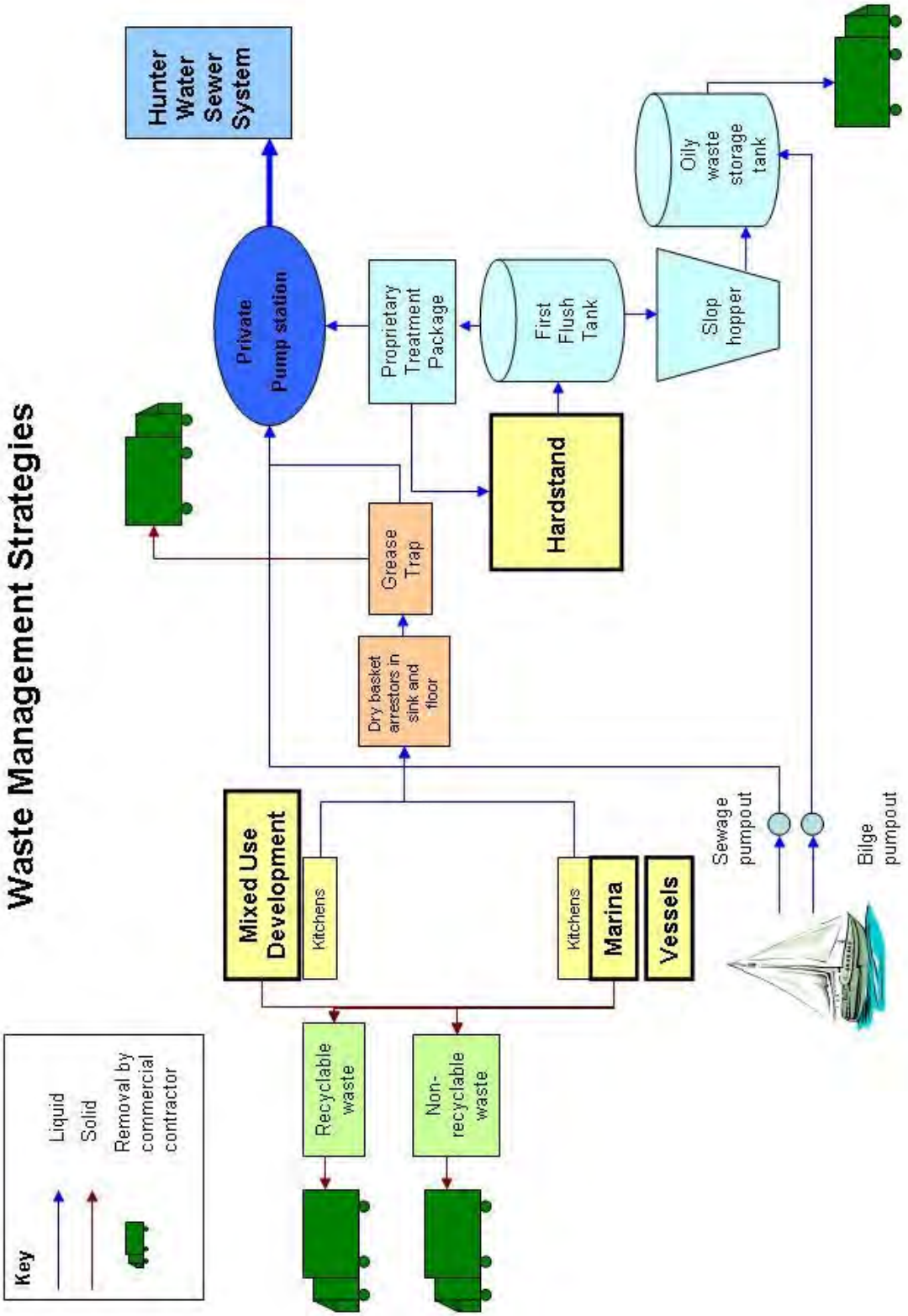
- use of recycled materials and recycling to be encouraged;
- containment of liquid waste in appropriate sealed containers;
- use of garbage bins with lids that contain general garbage and are emptied regularly off-site into a licensed landfill;
- recycling green waste where possible; and
- maintaining a register of waste disposal receipts as a record of appropriate waste disposal.

5.5.3 Operational Phase

The waste produced by the marina and mixed use development would include:

- general solid waste;
- domestic sewage;
- liquid waste resulting from preparation of food;
- drained oil;
- oily bilge; and
- sewage pump-out and chemical toilet wastes.

The proposed waste management strategy to manage and mitigate any potential impacts of operational waste is detailed in the following schematic.


Waste Management Strategies
Hunter Water Sewer System
Private Pump station
Proprietary Treatment Package
First Flush Tank
Slop hopper
Oily waste storage tank
Hardstand
Grease Trap
Dry basket arrestors in sink and floor
Mixed Use Development
Kitchens
Kitchens
Marina
Vessels
Sewage pumpout
Bilge pumpout
Recyclable waste
Non-recyclable waste
Key
Liquid
Solid
Removal by commercial contractor

5.5.4 Waste Management - Environmental Risk Rating

The overall environmental risk rating associated with waste management is considered to be moderate. Providing appropriate measures are put in place *(as outlined above)* and properly maintained, it is considered that waste impacts during construction and operational phases would be acceptable.

5.6 ECOLOGY

5.6.1 General

The existing seagrass beds, and the saltmarsh and mangrove stands to the north – west of the Marina site are considered an important local estuarine bird habitat and fish nursery for Lake Macquarie.

Minimal disturbance of the terrestrial environment would result from the proposed Marina. Any impacts on terrestrial ecology are outlined in **Volume I**.

5.6.2 Riparian and Intertidal Habitats

As described in **Section 3.3.12**, significant riparian and intertidal vegetation is restricted to the small bay to the north-west of the marina site. The proposed development would not impact on this vegetation.

As described in **Section 2.3.16**, a landscape concept plan has been prepared for the development which has been designed to complement and enhance existing native vegetation and provide habitat for native fauna. The landscape plan also aims to be in keeping with the visual character of the area.

5.6.3 Aquatic Habitat

The Ecology Lab, have indicated in their assessment that the proposed marina development has the potential to impact on protected estuarine habitats in the following ways (*refer* **Appendix R**):

- direct disturbance to aquatic vegetation during marina construction and subsequent use;
- indirect disturbance to aquatic vegetation via shading;
- impacts from boat movements on seagrasses when the marina is in operation;
- impacts on water quality that could affect seagrass and other estuarine habitat during marina operation;
- impacts from stormwater run-off from the resort complex on water quality that could affect aquatic vegetation during the operation of the resort; and
- impacts from the alteration of run-off on saltmarsh and mangrove habitats in the unnamed inlet to the north west of the site.

All these impacts could also ultimately affect fish and other aquatic faunal assemblages within the area due to the impacts that may occur to their habitats.

Direct Disturbance
Of the marina structures, none (*except for a section of the travel lift – see below*) would pass over any seagrass beds, and any disturbance to the unvegetated, soft sediment seabed would be minimal due to the hollow design of the piles. The inner section of the travel lift platform would pass over 9.5 m of seagrass (*Zostera*). The design calls for as many of the hollow steel tube piles as is structurally possible to be located outside the seagrass bed.

A proportion of the marina access jetty and breakwater accessway would be located over seagrass beds. The piles to be used for both of these jetties would be hardwood timber.

Piles associated with the short viewing platforms on the eastern shoreline would be positioned to avoid seagrass where possible.

Considering the extent of the *Zostera* along the area of this northern shoreline, the impacts on seagrass from direct disturbance as a result of piling are considered to be minimal. No seagrass beds would be fragmented and the area of direct disturbance is a very small proportion of the total seagrass bed. The breakwater comprised of timber slats penetrating the upper portion of the water column is designed such that the onshore and nearshore section of the structure *(to a distance of approximately 20m from the shoreline)* would be completely open. This design feature would allow the free movement of seagrass wrack in the nearshore zone.

As there is adequate depth along this part of Bardens Bay, no dredging needs to be undertaken prior to construction of the marina. As a result there would be minimal disturbance to the soft sediment bottom, and minimal siltation to impact the seagrass or release possible contaminants from bottom sediments. Results of sediment contamination by Douglas Partners indicated low levels of contamination (*refer* **Appendix G**).

