For consistency across assessments, TPK adopted the following factors sourced from the Better Transport Futures Traffic Impact Assessment that accompanied the Project Approval on the adjoining land:

- 1400vph mid block capacity; and
- 4% background growth on Tomago Road.

TPK confirmed that the area of influence for the traffic assessment is contained between the site and west to the Pacific Highway intersection.

TPK provided the following calculation of traffic demands adopted for the Stage 1 to Stage 4 developable areas:

ITEM	ADOPTED VALUE	
Total Developable Area for: Stage 1 (S1) Stage 2 (S2) Stage 3 (S3) Stage 4 (S4)	142ha – 1,420,000m^2 43.9ha – 438,842m^2 26.7ha – 267,162m^2 28.8ha – 287,783m^2 42.6ha – 425,920m^2	
35% for GFA Stage 1 (S1) Stage 2 (S2) Stage 3 (S3) Stage 4 (S4)	 153,595m^2 93,507m^2 100,724m^2 149,072m^2	
	AM PEAK (Peak into site)	PM PEAK (Peak into site)
0.33 trips per 100m^2 GFA – S1 0.33 trips per 100m^2 GFA – S2 0.33 trips per 100m^2 GFA – S3 0.33 trips per 100m^2 GFA – S4	507 Trips 309 Trips 332 Trips 492 Trips	507 Trips 309 Trips 332 Trips 492 Trips
Peak split 70:30 – S1 Peak split 70:30 – S2 Peak split 70:30 – S3 Peak split 70:30 – S4	354:153 216:93 232:100 344:148	354:153 216:93 232:100 344:148
85% to Pacific Hwy – S1 85% to Pacific Hwy – S2 85% to Pacific Hwy – S3 85% to Pacific Hwy – S4	301:53 – 130:23 184:32 – 79:14 197:35 – 85:15 292:52 – 126:22	301:53 – 130:23 184:32 – 79:14 197:35 – 85:15 292:52 – 126:22

Note: Total Developable Area excludes roads.

Traffic will ultimately have the option to enter and exit the Northbank Enterprise Hub at three intersections:

- Tomago Road and site access road – Access East. This intersection formed part of the approval of the adjacent land to the north (Project Approval 07_0086). This intersection is soon to be constructed.

- Tomago Road and site access road – Access Central.

- Tomago Road and site access road – Access Western.

The assessment of intersection capacity considered the following scenarios and the range of implications when other potential outcomes may delay or accelerate the need for the construction of the Central and Western intersections:

- Eastern Intersection – Existing traffic conditions plus the approved adjoining WesTrac Industrial Subdivision; termed WT1 & WT2 in this assessment plus S1 & S2.
- Central Intersection – Existing traffic conditions plus the approved adjoining WesTrac Industrial Subdivision; termed WT1 & WT2 in this assessment plus S1, S2 & S3.
- Western Intersection – Existing traffic conditions plus the approved adjoining WesTrac Industrial Subdivision; termed WT1 & WT2 in this assessment plus S1 to S4.

Approved Eastern intersection (Tomago Road and Site Access) (Westrac Drive)

The intersection had detailed traffic analysis completed by Better Transport Futures in their 2009 report as part of the Project Application documentation for the approved adjoining WesTrac facility and industrial subdivision (WT1 and WT2). The analysis and recommendations have not changed and are valid for this assessment covering Lot 1001 (S1 – S4).

The approved intersection layout for adjoining WesTrac Industrial Subdivision is a channelized T-Junction that includes right turn and left turn lanes on Tomago Road; basically a CHR Geometric Layout. The intersection as approved has been conditioned for review prior to WesTrac Stages 2 & 3 to determine the timing for the required intersection upgrade to a traffic signal controlled intersection.

The Better Transport Futures analysis included SIDRA modelling for a fully developed site for a base year 2019. The Level of Service, Queue and Delay factors indicated in both peak periods of their SIDRA modelling were acceptable in terms of intersection capacity.

The terms of development consent are consistent with that roadwork staging approach however it is noted that the T-Junction stage will not proceed and in fact the traffic signal controlled layout at Stage 1 (WT1) is currently under construction.

The question of additional loading to this intersection by the proposed estate expansion (say S1) is a valid inquiry. The key questions that will determine the answer are:

- Has the approved WesTrac Industrial Subdivision (WT1 & WT2) precinct reached its maximum potential in terms of traffic demand?

- Is that traffic demand in excess of the Better Transport Futures Report 2009 expectations in terms of over traffic demand?

The projected traffic generation, including construction traffic, will be reviewed prior to each stage being developed. This will include review of actual traffic generations from the WesTrac

Industrial Subdivision. If these traffic flows when analysed indicate that the eastern intersection (WesTrac Drive) will not have capacity for Stage 1 development (S1), then an additional intersection (ie. the central intersection) on Tomago Road will be required as part of the Stage 1 works. In the absence of this information TPK tested the following scenario:

- The year is 2020;
- 4% per annum has been applied to the 2010 Tomago Road through traffic;
- WT1 & WT2 are fully developed and the potential traffic generations assumed to be indicative; and
- S1 traffic is added to the intersection.

Note: In relation to year 2020 reference above, it is noted that adoption of 2022 was a request from RMS during the March 2012 adequacy review undertaken. The October 2011 TPK Traffic Impact Assessment (**Appendix L**) previously adopted a 2020 future year scenario. The TPK addendum report (**Appendix L**) rerun the central and western intersection modelling based on the 2022 scenario (the findings are discussed below). TPK found that given the results of the model rerun for the western intersection (which is subject to higher traffic volumes and has the same geometric layout as the eastern intersection (Westrac Drive)) disclosed no additional impacts for the extra two (2) years growth TPK concluded there is no necessity to rerun the Eastern Intersection (Westrac Drive) model at year 2022).

SIDRA modelling was undertaken for the am peak of the above scenario. The outcome based on these standard assumptions indicates that the intersection constructed for the WesTrac development and associated land use (WT1 & WT2) will not have the capacity to manage additional traffic demands from any stages of the development site under consideration in this report. Consequently review of existing traffic generation and analysis at the actual time of proceeding to S1 is the recommended approach to any decision on the construction of the central intersection.

Figure 29 below shows the SIDRA geometric layout for the Eastern intersection (Westrac Drive).

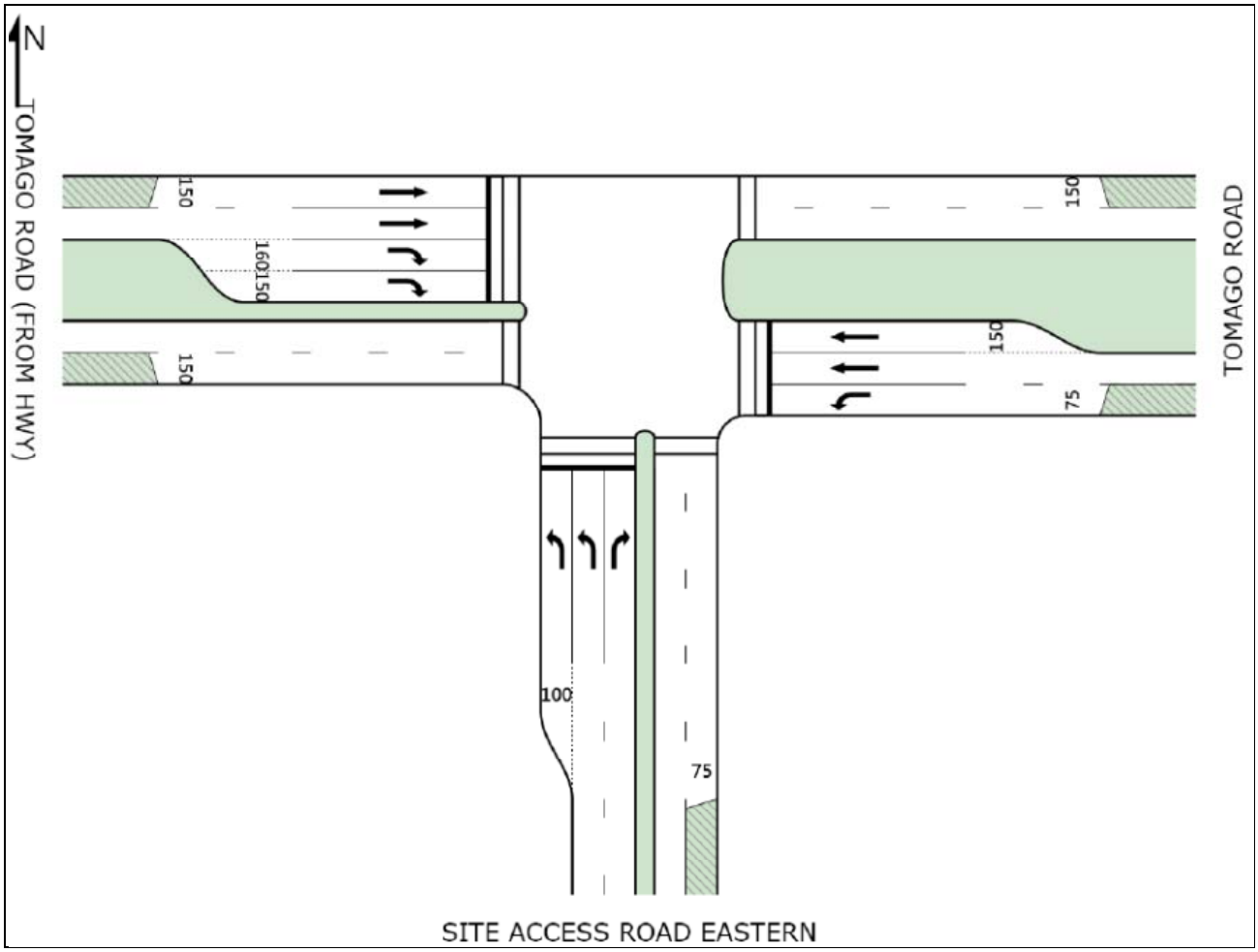

Figure 29 - SIDRA Geometric Layout, Eastern Intersection (WesTrac Drive).

Proposed Central Intersection (Tomago Road and Site Access)

The intersection is proposed at a location that allows the existing Campbell Road intersection, on the northern side of Tomago Road to be incorporated into the intersection forming a cross section.

Construction of this intersection will be a requirement before occupation by any of the subject development sites end land users but only in the event that WT1 & WT2 are fully developed.

The opportunity remains for site management to review the actual traffic generations of WT1 & WT2 when commencing development of the subject site for S1 to determine if actual generations were less than calculated generations and undertake modelling for capacity at that time.

Capacity analysis, at interim stages may confirm a short term use of the Eastern intersection feasible however the Eastern intersection would not be able to manage all potential demands for the precincts WT1, WT2 & S1 at full development; the Central intersection is the logical next access as growth in these sites occur.

The recommended form of control for the ultimate traffic demands is for a traffic signal controlled intersection, especially as it is proposed to incorporate Campbell Street as the fourth leg of the intersection forming a cross intersection.

TPK undertook SIDRA modelling for the predicted intersection traffic demands of S1 & S2 based on:

- WT1 & WT2 fully developed;
- S1 and S2 fully developed;
- Both of the above precincts are generated the predicted traffic demand;
- 10 years Background growth (year 2022 was adopted) on Tomago Road general traffic at 4%; and
- Indicative traffic demands for Campbell Street.

The central intersection provides sufficient capacity to allow for an exclusive right turn phase on the side streets (see Figure 30 below).

The outcome of the SIDRA modelling indicated that under the above scenario the central intersection will be approaching saturation in the peak periods. The need to monitor this intersection if the adopted traffic generations do eventuate will be a requirement by RMS.

Figure 30 below shows the SIDRA geometric layout for the Central intersection.

