Riverside at Tea Gardens Concept Plan Application

Environmental Assessment

Volume 1A

PART 2

for
Crighton Properties Pty Ltd

January 2012

0043707 - Final

www.erm.com

Delivering sustainable solutions in a more competitive world

ERM

6 ENVIRONMENTAL ASSESSMENT

This Chapter provides an assessment of key environmental issues arising from the proposed development and sets out mitigation and management measures aimed at minimising any deleterious impacts.

6.1 INTRODUCTION

The Director General's Requirements (DGR's) (refer *Table 2.2*) issued in October 2010 set out key environmental issues to be addressed in the EA. This chapter addresses the issues as set out in the DGRs including:

- Visual Impact;
- Infrastructure Provision;
- Traffic and Access;
- Hazard Management and Mitigation;
- Water Cycle Management;
- Heritage and Archaeology;
- Flora and Fauna; and
- Socio-Economic Impacts.

6.2 VISUAL IMPACT

6.2.1 *The NSW Coastal Design Guidelines (2003)*

The NSW Coastal Design Guidelines (2003) set out five design principles for coastal settlement. These are presented as best practice outcomes and form the basis for understanding, debating and designing the present and future form of coastal settlements in NSW. The five principles are:

1. Defining the footprint and boundary of the settlement ie establishing the outer limits of a settlement to protect the important visual and natural setting;
2. Connecting open spaces ie illustrating how open space creates recreation, conservation, public access, cultural and heritage opportunities in and around the settlement;

3. Protecting the natural edges of the settlement ie showing how the coastal edge is protected and understood as a public place, with public access and ecological values including mitigating the impacts of natural hazards;
4. Reinforcing the street pattern highlights ie how streets enliven centres, connect important places within and around the settlement, allow for improved choice when moving from place to place, and provide commercial and social benefits;
5. Appropriate buildings in a coastal context ie shows how specific development relates to the site's natural features and to its location within the settlement.

The Concept Plan has been designed taking into account the NSW Coastal Design Guidelines. The design responds to unique features, both internal and external to the site, so that it integrates visually into the landscape context. Open space corridors have been created along view lines from the public lookout to the headlands. Tree planting and a network of water bodies along the open space corridors will reinforce the view lines. The internal north-south oriented streets have been aligned with the existing view lines to create a layered view comprising parks, dwellings and the volcanic peaks which form the headlands to Port Stephens. The design and layout of the estate has been further enhanced by the selection of native vegetation and designated setbacks from Myall Street.

6.2.2 Visual Context

Tea Gardens is distinctive in terms of its existing high visual amenity and small scale development. The site is flat and vacant, having been substantially cleared of native vegetation. It has previously been used for a pine plantation. Some scattered isolated occurrences of both pines and native trees currently exist. The site has a long frontage (over one kilometre) to Myall Street, which is the main entrance to the township of Tea Gardens.

When approaching Tea Gardens from the north, there is a view of the site from the top of the ridgeline along Myall Street looking towards Yacaaba Head. The site comprises the middle-ground view from the public lookout at Elourera Park (refer to photomontage at *Figure 6.1*). Passing motorists also have views of the site as it is located adjacent to Myall Street.

The sharply rising land to the north of the site accommodates the North Shearwater Estate, which is characterised by low density residential properties in a bushland setting. Elourera Park is located to the west of Shearwater Estate. Land opposite the site on the western side of Myall Street is either vacant or occupied by industrial development. This land was originally part of a pine plantation and has remnant pines and a few native trees.

Photograph 1

Photomontage at the look out overlooking the site.

Photograph 2

Before photo of proposed tourist/residential precinct in north east section of the site from the Myall River.

Photograph 3

Photomontage of proposed tourist/residential precinct.

Figure 6.1

Photomontages of Riverside Site

Client:	Crighton Properties Pty Ltd		
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens		
Drawing No:	0043707h_CP_EA_11_C008_R0.cdr		
Date:	01/12/2011	Drawing size:	A4
Drawn by:	JD	Reviewed by:	SO'C

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

The site also has a two kilometre frontage to the Myall River. The majority of this is along the SEPP 14 Wetland. The views from the Myall River towards the site are largely of the vegetated wetland and adjacent conservation area.

Following inspections of the site and surrounding area, a number of vantage points have been identified as potentially sensitive viewer locations, including the public lookout at Elourera Park, Myall Street and the Myall River adjacent to the proposed tourist / residential precinct in the north east.

Photomontages of the Riverside development have been prepared from the following viewpoints:

- the lookout overlooking the site which is located on the main transport route from the Pacific Highway into Tea Gardens; and
- from the Myall River looking towards the proposed tourist / residential precinct in the north east part of the site.

The photomontages are provided in *Figure 6.1.* The Riverside development will be visible to motorists from the eastward approach as is the rest of the existing Tea Gardens township, with the view largely being confined to dwelling roofs interspersed by vegetation canopies and open space corridors.

The views of the site from the dwellings on the south side of Toonang Drive are obscured by vegetation. The dwellings on the northern side of Toonang Drive, immediately opposite the site do not have a direct view of the site as they are either orientated away from the site or obscured by dense vegetation.

The proposed tourist / residential precinct in the north east of the site will be visible from the Myall River. However this view will be obscured by existing vegetation.

The site will also be visible from the surrounding waterways. The site layout has been designed to reduce the visual impact from the waterway by providing appropriate landscaped buffer zones. The Landscape Design Report (A*nnex G, Volume 1B)* has recommended a range of edge treatments to reduce the visual impact of the proposal.

Overall, the new development is sensitive to the existing built and natural environment. Buildings are appropriate to the coastal context and properly relate to the site's natural features, ensuring that future development will not be visually intrusive.

6.3 *INFRASTRUCTURE PROVISION*

Crighton Properties engaged Tattersall Lander Pty Ltd to prepare a coordinated servicing strategy for Riverside and adjoining environs. The servicing strategy has been prepared in consultation with the appropriate services agencies and includes:-

- MidCoast Water for Water & Sewer Reticulation;
- Essential Energy for Electrical Reticulation; and.
- Telstra & NBN Co for Communications.

Natural Gas is not available and has not been incorporated into the strategy.

The strategy has been prepared to consider a holistic approach for the provision of essential services to the area of north Tea Gardens and to be a lead document for the reticulation of major services to other adjoining areas as well as to the future potential major development sites of North Shearwater, Hawks Nest North, Myall River Downs and the partly serviced Tea Gardens Industrial Park and Shearwater.

The servicing strategy for Potable Water, Recycled Water and Sewerage Servicing is based on the detailed Integrated Water Cycle Management Strategy and Sewerage Servicing report prepared by Worley Parsons (2010). This Integrated Water Cycle Management Strategy and Sewerage Servicing Report was prepared in response to a request from MidCoast Water to address aspects of sewerage servicing.

Great Lakes Council has prepared a Tea Gardens and Hawks Nest Conservation and Development Strategy as a strategic document to direct decision making for the development of identified areas. Riverside is one of the identified areas for development and, as it adjoins Tea Gardens, is a pivotal development for the reticulation of essential services to most other potential developments to the north, east and west of the site.

6.3.1 *Potable Water, Recycled Water and Sewerage Servicing*

In 2010 Worley Parsons assessed the potable water, recycled water and sewerage servicing options for Riverside at Tea Gardens. The investigation considered the Riverside at Tea Gardens development together with the entire catchment to be serviced by the Hawks Nest Sewage Treatment Plant. In particular, the three new developments Riverside at Tea Gardens, Myall River Downs and North Shearwater were considered.

The projected population for these areas is an ultimate 2,570 ET with an estimated total ultimate winter EP of 4,626 and a total ultimate summer EP of 6,939. The Worley Parsons (2010) report has been incorporated into the Intergrated Water Management Strategy prepared by Cardno (2011).

6.3.2 Water Supply

The traditional water supply for the Tea Gardens scheme is from the Tea Gardens aquifer, 6 km north of Tea Gardens. Groundwater is pumped from the aquifer, treated and transferred to reservoirs prior to distribution. The existing capacity of the borefield is 8.6 ML/d. The Water Supply Scheme identifies that augmentation of the borefield to 12.4 ML/day in 2016 and 16.2 ML/day in 2031 will be required to meet future demands.

According to Tattersal Lender (2011) MidCoast Water has, in anticipation of the imminent extension of development options for the north of Tea Gardens, recently completed the upgrading and augmentation of potable water storages at the Viney Creek Road Reservoirs. An additional 8.1ML reservoir has been commissioned and will provide sufficient capacity for the future immediate (~10 – 15 years) potable water requirements from the various potential developments.

Reticulated water supplies are available to the adjoining commercial area and in part these services are being utilised to service the proposed development. Tattersal Lender (2011) note that MidCoast Water is planning to provide a second supply to Hawks Nest via the North Shearwater, Riverside and the Hawks Nest North developments. Currently MidCoast Water are exposed if the single pipe water supply over the Singing Bridge to Hawks Nest is disrupted.

Potable Water Servicing Concept

The water management objectives adopted in developing a potable water supply concept for the site include the following:

- Minimise the potable water demand from the site by using water saving devices on fixtures and water efficient appliances;
- Installation of rainwater tanks and connection to toilet flushing and hot water systems;
- Use of alternative water supply sources, where possible;
- Retention of native vegetation and minimal use of turf to reduce irrigation requirements; and
- Infrastructure to be designed with long term sustainability in mind.

Tattersall Lander (2011) propose reorganisation of water supply services from the existing dual supplies in Myall Street to a triple pipe supply via North Shearwater. This third supply will also be potentially extended to Hawks Nest North via a connection point at the northern part of the Riverside project. In addition to the reticulation of potable water, the reticulation of "grey water" to all new residences within Riverside and areas to the north and west is currently being investigated with MidCoast Water. This "third pipe

solution" has the potential to marginally reduce the trunk main sizing and future demands on the potable water supply from the bore fields to the north of Tea Gardens and is discussed in detail below. Redundancies within the system for reticulated water have been designed to accommodate MidCoast Water requirements and the introduction of this third water main will have significant advantages to the Tea Gardens/Hawks Nest supply area.

Minimising Potable Water Demand

Potable water demand could be minimised through a combination of the following measures:

- Maintaining natural vegetation outside designated development envelopes on each lot;
- Where required, landscaping lots and road verges with natural vegetation and plant species that require no irrigation;
- Using water conservation measures throughout households, such as water efficient taps, dual flush toilets, shower roses or flow restricting devices, washing machines and dishwashers; and
- Installing rainwater tanks to reuse runoff for toilet flushing, washing machines and irrigation. Alternatively, utilising treated effluent from the future Hawks Nest WWTP recycling plant for reuse in toilets, washing machines and irrigation. The reuse application would depend on the level of treatment applied to the effluent.

Potable Water Demand

MidCoast Water (MCW) have advised that a typical design water demand per ET for their area of operation is 205 kL/ET/year, which is equivalent to 312 L/EP/day (assuming 1.8 EP/ET). This figure is seasonally variable, in that:

- 30% of total annual demand occurs in summer months
- 25% of total annual demand occurs in spring and autumn months
- 20% of total annual demand occurs in winter months

These seasonal variation assumptions account for the assumed peaking factor of 1.5 for summer to winter population. The potable water demands assumed in the Water Supply Strategy are shown in ***Table 6.1***, along with a comparison of the expected demands of the proposed development.

Table 6.1 Potable Water Demands

	Potable Water reduction %	Potable water average daily demand (m^3 / day)	Potable water peak daily demand (m^3 / day)
MCW Water Supply Strategy (1,085 ETs)		996	2,496
Potable water consumption with WSD plus recycled water used for toilet	40	597	1,497
Potable water consumption if alternative supply for both toilet and washing machine	45	548	1,373
Potable water if alternative supply for washing machine, toilet and outdoor	66	339	848

1. Cardno (2011) Intergrated Water Management Strategy.
2. The potable water reductions have been calculated based on BASIX household water consumption calculations

MidCoast Water have advised that their design water demand of 205 kL/ET/day has taken into account some uptake of water efficient devices in existing dwellings. For the purpose of this study and the estimation of recycled water demand, the following assumptions on water demand reduction compared to the MidCoast Water benchmark were adopted:

- 20% reduction for water saving shower heads (2 star rated)
- 35% reduction for dual flush toilets
- 15% reduction for water efficient washing machines (2 star rated)
- 20% reduction for water efficient kitchen taps (2 star rated)

The reduced demand represents a 15% decrease in total water demand, which is consistent with MidCoast Water's objective of offsetting effluent generation and potable water supply. It is also significantly less than the statutory BASIX requirement for a 40% reduction in potable water use for all new development. Therefore it is a very conservative allowance.

The incorporation of 2-star flow restrictors in the kitchen and bathroom, 2-star shower heads, 3-star dual flush toilets and 2-star dishwashers is estimated to directly reduce total potable water usage by approximately 24%.

The values for potable daily consumption (generated from consumption rates published in the MidCoast Water's Water Supply Strategy, 2004) were reviewed and compared to the BASIX traditional water consumption of 247.5 L/person/day. The comparison shows that the values generated from the MidCoast Water demands are very high compared to demands generated from BASIX.

Based on the MidCocast Water value of 335 m_3/ET/y, the average daily demand for Riverside at Tea Gardens, with 920 lots, is 844 m_3/day.

The peak summer population at Riverside at Tea Gardens is predicted to be 2,484 (based on 920 lots with 1.8 EP/ET and a summer peaking factor of 1.5 per the MidCoast Water Briefing Paper to the Project Assessment Committee, 7/4/09). Based on potable water consumption of 247.5L/person.day (BASIX traditional consumption), through the development, potable water demand is equal to 615 m_3/day, this is significantly less than 844 m_3/ET/day, which also includes non-domestic and un-accounted for water. A dwelling which is compliant with BASIX would consume 148.5 L/person.day, or the development demand of 369 m_3/day for the summer peak population.

Rainwater

The re-use of rainwater from rainwater tanks has the potential to make considerable reductions in potable water consumption. However, rainwater can compete with recycled water as they are both used for non-potable applications. Hence the use of rainwater and recycled water needs to be considered in an integrated manner.

It was concluded from the Cardno, 2008 study that the decision on implementation of rainwater tanks would not impact on the ability of the development to meet stormwater quality objectives, provided additional treatment is provided. It has been previously proposed to reuse harvested rainwater for toilet flushing, washing machines and irrigation/outdoor use with a mains water supply top-up system. However, full substitution could not be guaranteed due to the variability of rainfall. Infrastructure would need to be sized to deliver potable demand, assuming the rainwater tanks are empty due to extended periods of dry weather.

The optimum size of the rainwater tank would need to be confirmed by detailed design, but is expected to be about 3-4 kL in size.

Water Balance

The Worley Parsons in-house water balance model was used to estimate the likely recycled water irrigation demand and assess recycled water storage volumes for Myall River Downs, Riverside and North Shearwater. The model utilises local catchment data, historical rainfall and evaporation records to estimate the irrigation demand within a soil profile. The model comprises a

daily time step balance that can assess combinations of recycled water supply, recycled water demand and reservoir storage volumes.

The results of the water balance model are summarised as follows.

- Average daily irrigation: 52 L/EP/day; and
- Average annual irrigation: 91 ML (3 ML/ha/year).

The average daily irrigation calculated in the water balance represents approximately 60% of the MidCoast Water design ET outdoor usage (84.2 L/EP/day including garden irrigation, car washing, pools and spas).

A number of reservoir volumes were input into the water balance model to determine the number of days the recycled water reservoir would overtop and an average overtopping volume (refer to ***Table 6.2***). These results indicate the extent of upgrade required for the effluent disposal system at Hawks Nest STP with a recycled water system due to periods of rainfall when there is no recycled water irrigation demand.