Other aquatic vegetation, such as mangroves and saltmarsh habitat, are also at risk during the construction phase. However, the building of temporary roads and areas designated for stock piling would avoid damage to these habitats during this phase.

Shading Impacts
The design of the marina structures would take into account shading issues and minimise this impact to help prevent any damage to seagrass due to shading. Materials, such as aluminium mesh decking, would be substituted for more traditional timber structures over areas that contain seagrasses, which allow adequate levels of sunlight to reach the underlying seagrass. The structures to be constructed with aluminium mesh decking (refer Figure 1 **of Appendix R**) include:

- the marina access jetty - extending some 21 metres from the shoreline; and
- the breakwater accessway extending some 25 metres from the shoreline.

Due to the structural strength required for the travel lift, the travel lift runway beams would need to be constructed of steel and would create a relatively small shading footprint over the seagrass.

The three viewing jetties on the eastern shoreline would also be constructed of ‘seagrass friendly’ aluminium mesh, so as not to damage the underlying seagrass. In conclusion, any impacts due to shading from the proposed marina would be minor given the majority of the marina structures are located beyond the area of seagrass beds.

<u>Boat Movements</u>
Boat movements within the vicinity of aquatic vegetation have the potential to impact on their distribution and abundance.

It is not envisaged, however, that boat movements within the vicinity of the proposed marina would be great enough to cause any substantial boat wake as boat wake would be limited by navigational controls within and around the marina. In addition, due to the location of the seagrass in shallow water (*down to a depth of approximately 1.8 m*), it is considered unlikely that boats within the marina would be approaching this close to shore. In addition, access by boats to

the proposed viewing structures to the south of the marina would be limited by the use buoys, indicating an exclusion zone, located at the outer edge of the existing seagrass beds.

Run-off
Given the high sensitivity of aquatic ecosystems in the immediate receiving water, management of stormwater quality is an essential element of the environmental objectives for the proposed development. The quality of run-off from land is of particular importance to the local seagrass populations, some of which are located immediately adjacent to the proposed development site. Seagrass is typically highly sensitive to increased levels of suspended sediment and nutrients, which are commonly observed in high levels in runoff from urbanised catchments.

A range of current best practice stormwater control measures are proposed to mitigate any degradation in water quality as a result of the proposed development. In addition, a range of preventative, containment and treatment measures would be adopted to manage stormwater runoff quality from the workshop/hardstand area. Further detail of the proposed stormwater management controls are outlined in **Appendix W**. With the implementation of these preventative measures and source controls (i.e. all stormwater would be treated before it reaches the Lake) adverse impacts on seagrass beds due to stormwater quality is not considered an issue.

Water Quality
The proposed location of the fuel and sewer pump-out berths is at the T-head end of Arm A of the marina berths, in deep water (*greater than 5 m depth*). This location would minimise the impact a spill would have on the seagrass habitat located over 200 m away inshore, and mangroves and saltmarsh located over 250 m to the north-west.

The repair workshops and hardstands have been designed so that very little untreated run-off would enter the waterway (*refer* **Appendix W**). The timber slatted breakwater has been designed to be partially pervious, unlike traditional rock rubble breakwaters. This would allow the movement of water through the breakwater, and minimise the entrapment of sediments on the southern side of the breakwater.

An assessment of the extent and nature of potential leachate from antifouling paints on vessels moored within the marina has recently been undertaken to determine the potential effect on aquatic ecosystems. Sampling for dissolved and total copper and total suspended solids was undertaken within and outside of a number of marinas in Lake Macquarie and at the proposed Trinity Point marina site to establish background levels within the lake and assess typical levels within marinas generally.

All sampling results and detailed discussion are included in **Appendix W**.

The sampling undertaken indicated that Lake Macquarie is a highly modified water body with respect to copper concentrations. Moderate to high background copper levels were observed with 90% and 95% trigger values defined in ANZECC (*2000*) being exceeded, depending on the location. The Trinity Point sampling site was typical of these observations. As such, because of the existing background levels it is expected that the marine biota at the site will already be relatively copper tolerant. Trinity Point marina is expected to have similar flushing, copper levels and colonisation by marine organisms as the other marinas studied. The layout design of the Trinity Point marina will assist in maximizing dilution and dispersion. The design of the associated breakwater design with a partial depth wave screen and open section at the foreshore will assist in minimising restrictions to flushing. Thus the concentrations of copper within the Trinity Point Marina, if built, should not be extraordinary in comparison to existing marinas in Lake

Macquarie, or impact on biota such that the 90% to 95% species protected range would not be preserved.

Monitoring of dissolved and labile (bioavailable) copper gives a superior description of the biological effect of copper in the lake, as opposed to total copper by itself, and should be continued as part of the ongoing monitoring program.

Zinc dissolution from sacrificial anodes used to protect vessels moored within the marina from corrosion is another potential source of heavy metal impacting on water quality. In Lake Macquarie, as is reported to be the case in many other estuarine systems in Australia *(Warnken, Teasdale and Dunn, 2007)*, naturally occurring zinc levels in the water column and in the sediments are generally higher than copper levels. Zinc is also less toxic than copper to marine biota as is evident from ANZECC (*2000*) exceedance guideline values. **Section 3.3.11** indicates that Lake Macquarie is a modified system with elevated levels of some metals *(including zinc)* present in the water column. From sampling undertaken Trinity Point appears to be typical of this nature.

Based on rates of release from recreation vessels estimated for zinc *(Maes et al, 2002)* and for copper *(work done by PBP for Shellcove Marina)*, zinc rates of release are of the order of 60% of copper rates. Given the relatively lower toxicity and release rates and high naturally *(and otherwise)* occurring existing levels it is considered that elevated zinc levels at the proposed Trinity Point marina are of lesser concern that that posed by copper, discussed above. Design features of the marina to minimise the impact of copper levels, also discussed above, would be of similar benefit in relation to zinc.

The amount of zinc that can be released from a recreational vessel is likely to be too small to have any significant effect on the natural fluctuations in the water column and therefore on the ecosystem existing at the site. Bird et al *(1996)* reports that elevated concentrations of zinc in the water and sediment have been found for two marinas studied in the UK, but these levels did not exceed the local Environmental Quality Standards.

Although incremental increases in the concentrations of copper and zinc are unavoidable at a marina through the dissolution from boat surfaces whilst in the water, it is considered that the use of layout design measures *(as discussed above)* should mitigate any potential impact. The employment of best management practices at the site, such as:

- no in water hull cleaning;
- removal of zinc anodes during cleaning operations;
- the use of alternatives to copper based, or low copper content, anti fouling paint (where possible); and
- collection and treatment of maintenance/hard stand area wastewater

should prevent the any further contamination of the water way from copper or zinc.

5.6.4 Fauna Issues

Fish and Macro-benthos

Construction Impacts

The impacts on fish and macro-benthos of marina construction are minimal. The vast majority of piles would be driven into unvegetated sediment resulting in the loss of only a small area of soft benthic habitat.

Operational Impacts
Impacts on fish and macro-benthos as a result of marina operation are unlikely. The creation of a hardstand facility which includes full water pollution control would provide adequate protection of water quality and prevent contamination of sediments under and close to the marina. In addition, it is proposed to provide additional seahorse habitat within the marina in the form of netting.

Birds, Reptiles and Mammals
Construction Impacts
The proposed construction works may result in temporary displacement of fauna but would not impact estuarine habitats used by birds, reptiles and mammals.

Operational Impacts
The proposed development would not alter the utilisation of the aquatic habitats by aquatic birds. In addition the numbers of fishing birds are likely to increase in the Bardens Bay area as a result of the increase in boats and structures for them to utilise at the proposed marina

The potential for light interference from the walkway lighting on aquatic birds over-flying the facilities or roosting/feeding on the intertidal shoals and in the mangrove stands to the west and north of the facility would be minimised by use of downward directed lighting. The proposed downward directed lighting on the floating marina could alter the use of the Bay by both mobile aquatic fauna and birds by attracting small aquatic organisms which in turn could attract fishing birds. In addition, insects may be attracted to the light beams and become prey for insectivorous birds.

5.6.5 Threatened Species and Populations

Terrestrial Flora
HSO report that *(refer* **Appendix S***)* no threatened flora species were recorded or considered likely to occur within the site. A small area of Swamp Oak Floodplain Forest would require removal for the boat travel lift, however, as noted in **Section 3.3.12,** the endangered Swamp Oak Floodplain Forest within the site is highly disturbed and the area affected by the construction of the travel lift would be minimal. The proposed stormwater management measures would mitigate development impacts and planting with indigenous species would enhance this degraded community.