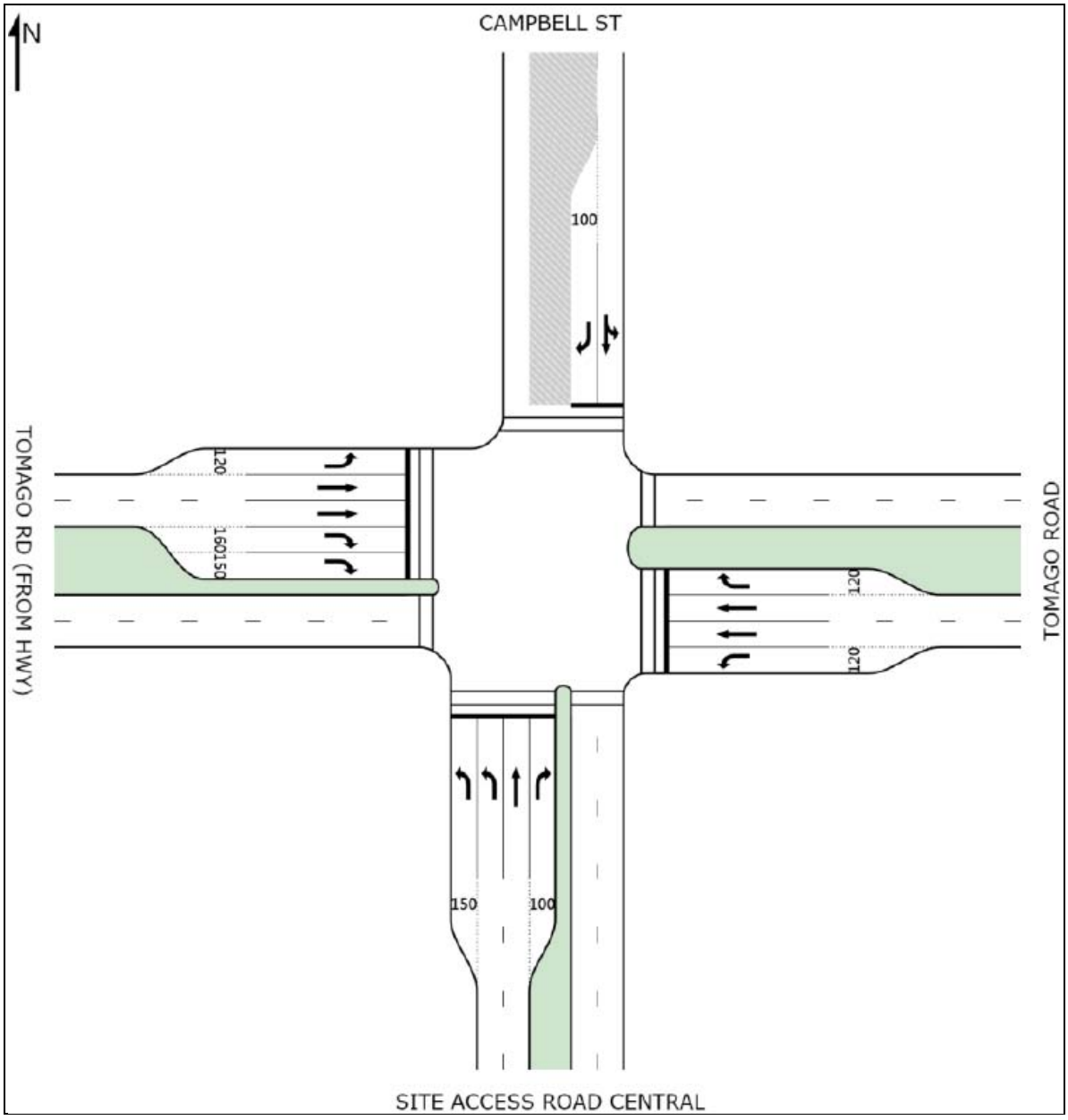

Figure 30 - SIDRA Geometric Layout, Central Intersection.

Proposed Western Intersection (Tomago Road and Site Access)

The location of the Western site access intersection is proposed in a location to connect the internal road loop. The internal layout is designed to ensure that site access in the ultimate is spread over the three access intersections and does not subject this intersection to overload due to internal rat running by traffic at the eastern end of the site.

The timing of construction of this intersection will be driven by:

- Any staging or full development of S3 or S4; and

- Any consideration of connection to S3 or S4 via the central intersection where analysis indicates the Tomago Road & Site Access Road Central cannot manage the increase in traffic demand.

The consideration for staging of S3 or S4 prior to S1 or S2 stages would generate the requirement for a Western Intersection. There may be potential for that to be an interim intersection layout dependant on the timing and existing traffic demands at that time.

The recommended form of control for the ultimate traffic demands is for a traffic signal controlled intersection. This form of traffic management:

- Is seen as a logical extension to the control proposed for the two site access intersections to the east as it can enhance the capacity and performance of Tomago Road through co-ordination of the three traffic signal sites; and

- Traffic Signal Control can also offer acceptable access to Tomago Road in both directions hence reducing the potential for rat running within the broader Industrial Site WT1 to WT4.

TPK undertook SIDRA modelling for the ultimate intersection requirements based on:

- WT1 & WT2 fully developed;

- S1 & S2 fully developed; and

- 10 years Background growth (year 2022 was adopted) on Tomago Road general traffic at 4%.

The outcome of the SIDRA modelling indicates that the western intersection can provide acceptable traffic management for the modelled scenario.

Figure 31 below shows the SIDRA geometric layout for the Western intersection.

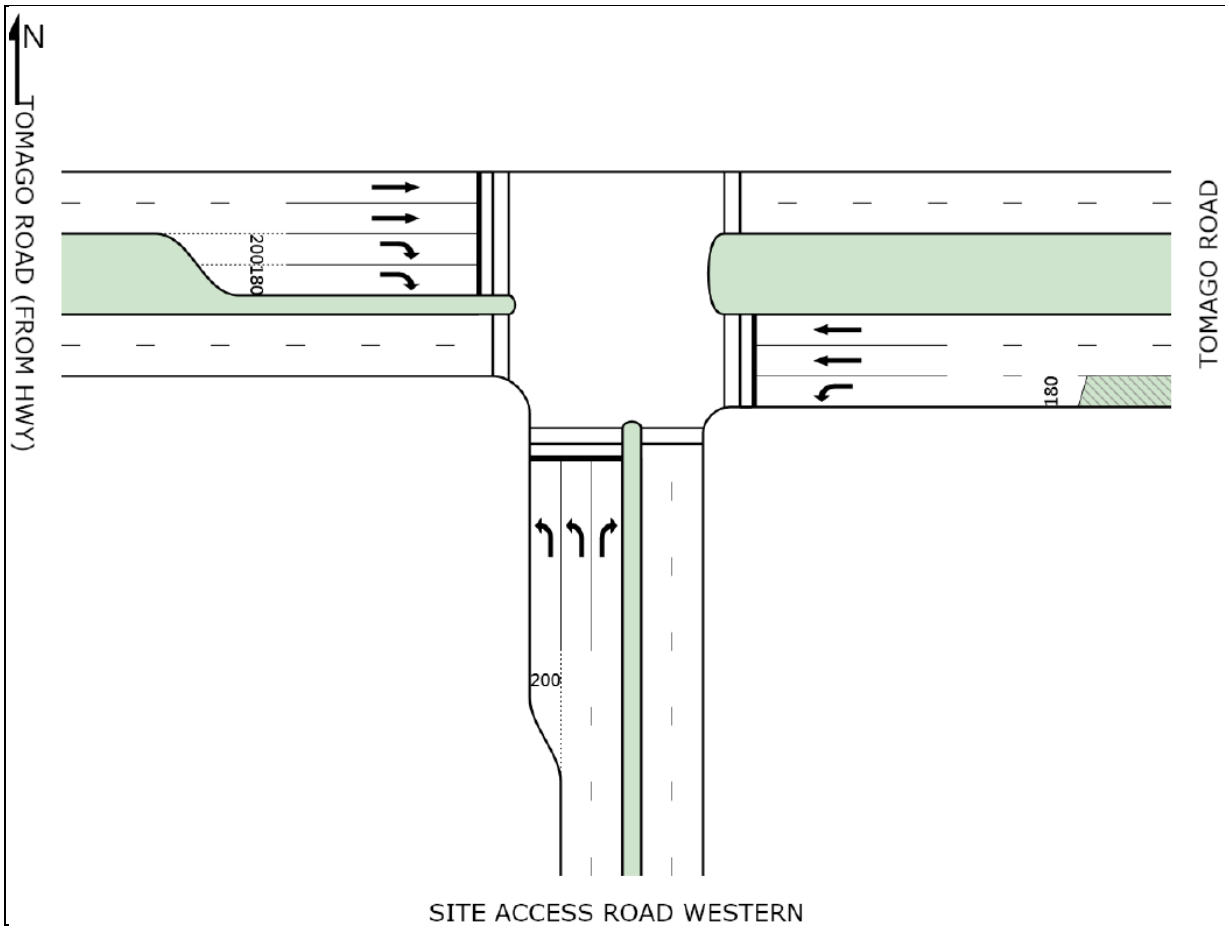

Figure 31 - SIDRA Geometric Model, Western Intersection.

During the March 2012 Adequacy Review, the RMS confirmed that *the western intersection shall be realigned opposite McIntyre Road (eastern occurrence) to allow flexibility in making possible future connection to McIntyre Road as a fourth leg to the intersection'.* This has been discussed with Mr David Young of the RMS Newcastle Office, and advice was given that Newcastle RMS is giving further consideration to this matter. Mr Young indicated that at this time, the Project Application and TPK Traffic Assessment should continue to support the current proposed location and 'T junction' intersection as proposed.

Summary of Intersections

The Traffic Impact Assessment provides the following summary of the three access intersections for the Northbank Enterprise Hub:

- The SIDRA modelling for the revised traffic generations provides a number of indicators for both the accesses to the subject site and the integration of the WesTrac and the proposed development site into the Tomago Road traffic strategy of the RMS; the main indicators are:

    1. The traffic generation rates provided by RMS have been applied to the models for the three (3) proposed access intersections; the outcomes suggest that traffic can be managed in the peaks under two lane traffic flows in each direction plus appropriate auxiliary lanes at each intersection providing access to both sites.

2. The Node Traffic Demands calculated indicate that introduction of additional traffic flows in excess of a fully developed WT1 & WT2 will generate the need to implement the two lane flow for through traffic.

3. The RMS has confirmed that it will be the RMS's accountability to manage and plan the progressive upgrade of Tomago Road. The TPK & Associates traffic assessment was only required to provide analysis for the 3 access intersections proposed to the subject site. The SIDRA Movement Summaries for the Central Intersection when viewed against the Eastern & Western Intersections would suggest that the inclusion of the existing Campbell Street into the proposed signalised intersection may have an unbalancing effect on intersection performance and SCATS co-ordination. That impact has been raised for RMS consideration in planning the Tomago Road strategy for overall access by all land use precincts.

4. This assessment has provided SIDRA analysis in a development sequential order of WT1, WT2 followed by S1 to S4.

   The report confirms that any plan to implement a further stage beyond WT1 & WT2 should include a review of the actual traffic generations at that time of occupied precincts of WT1 & WT2 benchmarked against the traffic generation rates adopted in the Better Transport Futures analysis. The benchmarking will allow reconsideration of the traffic generation rate for new stages to establish realistic measures and ensure greater confidence in the detailed planning for the route and intersections and also the scheduling of the central and/or western intersections to meet capacity requirements.

In relation to construction traffic, the reporting confirms that Stages 1 to 4 will generate two construction traffic considerations:

1. The delivery of fill to the site; and

2. Staff and deliveries to establish the road, servicing and lot construction.

The fill delivery will be provided by truck & dog vehicular classification to maximise loads. The truck activity will occur irregularly during each stage construction phase as fill is required. The fill process is not a daily constant and would generate up to 50 trucks per day over the business week working period of 6am to 6pm. At this in-fill time there will be minimal staff (up to 10) on site.

The establishment of the road, servicing and lot phase of construction will generate a greater level of on-site staff; during any one stage of construction the staff level could reach 50 persons generating trips in the peak periods plus the business hours delivery traffic generating trips spread over the working day.

For this assessment the TIA adopted the position that the Eastern Intersection is established therefore for any given stage of development (S1 to S4) the optimum site access to the construction zone could be:

1. Utilise an existing signalised intersection that provides acceptable access in terms of intersection capacity, impact on existing land use and/or suitability to mix existing land use and construction traffic.
2. Provide a dedicated construction area access intersection off Tomago Road.

The TIA outlined an example process to determine the preferred access for construction:

1. It is planned to commence S1.

2. The Eastern Intersection is not at full traffic load as land use within WT1 & WT2 has not become fully occupied and operational.

3. Modelling of the Eastern Intersection under the traffic demands at that time plus construction traffic confirms capacity.