Table 6.2 Recycled Water Reservoir and Overtopping Volumes

Reservoir volume (ML)	Number of days reservoir overtops (days per year)	Average Overtopping volume (ML/day)	Maximum overtopping volume (ML/day)
0	365	0.74	0.894
1.0	280	0.42	0.894
2.5	267	0.40	0.894
5.0	263	0.39	0.894

1. Cardno (2011) Integrated Water Management Strategy.

Table 6.2 indicates that increasing the reservoir volume does not greatly reduce overtopping. Therefore a reservoir would be sized purely to cater for the likely recycled water demand within the development areas.

It is noted that in utilising a lower irrigation demand the water balance is conservative in assessing the reservoir volumes and sizing effluent disposal infrastructure as there is a higher volume of excess recycled water.

6.3.3 Wastewater

The existing settlements at Tea Gardens and Hawks Nest are serviced by the existing Hawks Nest WWTP. However, due to limited treated effluent disposal capacity at the plant, the extent of augmentation to service further development is limited.

The site constraints with the land being of a generally flat nature have contributed to MidCoast Water undertaking the construction and commissioning of a state of the art Vacuum Sewer Pumping Station which is

located off Spinifex Avenue, west of Myall Street. This type of infrastructure has become a viable option and for this site, an ideal technology that has significant positive environmental outcomes.

Tattersall Lander (2011) has prepared a servicing strategy for the roll out of the reticulated sewer servicing for all lands within the catchment that this critical infrastructure facility can legitimately service. These plans have yet to be formally approved by MidCoast Water but their development has provided MidCoast Water the opportunity to commence the introduction of sewer services to the adjoining Tea Gardens Industrial Park and the North Shearwater project.

Areas to the south of the Riverside site are already serviced by a reticulated gravity sewer system and reticulated water supply. Redundancies in the water supply have been developed to assist MidCoast Water in guaranteeing the provision of its services to other areas within Tea Gardens and this has provided a higher level of supply for MidCoast Water customers.

Wastewater Servicing Concept

The water management objectives adopted in developing a servicing concept for the site include the following:

- Minimise impacts on existing infrastructure by reducing the sewage loads where possible;
- Minimise impacts on receiving waters by designing optimal effluent management practices and minimising effluent discharge;
- Reuse of treated effluent where possible and appropriate; and
- Infrastructure to be designed with long term sustainability in mind. This will involve location of sewerage systems with adequate buffer zones and flexibility for future expansion to meet potential augmentation requirements.
- Sewer Services

The overall sewer reticulation system currently envisages a roll out of 10 vacuum lines. Three (3) of these lines are to be directed towards Riverside, the Tea Gardens Industrial Park (currently under redesign) and North Shearwater. Other vacuum lines are being rolled out to accommodate the already approved Hermitage Retirement Village. A Sewer Rising Main servicing MidCoast Water's Bore Fields situated on land to the north of Lot 10 DP270100 is being accommodated within the Riverside development.

The vacuum sewer system has significant environmental advantages over the usual gravity service. Typical advantages are:-

1. Fewer pumping stations meaning less potential for environmental discharges;
2. Fewer pumping stations requiring long term maintenance;
3. Significantly less long term groundwater infiltration as the system uses welded plastic PE pipes;
4. Significantly less access chamber infiltration from stormwater as the system uses fewer access chambers. In some cases there is up to 500m between access chambers on the trunk mains;
5. Higher pipe depths so that the water table will be intercepted less often; and
6. Significantly lower wet weather allowances providing higher control of flows experienced at the treatment plant at Hawks Nest.

Disadvantages of the system relate to the location of the services into the front of the dwellings. For Greenfield developments, this presents an additional service that needs to be accommodated. Access to valve chambers on a 24 hour basis is also one of the requirements of the service.

Riverside would have required the provision of at least eight conventional pumping or lifting stations and this service has been completely replaced by one coordinated system. The vacuum system will result in a significant reduction in infrastructure costs and future maintenance costs, as well as reduced overall environmental impact.

The commissioning of the Vacuum Sewer Pumping Station creates the situation of a hugely underutilised facility. The approval of the Riverside development options will enable this facility to commence an appropriate servicing regime and as it has a significant reduction in overall environmental impact, the utilisation of the facility needs to commence without undue delay.

Loading Projections

The future population numbers were extracted from the MidCoast Water briefing paper, including both summer and winter estimates. No population estimates were available for the proposed Myall Way development and as such this has been excluded from our analysis.

Data from the NSW Department of Planning, including in the report titled Single Dwelling Outcomes 05-08 BASIX Ongoing Monitoring Program, was reviewed and yielded the following information:

- BASIX achieved an overall reduction in potable water use of 41%.
- Non-potable water uses account for 50-70% of total demand and hence recycled water could achieve even greater reductions than BASIX.
- Usage data for single dwellings indicates that effluent production is generally in the order of 75% of the water used.
- Water saving devices alone may achieve a 35% reduction in potable water consumption. More typical uptake of these devices would yield at least a 20% reduction for water saving devices alone.

The original sewage generation volume adopted by Mid Coast Water was 240 L per person per day, however it is expected this volume would now be lower for both existing and new developments due to:

- Uptake of water saving devices in existing dwellings,
- Water restrictions and heightened awareness,
- Current building codes, and
- BASIX requirements for new dwellings.

As a minimum, it is considered that in line with a reduction in potable water consumption the sewage production of new areas would be reduced by at least 20% due to the implementation of water saving devices including regulated minimum requirements. Hence, a rate of 192 L per person per day would apply for new dwellings.

If the use of rainwater tanks were limited to hot water systems, hot water usage would not be expected to change. Hence there would be no impact on the sewage loads.

6.3.4 Recycled Water

The opportunity may exist to recycle treated effluent from the existing Hawks Nest WWTP. It is assumed that the existing areas of Tea Gardens and Hawks Nest would not be serviced with recycled water and that only new developments would be included.

Recycled Water Supply Concept

The water management objectives adopted in developing a supply concept for the site include the following:

- Minimise the discharge of treated effluent to the environment by maximising the reuse of recycled water;

- Minimise impacts of recycled water reuse on the surrounding environment by designing optimal management practices (minimise runoff, effective irrigation practices etc.);

- To achieve unrestricted reuse status, the recycled water will most likely require tertiary filtration and disinfection at the Hawks Nest STP before distribution; and

- Infrastructure to be designed with long term sustainability in mind. This will involve location of additional treatment trains, recycled water management systems with adequate buffer zones and flexibility for future expansion to meet potential future reuse opportunities.

Additional treatment will most likely be required to achieve an effluent standard that allows unrestricted reuse. This is necessary to allow use of the recycled water in potentially primary contact situations. The most likely technology that would be used to achieve this would be tertiary filters and disinfection. The tertiary filters and disinfection treatment trains could be staged to allow for future upgrade of the plant and accommodate possible future reuse opportunities.

The recycled water supply to the development site would require a pumping station at the sewage treatment plant and a transfer main (nominally DN150mm) to deliver recycled water to a small recycled water reservoir. Recycled water would be distributed from the reservoir, through the development.

Recycled Water Demand

There was a concern previously expressed regarding the potential re-use applications for recycled water from the sewerage treatment plant for irrigation and whether this would affect the health of the aquifer that lies below Riverside at Tea Gardens. However, Martens 2011 (refer Appendix F) concludes that the demand for nutrients in garden areas alone far outstrips that which can be supplied by recycled water ie. irrigation of recycled water is not expected to threaten groundwater quality.

The potential demand for recycled water use in future development areas would be based on the reduced water demand and sewage generation including provision for water demand reduction.

It is assumed that recycled water would be used for external and internal use, including:

- Outdoor irrigation (27% of total water demand);

- Toilet flushing (12% of total water demand); and

- Washing machines (22% of total water demand).

Based on these assumptions, recycled water demand could comprise as much as 61% of total household water demand. For the purposes of this study and for sizing the trunk recycled water infrastructure, it was conservatively assumed that recycled water demand would include laundry use and the MidCoast Water design outdoor demand.

Based on the benchmark water demand, adopted water demand reduction and recycled water usage assumptions, the design flows that have been adopted for sewage generation, potable water demand and recycled water demand are included ***Table 6.3***.

Table 6.3 Design Flows for Future Development Areas

Area of Usage	Adopted Demand (L/EP/day)	Wastewater to sewer (L/EP/day)	Potable Water Demand (L/EP/day)	Recycled Water Demand (L/EP/day)
Outdoor	84.2	0	0	84.2
Toilet	24.3	24.3	0	24.3
Laundry	58.3	58.3	0	58.3
Bathroom	72.4	72.4	72.4	0
Kitchen	12.5	12.5	12.5	0
Other	15.6	15.6	7.8	7.8
Total	267.3	183.1	92.7	160.9

1. Cardno (2011) Integrated Water Management Strategy

It is noted that based on the MidCoast Water design water demand and the potable water demand the reduction in potable water demand as a result of BASIX demand reduction measures and a recycled water system could be up 75%.

MidCoast Water has prepared an Effluent Management Scheme concept design for recycled water use at Hawks Nest Golf Course (MCW, 2008). It is estimated that the scheme would supply up to 1.5 ML/day and could reuse an average of 101 ML/year (274 kL/day), which is equivalent to approximately 35% of the existing annual effluent load from Hawks Nest STP. This potential reuse is not included in the potential recycled water demand assessed in this study.

Future Supply Scenarios

Three potential scenarios for future water supply to new developments within the Hawks Nest STP catchment are:

- Scenario 1: Internal and external recycled water supply (including laundry);
- Scenario 2: Internal and external recycled water supply (excluding laundry); and
- Scenario 3: No recycled water supply.

Under Scenario 1, the ultimate excess effluent of 3.1 ML/day is within the ultimate capacity of Hawks Nest STP (3.6 ML/day). Under Scenario 2, the excess effluent would increase to 3.5 ML/day, which would still be within the ultimate STP capacity. Under Scenario 3, the ultimate STP capacity would be insufficient to service the total projected development.

The total ultimate sewage generation (4.4 ML/day) is greater than the future planned STP capacity, meaning the STP would need to be upgraded to cater for the projected development.

These upgrades would be dependent on the timing and staging of future developments. It is envisaged that timing and staging of upgrades to the STP would be considered in further detail in subsequent studies. The size of any future upgrades of the STP would be dependent on the projected recycled water demand and any changes to future development projections.

Due to the limited ultimate capacity of the effluent disposal system (3.6 ML/day), some form of offset of effluent disposal would be required to ensure the proposed development precincts can be adequately serviced. A recycled water system could offset effluent disposal at the STP and ensure the STP has adequate effluent disposal capacity to cater for the sewage generated by Riverside at Tea Gardens, Myall River Downs and North Shearwater.

Recycled Water Infrastructure

The recycled water strategy to service the development precincts would consist of constructing trunk infrastructure to transfer recycled water from Hawks Nest STP to the development. The trunk infrastructure would include the following components:

- A recycled water treatment facility at Hawks Nest STP, to produce recycled water of a standard suitable for unrestricted public access and internal reuse;
- A recycled water pumping station at the STP site;
- A recycled water reservoir adjacent to existing MidCoast Water potable water reservoirs;
- A rising main from the treatment facility at Hawks Nest STP to the proposed recycled water reservoir; and
- Distribution mains from the reservoir to the site.

Reticulation of Electrical and Communication Services

Electrical and Communications services are considered to be merely an extension of existing services. Crighton Properties has already provided Essential Energy with proposed layouts so that they can commence designs to accommodate the required major new linkages from the existing overhead supplies. Essential Energy are relocating their main supply substation further west along Viney Creek Road and are proposing major upgrading of the facility as well as incorporating a Maintenance Service Depot. Additionally, Essential Energy is proposing a major 33Kv substation alongside the Freeway adjacent to Viney Creek Road East.

Telstra have already provided communication upgrades to Tea Gardens including "fibre to the node" for The Hermitage. Telstra has also offered the provision of services to the other parts of Riverside via its "Smart Communities" program. Infrastructure services include fibre-optic technology which is available along Myall Street, connecting the main Telstra Depot to the Pacific Highway network.

Infrastructure Staging

Three stages have been identified for the provision of infrastructure. These three stages are to be implemented in co-operation with Service Supply Authorities, including MidCoast Water, to ensure that the connection and extension of infrastructure will not impact on the functioning or capacity of existing infrastructure. The stages are:

- stage one will include the servicing of Precincts 1, 2 and 3 (refer to drawing R.C.-09 in *Annex 1B)*;
- stage two will occur in the eastern portion of Riverside; and
- stage three will involve the servicing of tourist facilities.

6.4 TRAFFIC AND ACCESS

6.4.1 Vehicle Movement and Intersection Capability

Vehicle access to the site will be from Shoreline Drive via the existing intersection at Myall Street. Further intersections to Myall Street and Toonang Drive are proposed in subsequent stages.

A traffic impact assessment *(*provided in *Volume 5)* investigating traffic flow and intersection capacity has been completed by Mark Waugh Pty Ltd (October 2010). Since this report was issued the number of proposed lots has been reduced by 54. The traffic consultant has provided a letter (provided in *Volume 5*) stating that "*the report is still considered to be current as the change will*

have no impact upon our findings and ensures a more robust assessment for the project". The traffic analysis has considered the following:

- whether the existing Myall Quays intersection can cater for the initial stages of development;
- timing of when additional access via a second intersection with Myall Street is required
- impacts of the full concept plan development of 855 residential dwellings and 65 tourist lodges;
- likely further impact of additional 1300 lots to be developed at Myall River Downs; and
- the future impact of proposed industrial development to the west of Myall Street.

The study investigations have revealed the following outcomes in relation to traffic and access issues:

1. Operation of the existing intersection of Myall Street and Myall Quays Boulevard was assessed as having adequate capacity to cater for the flows associated with the initial stages of the development on the site (381 lots), for both the 2007 and future 2017 design years.
2. The existing intersection has also been analysed to assess the impact of further residential development with access via Myall Quays Boulevard. This analysis indicates that some 590 residential lots could be developed off Myall Quays Boulevard using the existing intersection. Beyond 590 lots, the junction would need to be upgraded, or an additional access provided.
3. The existing intersection when combined with the proposed second access to the north on Myall Street is able to cater for the full 920 lots under the concept plan.
4. The additional access available via Toonang Drive also contributes to a higher overall level of service at the proposed access junctions.
5. The proposed Myall River Downs residential development can be accessed via a single 4-wayroundabout upgrade of the existing Myall Street / Myall Quays Boulevard intersection, having adequate capacity to cater for both the Myall Quays and Myall River Downs development.
6. The second Myall Street access with development of about 500 lots of Myall River Downs would require upgrade to roundabout control, because of the additional through traffic movements.
7. With the introduction of the industrial land to the west of Myall Street, access to this activity can be catered for via a 4th leg to the second Myall Street access. This operates satisfactorily under roundabout control for both the 2007 and future 2017 design years.

From the study, it is concluded that the existing road system beyond the site is able to cater for the traffic demands of the proposed residential development of both Myall Quays and Myall River Downs. The existing intersection control at Myall Quays Boulevard and Myall Street, when combined with a 2nd intersection (of similar design) on Myall Street, and also with access to Toonang Drive can accommodate the entire Riverside Concept Plan area (920 dwelling/ lot yield).

The two southern intersections of Myall Street will only require upgrading at or before the development of either or both of Myall River Downs or the industrial land to the west of Myall Street.

The traffic impact assessment recommends the following commitments:

1. The second access to Myall Street (as a priority controlled junction) is provided prior to the development of 500 dwelling/ lot yield within the Concept Plan. (i.e. before the 590 threshold.);
2. Access to be provided to Toonang Drive in line with the Concept Plan staging, at say 700 dwelling/ lot yield).;
3. The Riverside Concept Plan in isolation be allowed to be developed in total (920 dwelling/ lot yield) based on the capacity of the proposed four intersections; and
4. The two southern intersections of Myall Street only to be upgraded at / before the requirement is reached for these to act as 4-way intersections (i.e. access is triggered by either or both of Myall River Downs or the industrial land to the west of Myall Street).