Terrestrial Fauna
Two threatened fauna species Eastern Freetail Bat and Large-footed Myotis were recorded within the study area during surveys (*HSO, 2001, refer* **Appendix S**). A further six threatened fauna species were considered likely to occur within the subject site on at least an occasional basis. All the threatened fauna species considered likely to occur within the subject site are highly mobile species able to exist or traverse in open habitats.

The removal or modification of minor foraging habitat (*vegetation*) for these threatened fauna species is considered to comprise a negligible impact. This is particularly the case given the proportion of habitat available in the local area and the small amount of foraging habitat to be removed within the subject site.

Potential nesting/breeding habitat in tall remnant trees for Osprey may be affected as a result of the proposal. However, the species, or evidence of Osprey nesting, was not recorded during a recent site investigation (**Appendix S**) or during the various previous surveys (*HSO, 2001; 2003b*). No roosting/breeding habitat was recorded within the subject site for the remaining

threatened fauna species considered likely to occur and as such they would not be impacted upon by the proposal.

Potential impacts arising from the proposed Trinity Point Marina on threatened fauna species recorded, or considered likely to occur, are of a small scale and magnitude and are considered unlikely to adversely impact on these species.

A helicopter landing pad and associated use of helicopters forms part of the Trinity Point proposal. Impacts that might be expected to occur upon primarily aerial terrestrial fauna, such as birds and bats are as follows. In terms of birds, the main issue of potential concern would be impacts upon flocking wader species. No significant resident populations of any such species have been recorded during the various surveys undertaken for the site. Bird mortality in general would not be expected to be significant as such impacts would be considered to consist primarily of occasional blade strike upon common species. Bat mortality in general would be limited to very occasional blade strike of individuals should the helicopter landing pad be operated at night (*note that the heli-pad would only be operated at night in an emergency situation*). While acknowledging that blade strike is a potential impact, it is likely to be low, or at insignificant rates.

In terms of impacts upon groundwater tables and groundwater-dependent ecosystems, no significant impacts are considered likely to occur since the groundwater-related ecosystems are primarily aquatic (*such as Mangroves and Saltmarsh*). However, the section on **Aquatic Flora**, below covers this in more detail.

Aquatic Flora
The endangered Coastal Saltmarsh is located around the unnamed inlet in the north-west of the site. However The Ecology Lab *(refer* **Appendix R***)* concluded that the proposal is unlikely to modify the composition or place the local occurrence of this community at risk.

Aquatic Fauna
No individual species listed in the schedules of the three relevant Acts (*TSC Act, Fisheries Management Act and EPBC Act*) were observed in, or likely to occur, within the subject site.

The proposed development could be undertaken in such a manner that the construction and use of the facilities would meet the fish and aquatic habitat protection provisions of the Fisheries Management Act as detailed in the NSW Guidelines *(NSW Fisheries 1999)* and as specified in the Habitat Protection Plans gazetted under the Act.

It was also concluded that the proposed development would not require a permit under the Fisheries Management Act *(1994)* and, as no threatened species would be adversely impacted, a Species Impact Statement is not required.

5.6.6 Ecology - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with ecology is considered to be low. Provided best management practices are used for the construction and operation of the proposed marina there would be no significant impacts on the riparian or aquatic biota of Trinity Point.

5.7 TRAFFIC AND PARKING

5.7.1 Construction Parking and Traffic

Preliminary bulk earthworks calculations undertaken by Patterson Britton & Partners indicate that as much as 30,000 m^3 of material may have to be removed from the site to create the underground car parking areas *(refer* **Figure 20***)*. This could equate to as many as 1,500 truck movements over the period of the construction.

A Construction Management Plan would be prepared at the detailed design stage to document vehicle movements associated with the construction works. This is typically prepared by the construction Contractor. As the site is currently vacant, parking for construction vehicles could be accommodated on site.

5.7.2 Operation Traffic Impacts

A traffic and parking assessment for the proposed development was undertaken by Better Transport Futures, refer to **Appendix T** for the full report.

As the development would be a combined residential and leisure facility, peak usage for tourist/leisure facilities would be spread over the weekends and weekday evenings. For example, peak traffic flows for the marina would coincide with racing events, e.g. twilight and weekend sailing events.

Table 5-2 shows potential traffic generation rates for the entire developments.

Table 5-2 - Potential Traffic Generation Rates

Feature	Rate		Area or number	Traffic Flows	
	AM Peak	**PM Peak**		**AM Peak**	**PM Peak**
Marina	0.54 per berth	1.08 per berth	300 berths	20 (assumed)	75 (assumed)
Gym	2 per 100m^2	2 per 100m^2	50 m^2	2	2
Beauty Salon	2 (staff)	2 (staff)	64m^2	2	2
Café	5 (staff)	5 (staff)	90m^2	5	5
Bookshop/Newsagent	4 (staff)	4 (staff)	130m^2	4	4
Function Rooms	45 (attendees & facilitators)	45 (attendees & facilitators)	350m^2	45	45
Restaurant	5 (staff)	5 per 100m^2	160m^2	10	20
Operations Management	2 (staff)	2 (staff)	40m^2	2	2
Offices	2 per 100m^2	2 per 100m^2	100m^2	2	2
Service Area/Workshop	5 (staff)	5 (staff)	450m^2	5	5
Tourist Units	1 per unit	1 per unit	75 (1-4 bedrooms)	75	75
Residential	0.5 per unit	0.5 per unit	30 (3 bedrooms)	15	15
	0.65 per unit	0.65 per unit	45 (4 bedrooms)	29	29
Total				**216**	**281**

Notes: Refer to **Appendix T** for assumptions made in arriving at these rates,

Within the development, the largest vehicle would be a fuel tanker making regular deliveries to the marina fuel storage facility. The tanker would be a large rigid vehicle, similar in size to a standard 12.5 m truck, such as a Council garbage vehicle. All other service vehicles would be smaller. The marina would not provide a facility for launching and retrieving large vessels *(only a boat lift for maintenance activities)*, therefore a manoeuvring area for a semi-trailer or larger vehicle for transporting vessels would not be required.

The majority of pedestrian movements associated with the proposed development would be internal to the site. There would be pedestrian movements from adjacent residential areas *(existing and under construction).* As part of the proposed development, new paths and linkages for pedestrians and cyclist would be provided *(both on-road and off-road)* to cater for future demands.

Better Transport Futures concluded that the existing road system would cater for the traffic demands of the proposed development subject to intersection upgraded *(see* **Appendix T** *for details)* and that existing pedestrian and cyclist facilities in the vicinity of the site are considered adequate.

5.7.3 Operational Parking Impacts

Parking provision for the proposed development *(as summarised in* **Table 5-3***)* was determined with reference to the *RTA (2002)*, AS 3962-2001 (*guidelines for design of marinas*) and Lake Macquarie City Council *(LMCC)* DCP No.1.

Table 5-3 - Parking Requirements

Element	Size/Number	Requirement	Source	Provision
Marina (includes offices, boat storage, clubhouse)	300 berths	0.3 per berth	AS3962-2001	90
Marina staff	4	0.5 per staff	RTA	2
Gym	50 m^2	1 per 10m^2	LMCC	5
Beauty Salon	64m^2	1 per 25m^2	LMCC	3
Café	90m^2	1 per 10m^2	LMCC	9
Chandlery	50m^2	1 per 25m^2	LMCC	2
Bookshop/Newsagent etc	130m^2	1 per 25m^2	LMCC	1
Function Rooms	350m^2	1 per 10m^2	LMCC	35
Restaurant	160m^2	1 per 10m^2	LMCC	16
Operations Management	40m^2	1 per 40m^2	LMCC	1
Offices	100m^2	1 per 40m^2	LMCC	3
Service Area/Workshop (2 staff)	450m^2	-	-	2
Tourist Units	67 x 1 or 2 bedrooms 8 x 3 or 4 bedrooms	1 per unit	LMCC	75
Residential Units	75 x 3 or 4 bedrooms	1.5 per unit	LMCC	113
Total		**357.5**		**357**

As shown in **Table 5-3**, the development would be designed to accommodate all parking requirements on site. It is also proposed to provide an element of valet parking during major events in the marina area allowing overflow parking immediately to the south where there would be surplus parking provision associated with residential apartments in this location.