4. The mix of existing land use traffic and construction traffic is not deemed unsafe.

5. S1 Construction Traffic approved to use the Eastern Intersection.

OR

1. Modelling of the Eastern Intersection under the traffic demands at that time plus construction traffic indicates unacceptable capacity and/or the mix of land use and construction traffic is not agreed to.

2. S1 Construction Traffic generates the requirement for Central Intersection or an interim derivation thereof.

The reporting confirms that the philosophy in the above steps can be applied to any stage of construction from S1 through to S4. As the key to the approved choice can be very dependent on operating conditions at an existing intersection TPK concluded that SIDRA analysis of potential scenarios would be of little value at this point in time.

The Traffic Assessment Report by TPK & Associates made the following conclusions:

1. The intersection and route capacity for Tomago Road west of the approved Eastern site access intersection could require a theoretical min – block capacity of 4 lanes at full development of the site.

2. The capacity needs are driven by many factors that must occur for the potential capacity requirements identified to eventuate. Of most significance are:

    a. The predicted areas of developable land adopted for this assessment are achieved.

    b. The traffic generation rates required by RMS for this site assessment eventuate.

c. The Tomago Road background growth of 4% per annum eventuates.

3. The subject site does not have a detailed staging strategy at this time and it may be a fact that the development timeframe, to full levels in all precincts exceeds a time period that is reasonable for traffic assessments made at this time to be adopted with confidence for the more detailed levels of traffic management such as ultimate auxiliary lane lengths.

4. It is unreasonable to have an expectation for detailed prediction of road network needs for expansive precincts of this nature when large areas have the potential to be taken up and by nature of their business footprint actually generate traffic levels well under the traffic generation rates adopted in these wide scope assessments.

5. The Tomago Road route also has a traffic function for the wider and nearby land uses; the overview and strategies for managing the long term needs can be established in concept form given the indicators from this assessment. It is suggested that there is a need for road authorities to establish in their strategies:

    a. A target road reserve area that ensures capacity can be managed.

    b. The potential for a future need to divert precincts traffic generations off Tomago Road to other routes to balance road network demand.

    c. That the upgrade of the Pacific Highway from F3 to Raymond Terrace considers the need for high standard connectivity to the high traffic demand precincts around Tomago.

6.11 INFRASTRUCTURE

The Northbank (Lot 1001) site lies adjacent to development lands with an existing Part 3A Approval 07_0086 & EPBC Approval 2007/3343. Stage 1 of the existing approval on the adjoining lands has been developed for a WesTrac Facility, recently completed. There are several large infrastructure works associated with the WesTrac Facility and the future development of the existing Part 3A approval. These infrastructure requirements overlap with the future infrastructure servicing requirements of the proposed Northbank (Lot 1001) development.

An Infrastructure Servicing Report has been prepared by ADW Johnson for the Northbank Enterprise Hub (Lot 1001) development (see **Appendix I**). The report addresses the Director General's requirements for the development and demonstrates that the infrastructure requirements as outlined have been met. The proposed staging of the Northbank (Lot 1001) development has been nominated as four (4) stages, but ultimately this will be market driven.

The infrastructure servicing requirements addressed include potable water, wastewater, electrical, gas and telecommunications, fill and intersections. Concept engineering drawings for concept site grading are also presented in the report. A summary of each of the items is presented below and an Infrastructure Servicing plan is provided in Figure 32 below.

1. Potable Water - Northbank (Lot 1001) will be connected to the Hunter Water Corporation's (HWC) regional potable water system. The area surrounding the Northbank (Lot 1001) development is currently serviced by the Tomago Water Pump Station (WPS) with back feed from the North Lambton Reservoir. A number of water mains currently run along the frontage of the site within Tomago Road. Hunter Water Corporation advised that the Northbank (Lot 1001) development will be able to connect into the existing DN 200CICL and DN 500CICL mains. The water servicing strategy was developed by ADW Johnson and approved by HWC. The water mains that the Northbank (Lot 1001) development will connect to are currently being constructed as part of the WesTrac development.

2. Wastewater – Northbank (Lot 1001) will be connected to the HWC's regional wastewater system. The Wastewater Servicing Strategy prepared by ADW Johnson was approved by HWC. Additionally a Deed of Agreement was signed between the client and HWC in regard to capacity available. The Northbank (Lot 1001) development will be serviced by a low pressure system that connects to the recently completed wastewater pump station (Tomago 2 WWPS) and pressure main currently being constructed as part of the WesTrac development. These works will form part of the HWC Williamtown to Raymond Terrace Wastewater Transfer Scheme. Under the Deed of Agreement HWC will ensure that at all times adequate facilities are in place to process discharge from the full Northbank landholding including Northbank (Lot 1001). Hunter Water's stringent emergency storage requirements will be satisfied by developing emergency storage both at the Tomago 2 WWPS as well as at each private pumping unit. Further details on emergency storage can be found in Section 4 of the Infrastructure Servicing Report.

3. Electrical - Preliminary electrical servicing investigations have been made with Ausgrid for the Northbank (Lot 1001) development. Ausgrid has recently completed a Zone Substation opposite Tomago House. This Zone Substation is necessary to service any sizeable stage proposed within the Northbank (Lot 1001) development. ADW Johnson is continuing to keep Ausgrid updated with milestones of the development so as to ensure that there is sufficient planning allocation made for capacity in the Ausgrid system.

4. Telecommunications - There is both existing optical fibre and local servicing telecommunication reticulation in Tomago Road available for extension into the Northbank (Lot 1001) development. ADW Johnson has been working closely with Telstra in provision of telecommunications into the WesTrac development. These works are currently under construction.

5. Gas – It is understood that there is capacity in the existing gas network adjoining the property with both primary and secondary mains in the vicinity. Provision is made in the typical road cross sections servicing the development for provision of gas servicing. If anchor tenants are known along with their gas demands, Jemena will consider, on merits, funding the infrastructure.

6. Fill – The elevation of the site indicates that significant quantities of fill are required for the development to have freeboard above the 1:100 year ARI flood level of the Hunter River. Concept civil design indicates that approximately 3.7 million cubic metres of fill will be required for development of the full Northbank (Lot 1001) development site. There are

several sources of fill in the area that can be utilised as stages of the development proceed including 'Macka's Sand' at Salt Ash which was used as a source of fill for the WesTrac development.

7. Intersections – A Traffic Assessment Report has been prepared by TPK and Associates (refer Section 6.10 of this EA Report). The report contains details of the projected traffic generation and assessment of the existing street network resulting from background growth rates and the development of Northbank. The Traffic Assessment Report also contains details on the three new signalised intersections with Tomago Road. The Eastern intersection (Westrac Drive), was recently completed to service the existing Part 3A approval 07_0086. The projected traffic generation, including construction traffic, will be reviewed prior to each stage being developed to assess existing intersection capacity and proposed intersection requirements for adequate access to Tomago Road.

8. Staging/Timing Issues & Maintenance Aspects - Actual staging of the site development will be market driven. Thus it is only possible at this time to give a broad outline of infrastructure staging/timing issues and maintenance aspects for the various infrastructure servicing elements. These are addressed in Section 11 - Table 1 of the Infrastructure Servicing Report (see **Appendix H**), which is supplied as Table 6 below.

The DGR's for infrastructure servicing have been met and there is adequate provisioning being made for the development of the Northbank Enterprise Hub.

Table 6 - Infrastructure Summary Plus Staging / Timing Issues

ELEMENT	AVAILABLE CAPACITY AND STRATEGY	FUNDING ISSUES	STAGING/TIMING ISSUES	MAINTENANCE
Potable Water	Water servicing strategy approved by HWC for combined sites (Northbank (Lot 1001) & MP07-0086 Project Approval Area). Network system design provides very good redundancy.	$ 10 million total for both sites – paid by proponent.	Able to connect to existing mains. Lead in mains into approved MP07_0086 site. Northbank (Lot 1001) connection depends on market demands.	Standard maintenance regimes by HWC for watermains in roads.
Wastewater	Northbank (Lot 1001) not currently serviced by HWC regional wastewater system. HWC developing Williamtown-Raymond Terrace wastewater transfer scheme. This caters for Northbank (Lot 1001) and MP07-0086 Project Approval Area. Leg B construction completed	By HWC, proponent to fund & build Leg B connection to system which is now completed. $20 million cost for proponent.	HWC to accept wastewater flows on completion of Leg B. Caters for full development of Northbank (Lot 1001) and MP07-0086 Project Approval Area. Pump Stns build sequencing depends on market demands. Adjustments possible subject to anchor tenant needs. Provision	Standard HWC practices – new system will be extension of HWC regional network.

ELEMENT	AVAILABLE CAPACITY AND STRATEGY	FUNDING ISSUES	STAGING/TIMING ISSUES	MAINTENANCE
			made in Leg B for extension into Northbank (Lot 1001).	
Electrical	Ausgrid has built Zone Substation opposite Tomago House which services substantial development area of Northbank (Lot 1001). ADW Johnson regularly appraise Ausgrid on development milestones to ensure sufficient allocation of capacity in system is made.	132kv relocation funded by proponent. Ausgrid servicing into development is funded by the proponent.	Ausgrid estimate further upgrade in 15-25 years, depends on rate of development of Northbank (Lot 1001) and other Tomago areas – market driven. Proponent to make standard provisioning in site roads. 132kv line through site to be relocated to Tomago Rd frontage – will not service site. Zone substation currently ready.	Standard public road access and easements for Ausgrid maintenance of reticulation and sub-transmission lines respectively.
Gas	Adequate capacity with primary and secondary mains in area.	Reticulation cost borne by proponent. Jemena may fund where anchor tenants & gas demand is cost effective.	Proponent to make standard provisioning in site roads for extension into site.	No specific issues. Installation into public roads for standard access by Jemena.
Telecoms	Optical fibre and local servicing reticulation exist in Tomago Road. No capacity issues expected for Northbank (Lot 1001), and standard negotiation with Telstra to be held later in development process. Telstra extended into MP07-0086 Project Approval Area site.	Design and costs yet to be assessed.	No specific issues.	No specific issues. Installation into public roads for standard access by Telstra or its representatives.
Fill	Several sources of fill in area to satisfy 3.7 million m^3 requirement. For MP07-0086 Project Approval Area Macka's Sand at Saltash used.	Preliminary design and costing have been completed.	Several sources available to satisfy site filling, noting that development to proceed market driven stages. Refer concept engineering drawings in Appendix H.	No specific issues. Standard erosion and sediment control issues.

ELEMENT	AVAILABLE CAPACITY AND STRATEGY	FUNDING ISSUES	STAGING/TIMING ISSUES	MAINTENANCE
Intersections	3 proposed signalised intersections for access to Tomago Road from Northbank (Lot 1001). One intersection currently constructed under approval MP07_0086.	Intersection works funded by the proponent. Opportunity for RTA contribution.	Eastern most signalised intersection capacity to be assessed for Stage 1. Central signalised intersection may be required for access to Tomago Road depending on traffic generation rates of future development.	Standard arrangements of Defects Liability period before handover to RMS or Council.