6.4.2 Urban Design Principles

The Riverside development provides an opportunity to contribute to the integration of land use and transport through the adoption of urban design principles that encourage the full range of transport alternatives for visitors and residents of the site. The transport goals for the development are outlined below:

Pedestrians:

- improve the Pedestrian Environment;
- promote walking as the principle local transport means through and to the site;
- give pedestrians priority over vehicles within the site;
- enhance walking linkages - provide direct links within the site and to neighbouring attractions to encourage walking as key local transport. Provide signage with travel times to local attractions;
- provide pedestrian links through proposed green/ open spaces;

- provide pedestrian linkages back to Myall Street and the local shopping centre; and

- provide a high standard of pedestrian accessibility / mobility within and to the site with continuity, consistency of materials, signposting, lighting.

Vehicle Access and Movement:

- primary vehicle access (including service vehicles) from Myall Street and Myall Quay Boulevard;

- in line with promoting pedestrian priority for the site minimise vehicle crossing points of footpath areas;

- promote traffic calming within the local road system to enhance pedestrian safety; and

- consider reducing road widths to improve pedestrian environment in areas of high pedestrian activity, low vehicle usage and high residential amenity (but still allowing for essential vehicle access and movement).

Public Transport:

- promote access to public transport from the site using local shops as focal point for access to bus services, with a high degree of permeability for local service access to the site; and

- provide high quality bus facilities at Myall Street and Myall Quay Boulevard.

Cycling:

- consider nominating a route for cyclists around (rather than through) the site to protect and enhance the environment in high pedestrian activity areas.

Parking:

- provide requisite parking on site to match development needs;

- recognise parking requirement for storage of vehicles; and

- manage on street parking adjacent to site for maximum benefit of site activities (cafes etc.).

These objectives have been taken into account in the development of the Concept Plan.

6.4.3 Public Transport

Riverside is currently served by buses along Myall Street. The proposed Riverside development will increase the population of Tea Gardens contributing to greater potential patronage levels to sustain a viable bus service.

There are two bus routes that serve Tea Gardens. Both routes are operated by Busways and provide a service to Raymond Terrace and Newcastle three times daily during weekdays and daily on the weekend (Duo, 2008). There are also buses to Hawks Nest, Bulahdelah, Forster Tuncurry and Taree that operate at different times during the week and weekends. School bus routes link Tea Gardens, indirectly or directly, with 23 schools in the area.

The Concept Plan incorporates a street hierarchy that aims to provide potential bus routes within 400 metres of all dwellings.

6.4.4 Shearwater Estate

The current design allows for the provision of access and servicing links between the site and Shearwater Estate. Future residents of Shearwater Estate will have the option of access through the site to existing commercial and community facilities within Hawks Nest and Tea Gardens.

6.5 NOISE IMPACT ASSESSMENT

A Noise Impact Assessment (NIA) was undertaken by ERM (2011b) to identify the likely noise impact of the existing industrial area (located directly west of the site) upon the proposed development. A copy of the NIA is provided in *Volume 5*.

The assessment was completed with reference to and in general accordance with the following documents, standards and guidelines:

- Director General Requirements – *Section 5.3* which states "*a Noise Impact Assessment in accordance with the NSW Environmental Protection Authority's 'Industrial Noise Policy' (2000) should be completed. This assessment should identify the likely impact of the existing industrial area upon the proposed residential development and if necessary include methods for noise attenuation*";

- the Department of Environment, Climate Change and Water (DECCW – formerly the NSW EPA) *Industrial Noise Policy* (INP), January 2000;

- the Department of Environment, Climate Change and Water (DECCW – formerly the NSW EPA) *NSW Environmental Criteria for Road Traffic Noise* (ECRTN), May 1999;

- Standards Australia AS1055.3 - 1997™ - *Acoustics – Description and measurement of environmental noise, Parts 1, 2 and 3*; and

- Standards Australia AS IEC 61672.1-2004™ - *Electro Acoustics – Sound level Meters Specification.*

6.5.1 Noise Assessment Locations

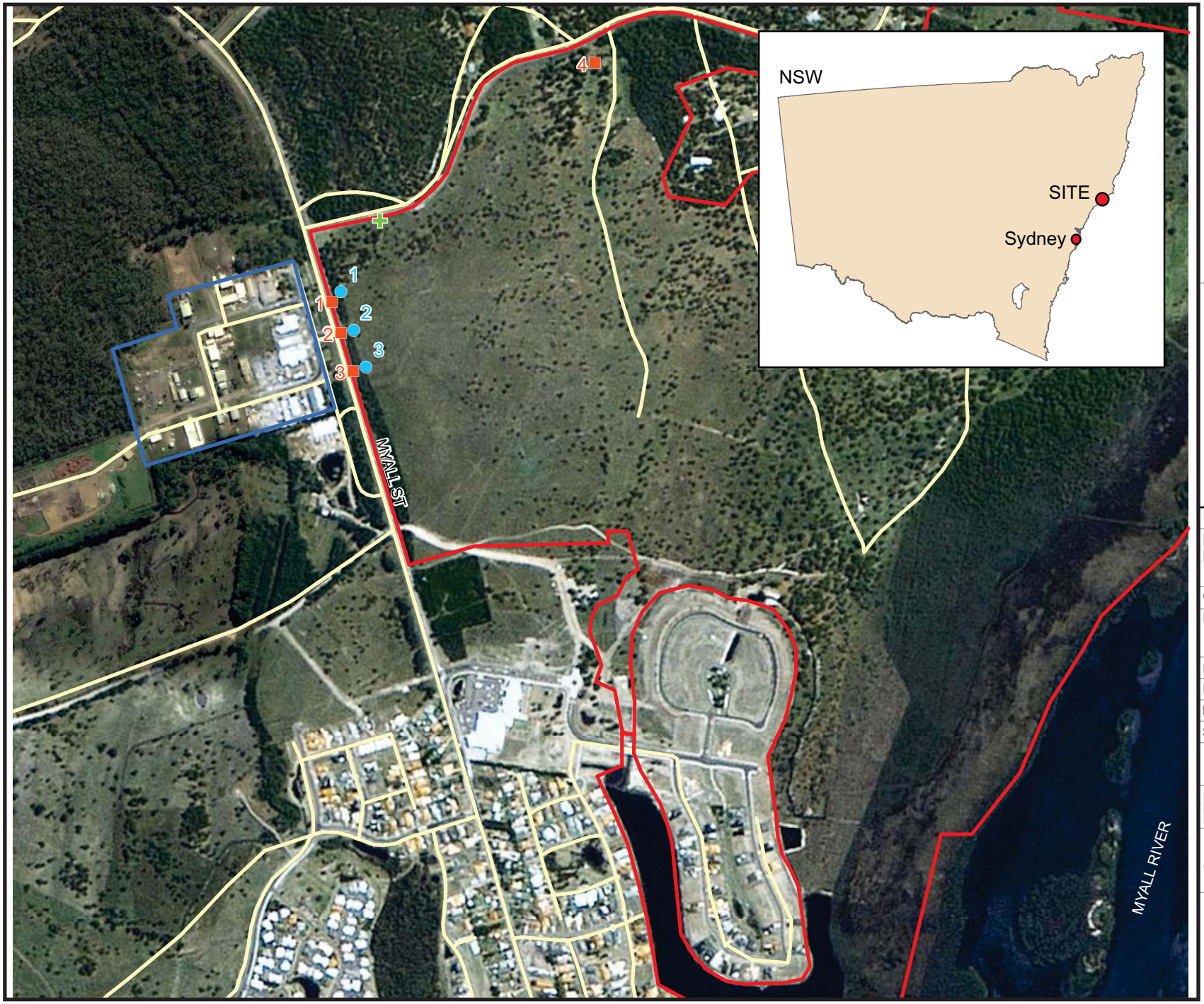
Noise assessment locations (NALs) were determined based on ERM's review of aerial photographs, observations made on site and in accordance with the relevant DECCW guidelines (INP and ECRTN) and represent the closest and/ or potentially most affected residential receiver locations in proximity to the Tea Gardens Industrial Estate.

The locations are detailed in *Table 6.4* and are presented graphically in *Figure 6.2*.

Table 6.4 Noise Assessment Locations (NAL)

NAL[3]	Description	GPS (UTM)	
		Easting	Northing
1	The closest and/or potentially most affected residential receiver locations in proximity to the Tea Gardens Industrial Estate. All located at the north-western extent of the site.	56H 419992	6387793
2		56H 420017	6387718
3		56H 420042	6387645

1. *Based on ERM's review of aerial photos and observations made whilst on site;*
2. *In accordance with the Industrial Noise Policy these NAL were determined as the most-affected points on or within the residential property boundary – or, where this was more than 30 m from the residence, at the most-affected point within 30 m of the residence; and*
3. *Refer to Figure 6.2* ***for a visual presentation of these locations.***



Legend

- Site Boundary
- Existing Industrial Area
- Noise Assessment Locations (NAL)
- Operator Attended Noise Measurement
- Environmental Noise Logging Location
- Road

Source:

Crighton Properties - Context Plan R.C. - 49 October 2010

Suffix	*Revisions*	*Date*	*Init*
R0	Preliminary Issue	01-12-11	JD

Figure 6.2

Noise Impact Assessment Locality Plan

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens	
Drawing No:	0043707h_CP_EA_11_C004_R0.cdr	
Date:	01/12/2011	Drawing size: A4
Drawn by:	JD	Reviewed by: SO'C
Scale:	Refer to Scale Bar	

N

0 100 200 300m

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

6.5.2 *Methodology*

Operating Hours – Tea Gardens Industrial Estate

ERM notes that operations at the industrial area would typically occur during the daytime assessment period (7am to 6pm) only. However, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the *Industrial Noise Policy* and *ECRTN*.

Operator Attended Environmental Noise Measurements

During the daytime assessment period (7am to 6pm) and whilst the Tea Gardens Industrial Estate was operating under normal conditions[1] a series of operator attended environmental noise measurements were completed in order to quantify the existing noise levels at each of the NALs, or the closest accessible point to each NAL.

Noise Modelling

During operator attended environmental noise measurements, noise levels from general operations were typically inaudible, therefore noise modelling was completed in order to more accurately quantify noise impacts potentially associated with the Tea Gardens Industrial Estate.

Brüel & Kjær's Predictor 7810 (Version 7.10) noise modelling software package has been used to calculate noise in accordance with the *ISO 9613.1* industry noise propagation algorithms (international method for general purpose, 1/1 octaves).

Noise Modelling Scenarios

Noise modelling has been undertaken for a range of noise emission scenarios, considered to be representative of worst-case noise level contributions at each of the NALs. These noise scenarios are based on measured noise levels noted during operator attended environmental noise measurements. Noise modelling considers standard daytime and out-of-hours (evening and night time) assessment periods[2]. The following worst-case likely noise scenarios were modelled:

---

[1] Based on ERM observations made whilst on site, 24 November 2010

[2] In accordance with the *Industrial Noise Policy* the assessment periods are defined as follows: Daytime is the period from 7am to 6pm - Monday to Saturday; or 8am to 6pm

- **Noise Scenario 1 –** Standard operations under calm meteorological conditions;
- **Noise Scenario 2 –** Standard operations under adverse meteorological conditions;
- **Noise Scenario 3 –** Out-of-hours operations under calm meteorological conditions;
- **Noise Scenario 4 –** Out-of-hours operations under adverse meteorological conditions; and
- **Noise Scenario 5 –** Sleep disturbance (night time only).

6.5.3 Existing Local Area Environment

Environmental Noise Logging

A key element in assessing environmental noise impacts is to quantify the existing ambient and background noise environment at or near to the closest and/or potentially most affected noise sensitive receiver locations.

Unattended environmental noise logging and operator attended environmental noise measurements were completed in accordance with the short-term methodology described in *Section 3 - Determining existing noise levels* of the *Industrial Noise Policy*[3][4].

Environmental noise logging was undertaken on 24 November 2010 during the daytime period for a period of approximately 2 hours at the Environmental Noise Logging Location (ENL), as described in *Table 6.5* and illustrated on *Figure 6.2*. Industrial noise associated with the Tea Gardens Industrial Estate was inaudible at this location, masked by ambient noise emissions.

---

on Sundays and Public Holidays, Evening is the period from 6pm to 10pm and Night time is all remaining periods.

[3] This methodology has been adopted based on project discussions between Crighton Properties and ERM which concluded that the site is considered a low risk development.

[4] This methodology in conjunction with operator attended environmental noise measurements, and the '*Estimated Average Background A-weighted sound pressure levels (LA90, T) for different areas containing residences in Australia*' from AS1055.3 - 1997™ has been adopted in order to quantify the existing noise environment of the area, and to establish the Rating Background Level (RBL) parameters for the daytime, evening and night time assessment periods.

Table 6.5 Environmental Noise Logging Location

ID	Description	GPS (UTM)	
		Easting	Northing
ENL1	Continuous unattended noise logging measurement location. The device was installed near the northern boundary of the site, approximately 140m from Myall Street and 210m from the nearest point of the Tea Gardens Industrial Estate.	56H 420067	6387934

Environmental Noise Logging Results

Noise level data was continuously recorded at 15 minute intervals throughout the monitoring period. The ABL and RBL were determined for daytime, evening and night time assessment periods, as defined in the *Industrial Noise Policy*. Results of ambient and background noise level measurements are presented in *Table* 6.6.

Table 6.6 Measured Noise Levels

Date	Time	Measured Noise Levels, dB(A)				
		Leq	L10	L90	Lmin	Lmax
24.11.10	12:30	55	54	43	39	77
	12:45	54	54	42	39	72
	13:00	52	52	43	39	74
	13:15	52	53	43	40	73
	13:30	54	55	45	42	73
	13:45	55	55	45	43	76
	14:00	55	56	44	41	74
	14:15	52	52	45	42	72

1. *The LA90 represents the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level;*
2. *The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period;*
3. *Where the measured LA90 (RBL) is lower than 30 dB(A), a RBL of 30 dB(A) is applied in accordance with the Industrial Noise Policy;*
4. *As per the Industrial Noise Policy application Notes, the LA90 (RBL) for evening must not be greater than the daytime LA90 (RBL), and the night time LA90 (RBL) must not be greater than the evening LA90 (RBL). When this occurs, the LA90 (RBL) is adjusted to the lower value;*
5. *All unattended noise measurements were of 15 minutes duration each; and*
6. *During the installation of the noise logging device the following meteorological conditions were noted. Temperature of approximately 23° Celsius, cloud cover of 2/8 Octas, wind speeds gusting up to but not in excess of 5m/s, average wind speeds of 3 to 4m/s and typically an easterly (45°) wind direction.*

Operator Attended Noise Measurements

Existing Industrial Noise Levels

In order to quantify the existing industrial noise contribution, during the daytime assessment period (7am to 6pm) on 24 November 2010 and whilst the Tea Gardens Industrial Estate was operating under normal conditions[5] a series of operator attended environmental noise measurements were completed on Myall Street at each of the NALs, or the closest accessible point to each NAL.

Results of these measurements including noted industrial and extraneous noise sources are presented in *Table 6.7*. The measurement locations are as per *Figure 6.2* and as previously described.