5.7.4 Traffic and Parking – Environmental Risk Rating

The environmental risk rating for traffic and parking is considered to be low. The proposed intersection upgrading works would cater for increased traffic flows associated with the future completion of the development and all associated parking would be accommodated on site.

5.8 ACOUSTICAL ENVIRONMENT

The closest noise-sensitive receivers to the development are the residential properties surrounding Bardens Bay, with the most sensitive receiver locations on Lakeview Road, Morisset Park. To assess the impact of helipad operations, noise sensitive receivers were adopted adjacent to the helicopter flight path. In all, 23 locations were used in the acoustic assessment for the flight path, refer to Figure 3 in **Appendix P**. Due to the size of the site, the closest noise-sensitive receiver varies between noise sources. The closest receivers to the marina and associated facilities are shown in **Table 5-4.**

Table 5-4 - Summary of Noise Sensitive Receivers for Marina Construction and Operation

Noise Source	Nearest Affected Residential Receiver	Approximate Distance to Nearest Affected Residential Receiver
Construction Noise – Workshop/Hardstand	57C Lakeview Road, Morisset Park	180 m
Construction Noise – Marina	52 Buttaba Road, Brightwaters	390 m
Construction Noise – Tourist/ Residential / Resort Buildings	57C Lakeview Road, Morisset Park	250 m
Vessels in Marina	57C Lakeview Road, Morisset Park	425 m
Helicopters on Helipad	52 Buttaba Road, Brightwaters	380 m
Mechanical Plant	57C Lakeview Road, Morisset Park Trinity Point Block A	20 m
Function Room Events	57C Lakeview Road, Morisset Park Trinity Point Block A	10 m
Workshop	57C Lakeview Road, Morisset Park Trinity Point Block A	70 m

Refer to **Appendix P** for receiver locations. Future noise receivers would also be located in adjacent development on the site.

Noise criteria for the proposed development were determined from several sources including DECC *(EPA policy)*, Australian Standards, and guidelines, polices etc referenced in LMCC's DCP No.1, such as the *NSW Environment Protection Authority Industrial Noise Policy (INP) 2000.* The objective of the INP is to protect residential areas from noise generated by commercial, industrial or trade premises. It adopts different noise intrusiveness criteria for the day, evening and night *(depending on whether it occurs on working days or Sundays and public holidays).*

5.8.1 Construction Noise

Predicted noise levels were made at the closest noise sensitive receiver from three components of the work, as shown in **Table 5-5.** Noise levels have been assessed against both the Environmental Noise Control Manual *(ENCM) (NSW EPA, 1994)* and the more recent Draft Construction Noise Guideline *(DECC, 2008)* criteria.

Table 5-5 - Predicted Construction Noise Levels for Marina and Associated Facilities

Noise Source	Most-Affected Receiver	Predicted Noise Level, dB	Noise Criterion, dB Draft Guideline	Noise Criterion, dB ENCM
Breakwater (Approximately 20 weeks)	52 Buttaba Road, Brightwaters	44	44	39
Travel Lift / Hardstand (Approximately 4 weeks)	57C Lakeview Road, Morisset Park	50	44	39
Marina/ Resort Buildings (Approximately 32 weeks)	57C Lakeview Road, Morisset Park	41	44	39

* Criteria for demolition/construction noise varies according to the construction period. As noted in **Section 2.4.4** construction of the marina would take approximately 40 weeks.

As indicated in **Table 5-5** the construction noise impact from the development would exceed the applicable noise criteria. This is, in part, due to the existing low background levels surrounding the site which means construction noise would be more intrusive than an area with higher background noise levels. However, construction activities would be restricted to the days and times shown in **Section 2.4.2** and the construction process could be managed to minimise noise impacts *(see* **Section 7** *which lists noise controls to ameliorate impacts)*. Guidance from the DECC's Draft Construction noise Guideline have been used to develop mitigation measures listed in **Section 7.**

5.8.2 Operational Noise

Site noise sources would include boat repair and maintenance activities, mechanical plant, vehicle traffic and helicopter landings and takeoffs. **Table 5-6** provides an overview of noise criteria for the site, and **Table 5-7** the predicted noise levels for what are expected to be the major noise sources.

Table 5-6 - Overview of Industrial Noise Criteria for the Development

Source	Time Periods of Operation	Criterion, $dBL_{Aeq,15min}$
Boat Repair – Boat Lift, Hardstand, Workshop	Day	39
Marina vessels in marina	Day	39
	Evening	39
	Night	35
Helicopters on landing pontoon	Day	39
Mechanical Plant	Day	39
	Evening	39
	Night	35

Operation of the travel lift, maintenance operations on the hardstand, and workshop activities were identified as the likely major noise sources. As equipment used on site has not yet been selected, empirical sound power levels for the following equipment were predicted and used top develop the noise levels shown in **Table 5-7:**

- engine noise from the 82kW housing-mounted diesel motor with high performance mufflers powering the travel lift;
- noise from maintenance operations in the hardstand area, including abrasive blasting, sanding and a 45kW air compressor; and
- noise from hand tools used for repair operations in the workshop.

Table 5-7 - Boat Repair Noise Predictions at Lakeview Road Receivers

Noise Source	Predicted Noise Level L_{Aeq} dB(A)	Noise Criterion dB(A)
travel lift *(diesel)*	38	39
travel lift *(electric)*	37	39
hardstand	37	39
workshop	16	39

As shown in **Table 5-7** predicted noise levels comply with noise criteria. However it is recommended that measurements of an actual travel lift engine housing *(once a model has been selected)* be conducted to clarify noise levels.

Predictions of peak traffic levels from the development were estimated at approximately 210 vehicles per hour by Better Transport Futures, see **Appendix T**. No information was provided on the proportion of heavy vehicles but this was assumed to be 7% for the purposes of noise predications, i.e. heavy service vehicle movements to and from the workshop and food service areas. A traffic speed of 50km/hr was also assumed. 67% of traffic was assumed to use Trinity Point Drive with the remaining 33% using Henry Road. The Calculation of Road Traffic Noise (CoRTN) methodology was used to calculate traffic noise levels

Table 5-8 provides noise criteria for the site and the predicted traffic levels along Trinity Point Drive and Henry Road. This shows that traffic noise levels on Trinity Point Drive would exceed the noise target by 3 dB(A). Noise on Henry Road is below the criteria. It should be noted that the predicted noise levels are likely to be conservative and hence noise levels may be less than predicted. The predicted noise levels are increased by the presence of heavy vehicles in the peak traffic flows, and therefore reducing heavy vehicle movements in peak periods may assist in reducing the traffic noise impact.

Table 5-8 - Traffic Noise Prediction

Receiver Location	**Predicted Noise Level** $L_{Aeq(1hr)}$	**Noise Criterion (ECRTN)* Day (7am-10pm)** $L_{Aeq(1hr)}$
Trinity Point Drive	63	60
Henry Road	54	60

* Environmental Criteria for Road and Traffic Noise (ECRTN) are planning goals for new developments (not legislative requirements).

There are currently no numerical noise criteria for marine vessel traffic associated with new developments, only the *Protection of the Environment Operations (Noise Control) Regulations* that stipulate that marine vessels are not to emit 'offensive noise'. However, noise from vessels within the marina itself would be assessed against the industrial noise level criteria *(refer* **Table 5-6***)*. The overall noise impact of marine vessel traffic would be minimal and could be controlled by administrative measures such as speed restrictions, combined with no-wash zones. Predicted noise levels from marina vessels, based on previous measurements conducted by Arup Acoustics and vessels movements at similar sized marinas are presented in **Table 5-9**.

Table 5-9 – Marina Vessel Noise Level Predictions

Receiver	Time Period	Predicted Noise Level	Criterion
57C Lakeview Road, Morisset Park	Day	32	39
	Evening	30	39
	Night	30	35
28 Pillipai Road, Windermere Park	Day	28	39
	Evening	27	39
	Night	27	35
52 Buttaba Road, Brightwaters	Day	30	39
	Evening	28	39
	Night	28	35
Block A, Trinity Point	Day	36	39
	Evening	34	39
	Night	34	35

As shown in **Table 5-9** predicted marina noise levels would be below the noise level criteria.