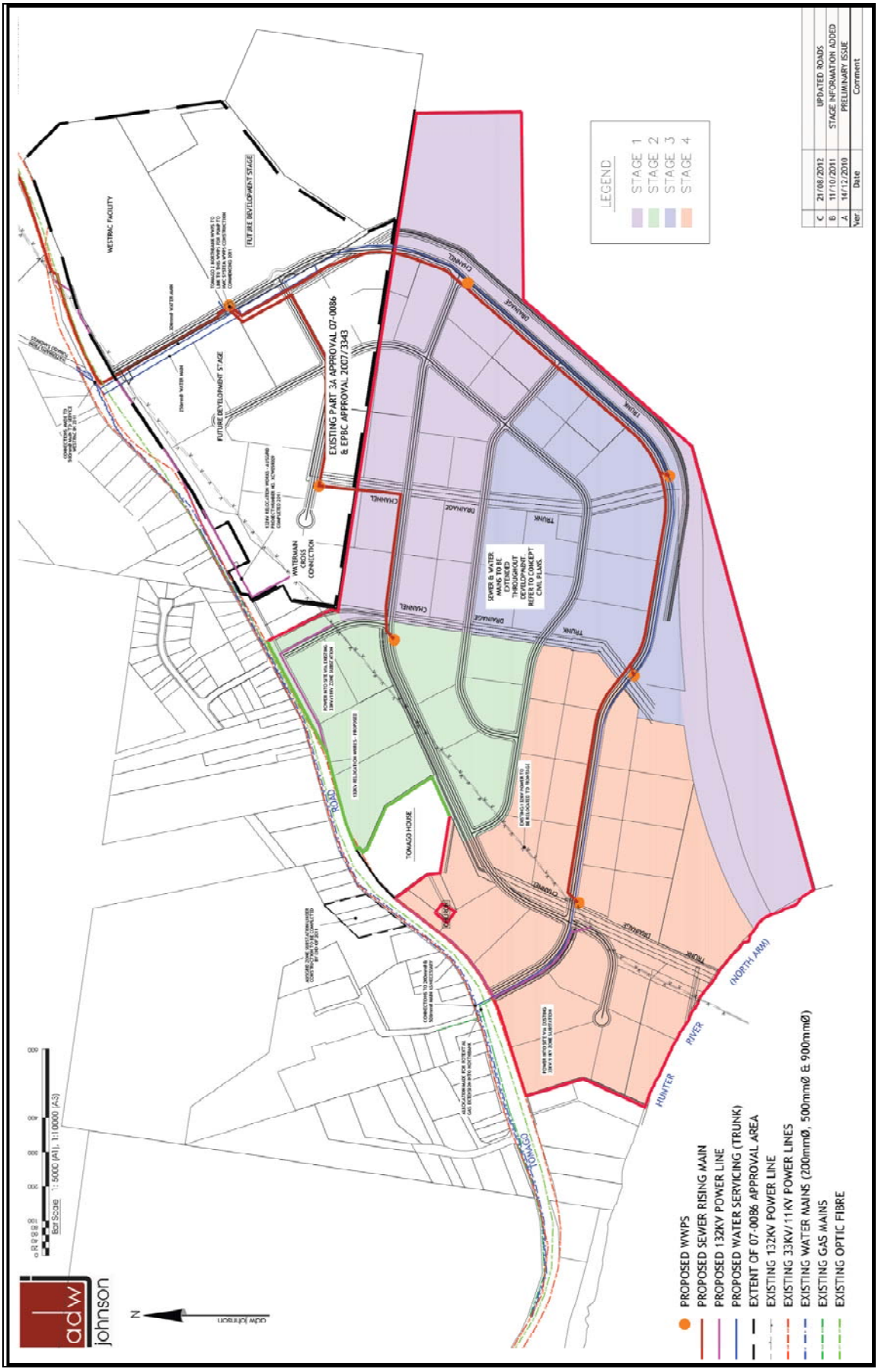

Figure 32 - Infrastructure Servicing.

6.12 LANDSCAPING

Landscaping documentation has been prepared by Terras Landscape Architects to accompany this report (see **Appendix M**). The landscape plan separates the site into a number of co-ordinated landscape components to achieve a cohesive treatment for the subdivision that creates a strong landscape character that unifies the site and forms an attractive environment.

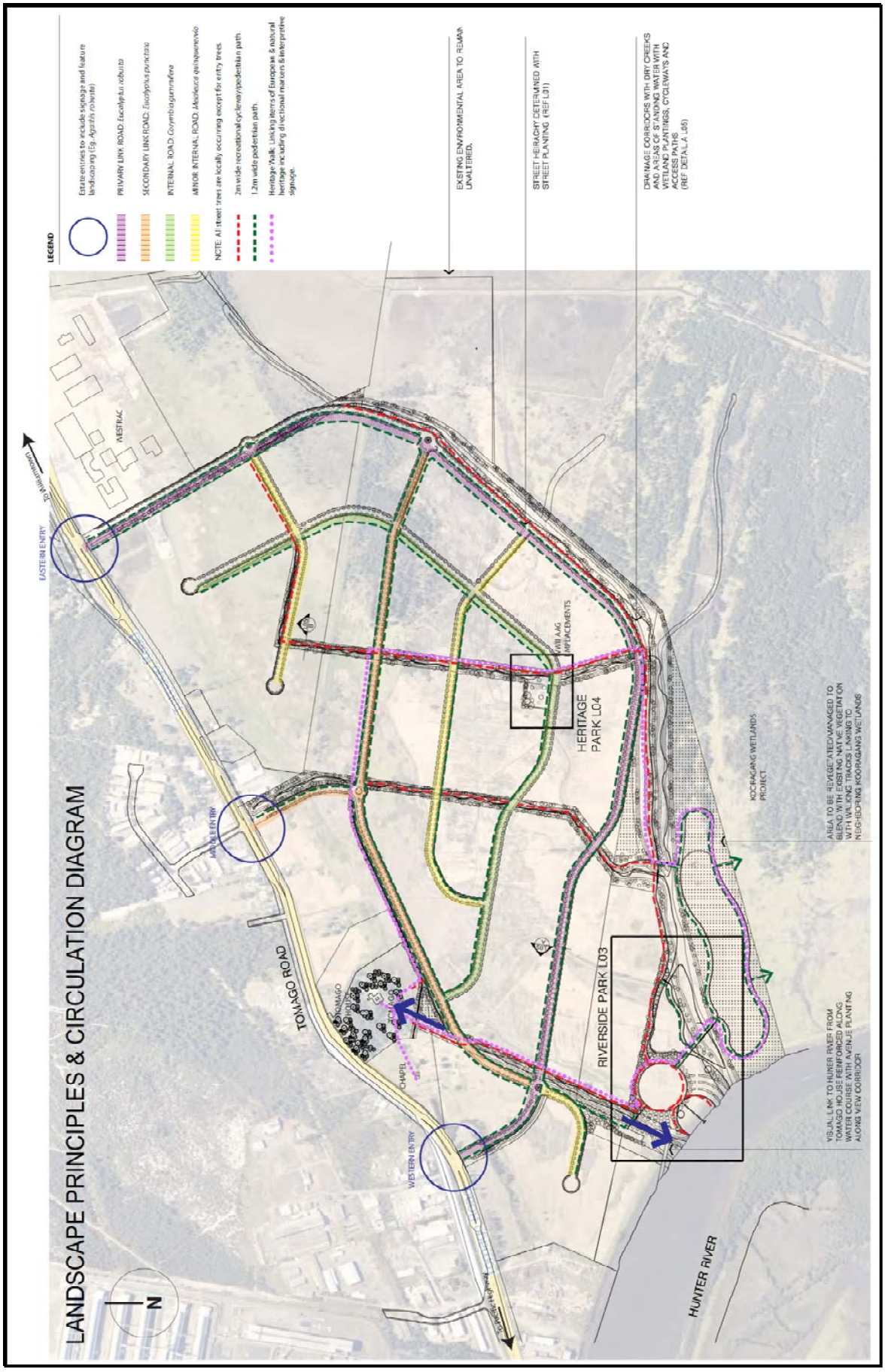

Figure 33 - Landscape Principles & Circulation Diagram.

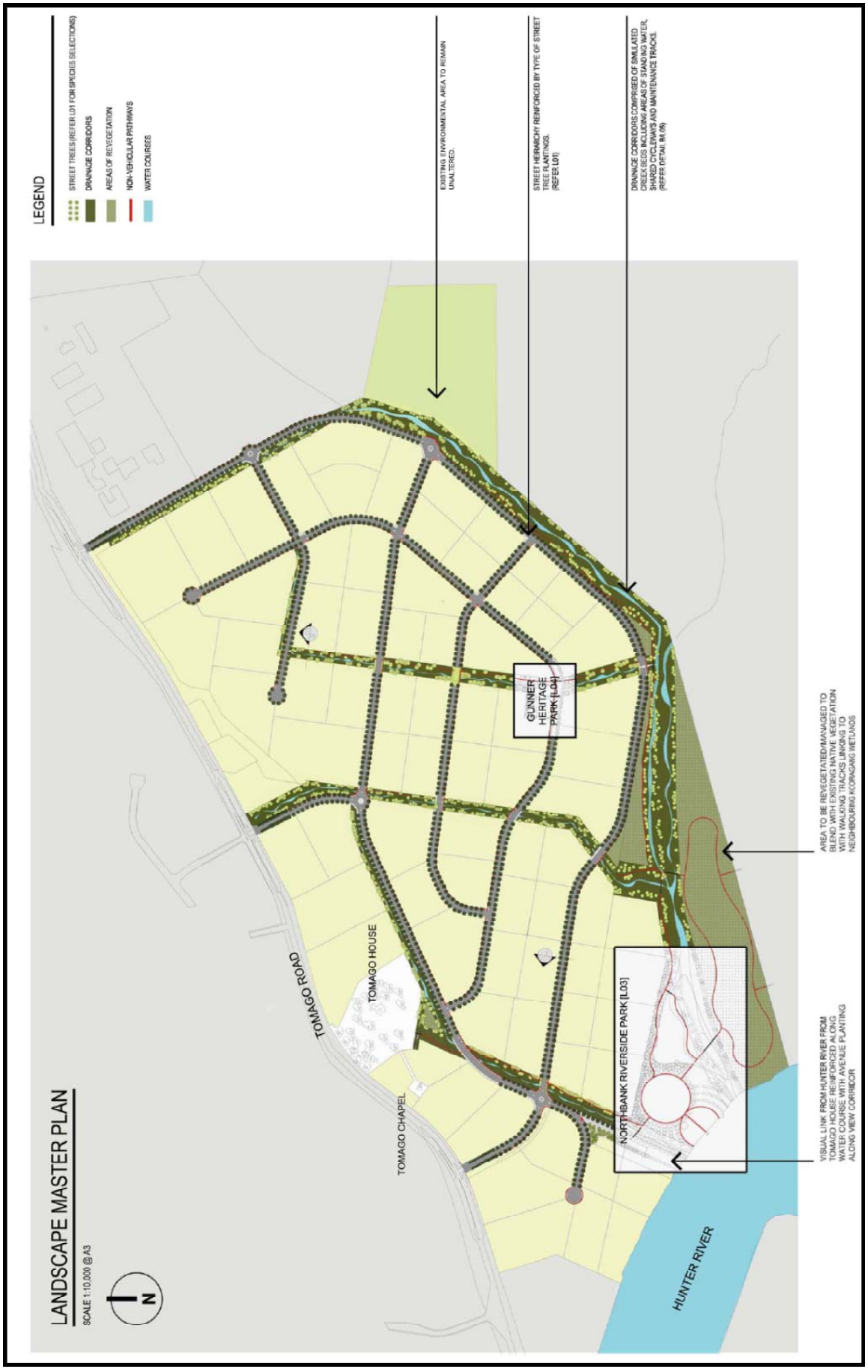

Figure 34 - Landscape Master Plan.

The landscape plan incorporates the following components:

Entrances

In addition to the use of entry features, which will be the subject of future approvals, avenues of *Agathis robusta* (Queensland Kauri Pine) will be used to designate the entries and create a sense of arrival. The trees will be set back from the intersections to allow for essential visibility. The trees will also have supplementary planting of *Doryanthes 159xcels* (Gymea Lily) and *Lomandra spp.* (Mat Rush) at ground level to increase the landscape presence at these locations. *Agathis robusta,* although an Australian native, will be the only tree species used that is not locally occurring.

Street Trees

Street trees will be used to designate a road hierarchy within the subdivision with tall, gum trees used for the major ring roads and smaller gums and paperbarks being used for the internal roads. In some instances, street trees will be located within designated power easements and as such smaller, alternate species such as *Corymbia ficifolia* (Red-flowering Gum) and *Tristaniopsis laurina* (Water Gum) are proposed to reduce long-term maintenance and address statutory requirements.

Northbank Riverside Park

This reserve, located between building lots and the Hunter River, is intended to be the major open space for the subdivision providing a range of spaces for active (e.g. soccer, touch football, cricket) and passive (e.g. picnics, reading, sitting) recreational activities. Two major open spaces are created through the use of scattered tree plantings that gradually become more formal forming radiating rings as they move towards the river. To assist in defining these spaces, concrete paths will be used to set the limits to these spaces and so encouraging others to keep to the edges when moving from one space to the other and so allowing the activities to remain uninterrupted.

A floating pontoon and connecting ramp will be used as the focus for the park enabling visitors to gain access to the Hunter River whilst protecting the fragile riverbank and regenerating mangroves. These structures will be the subject of future engineering and other technical investigations.

Tree species will be a continuation of those used as street trees and along the drainage corridors so as to create a strong link to the more developed parts of the site.

Access to the park is either via a road leading from the first western roundabout or connecting paths that are located along the drainage corridors allowing pedestrians and cyclists traffic-free routes through the subdivision.