Table 6.7 Operator Attended Noise Industrial Measurement

Measurement Location			Measured Noise Levels, dB(A)			
	GPS (UTM)					
ID	Easting	Northing	Leq	L90	Lmax	Lmin
OANM 1	56H 419975	6387773	65	45	84	40
OANM 2	56H 419992	6387713	66	45	81	39
OANM 3	56H 420016	6387713	66	46	81	41

1. ***OANM 1*** *noted noise sources include: wind blown vegetation (40 to 43 dB), animal noises (~43 dB), car-pass-by's on Myall Road (65 to 75 dB), vehicles entering and exiting the Tea Gardens Industrial Estate (x 14 at 42 to 55 dB), grinding (47 dB for approximately 15 seconds), reverse beeper (<45 dB for approximately 30 seconds) and general industrial noise e.g. air conditioning units was inaudible;*
2. ***OANM 2*** *noted noise sources include: wind blown vegetation (41 to 42 dB), animal noises (41 to 42 dB), distant traffic noise (43 to 46 dB), operator noise (55 to 65 dB for <25 seconds), car-pass-by's on Myall Street (70 to 80 dB), metal on metal contact (49 dB for approximately 3 seconds), vehicles entering and exiting the Tea Gardens Industrial Estate (x 29 at 55 to 70 dB) and general industrial noise e.g. air conditioning units was inaudible;*
3. ***OANM 3*** *noted noise sources include: wind blown vegetation (42 to 43 dB), animal noises (42 to 43 dB), car-pass-by's on Myall Street (65 to75 dB), vehicles entering and exiting the Tea Gardens Industrial Estate (x 12 at 45 to 55 dB) and general industrial noise e.g. air conditioning units was inaudible;*
4. *All operator attended noise measurements were of 15 minutes duration; and*
5. *During OANM1 to OANM 3 the following meteorological conditions were noted. Temperature of approximately 27° Celsius, cloud cover of 3/8 Octas, wind speeds gusting up to but not in excess of 3m/s, average wind speeds of between 1 and 4m/s and typically an easterly (45°) wind direction.*

[5] Based on ERM observations made whilst on site, 24 November 2010

Noted Noise Emission Sources

General and/or constant noise emissions from the existing industrial estate were inaudible for the duration of the operator attended measurements. Noted noise emission sources were more associated with intermittent noise sources such as vehicles entering and exiting the industrial area, reverse beepers, metal on metal contact and grinding. ERM has considered the modifying factors outlined in *Section 4 – 'Modifying Factor' Adjustments* of the *Industrial Noise Policy*. The correction factor for intermittent noise sources (+ 5 dB) is subjectively assessed, applied when noise levels vary by more than 5 dB and adjustments are to be only applied during the night time period. Based on ERM observations made during the attended noise measurements and review of typical industrial area operations, ERM has not applied the modifying factors outlined in *Section 4 – 'Modifying Factor' Adjustments* as the 5 dB noise level variation was not clearly determinable.

Existing Ambient and Background Noise Levels

Additionally an operator attended environmental noise measurement was completed in order to better understand the existing ambient and background noise environment and to validate the unattended noise logging data. This additional measurement was completed at a location considered to be acoustically different to that of the selected noise logging location e.g. road traffic noise was only just audible at this location.

Industrial noise associated with the Tea Gardens Industrial Estate was inaudible at this location. The measurement location is visually presented in *Figure 6.2* and as described in *Table 6.7*.

Results of this measurement, including all noted extraneous noise sources are presented in *Table 6.8*.

Table 6.8 Operator Attended Noise Environmental Measurement

Measurement Location			Measured Noise Levels, dB(A)			
	GPS (UTM)					
ID	Easting	Northing	Leq	L90	Lmax	Lmin
OANM 4	56H 420491	6388243	50	45	63	43

1. *OANM 4 noted extraneous noise sources include: wind blown vegetation (45 to 50 dB), animal noises (43 to 47 dB), car-pass-by's (x 3 at 50 to 53 dB), distant urban hum (<43 dB), distant traffic (<43 dB), operator noise (<20 seconds at 46 to 48 dB) and operator noise (LAMax 63 dB);*
2. *This measurements was of 15 minutes duration; and*
3. *During OANM4 the following meteorological conditions were noted. Temperature of approximately 26° Celsius, cloud cover of 3/8 Octas, wind speeds gusting up to but not in excess of 5m/s, average wind speeds of <4m/s and typically an easterly (45°) wind direction.*

Meteorological Conditions

The following meteorological conditions have been modelled:

- a 3m/s wind at 270° (source to receiver) for daytime and Class-D temperature inversion condition for the daytime assessment period; and
- a 3m/s wind at 270° (source to receiver) for daytime and Class-F (3° C/100m) temperature inversion condition for the evening and night time out-of-hours assessment periods.

In addition, calm meteorological conditions, which represent the majority of the time, have been modelled for standard daytime, evening and night time (out-of-hours) assessment periods.

Operations at the industrial area would typically occur during the daytime assessment period (7am to 6pm) only, however evening and night time periods are assessed to consider any out-of-hours works that may occur.

6.5.4 Project Specific Noise Levels

Operational Noise Criteria

Based on the measured ambient and background noise levels presented in *Section 6.5.3* and the '*Estimated Average Background A-weighted sound pressure levels (LA90, T) for different areas containing residences in Australia*' from AS1055.3 - 1997™ the Project Specific Noise Levels (PSNL) have been derived for daytime (as measured), evening and night time (as per AS1055.3 - 1997™) assessment periods.

The adopted ambient and background noise levels for daytime, evening and night time assessment periods and the resultant Project Specific Noise Levels (PSNL) are outlined below in *Table 6.9*. This identifies that the night time PSNL of 35 dB(A) as the most stringent criterion. Compliance with this limiting noise criterion indicates that impacts, if any, will be minimal during all assessment periods. This is particularly the case given that out-of-hours works are not expected to occur at the Industrial Estate.

Table 6.9 Project Specific Noise Levels

NAL	Period	RBL LA90	Intrusive Criteria (RBL + 5 dB) LAeq, 15 min	Acceptable Amenity Level[2] LAeq, period	Measured Ambient Noise LAeq, period[3]	Amenity Criterion LAeq, Period	PSNL LAeq, 15 min
1	Daytime	42	47	55	No 'period' measurement completed	55	47
	Evening	35	40	45		45	40
	Night	30	35	40		40	35
2	Daytime	42	47	55		55	47
	Evening	35	40	45		45	40
	Night	40	35	40		40	35
3	Daytime	42	47	55		55	47
	Evening	35	40	45		45	40
	Night	40	35	40		40	35

1. *The LA90 represents the level exceeded for 90 per cent of the interval period and is referred to as the average minimum or background noise level;*
2. *Where the measured LA90 (RBL) is lower than 30 dB(A), a RBL of 30 dB(A) is applied in accordance with the Industrial Noise Policy; and*
3. *As per the Industrial Noise Policy Application Notes, the LA90 (RBL) for evening must not be greater than the daytime LA90 (RBL), and the night time LA90 (RBL) must not be greater than the evening LA90 (RBL). When this occurs, the LA90 (RBL) is adjusted to the lower value.*

Sleep Disturbance Noise Criteria[6]

The DECCW has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance have not been defined under the *Industrial Noise Policy*. Furthermore, the application notes of the *Industrial Noise Policy* identify that current guidelines set out in the DECCW's Environmental Noise Control Manual (ENCM) *Section 19-3* are not ideal, and where exceedances occur, the DECCW recommends more detailed analysis be undertaken.

The DECCW's *Environmental Criteria for Road Traffic Noise* (*ECRTN*) provides further guidance on sleep disturbance and states that 'maximum' internal noise levels (L_{AMax}) below 50 to 55 dB(A) are unlikely to cause awakening reactions.

This internal noise criterion equates to an external sleep disturbance criteria of 60 dB(A) to 65 dB(A) assuming 10 dB(A) loss between the residential façade with windows partially open. This is based on a minimum of 20 % window area left open (*Environmental Criteria for Road Traffic Noise*, Environment Protection Authority, 1999).

Therefore, the derived ECTRN sleep disturbance criteria of 60 dB(A) L_{AMax} (preferred) and 65 dB(A) L_{AMax} (maximum) has been adopted for the assessment of potential sleep disturbance impacts at the site.

6.5.5 Noise Impact Assessment

Noise Emission Sources

The noise emission sources and Sound Power Levels (Lw) included in the noise model are detailed in *Table 6.10* and *Table 6.11*.

[6]Industrial area operations typically occur during the daytime assessment period only however, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the Industrial Noise Policy and ECRTN.

Table 6.10 Operational Noise Emission Sources

Description	Source type	Lw Leq, 15min dB(A)	Comments	
			Daytime	Night time
Vehicle Idling	Point source	70	Representative Lw noise level contribution over the 15 minute assessment period. - 100% 'operational' during standard daytime period	Representative Lw noise level contribution over the 15 minute assessment period - 25% 'operational' during evening and night time (out-of-hours) periods
Metal On Metal Contact		64		
Grinding		69		
Reverse Beeper 1		72		
Reverse Beeper 2		69		
Vehicle Idling (x 2)		70		
Vehicles moving on northern side of site entrance	Moving source	97	15 vehicles at 20 km/h - per 15 minute period[3]	7 vehicles at 20 km/h - per 15 minute period
Vehicles moving on southern side of site entrance		97		

1. *In each case the worst-case Leq, 15minute noise level contribution has been adopted;*
2. *Based on typical operational activities for industrial areas during daytime, evening and night time periods, a time weighting factor has been applied to the evening and night time Lw values so that the reduced noise levels that are expected to occur out-of-hours are accurately reflected; and*
3. *Based on the noted peak vehicle flow, entering and exiting the existing industrial estate.*

Table 6.11 Sleep Disturbance Noise Emission Sources

Description	Source type	Lw Leq, 15min dB(A)	Comment	
			Daytime	Night time
Metal on Metal Contact	Point Source	89	Not Applicable	LAMax noise level, representative of potential noise emissions associated with sleep awakenings and disruptions
Reverse Beeper 1		84		
Reverse Beeper 2		84		

Calculated Operational Noise Levels

Based on the measured Lw values presented in *Table 6.10* and the previously described noise scenarios, the worst case calculated operational noise levels for calm and adverse meteorological conditions are presented in *Table 6.12* and *Table 6.13* .

Table 6.12 Calculated Noise Levels - CALM

NAL	Calculated Noise Level LAeq, 15min			PSNL LAeq, 15min			Comply?
	Daytime	Evening	Night time	Daytime	Evening	Night time	
1	36	32	32	47	40	35	√
2	38	34	34				√
3	35	32	32				√

Table 6.13 Calculated Noise Levels - ADVERSE

NAL	Calculated Noise Level LAeq, 15min			PSNL LAeq, 15min			Comply?
	Daytime	Evening	Night time	Daytime	Evening	Night time	
1	36	33	33	47	40	35	√
2	38	34	34				√
3	36	32	32				√

Calculated Sleep Disturbance Noise Levels[7]

Based on the measured Lw values presented in *Table 6.11* the worst case calculated sleep disturbance noise levels are presented in *Table 6.14*.

Table 6.14 Calculated Sleep Disturbance Noise Levels

NAL	Calculated Noise Level LAMax	Preferred ECRTN criterion (external) LAMax	Comply?
1	38	60	√
2	39		√
3	36		√

[7] Industrial area operations typically occur during the daytime assessment period only however, in order to provide a comprehensive and robust analysis of potential noise impacts, noise modelling considers daytime, evening (out-of-hours) and night time (out-of-hours) assessment periods. Sleep disturbance noise impacts (night time only) have been assessed in accordance with the Industrial Noise Policy and ECRTN.

These calculated values are below the derived L_{AMax} *ECTRN* sleep disturbance criteria of 60 dB (preferred) and 65 dB (maximum) that have been adopted for this assessment.

Based on observations made by ERMs acoustician whilst on site, an industrial area of this type is typically unlikely to generate transient or impulsive noise emissions potentially associated with sleep arousal or disturbance during the out-of-hours assessment period. This assumed scenario provides worst-case noise level results and is not considered to be representative of normal noise conditions associated with the Tea Gardens Industrial Estate. Furthermore, the industrial/commercial noise emissions are not expected to typically occur outside of daytime hours. Although the potential exists for noise events to occur beyond this time, the frequency of the events is likely to be limited. Accordingly, operations are unlikely to cause awakening reactions and sleep disturbance impacts are not considered to be associated with, or a feature of, existing or future operations.

6.5.6 Discussion of Results

Results and findings of ERM's Noise Impact Assessment are summarised as below:

- calculated noise levels ($L_{Aeq,\ 15\ minute}$) are below the Project Specific Noise Levels (PSNL) at all Noise Assessment Locations (NAL) under calm and adverse meteorological conditions, during all assessment periods (daytime, evening and night time);
- calculated noise levels (L_{AMax}) are below the recommended DECCW *ECRTN* sleep disturbance noise goals at NAL, being the closest and/or or potentially most affected residential receiver locations in proximity of potential transient noise impacts;
- noise emissions associated with the existing industrial area do not result in adverse noise impacts on the residential receivers within the proposed Riverside at Tea Gardens development; and
- given the calculated compliance with the relevant noise standards and guidelines ERM make no further recommendations in regards to any methods for noise attenuation.

Technical Note:

ERM understands that the proposed road infrastructure (Myall Street) is being upgraded to a four lane road entering and exiting a near-by round a bout. This proposed upgrade is understood to include earth mounds and foliage at the edge of the road alignment and as part of the median strip. Shielding of this type (breaking the direct line of sight between the source and the receiver) may provide an additional 8 dB (A) to 10 dB(A) noise attenuation for the closest, and/or potentially most affected residential receivers in proximity to the existing industrial area.

6.6 HAZARD MANAGEMENT AND MITIGATION

6.6.1 Coastal Processes - Consideration of Climate Change

The Department of Environment, Climate Change and Water (DECCW) have advised that the Floodplain Risk Management Guideline titled *Practical Consideration of Climate Change* (DECCW, 2007) should be considered for all developments where there are potential impacts as a result of climate change. This relates to impacts associated with sea level rise and increase in rainfall intensity.

The NSW Coastal Planning Guideline: Adapting to Sea Level Rise has been prepared by the NSW Department of Planning to provide guidance on how sea level rise is to be considered in land use planning and development assessment in Coastal NSW. The NSW sea level rise planning benchmarks are an increase above 1990 mean sea levels of 40cm by 2050 and 90cm by 2100.

The Intergovernmental Panel on Climate Change (IPCC) has recommended that for the east coast of New South Wales the sea level rise is expected to be 0.18 to 0.91 metres by between 2090 and 2100. Additionally, climate change impacts on flood producing rainfall events to 2070 show a trend for larger scale storms which will potentially impact on current design Annual Recurrence Interval (ARI) due to increases in rainfall.

Cardno (2011) completed an assessment of 100 yr ARI flood levels for the final scheme resulting from local runoff under a possible climate change scenario including a 30% increase in rainfall intensities. The assessment demonstrates that all residential lots within the proposed development remain free of inundation during a 100 yr ARI event under current conditions and under future conditions with climate change. In a 100 yr ARI event inundation within the site is generally confined to opens pace areas and drainage corridors. It should be noted that while local inundation of some local roads is expected under climate change the level of inundation would be safe for wading and that all residential would be able to evacuate to higher ground via the proposed public roads.

6.6.2 Contamination and Acid Sulphate Soils

Acid Sulphate Soils

A geotechnical assessment which investigated the potential for acid sulphate soils on site was carried out by Coffey Geotechnics Pty Ltd (2008) (refer to *Volume 4*). A supplementary assessment prepared by Coffey Geotechnics Pty Ltd (2011) is also provided in *Volume 4*.

The investigations related principally to the area in the central and south eastern portions of the site (refer to Figure 1 of the assessment within *Volume 4*). Precinct 1 which included 71 lots previously located in the south east

portion of the site has been deleted and will become part of the conservation area. It is expected that the subsurface conditions in the south and eastern parts of the site will be similar to those encountered during the geotechnical assessment. The land to the north and north west will be subject to further detailed geotechnical investigations as part of the future development application for the site.

According to the Acid Sulphate Soils Risk Map for Port Stephens the site is located in an area where there is a low probability of acid sulphate soil materials occurring between one metre and three metres below the ground surface. The map indicates that acid sulphate soil (ASS) materials, if present, are irregular and may be buried by alluvium or windblown sediments (Coffey, 2008).

Groundwater modelling undertaken by Marten and Associates (2011) (refer to *Volume 3*) concluded that the proposed development was likely to reduce groundwater levels in the area of the proposed unlined lakes by up to approximately 0.5 metres due to interception of groundwater.