Heli-Consultants advised Arup Acoustics *(see* **Appendix P***)* of likely helicopter flight paths and the type of helicopters likely to use the proposed Trinity Point helipad. From these, the Bell407 helicopter was selected as a typical scenario. Helicopter movements were estimated at a maximum of four movements per day, or 28 per week. Measured noise levels from the Bell407 were used to predict values in

Table 5-10.

Noise criteria were adopted from the AirServices Australia “Principles and Procedures for Minimising Aircraft Noise “ and “Fly Neighbourly” guidelines.

Table 5-10 - Helicopter Noise Predictions (Flyover, Bell407 Helicopter)

Receivers	Predicted Noise Level $L_{Aeq,24hr}$ downwind	Noise Criteria dB(A)	Predicated Noise Level L_{Amax} downwind	Noise Criteria dB(A)
Block C, Trinity Point	48	**50**	77	**95**
57C Lakeview Road, Morisset Park	43	**50**	71	**95**
6 Macquarie Road, Morisset Park	42	**50**	68	**95**
6 Lakeview Road, Morisset Park	45	**50**	74	**95**
28 Pillapai Road, Windermere Park	50	**50**	82	**95**
Brightwaters Christian College	47	**50**	77	**95**
34 Bulgonia Road, Brightwaters	45	**50**	73	**95**
52 Buttaba Road, Brightwaters	45	**50**	74	**95**
6 Dandaraga Road, Brightwaters	42	**50**	68	**95**
11 Omaru Place, Summerland Point	44	**50**	73	**95**
14 Scott Road, Vales Point	33	**50**	59	**95**
39 Henry Road, Morisset Park	39	**50**	64	**95**
34 Rhodes Parade, Windermere Park	42	**50**	69	**95**
57 Asquith Avenue, Windermere Park	42	**50**	70	**95**
117 Grand Parade, Bonnells Bay	39	**50**	69	**95**
21 Riesling Road, Bonnells Bay	48	**50**	79	**95**
16 Wilson Street, Bonnells Bay	45	**50**	77	**95**
5 Lakeside Close, Bonnells Bay	43	**50**	74	**95**
63 Waikiki Road, Yarrawonga Park	38	**50**	65	**95**
2 Yoorala Road, Yarrawonga Park	33	**50**	60	**95**
4 Kimbul Road, Brightwaters	40	**50**	67	**95**
30 Mirrabooka Road, Mirrabooka	36	**50**	60	**95**
205 Dandaraga Road, Mirrabooka	36	**50**	61	**95**

As shown in **Table 5-10** predicted average and maximum noise levels would be below the noise level criteria.

Noise levels for helicopters while on the landing pontoon were also predicted from the measured data from the Bell 407 and found to be below the industrial noise level criteria *(refer* **Table 5-6***)*.

Table 5-11 presents the predicted noise levels against this criteria.

Table 5-11 - Helicopter Noise Predictions (On-Ground)

Receiver	Time Period	Predicted Noise Level, $L_{Aeq,15min}$	INP Criterion
57C Lakeview Road, Morisset Park	Day	31	39
28 Pillipai Road, Windermere Park	Day	27	39
52 Buttaba Road, Brightwaters	Day	38	39
Block A, Trinity Point	Day	39	39

High levels of aircraft noise can have a detrimental effect on the health of animals, through a combination of direct physical damage, masking of crucial audible information such as mating calls or predators, and by causing high levels of stress and/or behavioural change. The US Department of the Interior, in conjunction with the US Air Force *(1988),* presented a summary of the effects of aircraft noise on wildlife and this document was used as guidance in assessing effects *(reference is made to this document as most research in this field has been carried out overseas and relates to noise levels that would be distressing to humans).*

This information suggested that sound levels above 90 dB(A) are likely to have an adverse affect on mammals. The maximum predicted over land noise level from helicopter operations is 82 dB(A) which occurs in a residential area with noise levels at other locations, including the Lake Macquarie State Conservation Area, being lower. No adverse impact on aquatic fauna is expected within the flight path of the helicopter as only 1% of acoustic energy contained in an incident sound is transmitted to the water. In addition, based on available research on the sensitivity of fish to anthropological noise, helicopter noise at the helipad would not be likely to cause an adverse impact on fish.

In summary, operational noise levels would generally be expected to meet the criteria, subject to appropriate noise mitigation measures including treating equipment where necessary and managing traffic movements on site. Mitigation measures to ameliorate operational noise impacts are listed in **Section 7**. Boat repair activities at the workshop, operation of the boat lift and operation of the helipad would generally only occur during the day. Helicopter and marina vessel noise levels would not be expected to cause an adverse noise impact on residential amenity or on terrestrial and aquatic fauna.

5.8.3 Acoustical Environment – Environmental Risk Rating

The environmental risk rating relating to the acoustical environment is considered to be moderate. This rating relates mainly to traffic noise during the AM and PM peaks and accordingly would not occur through out the day. Similarly construction noise impacts are temporary and not continuous over the entire construction period. As noted in the above sections, the noise predications are conservative and actual noise levels may be lower.

5.9 AIR QUALITY

The nearest sensitive receptors are the series of residences located on the foreshore of Bardens Bay to the north west of the site accessed from Lakeview Road. The nearest of these receptors *(57A Lakeview Road)* is approximately 100m to the north west of the site. These residences are buffered by eucalypts along the foreshore such that they are not visible from within the site.

Other potentially significant receptors include the residents on the opposite side of Bardens Bay, approximately 700m from the foreshore of the site and 400m from the outer extent of the marina within the suburb of Brightwaters.

Future sensitive receptors also include the residential area to be developed to the immediate west of the site and the future occupants of the commercial and tourist areas within the marina itself. The location of the nearest, and potential sensitive receptors are shown in Figure 2 of **Appendix Q**.

5.9.1 Construction Air Quality

Stage 1 includes construction of the breakwater, marina arm A, helipad, boat repair facilities and the commercial and tourism accommodation building. This is expected to take approximately 46 weeks. Emissions associated with the offshore construction works are anticipated to be minor. The major emissions sources during onshore construction are likely to be :

- dust generation where soil is exposed during excavation and piling; and
- emissions from construction plant and equipment including particulates, carbon monoxide, nitrogen oxides and volatile organic compounds.

Stages 2, 3 and 4 include the construction of the other 3 arms of the marina, with each stage taking approximately 25 weeks. These works are mainly based offshore with the exception of the installation of services and emissions associated with the offshore construction works are therefore anticipated to be minor.

The construction process could be managed to minimise air quality impacts *(see **Section 7** which lists mitigation measures to ameliorate impacts)*.

5.9.2 Operational Air Quality

A summary of the potential emission sources, associated pollutants and potential impacts is presented in **Table 5-12**.

Table 5-12: Potential Sources of Air Pollution During Operation

Facility/Activity	Location	Potential Impact	Impact with Management Measures	Associated Pollutant
Ship Travel lift	Hardstand area	Negligible	Negligible	SOx, NOx, CO, Particulates (PM10, TSP)
Operational Road Traffic	Marina Village	Negligible	Negligible	SOx, NOx, CO, Particulates (PM10, TSP)
Helicopters	Helicopter Pontoon	Negligible	Negligible	SOx, NOx, CO, Particulates (PM10, TSP)
Vessels	Marina	Negligible	Negligible	SOx, NOx, CO, Particulates (PM10, TSP)
Fuel storage and delivery	Above ground storage tank adjacent workshop	Low	Negligible	VOCs
Fuel dispensing	Fuel berth	Low	Negligible	VOCs, Particulates (PM10, TSP)
Surface Preparation	Hardstand area	Medium (under unfavourable wind conditions)	Negligible	VOCs
Painting	Workshop/hardstand area	Low	Negligible	VOCs
Fibreglass	Hardstand Area	Low	Negligible	VOCs, Particulates (PM10, TSP)

5.9.3 Mitigation Measures

Section 5.2 and 6.2 of **Appendix Q**.propose detailed lists of mitigation measures for the Trinity Point site to alleviate any potential air pollution problems. These potential problems are relate to the following:

- construction phase;
- surface preparation;
- paint application;
- fibreglass
- vessels;
- travel lift; and
- fuel storage, filling and dispensing

These mitigation measures have been included in full in **Section 7** of this EAR Volume. **Table 7-1** lists those mitigation measure relating to the construction phase and **Table 7-2** lists those mitigation measures relating to design and operation of the site.