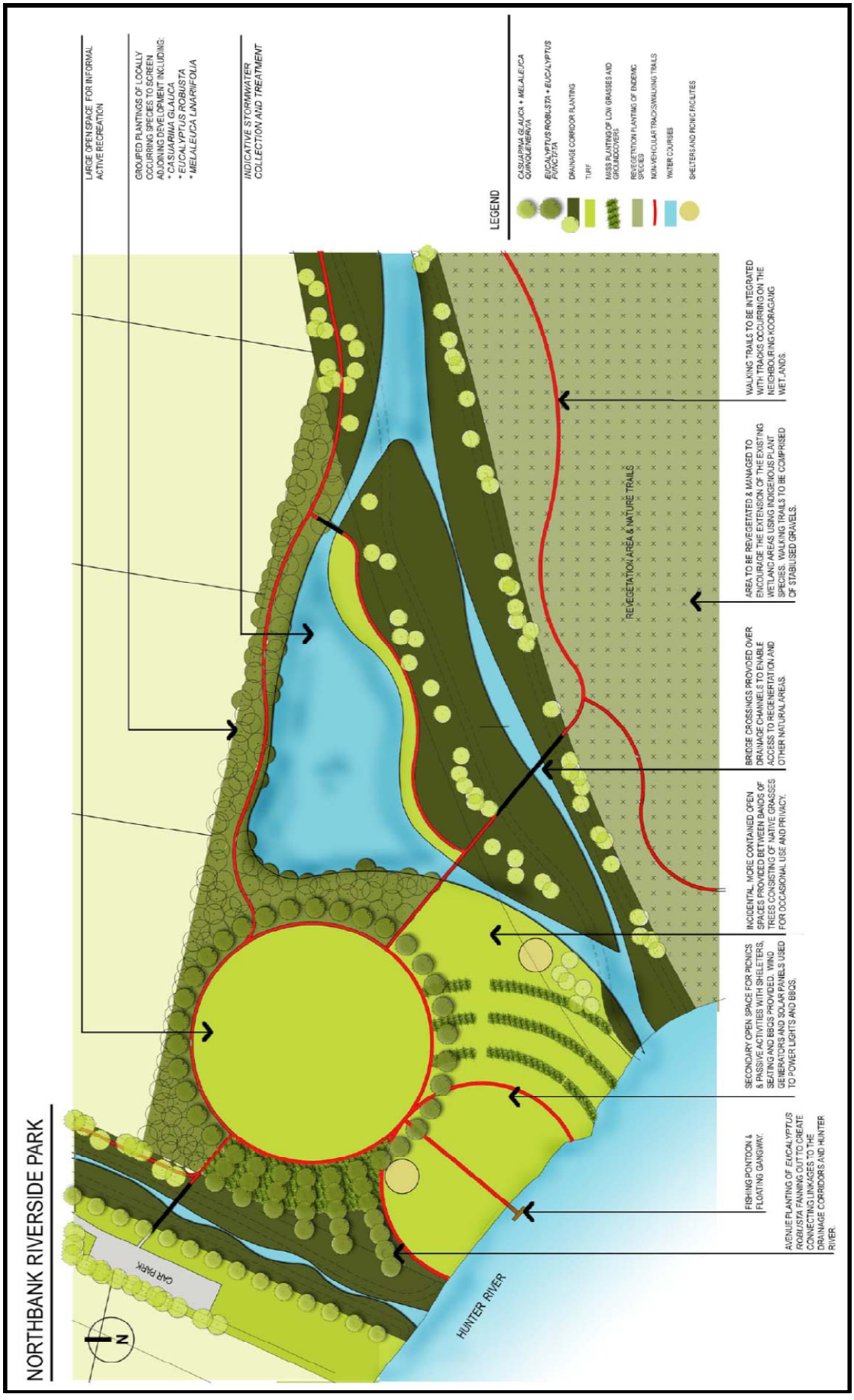

Figure 35 - Northbank Riverside Park.

Gunner Heritage Park

The treatment of this park is governed by the constraints arising from the need to conserve and interpret the significance of the heritage items (as outlined in Section 6.7 above). To this end the treatment within the park has been kept simple to reflect a number of WWII heritage items.

The actual treatment of the heritage items and their respective curtilages will need to be developed as part of a conservation management plan for the area, however, it is anticipated that tree planting will be required to the edges to screen views of modern development whilst improving the amenity of the park. If possible, water within the nearby creek will be held to create a water feature further increasing the recreational benefits of the reserve.

As existing levels will need to be maintained, a retaining wall and stairs are proposed which will lead people down and into the park from the ring road. The wall will offer an opportunity to incorporate interpretive material and so conveying the purpose and appearance of the WWII heritage items.

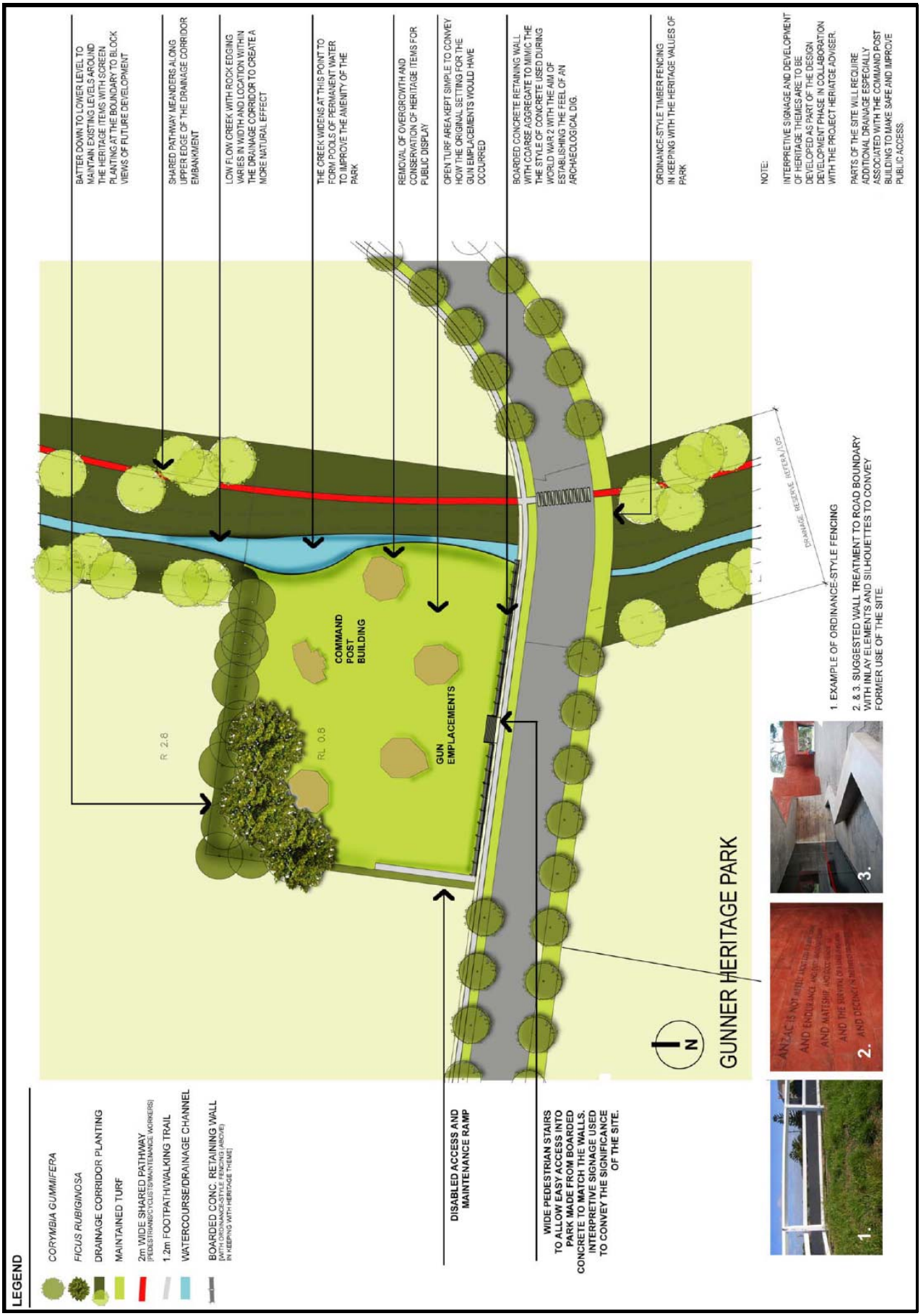

Figure 36 - Gunner Heritage Park.

Drainage Corridors

Generally, the drainage corridors have been located where existing drains have been previously constructed. Their widths have been increased to handle peak flows to cater for 1 in 100 year storm events. This has created an opportunity to provide landscaping to these areas that assists in improving the appearance of the subdivision whilst creating a network of traffic-free, circulation paths for pedestrians and cyclists. It is proposed that local wetland species will be planted in the base of each corridor using rocks to create a creek-like appearance with the low-flow path varying in width and direction. Tree planting will be incorporated into the upper embankments so as not to impede flows and to create a green-belt between allotments. A two metre wide shared cycleway will be provided to one side and located above the 1 in 100 year storm level. Tree and shrub planting will be kept clear of the shared cycleway to enable maintenance vehicles to use the tracks on an occasional basis.

It is considered that the proposed street landscaping, public reserves and drainage corridors have been designed such that the landscaping integrates all areas and improves the amenity of the development whilst providing a connection to the adjoining natural areas of the Hunter River and Kooragang Wetlands.

6.13 GEOTECHNICAL, ACID SULPHATE SOILS & GROUNDWATER MODELLING

The geotechnical assessment for the project comprises the following:

- Preliminary assessment of fill methods by Douglas Partners, described in Section 6.13.1 (Full report **Appendix P**);
- Acid Sulphate Soils Management Plan by Douglas Partners, described in Section 6.13.2 (Full report in **Appendix V**); and
- Groundwater Modelling by Environ Australia, described in Section 6.13.3 (Full report in **Appendix U**).

6.13.1 Preliminary Fill Methods

A Preliminary Geotechnical Assessment has been undertaken by Douglas Partners (see **Appendix P**).

Investigation of the site confirms the following features of the sub surface conditions encountered:

- The site is underlain by alluvial and fluvial sediments of Quaternary age, associated with the meandering river valley of the Hunter River;
- The soil profile comprises a mixture of sand, silt, clay and gravel;
- The upper strata comprise compressible soils, including very soft to soft clayey soils (silty clay, sandy clay, clayey silt), and very loose to loose sands (silty sand, clayey sand); and

- The upper compressible soils are underlain by medium dense to dense sand and very stiff sand clay / silty clay, then bedrock.

The investigations identify that the main implications of the geotechnical conditions at the site arise due to the upper weak alluvial strata. The silty clay and silty clay & clayey sand are compressible soils that will consolidate under the loads imposed by the development.

Closer to the Hunter River the thickness and depth of the upper weak alluvial strata increases, and also the depth to bedrock increases. The time for consolidation of these clay layers increases with greater clay thickness and the coefficient of consolidation (c_v) of the clay. Hence, if no ground treatment was used loads imposed by the development would result in settlement times ranging from a few months to several years. Also, without any ground treatment overall settlement (fill induced and structure induced) would be excessive and have significant adverse implications for buildings, services pavements and drainage.

To complete the majority of fill induced settlement prior to development commencement, a number of ground treatment options have been identified by Douglas Partners (see below). None of these techniques would eliminate post-construction settlement, but would reduce settlement to manageable/tolerable levels.

Preload and / or preload with wick drains are likely to be the most effective ground treatment methods for the site, assuming there is enough time and fill to surcharge the site. These methods assume that surcharge fill (additional fill to the finished level) is placed to achieve effective reduction in post-construction settlements. The methods are described below:

Preload

Principle – Application of a load to the foundation which is usually greater than the final loads after construction. The fill over and above the final fill level is called 'surcharge'.

Comment – The load is usually applied in the form of additional fill (surcharge) which is later removed. This method is one of the simplest ground treatment methods but requires sufficient time and excess fill material.

Wick Drains with Preload

Principle – Installation of vertical drains to accelerate consolidation by providing a shorter drainage path for the expulsion of water.

Comment – Requires preload (as above) but can significantly shorten the construction time, particularly where the clay is thick. May only be required if developing the thick clay areas. The report notes that where there can be a substantial delay between filling and building on the site, the use of wick drains would not be required.