Results also indicate that groundwater levels are likely to be drawdown by approximately 0.05 to 0.1 m over the adjacent SEPP14 wetlands due to reductions to recharge in the area of the site which would be balanced by approximately 10 years of sea level rise. Changes to groundwater flow direction at the site boundaries and within adjoining wetlands are negligible.

Todate there is no indication of the potential for sulfate production in the area. Notwithstanding this a number of bores were drilled within close proximity of the proposed development. Several test holes were drilled by Coffey and the soils tested for the potential to produce acid sulfate soils. BH37 is located in the area where the maximum drawdown has been predicted and the results of SPOCAS analysis indicate that from 2 m below surface, samples tested exceed the Acid Sulfate Soil Management Advisory Committee (ASSMAC) action criteria. The potential to produce acid soils increased with depth with the interval 2.0 – 2.5 m just exceeding the criteria.

Groundwater levels in this area are approximately 1.5 m below surface and a 0.5 m groundwater level decline will lower groundwater levels to around this zone however it is anticipated that the area that may be impacted is small.

A comparison of pH from previous investigations conducted in April 2004 with recent results collected in March 2007 indicates that there has been no discernable change in groundwater pH. This suggests that even with the groundwater level reductions assessed to be affected by lower than average rainfalls in the last few years, there has been no additional increase in acid production resulting from the drying of acid producing soils.

An Acid Sulphate Soils Management Plan has been prepared in view of the potential for acid sulphate soils to be present (refer to *Volume 4*) and relates to future earth works at Riverside. The plan provides a reference to all lot purchasers and contractors required to work on the site (Coffey, 2008). With

the exception of the construction of water detention lake basins and ponds, the majority of the Riverside site will be subject to filling in order to obtain required grades. Therefore, there is limited potential for the exposure of acid sulphate soils in these areas.

Contamination

Phase 1 Environmental Site Assessment

A Phase 1 Environmental Site Assessment (ESA) was undertaken (ERM, 2010) to identify potentially contaminating activities that have previously, or may currently be occurring on the Riverside at Tea Gardens site. Key findings of the assessment are summarised below. The full assessment report is presented in *Volume 5*.

The following was noted during the assessment:

- the title search review undertaken as part of the assessment did not identify potentially contaminating activities on the site; and
- a limited risk might exist as parts of the site were previously used as a commercial pine plantation. Therefore, impact due to fertilizer and/or pesticides cannot be excluded or that minor oil and/or fuel spills from machinery might exist on the site.

Pesticide use in pine plantations is usually confined to the first two years of a plantation crop cycle. Furthermore all chemical pesticides used in commercial pine plantations in Australia are also used in general agriculture (Forest and Wood Products Research and Development Corporation, 2006). Therefore the potential impact to the site from the use of pesticides associated with the former pine plantation is considered to be minor.

The assessment identified that the greatest potential for potential transport mechanisms and pollution linkages on the site is via the shallow groundwater aquifer. The shallow aquifer is unconfined and is considered to have significant potential to act as transport mechanism for the offsite migration of contaminants. A secondary transport mechanism is considered to be the potential for airborne migration of contaminated soil due to wind erosion. The secondary transport mechanism is considered to have minor potential only, as the site surface is well vegetated and the potential for wind erosion is therefore low.

The assessment considered the risks of potential contamination on identified 'receptors', including persons (residents, future residents, patrons, workers and off site persons), water supply and wells, and the Myall River that are or may be adversely affected by the chemicals of concern.

The assessment identified the following:

- the site was assessed as being free of potential contaminants or past and present contaminating activities likely to have a significant adverse impact on human health or the environment;

- the site, although disturbed in parts by former use as a commercial pine plantation, is currently free from development;

- no evidence of former development was noted; and

- as the site is largely uncontrolled it cannot be discounted that illegal dumping of potentially contaminating materials has occurred, however based on the information reviewed it is considered that the potential for such dumping is low.

Potential for existing site contamination therefore is considered to be low and if encountered, contamination is likely to be limited in extent to localised zones within the site. Therefore the site is considered to have low potential to adversely affect human health or the environment either on surrounding properties or local receiving waters. The Phase 1 ESA undertaken for the Riverside at Tea Gardens site did not identify any significant potential for site contamination. The site is therefore considered suitable for the proposed development.

Myall Quays Detention Lake Sediment Sampling and Analysis

Lake sediments were investigated within the Myall Quays Detention Lake to look for the existence of a build up of nutrients and persistent chemical pollutants.

Coffey Environments (Coffey) undertook fieldwork on the 5 October, 2007. The sediment sampling was assessed for contamination levels against the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).* Twenty-one (21) sediment samples were collected at locations within the lake. The sediment samples analysed from the lake show low heavy metal (Cr, Cu, Pb, Hg, Ni and Zn) concentrations which are below the adopted warning levels and may possibly be at background levels (Coffey, 2007b).

Organochlorine pesticides (OCP) and polychlorinated biphenyls (PCB) were not detected above the laboratory reporting limits. Polynuclear aromatic hydrocarbons (PAH) were detected at concentrations below the warning levels for this investigation. Nutrient concentrations (total nitrogen and total phosphorous) indicate they have not accumulated to levels typical of urban ponds and lakes (Coffey, 2007b).

Based on the sampling and analysis it appears that the lake is not acting as a "pollutant sink", showing little or no evidence of build up of pollutants within the lake bed. The Lake Sediment Sampling and Analysis report prepared by Coffey dated October, 2007 has established baseline comparison data for future development and monitoring of the sediments of the lake (Coffey, 2007b).

6.6.3 Bushfire

A Bushfire Threat Assessment was undertaken by Conacher Environmental Group (CEG) (2011a) (refer to *Volume 4*). The site is mapped as Bushfire Prone as identified in the Great Lakes Council Bushfire Prone Land mapping. It is categorised as having a Forest Fire Danger Index (FDI) of 80 and therefore Table A3.4 of *Planning for Bush Fire Protection, 2006* was used to determine appropriate asset protection zones.

The potential bush fire threat was identified from Dry Sclerophyll Forest vegetation to the north of the site. A reduced risk is present to the east of the site comprising the Forested Wetlands and Saline Wetlands. A greatly reduced risk is present from the west and south west as a result of cleared grass land, scattered trees, industrial land use and existing residential development (CEG, 2011a) (refer to *Volume 4*).

The proposal incorporates a range of bush fire mitigation measures, including Asset Protection Zones (APZs), which were determined in accordance with *Planning for Bush Fire Protection Guidelines 2006*, building construction standards, hazard management, evacuation routes, availability to fire fighting services, water supply and communication as detailed herein.

Asset Protection Zones

The required APZs for residential development and development identified as special fire protection purposes (which includes tourist development) are outlined in *Table 6.15* and *Table 6.16* and are as detailed within the *Planning for Bush Fire Protection Guidelines* (RFS, 2006).

Table 6.15 Asset Protection Zone Requirements for Residential Development

Table 1 Bushfire Attack and APZ requirements for Residential Development						
Direction	Vegetation within 140m	Effective Slope Gradient	Minimum APZ (m)	Bushfire Attack APZ Range (m) Construction Standard		
				Level 3 (High)	Level 2 (Medium)	Level 1 (Low)
North west	Pasture Managed Grassland	0-5 U	No requirement	-	-	-
North to North west	Dry Sclerophyll Forest	0-5 U	20	-	25-35	35-100
East	Forested Wetlands	0-5 D	20	17-24	24-34	34-100
South-South east	Saline Wetlands	0-5 D	No requirement	-	-	-
South	Residential	0-5 D	No requirement	-	-	-
West	Pasture Industrial	0-5 D	No requirement	-	-	-

*Construction Standard AS 3959
U = Upslope
D = Downslope

Table 6.16 Asset Protection Zone Requirements for Special Fire Protection Purposes

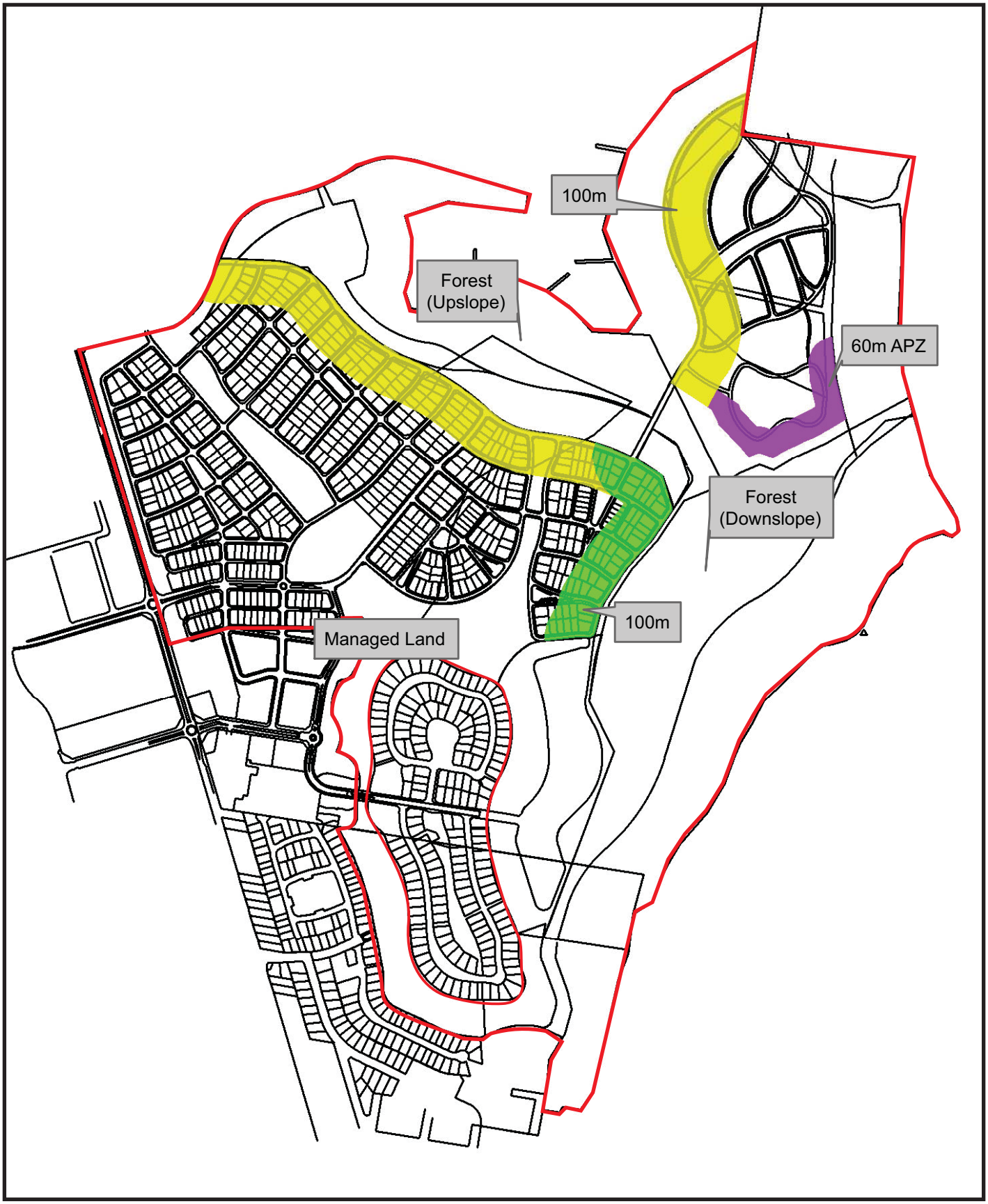
Table 2 Bushfire Attack Assessment Tourist Units (Special Fire Protection Purposes)			
Direction	Vegetation within 140m of Development	Effective Slope Gradient	APZ (m)required
North to North east	Managed Lands/ Residential development	0-5 U	Nil
East	Saline Wetlands	0-5 D	Nil
South	Forested Wetlands	0-5 D	60 metres*
South west	Forest	0-5 U	60 metres*
West	Forest	0-5 U	60 metres*

The APZs will be measured from the building line of the development. Fuel management within the APZs will be regularly maintained in accordance with a site specific fuel management plan as generally described in *Planning for Bush Fire Protection, 2006*.

Construction

Construction standards set out in the Australian Standard AS3959 *Construction of Buildings, in Bush Fire Prone Areas*, as amended will apply to the future development.

Residential dwellings: Future residential development should be constructed to a Bushfire Attack level of between BAL 40 and BAL 2.5 to protect against the level of bushfire attack depending on the distance from the bushfire hazard as shown in *Figure 6.3*.



Legend

Riverside at Tea Gardens Site Boundary

	Bush Fire Attack Levels (BAL)	Distance (metres) From Hazard
	BAL Flame Zone	0 – 16
	BAL 40	16 – 21
	BAL 28	21 – 31
	BAL 19	31 – 42
	BAL 12.5	43 - 100
	BAL Flame Zone	0 – 20
	BAL 40	20 – 27
	BAL 28	27 – 37
	BAL 19	37 – 50
	BAL 12.5	50 - 100
	Tourist Lodging	
	APZ	60

Notes:

1. Subject Site Boundary subject to final survey.
2. Plan for indicative purposes only. Not for detailed measurement.

Source:

Conacher Environmental Group- Bushfire Protection Assessment Report - Riverside Tea Gardens November 2011 (Ref:10122)

Suffix	Revisions	Date	Init
R0	Preliminary Issue	09-01-12	

Figure 6.3

Bushfire Attack Levels

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens	
Drawing No:	0043707h_CP_EA_11_C023_R0.cdr	
Date:	09/01/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: SO'C
Scale:	Refer to Scale Bar	

N

0 100 200 300m

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

Tourist development: as detailed in Table 5.2, Class 9 structures as defined by the Building Code of Australia and Special Fire Protection buildings as defined by the RFS are required to be provided with asset protection zones. In this case, the maximum heat flux of 10K/W m can be accommodated by providing APZs of 60 metres form the forest vegetation in the north west and 60 metres to the Forested Wetlands in the south.

Hazard Management

The managers/owners of the lot/s will have an ongoing liability to ensure the management of the APZs within the property to prevent the build up of combustible fuel.

Section 63(2) of the Rural Fires Act states that '*it is the duty of the owner or occupier (including Councils) of land to take the notified steps (if any) and any other practicable steps to prevent the occurrence of fires on, and to minimise the danger of the spread of fires on or from that land*'. A site specific fuel management plan should be developed in accordance with the *Planning for Bush Fire Protection, 2006* to properly manage regular maintenance.

There is no physical reason that should constrain hazard management in any potential asset protection zone from being successfully carried out by normal means e.g. landscaping /mowing / slashing following initial clearing works (CEG, 2011a).

Evacuation Safety

The proposal provides evacuation routes from the proposed development during a bush fire. The proposal includes two access points to Myall Street, including the existing access point at Shoreline Drive. From Myall Street safe egress is available to the north and south, to areas that provide adequate separation from the surrounding bush fire threats.

Availability and Access to Fire Fighting Service

The site is in close proximity to two rural fire services. The closest Rural Fire Brigade is located in Tea Gardens, approximately three kilometres to the site. This fire brigade would have a response time of 10 – 15 minutes if they were not assisting elsewhere. There is also a Rural Fire Service located at Bulahdelah to the north. They would have a response time of 30-45 minutes if they were not assisting elsewhere.

All access requirements are to be compliant with the provisions of the *Planning for Bush Fire Protection, 2006.* The proposed internal road layout and connection to existing road provides adequate access / egress for emergency services.

Water Supply and Communication

Reticulated water is available to the site therefore additional supplementary water supply for fire fighting purposes will not be required. Hydrants will be installed in accordance with Australian Standard AS2419-1 (1964). Access points for reticulated water supply are to incorporate a ring main system for all internal roads.

Telephone communication is also available to the site, which will assist in communications during a bushfire.

Bush Fire Evacuation Plan

A Bush Fire Evacuation Plan should be prepared and incorporated into the Community Management Statement.