5.9.4 Air Quality – Environmental Risk Rating

The environmental risk rating relating to air quality impact to sensitive receivers as a result of the marina operations is likely to be moderate. This rating is elevated above low primarily as a result of the potential for dust emissions from surface preparation such as abrasive hull blasting and sanding to have a significant impact on nearby residents in unfavourable wind conditions. However, this impact can be controlled such that a rating of low is achieve due to:

- the predicted negligible impact of the air pollution sources through implementation of management systems for controlling emissions;
- the dispersion conditions; and
- the mitigation measures proposed *(refer* **Section 7***)*

Furthermore the relatively good air quality in the vicinity of the site means that no new criteria exceedances are likely to occur at the sensitive receptors.

5.10 DESIGN AND VISUAL AMENITY

5.10.1 View Analysis

The following summary of the visual impacts of the marina is taken from the assessment by Dr Richard Lamb & Associates *(see* **Appendix K** *for full report).*

- The intrinsic visual character of the development site would be moderately affected however, there would not be an introduction into the visual catchment of elements that are unexpected or out of character with land of similar zoning within the general Lake Macquarie area. As noted in Section 3.3.16, the site is of a moderate scenic quality rating with generally low visual accessibility. Subject to other considerations, the landscape has a higher potential to absorb visual impacts than one of high scenic quality and high accessibility.

- The effect on view composition of the marina would be greater than that of the built component of the proposal. The greatest effect would be on locations along Lakeview Road in the vicinity of the site and from the immediate waterway. The effect on view composition would also be high for a small number of viewing locations from where there are restricted, focal or feature views towards the site.

- The visual effects of the proposed development would be slightly increased for viewing locations that are close to level with the marina facilities and located at close or medium distance from it such as from the waterway, such as Brightwaters Park, the boat ramp and the immediate streetscape of Lakeview Road.

- Visual effects would be increased for passive users of recreation areas and foreshores and for frequent users of the immediate waterways. The marina would cause some view loss and blocking effect, in views toward the site, however the buildings would not. There would be some view loss to parts of the shoreline from part of Brightwaters and some of the immediate waterways.

- The Physical Absorption Capacity *(PAC)* for the marina was rated to be low for medium range expansive or panoramic views, or restricted views. This is due to its high intrinsic visibility and the lack of structures or vessels on the waterway. It would be medium for close locations with panoramic views from the waterway, or from the adjacent residential subdivision approved for construction, distant restricted views, expansive or panoramic views.

- The visual compatibility with maritime features would be high or medium for locations from which there were views of a number of swing moorings, jetties, boatsheds etc in the foreground or background of views including the immediate waterway, the boat ramp on Lakeview Road, and views from the waterways and roads to the east and southeast.

- The radial form of the marina and low viewing angles for viewers mean that the vertical slats that act as a breakwater feature, the length of the marina arms and the vessels moored cause the main visual effects. Reducing the scale of the marina by reducing the number of arms, would make little difference to the visual effects on views from the Lake or residential development to the northeast. Other than by significantly decreasing the length of the arms, there would be little difference to the visual effects. The character and quality of the view would remain the same.

- The marina component of the development when it is completed would be the largest one in the locality, however it would be constructed in stages according to demand. The existence of other marinas and boat accommodation of various kinds is a general feature of the Lake; however, there are no large facilities in the southern basin. Thus, there is considered to be a general compatibility of the facility with the maritime environment of the Lake, but a significant contrast in scale.

- The visual effects and residual impacts of the proposal were assessed as being acceptable in the context of a destination development of distinctive character with a significant tourism and marina component.

5.10.2 Landscaping

The landscape proposal for the areas within and surrounding the marina precinct would allow access to the foreshore and stands of native vegetation in the east and north. Vegetation used would be in compliance with Lake Macquarie City Council's DCP whereby plants would be generally native and areas adjoining bushland areas would be indigenous.

The development retains the majority of existing vegetation on a previously cleared site. The proposed landscape plan demonstrates an enhancement of the existing native flora coverage of the site, to what is believed to be an overall net benefit in terms of terrestrial and emergent / riparian habitat for local indigenous species.

Plants would be used to inform the form of the development with exotic and cultivated native plants used predominantly in the formal areas with indigenous planting adjoining the lake edge.

Rooftop gardens could be used to achieve a reduction in runoff volume and treatment of runoff by infiltration into the soil media. An alternative to green roofs would be to harvest rainwater directly from the impervious roof surface, and to increase the area of downstream bio-retention area to compensate for the loss of potential green roof areas

The roof gardens would consist of plants and decorative gravel mulches. This treatment is aimed at reducing heat absorption and stormwater run-off. Rooftop planting would consist of small shrubs and groundcovers that can survive extensive dry periods, high wind and salt exposure.

Stormwater bio-retention swales would be located beside the proposed boardwalk and would treat water outside the courtyard areas. Planting would consist of hardy native plants. Planting would be low, minimising security issues while requiring no irrigation after establishment.

The existing foreshore trees would be protected across the site. A staged supplementation program would be developed to augment the existing ageing trees. Where possible stormwater would be directed away from the foreshore to avoid scouring and unnecessary erosion along the foreshore embankments. Access to the water would be available beside the breakwater with a stone shingle beach, the coarse stones would not encourage users to linger on the foreshore but would allow free access for maintenance.

The area between the Breakwater and the stairs leading to the Marina Forecourt would be turfed with native species. This would become a level, passive, open, public space between the commercial precinct and the water. A buffer between the boardwalk and the foreshore would be planted with low indigenous coastal plants stabilising the foreshore and providing a soft barrier between the lake and the pedestrian areas without interrupting views.

The north western foreshore area would consist of an interface between the proposed development and the unnamed inlet to the north west of the site. No access would be available directly between the proposed development and the inlet and infill screening in the form of tree planting is proposed to minimise the exposure of the subject development from the west. Therefore existing indigenous vegetation would be protected beyond the proposed built area. Weeds and turf grass would be removed and mass planting of both saltmarsh and wetland plants would occur between the access road and Bardens Bay.

5.10.3 Public Access

Section 2.3.2 and **Section 2.3.15** provide details of modes of public access to and within the proposed development site. These include vehicular (including parking arrangements), boating, pedestrian, foreshore, and access for people with disabilities.

As discussed in **Section 2.3.15** limitations would exist with respect to pedestrian access along the foreshore reserve in the direct vicinity of the marina maintenance area travel-lift facilities. Access in this locality of the site would be temporarily restricted during the movement of vessels from the travel-lift rails to the hardstand area. **Section 2.3.7** also discusses limitation to access to the floating marina berths at night, necessary for security reasons. Access would be only available to owners of the private berths and marina staff through the use of key card gate system. A similar system would operate at night for the public berths with only marina staff having the ability to operate the gate system.

As discussed further in **Section 5.11.3** the waterway area of the impacted by the proposed marina is not considered significant in terms of the overall lake area. In addition to this public access to this area would not be lost, but the usage would be modified. Public access to, and berthing within, the marina would enable the public to access previously inaccessible private property *(proposed as a pubic foreshore reserve)* and utilise the amenities provided by the marina complex, including boating services such as refuelling and sewage/bilge pumpout, the breakwater *(which also offers recreational fishing opportunities)* and food and beverage outlets.

5.10.4 Design and Visual Amenity - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with design and visual amenity is considered to be low to medium. Careful attention to the built form through the management of the architectural and landscape elements would ensure an acceptable visual impact. The marina itself has been designed with architectural input to ensure the minimisation of visual impact. The marina is considered to be superior in visual impact to the alternative of ad-hoc swing moorings distributed across Bardens Bay and surrounding lake areas. The landscape proposal involves retention and supplementation of existing native indigenous flora wherever possible, with emphasis on the protection of the foreshore and foreshore reserve for public access and amenity.

5.11 WATER TRANSPORT ISSUES

5.11.1 General

A number of water transport issues can be identified:

- impact on navigation;
- impact on water based recreation;
- public berthing; and
- impact on swing moorings.

5.11.2 Navigation

It is proposed to have a single main navigation channel which would provide access to the proposed marina and public berthing along the inside of the marina breakwater. The channel entrance is proposed to be located on the north western extremity of the marina layout *(regardless of the state of staged construction)*. The main navigation channel would be situated along a north west - south east alignment with fairways perpendicular providing access to berths within the marina. Once past the marina arms, the main channel would turn to align north east - south west, following the breakwater alignment, to provide access to the public floating wharf.