The investigation confirms that while there is sufficient geotechnical data for preliminary or concept design purposes, there will need to be further geotechnical investigation and design to proceed with detailed earthworks and ground treatment design. The recommended further investigations are as follows:

1. Undertake additional geotechnical investigation to fill in the data gaps and target the proposed development area. This would comprise a combination of bores and CPTs (Cone Penetrometer Tests) and include revision of clay thickness contours and design parameters.
2. Undertake a Stage 2 Contamination Assessment in accordance with NSW DECCW (now OEH) guidelines. This would include sampling and chemical testing, targeting the areas of interest identified in the Preliminary Contamination Assessment. *Note:* The Stage 2 Contamination Assessment has been completed and is included at **Appendix O** (refer to section 6.14 of this EA Report for further information).
3. Assess alternative ground improvement measures for each part of the site and recommend most suitable options. This should include preload design, optimal wick drain spacing and typical requirements for other suitable ground improvement methods.
4. Undertake a geotechnical review of suitable fill materials and sources. Proposed materials should be classified in accordance with DECCW (now OEH) Waste Classification Guidelines as ENM (excavated natural material) or VENM (virgin excavated natural material), or obtain specific DECCW (now OEH) exemption / approvals as required (refer to Infrastructure Report, **Appendix H**).
5. Assess potential effects of the development on the local groundwater regime, taking account of the type of fill material that forms the fill platform and staging of the filling works. Groundwater modelling has been completed by Environ Australia Pty Ltd (refer **Appendix U** and Section 6.13.3 of this EA Report).
6. If preload is adopted, refine the preload design, comprising heights, batter slopes and staging (sequencing) to minimise the amount of imported fill required, and prepare preload and earthworks plans.
7. If preload is adopted, prepare a plan of geotechnical instrumentation – numbers, locations and depths. For other ground treatment measures, prepare inspection and test plan (ITP) and verification procedures.
8. For proposed pavements and structures, determine the likely applied foundation pressures and tolerable total and differential settlements. This could include generic geotechnical pile designs for typical structural loads to assist development of individual allotments.
9. Prepare pavement thickness designs for internal roads, including material quality and compaction specifications.

Northbank Enterprise Hub Pty Ltd has an excellent understanding of the geotechnical requirements associated with the filling of the site given the development of the WesTrac facility on the adjacent land to the north east. The appropriate investigations will be undertaken at the required time to facilitate the proposed subdivision development.

6.13.2 Acid Sulphate Soils

The full report on the ASSMP has been completed by Douglas Partners and is contained in Appendix V.

The site is underlain by alluvial and fluvial sediments of Quaternary age, associated with the meandering river valley of the Hunter River. The soil profile comprises a mixture of sand, silt, clay and gravel. The Department of Land and Water Conservations 1:25,000 scale "Acid Sulphate Soil Risk Map for Beresfield and Williamtown indicates that the site lies in an area of high risk (alluvial plains) for the majority of the site and low risk in the north west over the sands.

Acid sulphate screening tests have been conducted from 129 samples taken from 27 bore/test pits over the site. Acid sulphate screening tests on the samples were then completed by ALS Environment Pty Ltd (ALS). Test results have established that the Acid Sulphate Soils Advisory Management Committees (ASSMAC) action criteria for excavations above and below 1000 tonnes has been exceeded, confirming that potential acid sulphate soils are present within the site.

For construction purposes, the disturbance of soils through excavation and dewatering within natural soils (excluding fill) should be treated as having potential for oxidising PASS and thus must be managed under the Acid Sulphate Soils Management Plan (ASSMP). Construction activities for the site for which the ASSMP will apply is some lengths of open drain connections, overflow wetland rehabilitation area and potentially some sewer servicing, roads and stormwater drainage installations.

Acid sulphate produced from excavated soil and dewatering will be appropriately managed in accordance with the ASSMAC guidelines. Excavated soil, dewatering and leachate will all be treated with suitable neutralising agents of acid sulphate. Treatment agents include agricultural lime ($CaCO_3$), calcined magnesia (MgO or $Mg(OH)_2$) and dolomite ($MgCO_3.CaCO_3$).

An assessment for the dosing rates for treatment has been calculated with results from detailed laboratory tests. Stockpiled soil should be initially limed at an average rate of 3 kg/m^3-for sand and 18kg/m^3 of clay (2kg-13kg lime/tonne of soil) for neutralisation as soon as practicably possible. These are the recommended liming rates initially, and should be refined based on monitoring results as construction proceeds. Continuous monitoring of soils, water and leachate will be conducted throughout construction, thus levels and frequency of dosing will be altered accordingly to requirements.

Excavated soils and leachate containing acid sulphate will be appropriately stored within a bunded area with an impermeable base. The Soil and leachate will be appropriately treated prior to authorised disposal according to the acceptance criteria outlined in Acid Sulphate Management Plan and regulatory requirements. Water produced from excavation will be similarly stored in multi-stage sediment tanks with treatment to regulatory requirements and acceptance criteria before disposal. No excessive amounts of PASS will be disturbed to minimise impact of required dewatering and excavation.

Records of the treatment of acid sulphate soils on site should be maintained by the contractor with necessary detailed information. A record of contingency measures and additional treatment used shall also be undertaken. A final report upon completion of works will present the monitoring regime and results to confirm that no adverse environmental impact has occurred during construction.

The contingency plan involves remedial action if the agreed standards or acceptance criteria have not been achieved. Remedial action involves increased lime dosing to treat acid sulphate as well as mitigation actions during rainfall events affecting acid sulphate soils. Sufficient lime should be stored during construction for the neutralisation of acid sulphate soils and contingency methods

The Acid Sulphate Soils Management Plan by DP has identified acid sulphate soils within the site. Analysis has been provided of the acid sulphate soils and appropriate mitigation necessary for excavation activities during construction. This plan should be adopted directly into the CEMP for the applying to excavation activities.

6.13.3 Groundwater Modelling

A report presenting the hydrogeological review and numerical groundwater flow modelling was conducted by Environ Australia Pty Ltd. The full report is contained in Appendix U.

The groundwater system comprises an unconfined aquifer in the upper strata, a semi-confining layer (leaky aquitard) of low-permeability clay and silty clay, overlying a semi-confined sand aquifer which responds to changes in head in the river.

Groundwater levels were gauged in all monitoring wells on 5th September 2011 to provide comparable water levels across the site. This information was used to construct a preliminary groundwater contour plan for the site. Since then, data loggers recording water levels every 20 minutes from September 2011 through to July 2012 were used to calibrate a groundwater model of the site.

Groundwater flow is predominantly to the south-west towards the North Arm of the Hunter River (located adjacent to the south-western boundary of the site). Groundwater also flows to the south-east (at a much reduced flow rate) towards the SEPP 14 wetlands (and Ramsar wetlands). It should be noted that groundwater levels and flow patterns vary locally due to surface drains and the complexity of soil conditions. Groundwater levels are also affected by climatic conditions and soil permeability, and will therefore vary with time.

A three-dimensional finite difference numerical model (MODFLOW) was used to model current groundwater conditions and to predict changes to the groundwater flow regime following site development. The model domain comprised of an area of 3.3 km in the east-west direction by 6.2 km in the north-south direction, in which the proposed development site was located towards the centre of the model.

The cell size adopted was 20m by 20m in the vicinity of the site and increased to 100m by 100m outside the site boundaries towards the model boundaries. This cell size is considered to give sufficient resolution to model impacts from the proposed site development.

The main modelling objectives for this investigation included:

- Identifying the current hydrogeological conditions for the site;
- The prediction of changes in shallow groundwater conditions on the site following the proposed development of Lot 1001;
- The assessment of potential impacts on the neighbouring wetlands area; and
- Identifying contingency monitoring and management measures as required.

Shallow groundwater is present within the sands and clays on the site at depths between 0 and 2m below surface. Wells installed across the site indicated groundwater flow directions generally towards the south-east to the south-west and toward the adjacent SEPP14 wetlands and Hunter River, respectively. Groundwater reportedly discharges to the surface from the shallow sands in the slightly elevated northern sandy strip onto the lower surface of the south-eastern area. The groundwater flow directions were interpreted to be strongly influenced by rainfall recharge and the presence of the adjacent Hunter River.

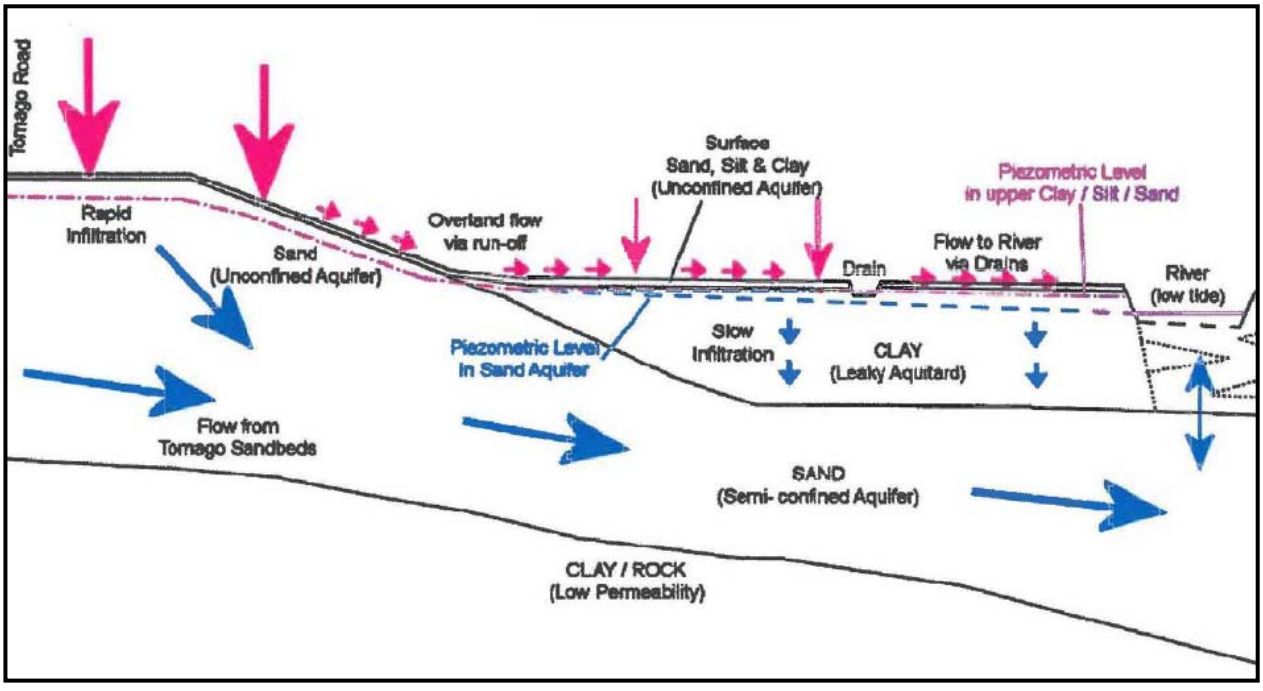

Figure 37 - Site Hydrogeological Model.

Through modelling, it has been predicted that the proposed development will not impact measurably on the groundwater flow relationship between the site and the adjacent wetland. There is no measurable change in the groundwater potentiometric surface from pre development to post development. The contribution of groundwater flow from the project site to the wetland, in the upper layers (within 4.0m of the surface), represents 5%

of total groundwater recharge within the wetland footprint. As groundwater flow from the project site represents a small contribution, any change to this contribution is insignificant to the overall water balance for the wetland.

However, as a contingency against unexpected conditions or changes in existing conditions, Environ recommends the following contingency management/monitoring strategy, be incorporated in a Groundwater Monitoring Plan (GMP), for the site.

Monitor three of the existing groundwater monitoring wells shown on the ADWJ Groundwater Monitoring Plan Figure and located on the south eastern boundary providing that these wells are immediately down-hydraulic gradient of the proposed perimeter berm (ie, on the wetlands side). If in the event that the perimeter berm is installed on the eastern (wetlands) side of the existing wells, installation of three new groundwater monitoring wells immediately down-hydraulic gradient of the proposed perimeter berm (ie, on the wetlands side), along the perimeter will be undertaken.

Monitoring of groundwater levels in these wells to be undertaken, prior to development, to establish baseline conditions; (ie, groundwater level fluctuation, based on seasonal and regular tidal cycles), with at least one of the wells instrumented with a data logger.