6.6.4 Geotechnical Assessment

A geotechnical assessment including field investigations and laboratory testing was carried out by Coffey Geotechnics Pty Ltd (2008) (refer to *Volume 4*). A supplementary assessment prepared by Coffey Geotechnics Pty Ltd (2009) is also provided in *Volume 4*.

On the basis of the soil profiles encountered during the field investigations, results of Dynamic Cone Penetrometer testing and results of laboratory shrink / swell testing carried out in the adjoining Myall Quays Estate, lots within the proposed subdivision are currently classified in accordance with AS2870- 1996 'Residential Slabs and Footings', as Moderately Reactive, Class 'M'. A characteristic free surface movement of up to 40mm is estimated for the natural soil profiles encountered.

The assessment provides recommended material, construction specification and pavement make-up details and a number of recommendations relating to site preparation and earthworks, excavation methods and reuse of materials (refer to *Volume 4*).

6.7 WATER CYCLE MANAGEMENT

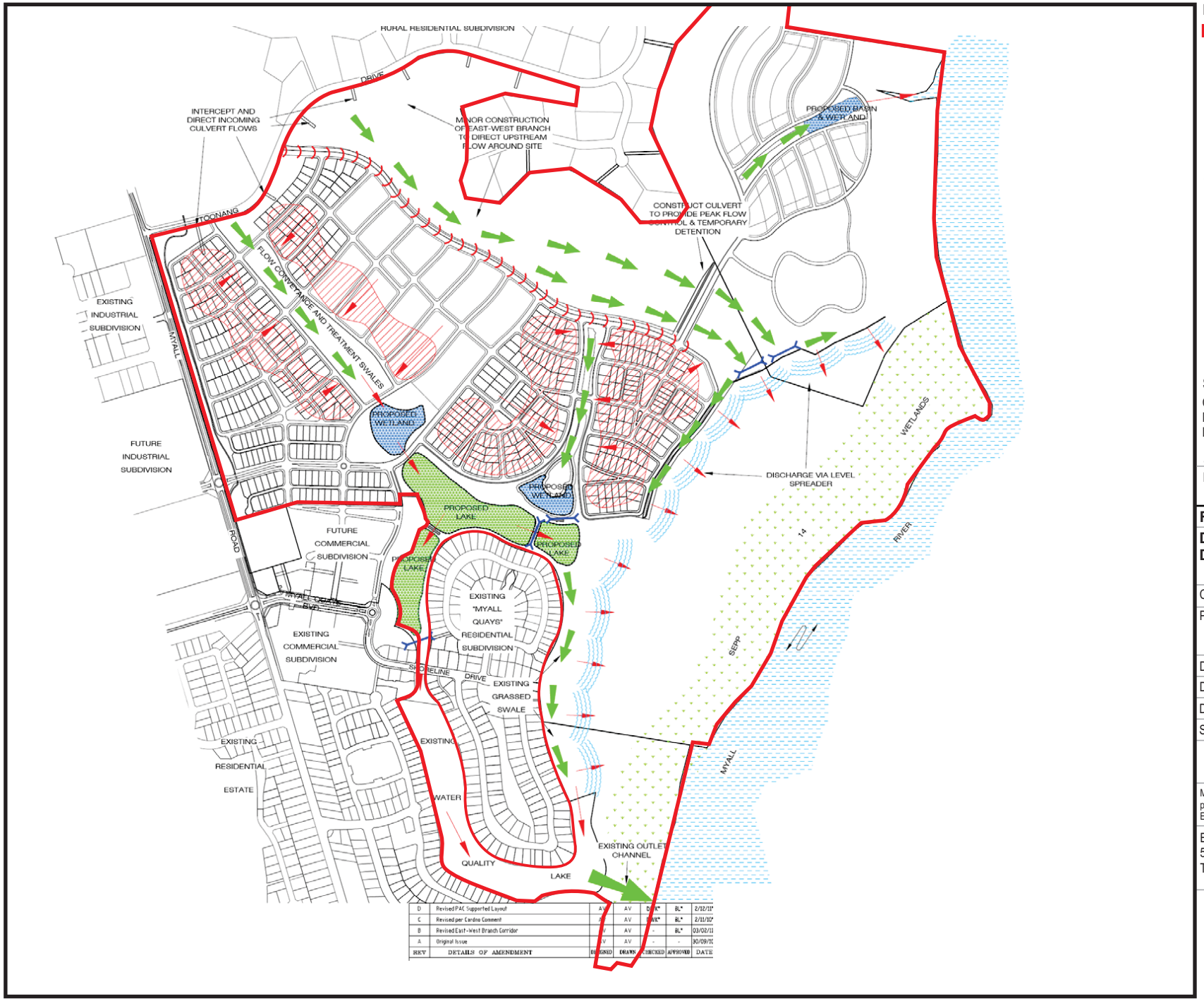
When assessing the previous concept plan and project application for the site, the Planning Assessment Commission (PAC) raised several concerns in relation to the impact of the development on existing groundwater conditions, the adjoining SEPP 14 wetland and flooding. In response to the issues of concern Cardno, Martens and Associates and Worley Parsons have formulated an amended Integrated Water Cycle Management (IWCM) strategy based on water Sensitive Urban Design (WSUD) principles for the Riverside at Tea Gardens site (refer *Volume 3*).

The integrated water management system proposed for Riverside is based on a strategy which collects, detains and treats stormwater runoff in an integrated train of local, neighbourhood and regional facilities and incorporates the detailed consideration of potable water, rainwater, wastewater and recycled water.

The strategy is based upon the following principles:

- intensive analysis of existing site conditions;
- a significant assembly of base data regarding performance of the existing surface and groundwater systems and in particular the existing lake;
- detailed computer modelling and assessment of a range of development options against performance criteria and legislative requirements;
- refinement of the selected management strategy;
- modelling of likely future performance and impacts of the selected management strategy; and
- consultation with the Department of Planning &Infrastructure (DP&I), MidCoast Water and Council.

A diagrammatic stormwater concept plan is given in *Figure 6.4*.



Legend

- Riverside at Tea Gardens Site Boundary
- Denotes Limited Opportunity for Biofiltration Dependent upon Specific Finished Level Ground Water Height & Soil Condition at Each Location
- Denotes Control Height for Post Climate Change Discharge at Min RL 1.4m AHD
- Denotes Diversion Bank to Help Direct Offsite Runoff
- Denotes Discharge via Level Spreader
- Denotes Constructed Unlined Flow Conveyance & Treatment Swales/ Channels
- Denotes Lined Treatment Structures
- Denotes Unlined Treatment & Infiltration Structures
- Denotes Flow Direction

Source:

Cardno ' Riverside at Tea Gardens Integrated Water Management Main Report' December 2011 - Tattersall Lander Pty Ltd Ref:21000166

Suffix	*Revisions*	*Date*	*Init*
R0	Preliminary Issue	09-01-12	JD

Figure 6.4

Diagrammatic Stormwater Concept Development Plan

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens	
Drawing No:	0043707h_CP_EA_11_C019_R0.cdr	
Date:	09/01/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: SO'C
Scale:	Refer to Scale Bar	

N

0 100 200 300 400m

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

6.7.1 Flooding And Drainage

Existing Conditions

The catchment of Riverside at Tea Gardens is bounded to the north by the ridge line of the ridge outcrop, and to the south-west by Myall Road. Riverside at Tea Gardens represents a major portion of the catchment. With the exception of the portion at the south of the site that has already been developed, there is little natural development of surface drainage features and as the surface soils are generally sandy such that a high level of rainfall infiltration to the groundwater system takes place. As a result, significant surface runoff is unlikely except during periods of high rainfall.

The site contains several low natural sand ridges which tend to channel runoff in the western half of the site from north to south. However a number of shallow drains have been previously constructed to convey runoff from the western areas of the site to the east to join with runoff from the eastern area of the site that flows east towards the SEPP 14 wetlands and the Myall River.

During wet periods, water ponds in low lying areas in the western and northern areas of the site.

The estimated peak 5 yr ARI, 20 yr ARI and 100 yr ARI outflows from the site are summarised in *Table 6.17*.

Table 6.17 Estimated Peak Flows (m3/s) at key locations in Riverside under Existing Conditions

5 yr ARI	20 yr ARI	100 yr ARI	Comment
5.3 *(9)*	9.8 *(9)*	17.1 *(2)*	Total inflow to the existing detention lake
3.3 *(9)*	8.6 *(9)*	14.7 *(2)*	Outflow from the existing detention lake
6.9 *(9)*	8.7 *(9)*	10.9 *(9)*	Aggregated flow to the Conservation Zoned
0.58 *(9)*	0.88 *(9)*	1.25 *(9)*	Outflow to an existing drainage line that discharges directly into the Myall River

1. *Note: The Critical Storm Burst Duration (hrs) is reported in brackets*

Developed Conditions

Previously, the approach to drainage design in Tea Gardens was to maintain drainage structure outlet levels at or above Mean High Water, at approximately RL 0.5m AHD. This is reflected in the levels of drainage structures throughout the existing Tea Gardens township, including all existing stages of the Myall Quays estate.

In order to account for the possible impacts of climate change, modifications have been made to the previously proposed drainage regime in the Riverside proposal. In order to maintain the existing approach, the most significant change has been to lift the entire site, to ensure that the minimum invert of all new drainage structures at Riverside are now proposed at or above the predicted worst post climate change Mean High Water of 1.4m AHD. In discussions with Great Lakes Council's engineering department, this has been supported as an appropriate response.

The other possible effect of climate change has been to increase flooding levels due to potential increases in tail water and rainfall intensities. Revised flood levels across the site have then been accounted for in determining landform levels. A direct result of this raising of the drainage network is the raising of the surface levels across the site to provide cover to the pipes. Consequently the majority of the site is already raised above the revised flood levels. Additional lot filling is proposed in any remaining low-lying areas to ensure that all lots remain flood free above the modelled 100yr flood levels, with climate change. It should be noted that finished floor levels will be a minimum of a further 0.3m above this lot fill level.

It is proposed to direct runoff in events up to the 100 yr ARI event from the upper catchment areas east along the proposed open space corridor located on the northern boundary to a major retarding basin (Basin EW) with outflows from the basin discharging south east to a swale located on the eastern boundary of the site. This swale is intended to distribute runoff along the western boundary of the buffer zone to reduce the concentration of runoff into the buffer zone and the SEPP14 wetland. Two local basins (Basins N42 and N43) are proposed to manage runoff from the Tourist Precinct.

The planned development located south of the open space corridor will drain southwards towards a number of ponds, wetlands and freshwater lakes that will discharge via swales into the existing saline lake. The planned development will increase the rate of local runoff and peak flows. A number of basins have been sized to ensure that the post development peak flows in the 100yr ARI event is no greater than under existing conditions.

6.7.2 *Practical Consideration of Climate Change*

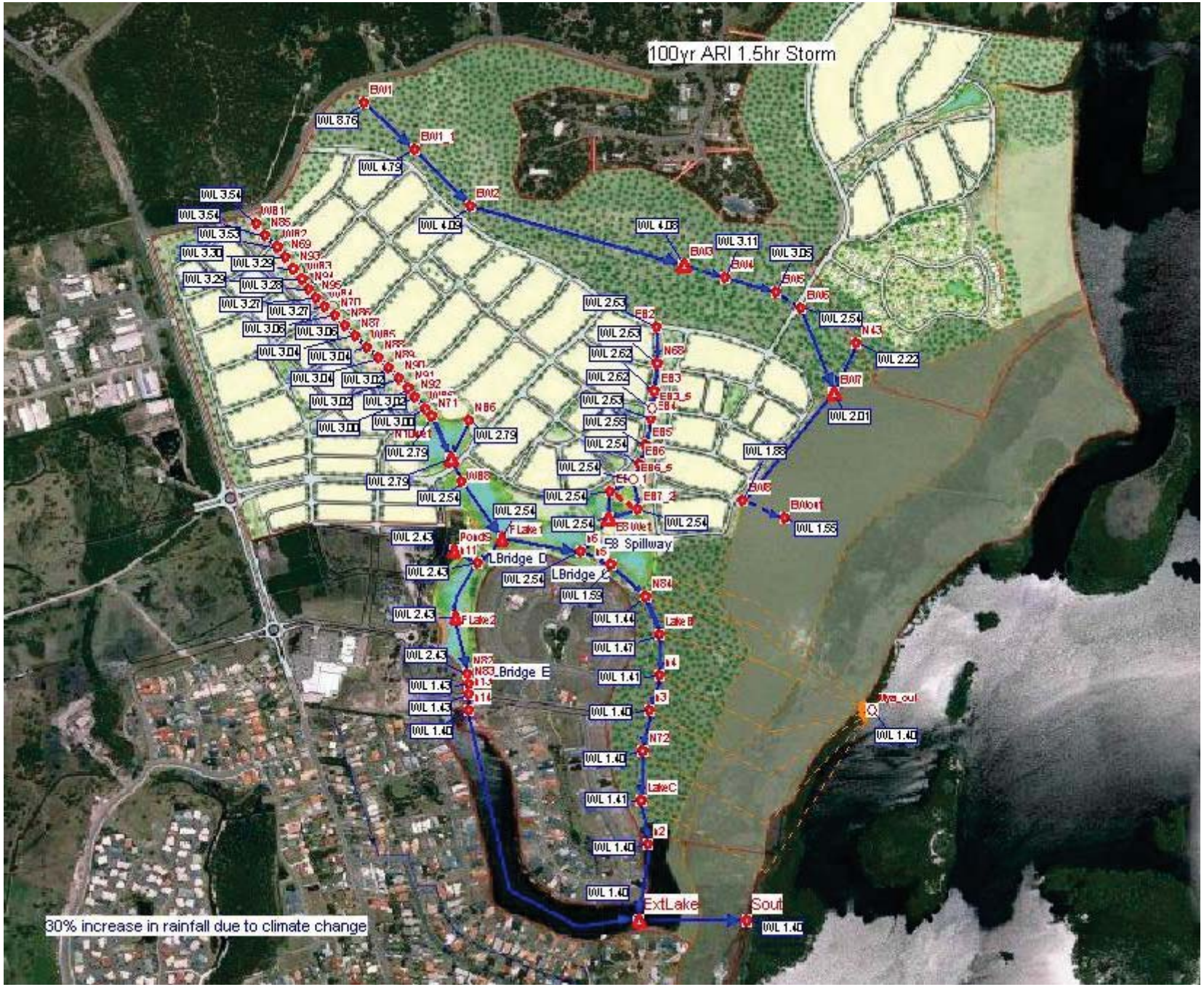
The planned development is subject to flooding from both the Myall River and from runoff from the local catchment. In 2008 sensitivity assessments of climate change were undertaken for the scenarios given in the 2007 DECC Guideline titled "Practical Consideration of Climate Change". These scenarios include +0.18m, +0.55 m and +0.91 rises in sea level as well as 10%, 20% and 30% increase in rainfall intensities (Cardno Willing, 2008b)

It was concluded from the results of the sensitivity runs for the Myall River that:

- the current adopted 100 yr ARI level of 2.1 m AHD could accommodate up to a 30% increase in rainfall under conditions where there is no increase in sea level; and
- the increase in 100 yr ARI levels in the Myall River in the vicinity of Riverside due to increases in rainfall reduce as the sea level rise increases ie. a 30% increase in rainfall increases 100 yr ARI levels in the Myall River by:
  - 0.06 m to 0.07 m under a sea level rise of 0.18 m;
  - 0.04 m to 0.06 m under a sea level rise of 0.55 m; and
  - 0.03 m to 0.04 m under a sea level rise of 0.91 m.

An assessment of 100 yr ARI flood levels for the final scheme resulting from local runoff under a possible climate change scenario including a 30% increase in rainfall intensities was undertaken. The estimated local 100 yr ARI flood levels for the final scheme under 1.5 hour and 9 hour storm bursts with possible climate change conditions (based on a 30% increase in rainfall intensities) are presented spatially and *Figure 6.5* and *Figure 6.6*

The extent of inundation in a 100 yr ARI combined local and regional flooding event under climate change is plotted in *Figure 6.7*.