The channel would be 30m wide and would comply with the *Australian Standard AS3962-2001 'Guidelines for Design of Marinas'*. The main channel width provided between the public floating wharf and the proposed marina takes into account the width of vessels occupying the public berths. Depths within the main navigation channel are consistently 5.8m below AHD, accommodating any size craft able to enter Lake Macquarie.

Figure 26 indicates a plan of proposed navigation markers, signs and zones. A no wash zone would exist within the marina area. This would be indicated with a navigation sign on the breakwater adjacent to the entrance channel. A 'west mark' cardinal marker would also be located in this location to provide assistance in navigation from the main body of the lake to the marina entrance. Other navigational markers would include yellow markers marking exclusion zones, surrounding the helipad *(a radius of 35m)* and the seagrass bed to the south of the marina. A single beacon light would be located on the eastern most yellow marker for the helipad to identify the helipad structure location at night.

Appendix AA details an assessment of helicopter rotor wash impacts in relation to water craft situated in the vicinity of the helipad during helicopter movements. This assessment was based on comparing contour lines of rotor wash wind speeds from a range of helicopters with a standard 30m exclusion zone surrounding the helipad. The potential wind speed caused by rotor downwash generated by helicopters landing and taking off was calculated. The mean rotor downwash velocity estimated likely to be experienced 27 metres away from the largest helicopter

intended to use the site *(Agusta A109E)* hovering in ground effect over the helipad is just over10 knots. The peak momentary wind speed *(gust)* likely to be generated by that helicopter from that distance is between 20 and 25 knots. This "worst-case" scenario *(i.e. hovering in ground effect over the helipad)* is well below the magnitude of naturally-occurring mean and gust wind speeds experienced in the coastal environment and therefore unlikely to significantly impact vessels provided they are located outside the proposed 35m exclusion zone. Helicopter movement management procedures for marina ground staff would include ensuring that the exclusion zone is clear of all non participants *(including vessels)* and that vessels in the vicinity are aware of imminent helicopter movements.

No berthing would be allowed on the outside of the southern breakwater which would also assist in keeping vessels clear of seagrass areas. This would be sign posted on the southern breakwater structure at regular intervals. The general layout of the marina and location of the entrance channel have been designed to give consideration to the location of the seagrass beds. The arrangement encourages navigation, from the main lake body into Bardens Bay and the marina, to take place through the centre of the Bay avoiding vessel impacts (*from increased traffic*) on the seagrass. However, there exists the possibility of incorporating public wharfage along the outside of the eastern breakwater to accommodate large tourism vessels or public transport vessels.

A number of vessels are currently moored (*on swing moorings or private jetties*) to the west of the proposed marina site. Following the completion of the marina, these vessels would need to navigate around the marina and breakwater structure if they chose to proceed directly eastwards from the foreshore west of the marina. Following the first stage of construction this impact would be minimal. However, the impact would become more prevalent as future stages of the marina were constructed. The proposed marina at full construction would add up to approximately 300m to the navigation path for these vessels wishing to proceed directly eastwards from the foreshore west of the marina.

The marina would reduce the width of the bay and amount to a loss of open water available for sail craft to navigate and would impact on sailing activities undertaken wholly within Bardens Bay, although this is still considered possible. The provision of facilities and services to the general boating public is considered more than adequate compensation for the proportional small loss, given there are large areas of open water for sailing in close proximity to Bardens Bay in the main lake body.

It considered that the 330m width (at the minimum) is sufficient to navigate under sail out of the bay to other areas of the lake. For a SE wind direction, exiting the Bay may become more time consuming and onerous (or require navigation under power) due to the reduced width to tack within the bay (similarly for entering the bay with a NW wind direction). For all other wind directions navigation under sail into or out of the Bay is not considered to be significantly impacted.

5.11.3 Water Based Recreation *(including fishing)*

Water skiing and wake boarding is known to be undertaken in general on Lake Macquarie, and specifically within Bardens Bay. The construction of the proposed marina, breakwater structure and associated navigational constraints, would exclude these activities in the southern portion of Bardens Bay. However, the impact on these towing activities in general is of minimal significance given the small percentage of the total lake area occupied by the marina and the high mobility of the craft involved in these activities.

The marina would provide different recreational opportunities and facilities and hence diversify recreational experiences within the general locality for both the boating and non-boating public, locals and visitors. Whether this is viewed positively or negatively depends on an individual's interests and consideration of local versus regional recreational demand.

It is considered that the surface area of lake lost due to the Marina and helipad would be relatively low compared to the available area in Bardens Bay and the greater southern Lake Macquarie *(refer to* **Figure 27)** *which demonstrate the footprint of the Marina against the surrounding waterway area).* As a percentage, the proposed Marina footprint is 10% of Bardens Bay and only 0.1% of southern Lake Macquarie. This is not considered a significant loss of open waterway. Compared to Northern Lake Macquarie, where there are five marinas, southern Lake Macquarie is relatively free of facilities and provides considerable opportunities for water based recreation in close proximity to the development location.

Should the proposed Marina not be constructed to cater for the inherent latent demand for mooring facilities, then a probable outcome would be pressure for more swing moorings and private jetties *(approved or otherwise)* within southern Lake Macquarie, causing a far greater loss of waterway area within the lake and more significant environmental impact on waterway use than the proposed marina.

As noted in **Section 6**, there would be fewer than 30 helicopter movements per week. Operational procedures would minimise impacts of water-way users. **Figure 26** shows the proposed vessel exclusion zone while the helicopter landing platform is in operation. Some noise impact within the vicinity of the helipad would be unavoidable.

The percentage increase in the total number of vessels currently moored in Lake Macquarie due to the marina would be approx. 10%. This would occur over a number of years, as the proposal includes development of the marina in 4 stages.

Research undertaken of recreational boating on open waterways such as Brisbane Water *(Public Works Department, 1988)* and the Hawkesbury River *(Soros-Longworth & McKensie, 1977)* suggests each vessel requires 1.2 ha *(or 5ha for towing activities)* of space for recreational, safety, comfort and other amenity considerations. Based on a maximum proportion of 15% of moored boats utilising the lake at one time the increase in lake area taken up by the addition of boats from the proposed Trinity Point Marina would be 0.5% of the total lake area *(given that vessels from the Marina would not be of the type to conduct towing activities such as skiing and wake boarding)*. This would take the area taken up by boats from all moorings within Lake Macquarie *(on a peak usage day based on 15% of moored vessels using the lake simultaneously)* from 5% to 5.5% of the total lake area. This is not considered a significant cumulative impact on recreational amenity.

Structures associated with marina developments *(jetties, pontoon etc.)* are now accepted as providing structure and habitat beneficial to the breeding and sustaining of fish communities *(especially in urban areas where loss of foreshore habitat. has occurred previously)*. The creation of fish habitat is considered a net gain to the overall lake recreational fishing opportunities. Public access to the foreshore and breakwater structure may provide additional recreational fishing opportunities for a wider cross section of the community *(i.e. those without access to boats)* diversifying enjoyment of the Recreational Fishing Haven *(refer to* **Section 3.2.2***)* within the community. However, it may be considered more beneficial to the overall fishing haven to prohibit fishing from the marina structure to maximise the ecological benefit of the additional habitat provided.

5.11.4 Public Berthing

The construction of the proposed marina includes the provision of public berthing in two manners. Firstly, a dedicated floating public wharf (*pontoon system*) is to be incorporated into the design and available for use during the hours of operation of the marina. The public berthing arrangement would be accessed from the breakwater structure which would also have full public access.

Secondly, berths within the marina which have not been allocated as private berths would be available to the general public for berthing at casual rates during the hours of operation of the marina. Casual berthing would be controlled by marina management.

It is also proposed *(if demand for such a service is identified in future)* during later stages of the marina and breakwater construction, that provision be made for a fixed wharf on the outside of the eastern breakwater. This could service larger vessels such as tourist charter cruisers and public transport ferries from other regions of the lake.

With the inclusion of a public foreshore reserve in the proposed development (***Volume I***), the provision of public berthing would see public access at the site that has not existed in recent times.