Monitoring of water levels in these three new wells be included in the groundwater monitoring programme undertaken over key site development/construction periods (based on the development timing) including:

- Regular review of the water level data by a qualified hydrogeologist using statistical techniques (eg, Mann-Kendall, or cusum) to assess trends in water levels on the wetlands site; and

- Where a trend in water levels is identified (and confirmed), a detailed site hydrological/hydrogeological assessment be commissioned to identify causes and potential remedial options to ameliorate the impacts on the wetland site. These may include modification of the surface water drainage system and other surface water controls.

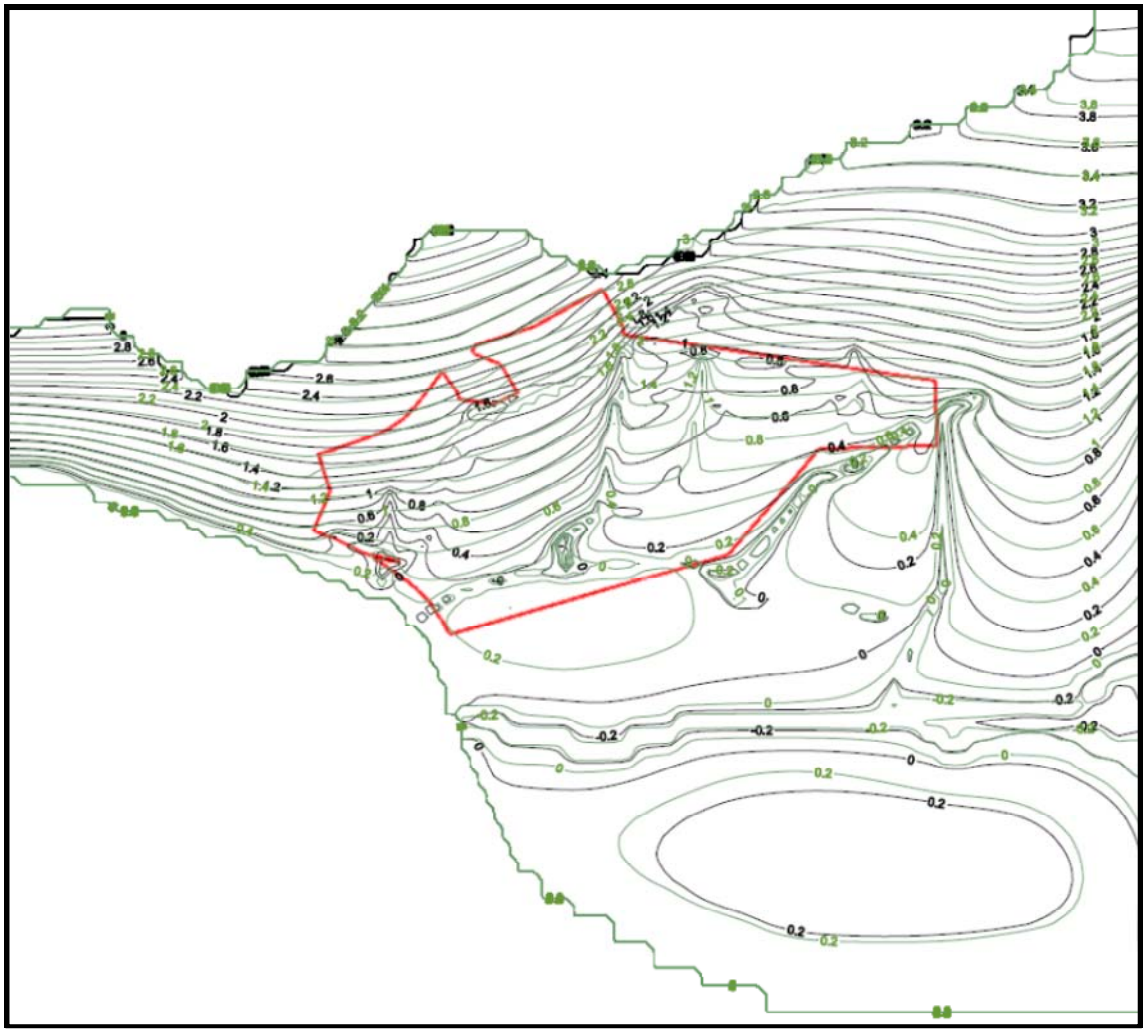

Figure 38 - Predicted Potentiometric Surface Pre & Post Development.

Note: Pre Development Contours are shown in **black**
Post Development Contours are shown in green

6.14 CONTAMINATION

Douglas Partners carried out a Preliminary Contamination Assessment in relation to the proposed development site, and subsequently completed a Stage 2 Contamination Assessment report. These reports are provided in **Appendix O**.

Preliminary Contamination Assessment

The methodology of the assessment included the following:

- A review of site history comprising:
  - Records search – PSC, NSW DECCW (now OEH) & NSW WorkCover;
  - Historical aerial photo review; and

- Historical title deed search.

- A review of previous reports held in–house by Douglas Partners Pty Ltd;
- Site visits on 2 and 5 July 2010;
- Discussions with Tomago Aluminium's Environmental Manager; and
- Surface water sampling at selected locations over the site.

Reporting was undertaken with reference to NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites".

The principal sources of potential contamination were identified as follows:

On-Site

- Imported fill materials observed predominantly within access tracks across the site, within the levee bank along the Hunter River and associated with access for transmission easements, but also at former / current structures and where drain diversions have occurred (including ash, roadbase, coal reject, asphalt, gravels, soil stockpiles etc) which may contain a range of contaminants depending on the source of fill;
- Demolition waste including fibro sheeting fragments and paint residues / flakes observed at the ground surface in the vicinity of former buildings / sheds which may contain potential contaminants including asbestos, heavy metals and hydrocarbons;
- Former buildings / sheds / structures which may contain a range of potential contaminants depending on the use and chemicals stored including asbestos, hydrocarbons, pesticides, PCB, heavy metals;
- Possibly former WWII gun emplacements and associated infrastructure which may possibly contain a range of potential contaminants including acids, ammonia, solvents, chlorinated hydrocarbons, heavy metals, petroleum hydrocarbons and explosives;
- Former cropping which may have resulted in pesticide, heavy metal and hydrocarbon impact to near surface soils;
- Former dairy farming activities which may have resulted in localised hydrocarbon, heavy metal, pesticide impact to surface soils in the vicinity of former sheds / infrastructure where chemicals were used;
- Former agricultural practices (ie. Clearing / ploughing) and construction of drainage networks across the site, which may have resulted in the oxidation of potential acid sulphate soils and / or the promotion of salinity issues; and

- Former on-site wastewater disposal systems, which may have resulted in localised heavy metal, hydrocarbon, nutrient and microbiological impact to soils and groundwater.

Off-Site

- The site falls within the Tomago Aluminium smelter buffer zone. A monitoring station on-site forms part of the smelter's environmental monitoring network. Potential contamination from the smelter includes fluoride and sulphates from atmospheric fallout and possibly fluoride in groundwater migrating onto the site (although considered low risk given discussions with Tomago Aluminium); and

- Migration of potential contamination in groundwater and surface water from up-gradient industrial subdivisions, including the former Genkem site, adjacent scrap metal yard and other industrial sites which have on-site septic systems or may be contaminating soils/groundwater from other site activities.

The report notes that while a number of potential contaminant sources / activities have been identified above, the majority of potential contaminant sources are likely to be localised and readily remediated using standard remedial procedures.

Surface Water Testing

During the site inspections a total of 15 surface water samples were collected from drains within the site and at the two discharge points within the Hunter River (down slope). These were tested for pH and EC using a calibrated portable meter.

The results of surface water monitoring indicate surface waters within the site are generally neutral to moderately acidic and fresh to slightly brackish. Surface waters tested from the Hunter River were generally slightly basic and saline.

Conclusions

The report provided the following conclusions in respect to potential contamination at the site:

- No indicators of widespread gross contamination were identified at the site;

- A number of potential contaminant sources / activities have been identified on-site and off-site, which may have resulted in impact to the site; and

- The majority of these potential contaminant sources are localised and likely to be readily remediated using standard remedial procedures.

Additional targeted contamination assessment was required to investigate the potential contaminant sources identified above and confirm remediation requirements (if any) to render the site suitable for the proposed industrial development. Consequently, a Stage 2 Contamination Assessment was completed (see below and refer **Appendix O**).

The Preliminary Contamination Assessment made the overall conclusion that the site is considered suitable for industrial development from a contamination perspective, subject to appropriate management.

Stage 2 Contamination Assessment

The Stage 2 contamination assessment was undertaken to assess potential contamination sources, both On-site and Off-site, identified in the Preliminary Contamination Assessment conducted in late 2010.

Details of the site conditions were previously determined in early July 2010 for the Preliminary Contamination Assessment. An additional site inspection was conducted between 12-14 July 201 for the Stage 2 Contamination Assessment, and included areas of the site not previously inspected due to access constraints.

The methodology of the assessment included the following:

- Application for and receipt of a bore license from the NSW Office of Water for groundwater wells;
- Review of previous relevant studies for the site and immediate surrounds;
- Site walkover inspection by an experienced environmental engineer;
- Clearance of pertinent test locations for underground services and unexploded ordinances (UXO) by a professional service locator / registered UXO clearance professional prior to field work;
- Field sampling and testing at 141 locations, comprising test bores, test pits, groundwater sampling, surface water sampling and automatic logging of water level data;
- Chemical testing of selected soil and water samples for potential contaminants; and
- Acid sulphate screening tests and detailed testing of selected soil samples for the assessment of acid sulphate soil conditions.

Soil Testing

Soil testing results indicated contaminant levels are generally below the adopted relevant land use criteria, with exception of localised occurrences of asbestos, petroleum hydrocarbons and polycyclic aromatic hydrocarbons. The location of these exceedances is shown in the figure below.

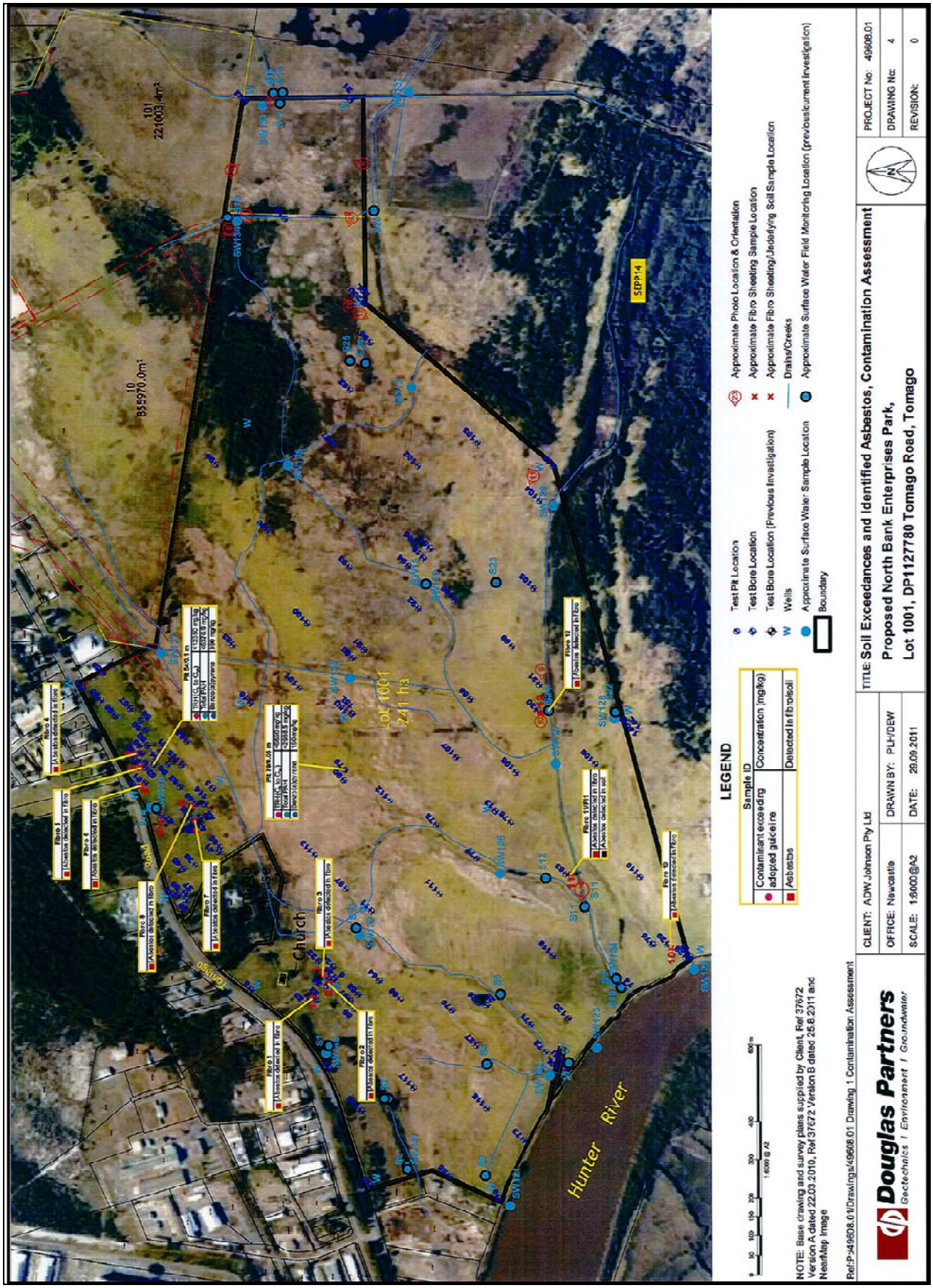

Figure 39 - Areas of Localised Soil Exceedances & Identified Asbestos.