Source:

Cardno ' Riverside at Tea Gardens Integrated Water Management Main Report' December 2011

Suffix	*Revisions*	*Date*	*Init*
R0	Preliminary Issue	09-01-12	JD

Figure 6.5

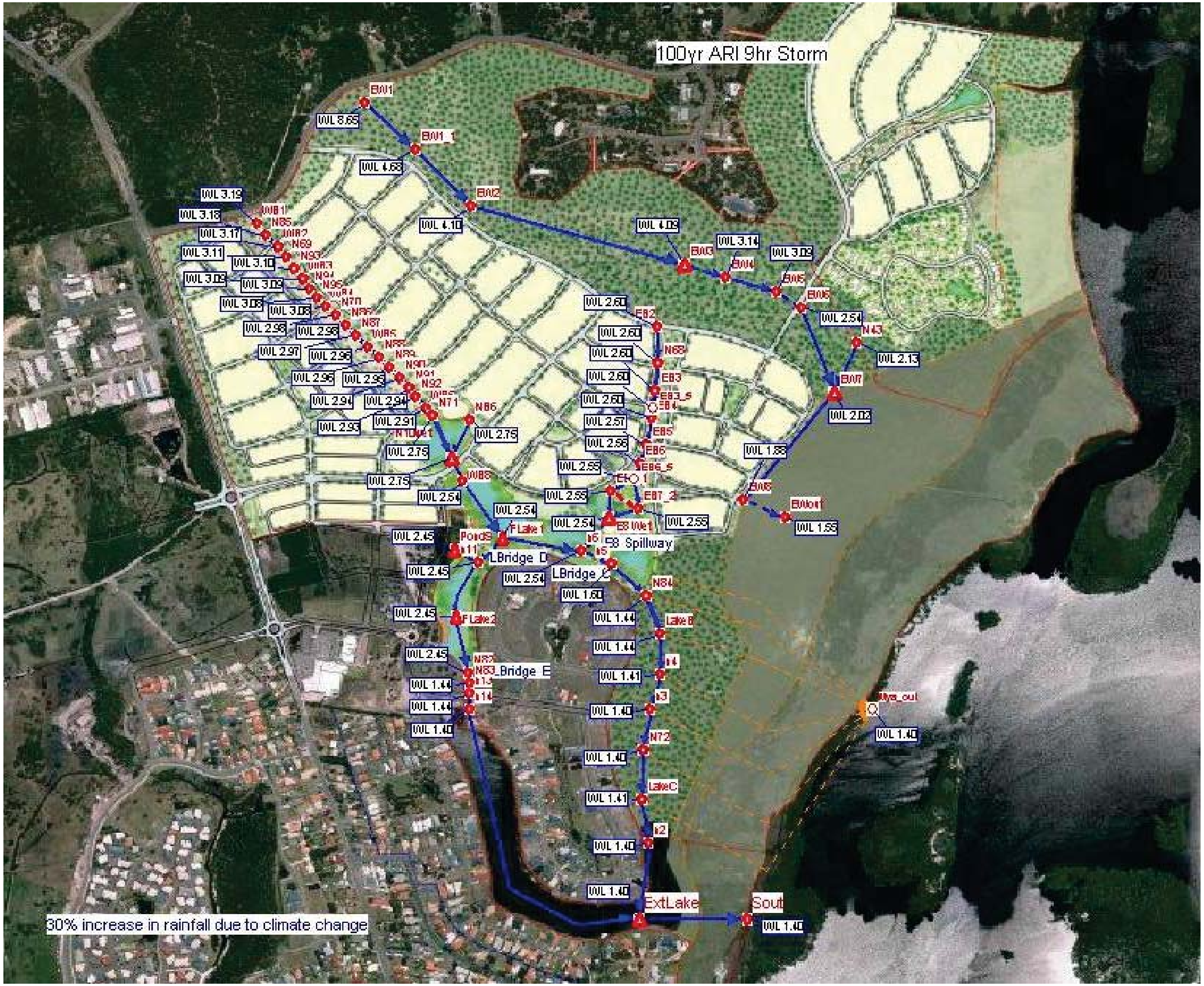
100 yr ARI Peak Flows and Flood Levels for 1.5 hour Storm Burst Under Climate Change

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens	
Drawing No:	0043707h_CP_EA_11_C020_R0.cdr	
Date:	09/012/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: SO'C
Scale:	Not to Scale	

N

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM



Source:

Cardno ' Riverside at Tea Gardens Integrated Water Management Main Report' December 2011

Suffix	*Revisions*	*Date*	*Init*
R0	Preliminary Issue	09-01-12	JD

Figure 6.6

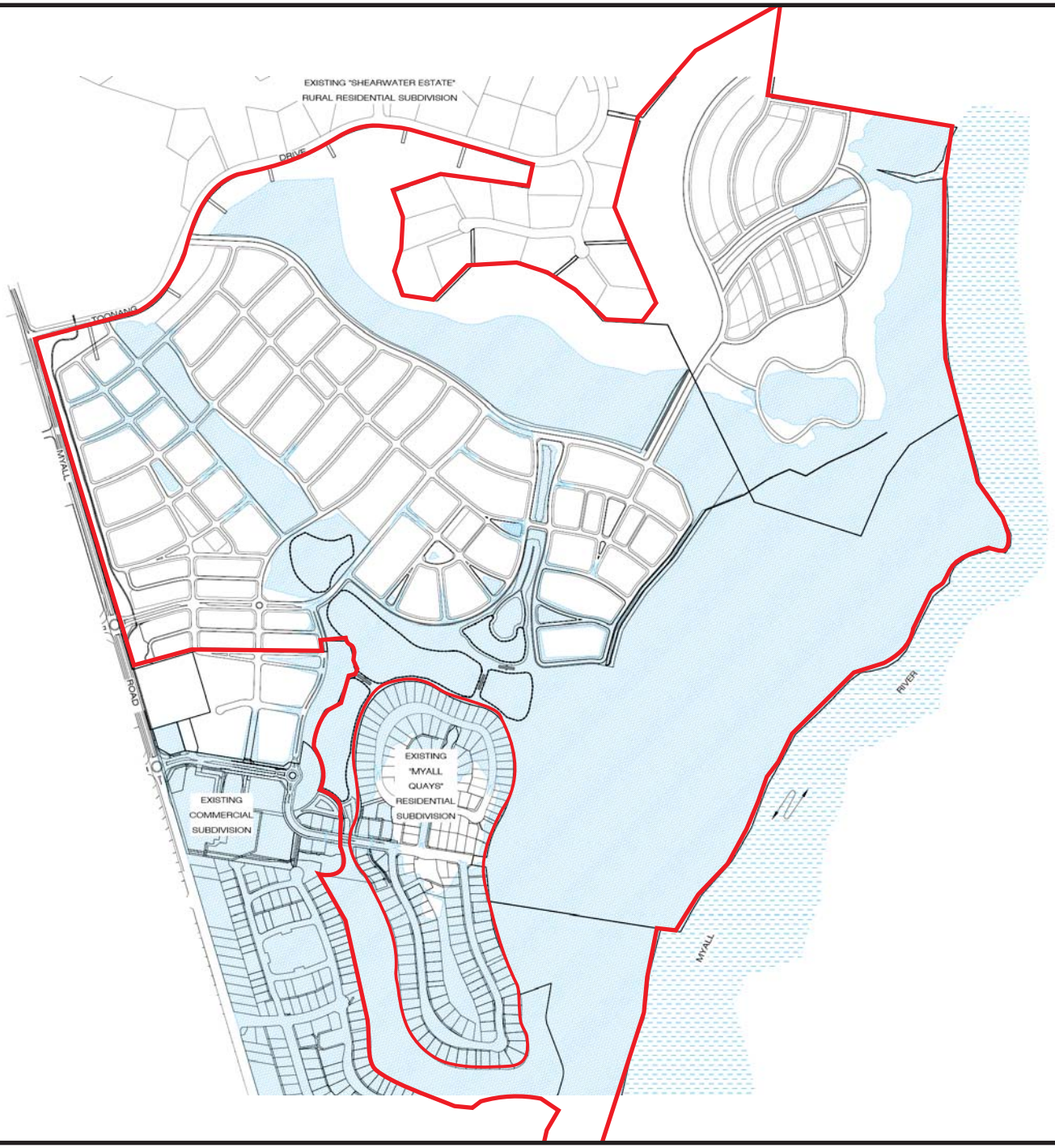
100 yr ARI Peak Flows and Flood Levels for 9 hour Storm Burst Under Climate Change

Client:	Crighton Properties Pty Ltd
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens
Drawing No:	0043707h_CP_EA_11_C021_R0.cdr
Date:	09/01/2012 Drawing size: A4
Drawn by:	JD Reviewed by: SO'C
Scale:	Not to Scale

N

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM



Legend

Riverside at Tea Gardens Site Boundary

Flood Inundation

Source:

Cardno ' Riverside at Tea Gardens Integrated Water Management Main Report' December 2011

Suffix	*Revisions*	*Date*	*Init*
R0	Preliminary Issue	11-01-12	JD

Figure 6.7

100 yr ARI Combined Flood Inundation Under Climate Change

Client:	Crighton Properties Pty Ltd	
Project:	Concept Plan 2011 Environmental Assessment Riverside at Tea Gardens	
Drawing No:	0043707h_CP_EA_11_C022_R0.cdr	
Date:	11/01/2012	Drawing size: A4
Drawn by:	JD	Reviewed by: SO'C
Scale:	Refer to Scale Bar	

N

0 100 200 300 400m

Environmental Resources Management Australia Pty Ltd
53 Bonville Avenue, Thornton, NSW 2322
Telephone +61 2 4964 2150

ERM

6.7.3 Groundwater

Existing Conditions

The subsurface sands form an aquifer characterised by moderate to high transmissivity, previously estimated at 200m^2/day, which is present over much of the development site and over the SEPP 14 wetland area. Previous groundwater levels indicated shallow water tables are present over the site generally within 1 m of the surface and at the western limit of the SEPP 14 wetlands and Myall River, groundwater levels are within 0.5m of the ground surface.

Groundwater flow is south-east toward the Myall River and groundwater is relatively fresh in the main body of the sand aquifer. There is a secure town water supply well to the north of the area and currently groundwater is not used except for minor home irrigation.

The shallow rock levels to the north of the site provide a barrier to groundwater inflow from that direction. The sand aquifer is expected to extend to the south and west of the site and be in hydraulic contact with the waters of the Myall River to the south, Wobbegong Bay and Pindimar Bay (Port Stephens) to the south-west and Kore Kore Creek to the west.

During periods of low rainfall, losses from the groundwater system will occur due to seepage to the Myall River and evapotranspiration from areas of shallow water table. Evapotranspiration losses from the water table reduce with increasing depth of the water table in a non-linear fashion (CPI, 1996).

Rainfall infiltration forms the main groundwater recharge mechanism. Previous monitoring results from the bores over the site show marked groundwater level response to rainfall events.

The aquifer is in contact with saline water in the Myall River and also in contact with the brackish water in the lake in the south of the site. This results in the development of an interface between high quality fresh groundwater and saline water. The depth of the fresh/salt water interface is a function of the density difference between fresh and salt water and the height of the groundwater surface.

The final scheme involves the retention of the existing lake and three freshwater lakes. Evaporation from these lake extensions would be greater than evapotranspiration losses from the water table over a similar area. These increased evaporative losses are expected to be balanced in part by the reduced evapotranspiration losses that would accompany covering part of the ground surface for residential development.

Existing Groundwater Levels

Following groundwater monitoring undertaken by Martens and Associates in 2011 (refer to *Volume 3*), which is in addition to previous monitoring undertaken by Coffey Geotechnics in 2004 and 2007, and by Douglas and Partners in 1994, the following was concluded:

- groundwater levels are generally shallow (typically <1 m BGL);
- groundwater reached the surfaces at times at Groundwater Monitoring Bores (GMBs) 7 and 23 during the Martens and Associates (July, 2009) continuous data logging period;
- short-term groundwater level fluctuation is likely to typically be <1 m;
- lake levels are consistently lower than groundwater levels and therefore suggest that groundwater discharges to the existing lake; and
- groundwater response to rainfall appears to be relatively rapid and occurs within 1-2 days of incident rainfall. Groundwater responses appear more substantial at higher ground elevations (Martens, 2011).

Groundwater Quality

In 2007 Coffey Geotechnics concluded that laboratory results from the groundwater bores selected for analysis indicated that groundwater quality has not changed significantly since the last monitoring round in 2004. The 2004 report indicated that groundwater chemistry had not changed significantly since the groundwater quality monitoring undertaken in 1994/1995 (Coffey Geotechnics, 2007b).

Continuous monitoring of groundwater and lake EC concentrations was undertaken concurrently with groundwater level monitoring by Martens and Associates (July, 2009) for groundwater monitoring bore (GMB) 1A, 2A, 25 and 26 (lake). Results indicated that saline/brackish groundwater was not intruding from the lake to the local groundwater system.

Martens, 2011 concluded that:

- groundwater quality is not to a standard to meet a potable quality in accordance with the Australian Drinking Water Guidelines (NHMRC, 2004), primarily on the basis of acid levels, variable salinity and elevated concentrations of a range of analytes (Martens and Associates, 2009);
- the most significant beneficial uses for groundwater in some locations of the site are for irrigation and ecosystem maintenance (Coffey, 2007);

- the median EC and TDS concentration within the lake is higher than in GMBs and is indicative of saline water. This is expected as the invert level of the lake's drain is reported to be at an approximate elevation of 0.66 m AHD (Coffey, 2007);

- the median EC and TDS concentration within GMBs is indicative of fresh water; and

- monitoring data indicates that lake nutrient concentrations are lower than those observed in nearby GMBs.

Potential Impacts on Groundwater Levels

To assess the potential impacts of proposed development on groundwater levels a series of preliminary steady state groundwater models of the study area were developed by Martens and Associates. Modelling works extended a concept model previously prepared by Coffey, 2007 which was modified by Martens and Associates. Three steady-state conditions were assessed including current conditions; post-development conditions and post-development conditions under possible climate change.

Results indicate that groundwater levels are likely to be drawdown by approximately 0.05 to 0.1 m over the adjacent SEPP14 wetlands due to reductions to recharge in the area of the site which would be balanced by approximately 10 years of sea level rise. Changes to groundwater flow direction at the site boundaries and within adjoining wetlands are negligible.

Simulation results also indicate that sea level rise will lead to inundation of the majority of the SEPP14 wetland area adjacent to the site. Groundwater levels in the area of the site where development is proposed are modelled to increase by a maximum of 0.4 m.

Potential Groundwater Contamination Resulting from the Development

<u>Potential Impact of Runoff on Groundwater</u>

The planned development has the potential to impact on groundwater quality through the discharge of urban runoff into window lakes/ponds. Consequently the following stormwater quality objectives were adopted to avoid adverse impacts of runoff on groundwater quality:

- Nil or Beneficial Effect ie, no increase in the overall TSS, TP and TN exports to the Myall River (based on the performance targets identified in the Great Lakes Council Draft Water Sensitive Design DCP (Version 1.1, May 2010); and

- Mean TP and TN concentrations in discharges to window lakes/ponds to not exceed limits identified by Martens & Associates in November 2009, namely TN < 1.0 mg/L and TP < 0.2 mg/L ie. background groundwater quality.