5.11.5 Swing Moorings

There are three main elements to the impact of the proposed development on swing moorings:

- There would be no need to remove any of the existing swing moorings in Bardens Bay to accommodate the proposed marina area. Vessels moored on these swing moorings would benefit from the provision of commercial boating and maintenance goods and services at the marina;
- Navigation to and from existing moorings immediately west of the marina would be impacted as described in **Section 5.11.2**; and
- There is an opportunity to limit the potential proliferation of swing moorings and the associated navigational and environmental problems that have been experienced in other waterways adjacent to rapidly expanding urban development. The consolidation of moored vessels into managed floating marina arrangements, in response to increasing demand for moorings, provides spatial and environmental control mechanisms otherwise unachievable. Additionally, the vessels would be able to utilise the maintenance and service facilities at the marina which would also improve environmental control of boating impacts within Bardens Bay.

5.11.6 Water Transport Issues - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with water transport is considered to be low to moderate. Navigation paths from within some parts of Bardens Bay would be lengthened due to the presence of the marina, navigation under sail may become more onerous exiting or entering the Bay under some conditions and recreational towing activities would need to relocate to nearby areas of the main lake body. All these impacts on recreational activities are localised. Public berthing at the site would provide a facility and access currently unavailable in the locality. Some boats moored at swing moorings in the vicinity would benefit from the protection offered by the breakwater (*others would be unchanged*) and all would benefit from the provision of maritime and public services and facilities at the marina.

5.12 HERITAGE

The marina component would have minimal impact on the non-indigenous heritage significance of the site, however, it would impact on indigenous heritage.

5.12.1 Aboriginal Heritage

As identified in **Section 3.3.17**, the marina component of the proposed development would impact on the registered *Aboriginal site No. 45-7-0228* and associated deposits. There is however, potential to conserve in-situ representative samples of the deposits along foreshore areas and underneath proposed boardwalks. Salvage excavations would also be carried out where potential for intact deposits remains. The marina and breakwater would have minimal impact on any offshore archaeological resource due to the method of construction *(piling)*.

5.12.2 Native Title

Section 24FC of the *Native Title Act 1993* applies. Based on the fact that mediation with those Aboriginal groups who submitted their interest in this proposal during the exhibition period has occurred, the applicant is now at liberty to negotiate the lease of submerged lands with the Department of Lands.

5.12.3 Heritage - Environmental Risk Rating

As outlined above, the overall environmental risk rating associated with heritage for the proposed marina is considered to be low. The proposed marina development would not have any impact on European heritage, and no native title claims exist over this area of Lake Macquarie.

5.13 HAZARD ASSESSMENT

5.13.1 General

A number of potential hazards have been considered in the conceptual design of the proposed marina development. In particular the potential sources of risk associated with the development and operation of the marina including fuel storage, fire, personal accidents, collisions, spillage, waste materials and dangerous goods.

The following sections describe these potential hazards in more detail along with the safeguards to be adopted to minimise risk.

5.13.2 Fuel Storage Arrangement

It is proposed to locate the fuel and sewage and oily bilge pump-out facilities to the end of Arm A of the marina. A dual bowser would dispense diesel and unleaded petrol *(ULP)*. Fuel storage would be provided in two steel tanks which would have integral secondary containment in accordance with AS 1940 – 2004 (*i.e. be double – skinned to prevent any leakage in the case of rupture of the primary inner tank*). The tanks would be located above ground adjacent to the hardstand area at the end of the peninsula on which the development is located (*a 20,000 - 25,000 L capacity tank would be used for diesel storage, for which there is greater demand. A 10,000 - 15,000 L tank would be used for ULP*).

WorleyParsons conducted a preliminary investigation and review of relevant legislation to determine the applicability of SEPP 33 and the classification of the site as a bulk liquids storage. The investigation concluded that:

- The quantities of Dangerous Goods stored at the site do not exceed the threshold levels in Applying SEPP 33 and hence, the proposed Marina Facility would not be subject to SEPP 33.
- The proposed types, quantities and uses of Dangerous Goods stored at the site would not classify the site as a "Bulk Liquids Storage" facility. Hence, it would not be necessary to conduct a Hazard and Operability *(HAZOP)* for the proposed storages. However, it would be necessary to design, construct and operate the proposed storage facilities in accordance with the NSW Occupational Health and Safety *(Dangerous Goods Amendment)* Regulation - 2005 and the relevant Australian Standard applicable to the Dangerous Goods. Based on this requirement, it is concluded that the effective safety would be incorporated into the Dangerous Goods storages and that the application of the findings of a HAZOP study would be limited by the Regulation and Australian Standard requirements *(i.e. it would not be possible by law to make any changes outside the requirements of the Regulations and Standards)*.

On completion of the Dangerous Goods storage facilities installation, an independent review of compliance would be conducted to ensure compliance with the applicable designs, installations and documentation. More specifically the diesel and ULP tanks would be stored in accordance with AS 1940, Section 5.7 Separation of Above Ground Tanks. Specifically, the tanks would comply with the following:

- The tanks would be least 5m from any other building or structure / fence; and
- The fill points would be at least 3m from the tank (or the tank diameter if greater than 3m).

The fuel tanks would be designed and installed by licensed and qualified contractors in accordance with the relevant Australian Standard. All Staff would be trained for emergency response to spills and made aware of the procedures to follow during an emergency.

All fuel tanker unloading would be carried out under marina management supervision.

A number of features which would be incorporated into the system to reduce potential hazards associated with the refuelling facilities are included in **Section 5.3.2**.

5.13.3 Fire

The risk of fire is primarily associated with onshore building/facilities, moored vessels and the refuelling berth. Emergency procedures are required for the refuelling area.

Fire fighting equipment would be provided in accordance with *AS 3962-2001* and to the requirements of relevant authorities. The equipment would include fire hose reels, a fire hydrant, fire extinguishers and fire alarm system.

The fire fighting equipment provided should be capable of rapidly extinguishing any fire in its initial stages. A safety committee would be formed and appropriate emergency procedures would be developed in consultation with the local fire brigade. A fire warden and supporting squad would be appointed by the safety committee so that sufficient staff would be familiar with:

- the procedures to follow in the event of a fire;
- the layout of the installation;
- the location of fire fighting equipment; and
- the principles of fire fighting, the use of extinguishers and fire fighting appliances

These procedures would be reinforced with regular fire drills.

In addition to the above it is a requirement of the NSW Maritime that appropriate fire fighting equipment *(e.g. handheld extinguishers)* are located onboard all craft likely to be using the marina and its associated facilities.

Advisory notices outlining safety procedures would be prominently displayed and deployed at a number of strategic locations around the development. At the refuelling berth the following notice would be provided:

Before fuelling:
(a) Put all passengers ashore.
(b) Close all hatches etc, to prevent fumes entering the hull and lying in the bilges.
(c) Put out all cigarettes, pipes, sparks etc.
(d) Turn off the pilot light of a gas refrigerator.
(e) Cut off electric power at the main switch.

During fuelling:
(a) Maintain contact between the hose nozzle and filler pipe to prevent static sparks.
(b) Carefully clean up all spilled fuel.

After fuelling:
(a) Open all hatches and ventilate the boat.
(b) Sniff in the bilges for traces of fumes.
(c) If fuel is spilt, pump out bilges at the bilge pump-out facility and leave boat wide open for at least 30 minutes.
(d) When satisfied that the boat is free of fumes start engine before bringing the passengers aboard.

5.13.4 Personal Accidents

The risk of personal accidents, in particular drowning or injury is a hazard that can be significantly reduced by the incorporation of a number of safeguards into the design and operation of the marina and associated facilities. These safeguards are listed below:

- implementation of regular safety awareness program by the safety committee;
- provision of suitable first aid kits that are readily accessible;
- provision of an oxygen supply device within the development and the training of staff in first aid and resuscitation;
- provision of rescue equipment such as rescue buoys *(life rings)*, life preservers and reaching poles at a number of locations adjacent to the water;
- warning signs to highlight electrical safety for supplies to moored vessels and associated onshore facilities;
- illumination of all walkways and waterfront structures and provision of non-slip surfaces where practicable on all structures to prevent accidents and to facilitate rescue;
- provision of hand railing on ramps and gangways, and ladders at regular interval on the breakwater structure;
- notices to be erected at suitable locations to inform users on safety and first aid procedures;
- installation of an appropriate public address system; and
- compliance with all requirements of the regulatory authorities and completion of regular on-going maintenance inspections.