The treatment train for stormwater discharging through the existing saline lake to the Myall River includes (refer *Section 6.7*):

- Gross Pollutant Traps (GPTs) if appropriate on outfalls from the commercial centre;
- Two lined wetlands (not in contact with the groundwater table) with a total surface area of around 1.4 ha;
- Additional point source subsurface biofiltration pits;
- Freshwater (window) recharge lakes with a combined surface area of around 3.5 ha;
- A 550 m long swale connecting the eastern arm of the freshwater lakes to the existing saline lake; and
- The existing saline lake with a surface area of around 6 ha. There is no direct link between the saltwater and freshwater lakes and the single existing drain outlet from the saline lake to the Myall River will not be upgraded or duplicated.

It was concluded from the water quality assessments that the proposed treatment train meets the stormwater quality objectives thereby protecting the quality of groundwater.

Aquatic Ecosystems

Groundwater quality results are generally below the key criteria for protection of species in marine water (90% protection) presented in the ANZECC (2000) guidelines, with the exception of some metal concentrations. Groundwater quality modelling indicates that the salt water interface would not be significantly affected by the development and groundwater level modelling indicates that there will be little impact within the wetland area.

Groundwater level changes resulting from the proposed development are assessed to be and 0.05 m to 0.1 m within the wetland area. Changes of this magnitude would be within the existing groundwater level variability and are therefore considered unlikely to adversely affect adjacent ecosystems.

Future Potable Water Source

Groundwater quality is not considered to be potable due to concentrations of a range of analytes exceeding the drinking water guidelines (ANZECC 2000). Groundwater in all bores and the surface water in the lake are acidic to

slightly acidic and below the criteria for drinking water of pH 6.5. Groundwater near the Myall River (including GMBs 21, 22, 24) has elevated levels of EC, anions and cations (due to the interaction of groundwater with seawater in this area) above the criteria for drinking water. Groundwater in GMBs 9, 21, 22 and 24 are not potable due to the concentration of ammonia exceeding the ANZECC (2000) guidelines.

The groundwater results indicate that it is generally select parameters, namely pH, ammonia and salinity (or TDS) that are limiting the potential use of the groundwater rather than a wide range of parameters. Consequently, some treatment of groundwater with respect to these parameters is likely to increase the potential uses of the groundwater across the site.

It is also noted that groundwater away from the Myall River tends to have greater potential usability, primarily due to lower salinity (or TDS) and lower concentrations of sodium and chloride.

Groundwater quality is such that treatment would be required to allow potable use given the limited extent of the aquifer and the constraints on usage rates which would need to be imposed to avoid saltwater intrusion and the impacts on wetland areas. Consequently, Coffey consider the groundwater resource unsuitable for development as a significant potable supply.

Irrigation of Recycled Water

There was a concern previously expressed regarding the potential re-use applications for recycled water from the sewerage treatment plant for irrigation and whether this would affect the health of the aquifer that lies below Riverside at Tea Gardens.

However, Martens 2011 (refer *Appendix F* of *Volume 3*) concludes that the demand for nutrients in garden areas alone far outstrips that which can be supplied by recycled water and as such the irrigation of recycled water is not expected to threaten groundwater quality.

6.7.4 Water Quality

Stormwater Quality Objectives

When formulating the final scheme (which is a modified version of the preliminary scheme without rainwater tanks which was amended in response to comments from the DP&I, the PAC and other authorities) consideration was given to the two following stormwater quality objectives:

- Nil or Beneficial Effect ie, no increase in the overall TSS, TP and TN exports to the Myall River (based on the performance targets identified in the Great Lakes Council Draft Water Sensitive Design DCP (Version 1.1, May 2010); and

- Median TP and TN concentrations in discharges to window lakes/ponds to not exceed limits identified by Martens & Associates in November 2009, namely TN < 1.0 mg/L and TP < 0.2 mg/L.

These objectives are compatible with the Director-General's Environmental Assessment Requirements for water cycle management.

Developed Conditions

Catchment water quality assessments of the planned development demonstrate that the preferred final water management scheme meets the stormwater quality objectives under current conditions and under possible climate change conditions.

The treatment train for stormwater discharging through the existing saline lake to the Myall River includes:

- GPTs if appropriate on outfalls from the commercial centre;
- two lined wetlands (not in contact with the groundwater table) with a total surface area of around 1.4 ha;
- freshwater (window) lakes with a combined surface area of around 3.5 ha;
- a 550 m long swale connecting the eastern arm of the freshwater lakes to the existing saline lake; and
- existing saline lake with a surface area of around 6 ha. There is no direct link between the saltwater and freshwater lakes and the single existing drain outlet from the saline lake to the Myall River will not be upgraded or duplicated.

A comparison of the saline lake under the final scheme with the saline lake under existing conditions concluded that:

(i) In the near term the lake will become less brackish due to the requirement that the existing outlet to the Myall River remains unchanged. In the longer term sea level rise and increasing tidal inflows will increase the salinity of the lake. In the event that a sea level rise of 0.9 m or greater occurs then the lake will become part of the Myall River and salinity levels would be expected to match the salinity of the Myall River;

(ii) The DO levels in bottom waters and DO saturation would improve slightly;

(iii) TP and TN concentrations would increase slightly;

(iv) Algal concentrations are comparable to existing conditions;

(v) Salinity and DO saturation remain within the ANZECC, 2000 range; and

(vi) TP, TN and algal concentrations remain under ANZECC, 2000 trigger values.

It was also noted that the freshwater lakes may experience algal blooms occasionally.

It was concluded from the results that under Developed Conditions:

- The export to the Myall River of TSS, TP and TN is reduced to that under Existing Conditions; and
- Median concentrations of TP and TN to the window lakes/ponds do not exceed the limits as set out by Martens & Associates.

It is also concluded that any decision on implementation of rainwater tanks would not impact on the ability of the development to meet stormwater quality objectives, as they can be met without rainwater tanks.

6.7.5 Potable Water, Recycled Water and Sewerage Servicing

Potable Water

The existing water supply for the area comes from the Tea Gardens aquifer six kilometres north of the site. Groundwater is pumped from the aquifer, treated and transferred to reservoirs prior to distribution. The existing capacity of the bore field is 8.6ML/d, which is identified to be augmented to 12.4ML/d in 2016 and 16.2ML/d in 2031 to meet future demands (Worley Parsons, 2010).

The water management objectives adopted in developing a potable water supply concept for the site include the following:

- minimise the potable water demand from the site by using water saving devices on fixtures and water efficient appliances;
- the use of third pipe alternative water supply connected to toilet flushing and hot water systems;
- retention of native vegetation and minimal use of turf to reduce irrigation requirements; and
- infrastructure to be designed with long term sustainability in mind.

Wastewater

The existing settlements of Tea Gardens and Hawks Nest are serviced by the Hawks Nest Waste Water Treatment Works (WWTW). The WWTW currently has limited capacity and will need to be augmented to accommodate additional flows.

The management objectives adopted in developing a servicing concept for the site include the following:

- minimise impacts on existing infrastructure by reducing sewage loads where possible;
- minimise impacts on receiving waters by designing optimal effluent management practices and minimising effluent discharge;
- reuse of treated effluent where possible and appropriate; and
- infrastructure to be designed with long term sustainability in mind. This will involve location of sewage systems with adequate buffer zones and flexibility for future expansion to meet potential augmentation requirements.

In 2010 Worley Parsons assessed the potable water, recycled water and sewerage servicing options for Riverside at Tea Gardens. The investigation considered the Riverside at Tea Gardens development together with the entire catchment to be serviced by the Hawks Nest Sewage Treatment Plant. In particular, the three new developments: Riverside at Tea Gardens, Myall River Downs and North Shearwater, were considered. The assessment of the potable water, recycled water and sewerage servicing options for Riverside at Tea Gardens is outlined in *Section 6.3.1*.

6.7.6 Management, Maintenance and Monitoring

The management of aquatic weeds in constructed pond and wetland systems will be based on the practices already implemented for existing ponds and wetlands located within developed areas of the Riverside estate and the Myall River Downs estate. A monitoring program is proposed for the SEPP 14 wetlands and constructed ponds and wetlands. The management actions proposed to rectify any failures to meet the water quality objectives are also identified.

6.7.7 Architectural and Landscape Treatment

In addition to the environmental performance of the proposed system, a number of opportunities are presented with regard to visual and physical interaction with the system that intelligent architectural and landscape design can capitalise upon, such as foreshore parks, walkways, cycleways, placement of public buildings etc. The internalisation of the water management system and the unfettered public access which is proposed to be provided to all new water bodies and detention basins will ensure ongoing adoption of maintenance regimes due to the surveillance and public amenity that the system provides. This maintenance discipline has been proven to date, even though the existing lake does not enjoy the same level of public visibility (due to site layout) as the design currently proposed. Detailed water quality data

collected since 1996 has demonstrated the effective performance of the existing water management system, which is similar to that proposed for the planned development.

6.8 HERITAGE AND ARCHAEOLOGY

An Aboriginal Heritage Assessment (the Assessment) was undertaken by ERM (2011a) (refer to *Volume 5*), which addressed the OEH Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation. The assessment identified that the majority of the site was cleared in 1932 for a pine plantation which was burned in 1979 and not maintained (ERM, 2011a).

6.8.1 AHIMS Database Search

A desktop analysis of the Aboriginal Heritage Information Management System (AHIMS) Aboriginal Site Database located 31 significant sites within the search area which included the Riverside site and surrounding areas. One midden site (NPWS 38-5-148) was identified within the Riverside site area and two (2) middens sites were identified 300 metres to the south of the site. The remaining significant sites were located more than 1.5 km from the Riverside site scattered throughout the Port Stephens catchment. A strip of wetland area along the Myall River and a small area in the north eastern corner of the site were also identified as potential archaeological sites.

6.8.2 Previous Surveys

Archaeological surveys carried out by Dallas (1982) and Brayshaw McDonald Pty Ltd (1987) identified an archaeological site, which incorporated four occurrences of shell midden within a 220 metre by 40 metre strip along the bank of the Myall River (Gardner Brown Planning Consultants et al, 1991). This was recorded as NPWS 38-5-148 in the Kinhill 1994 report and is shown in Figure 4.1 of the *Aboriginal Heritage Assessment*, (ERM, 2011) incorporated in *Volume 5.* It was previously assessed by Brayshaw (1988) as having high archaeological significance and recommended for protection (Kinhill, 1994).

This archaeological site will not be impacted by the proposal as it is located within the SEPP 14 Wetlands, which will not be subject to development. As this site is not to be disturbed no further assessment was completed as part of this EA.

Two other sites (NPWS Site No 38 – 5- 76 and NPWS Site No 38-5-147) were previously identified and investigated as part of the 'Myall Quays' development, immediately south of the site (Kinhill, 1994). These sites are located in the Myall Quays development and outside the concept plan area.

6.8.3 Consultation

DECC released an Interim Community Consultation Requirements Guideline (2004) for Aboriginal consultation in relation to any study area that might eventually be used to support an application under *Part 6* of the *National Parks and Wildlife Act 1974* (ERM, 2011a). In accordance with the Interim Guideline ERM invited Aboriginal groups to register as a party to the consultation process.

A letter requesting advice from Aboriginal groups regarding any known heritage issues was sent on the 4 May, 2007 to the DECC, Registrar of Aboriginal Land Rights Act 1983 (NSW), Great Lakes Council and Karuah Local Aboriginal Land Council (KLALC). DECC and the Registrar identified additional groups which were included in the consultation process.

A local press advertisement was placed in the Myall Coast Nota newspaper on the 10 May, 2007 inviting any Aboriginal groups to be involved in the consultation process. One response to the advertisement was received and included in the consultation process.

A search of the Native Title Tribunal website on the 4 May, 2007 failed to reveal any active claimant applications in the study area.

A total of three responses were received from KLALC, a private individual and the Interim Board of Management for Worimi Conservation Lands. Maaiangal Cultural & Heritage identified the study area as being outside their area of interest.

The three parties that registered an interest were provided with a proposed desktop assessment methodology in June 2007 and a survey methodology in March 2008. Verbal responses to these methodologies were received from KLALC and the private person, each indicating their agreement. Field survey was undertaken in accordance with the agreed methodology on Monday 21 April 2008 with two representatives of the KLALC.

The consultation process is detailed in Annex A of the Aboriginal Heritage Assessment (refer to *Volume 5*). A copy of the Aboriginal Heritage Assessment was sent to the registered Aboriginal parties for comment on the content and recommendations. This review process is appended to the Aboriginal Heritage Assessment Report.

6.8.4 ERM Aboriginal Heritage Assessment 2008

The field investigations undertaken on 21 April 2008 recorded one new midden site located on a sand dune in close proximity to the SEPP 14 wetland and wetland buffer within the proposed tourist precinct (refer to *Figure 5.3* of the Aboriginal Heritage Assessment Report (ERM, 2011) in *Volume 5*). The midden is located within a paddock and shows signs of disturbance (broken shells on the surface). Given the level of disturbance, this midden is considered to have moderate significance only. Further investigations would be required to confirm the extent, depth and contents of this site should development be proposed within 10 metres of its current extent.

Given the potential depth of deposit and the range of shell species represented (cockle, oyster, whelk and pipi) within the midden site previously identified by Brayshaw McDonald (1988) (site 38-05-0148), the site is recognised as having high archaeological significance. Given its location within a protected SEPP 14 wetland it is likely to continue to survive with only minimal disturbance, which further emphasises its significance within the region (Brayshaw McDonald, 1988).

Neither the newly identified midden nor that previously recorded by Brayshaw McDonald (1988) will be directly impacted by the proposed development, however ancillary or indirect impacts may occur. Alterations to drainage patterns could accelerate erosion of the deposits and greater visitation (on foot and vehicular) may cause damage or erosion. To ensure that indirect impacts do not damage the middens (in particular the recently identified midden located within the proposed tourist precinct, 'Riverside_01', the following recommendations will be implemented on site:

- Riverside_01 is to be protected on all sides by a minimum 10 metre buffer. No construction/excavation works, including the storage of machinery can impinge on this buffer zone;
- a management plan will be developed in consultation with the local Aboriginal community to consider its significance and treatment within the site. This management plan may include the use of fencing, designated walkways and interpretive signage at Riverside_01 as an educational resource;
- if the current development plan is amended, further subsurface investigation may be required to further assess the significance of the sites;
- based on the location of site 38-05-0148 (Brayshaw McDonald, 1988) within the protected SEPP 14 Wetland and associated adjacent conservation zone, no further protection measures are required;
- while there was limited visibility over the whole site, no further survey work is recommended. However, if the concept plan is amended, subsurface investigation may be required to further assess the significance of the sites;

- monitoring of clearing and initial excavation works across the whole site should be undertaken by the Karuah LALC;
- if during clearing or construction works Aboriginal artefacts are recovered an immediate stop work protocol should be in place in the immediate vicinity of the artefact. A qualified archaeologist should at this time be contacted and the site recorded. Once recording has occurred any salvage can be undertaken and works (with minimal disruption) can continue; and
- a suitable area should be set aside for the possible containment of any cultural heritage material that is uncovered during the construction works. This dedicated 'keeping place' would only be required in the event that material is uncovered and would be under the care and control of the local Aboriginal community.

In the unlikely event of discovery of skeletal material all works should cease, and the police, relevant local Aboriginal community groups and a suitably experienced archaeologist or physical anthropologist should be contacted to assess the material before determining the correct management action. Works should not resume until the Police and/or DECC have given authority in writing and approved a management plan.

6.8.5 DECC Comments 2008

In correspondence dated 19 December 2008, DECC provided the following comments associated with the heritage component of the Environmental Assessment:

- *"Further field assessment, which appropriately samples all landscape unit not assessed to date to determine the significance of the ACH values of the site and to justify proposed mitigation measures;*
- *A comprehensive survey of the identified Potential Archaeological Deposit (PAD) area and similar landform units in the south of the development area;*
- *Demonstration of how the community have been consulted in relation to field assessment methodology and general correspondence;*
- *Adherence to statutory requirements under the National Parks and Wildlife Act 1974; and*
- *Additional justification for the buffer size around Midden site 38-5-148 and provision within the EA of details of the on-going conservation for this midden."*

These points have been taken into consideration for the 2009 fieldwork.