Concentrations of fluoride within near surface soils across the site were generally higher in the north-western corner of the site (i.e. closest point on site to Tomago Aluminium), suggesting some impact on surface soils from fluoride has occurred.

Elevated nutrient concentrations were measured within near surface soils in the vicinity of former effluent disposal systems (i.e. septic tanks) and WWII facilities.

Test results also indicated the presence of Chrysotile and Amosite asbestos within 11 of the 12 fibro sheeting fragments analysed. However, only one of the 25 soil samples tested detected asbestos. Asbestos materials were generally observed at the location of former structures on-site.

Groundwater Testing

The results of groundwater testing indicate prevalent exceedances of adopted ANZECC trigger values for pH, total phosphorous, ammonia, total nitrogen NO_x and metals. Elevated fluoride levels were also recorded but there are no ANZECC criteria for fluoride. The results for other compounds were generally within the adopted ANZECC trigger values, where criteria are given.

The location of exceedances is shown in the below figure. Additional background data is described in Section 6.22 and raw data contained in **Appendix W**.

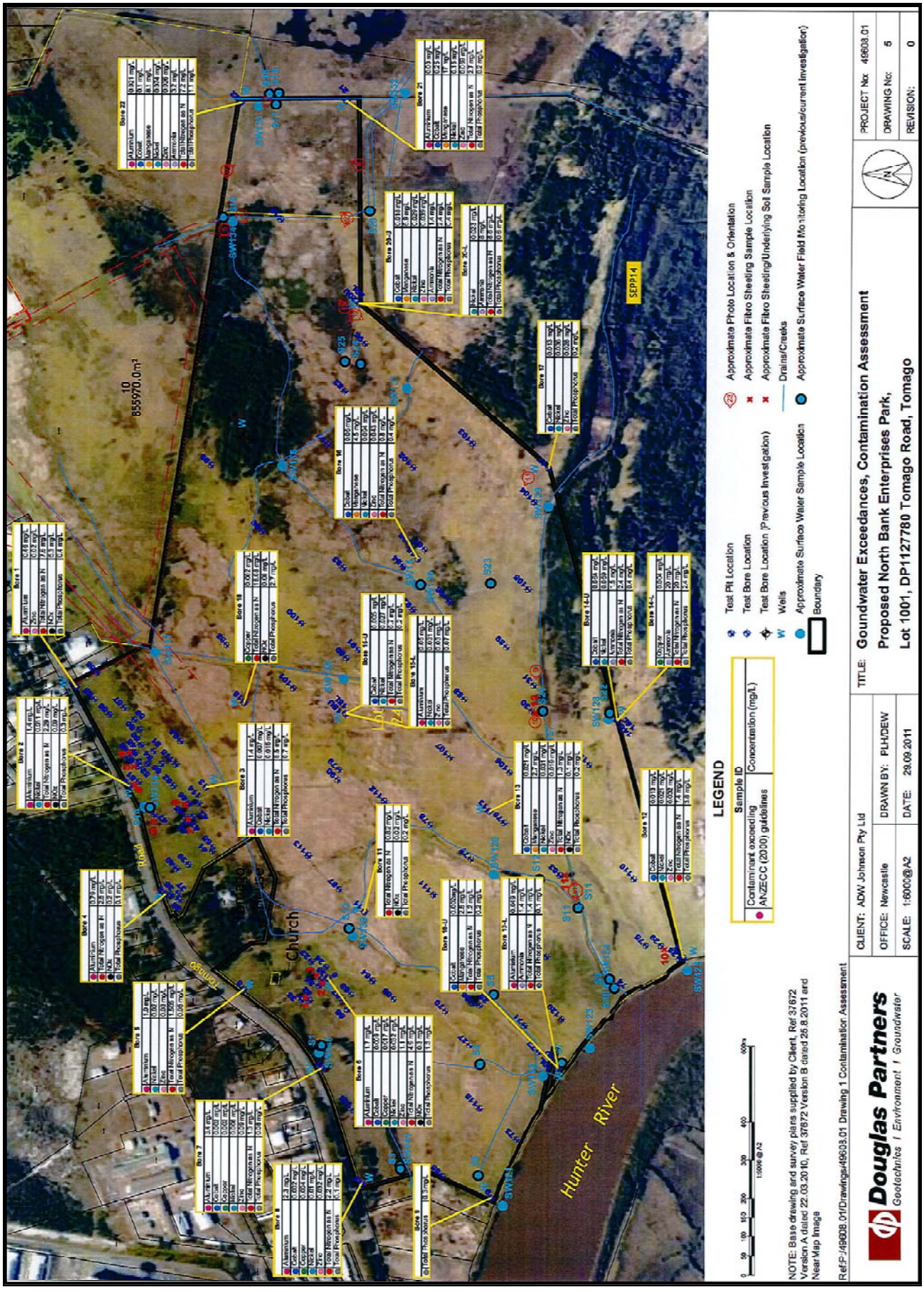

Figure 40 - Groundwater Exceedances.

The majority of metal exceedances were located in the north-western parts of the site adjacent to Tomago Road, with the highest concentrations located downslope of the Tomago Road industrial development.

Also, elevated concentrations of fluoride were detected in all but 3 samples, with the highest concentrations also occurring in the north-western part of the site near Tomago Road.

The results of groundwater testing suggest the impact to groundwater quality has largely resulted from groundwater migration from off-site sources (i.e. Tomago Road industrial developments).

Surface Water Testing

Surface water testing showed prevalent exceedances of the adopted ANZECC trigger values for pH, total phosphorous, total nitrogen, NO_x and metals. Elevated fluoride levels were also recorded but there are no ANZECC criteria for fluoride. The results for other compounds were generally within the adopted ANZECC trigger values, where criteria are given.

The location of exceedances is shown in the below figure. Additional background data is described in Section 6.22. Raw data is contained in **Appendix W**.

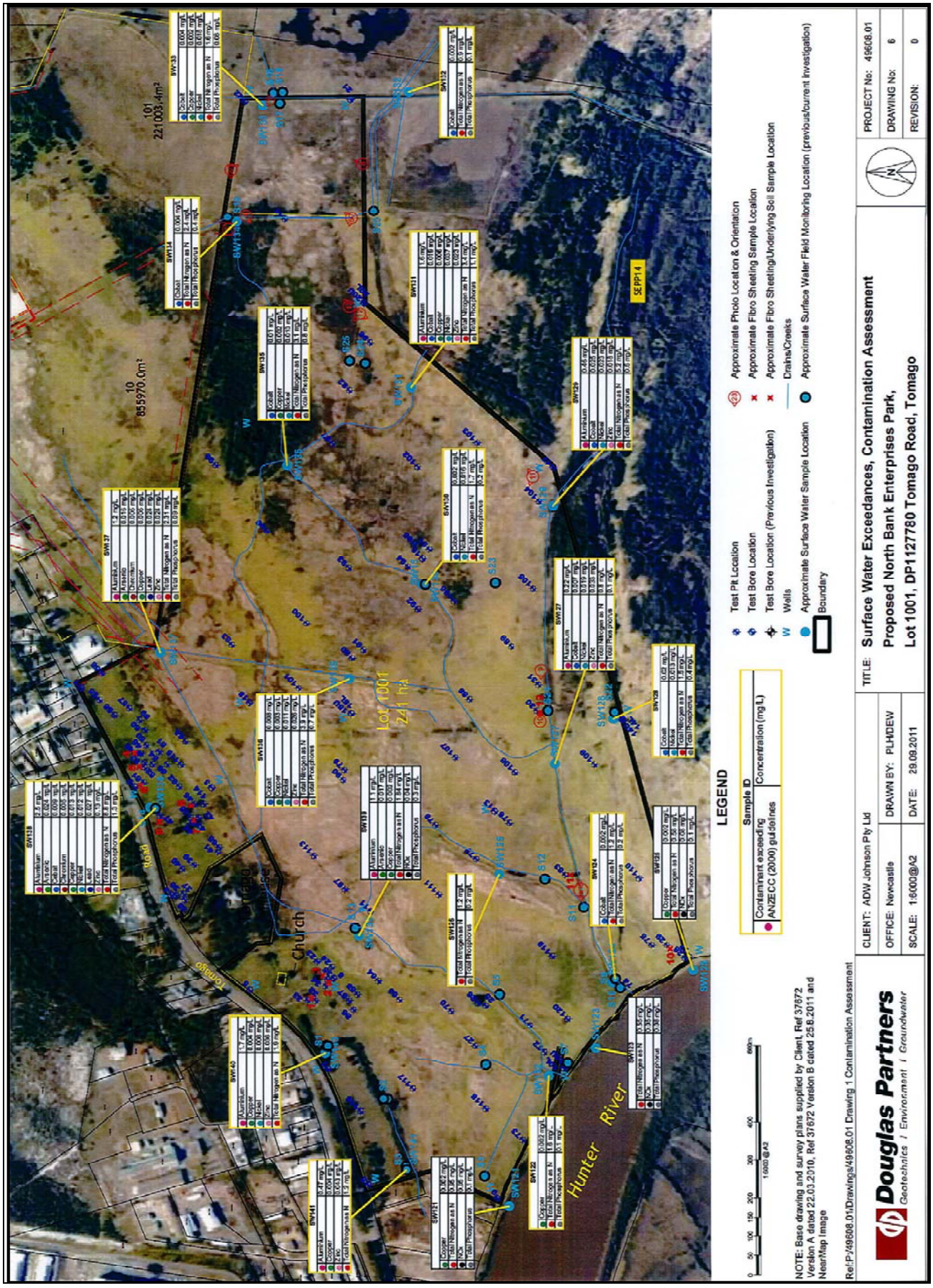

Figure 41 - Surface Water Exceedances.

Elevated concentrations of fluoride were detected for all surface water samples, with the highest concentrations in the north-western parts of the site. The highest concentration was located directly adjacent to Tomago Road.

All surface water samples registered elevated concentrations of nutrients. The highest concentration for Total Nitrogen was in a drain adjacent to the northern site boundary, which receives runoff from the upslope industrial development.

The results of surface water testing suggest some impact to surface water quality has resulted from groundwater migration from off-site sources (i.e. Tomago Road industrial developments), and is influenced by surface water drains present within the site.

Conclusions

The testing undertaken indicates some impact to groundwater and surface water that is considered to be mainly due to off-site industrial activities along Tomago Road.

Comparison of upstream and downstream samples from the Hunter River adjacent to the site indicate similar results, implying that the subject site is causing little or no off-site impact.

Localised remediation of soils will be required to address the localised presence of hydrocarbon and asbestos contamination. This should include the removal of remnant effluent disposal systems and remnant building structures (i.e. tanks, slabs and footings). These activities can be readily undertaken in conjunction with construction activities, subject to a Remediation Action Plan (RAP) that would set out remediation procedures and clean-up criteria.

It is concluded that the site is suitable for the proposed industrial development, subject to localised remediation (to be detailed in an RAP), and suitable management of surface water and groundwater.

6.15 NOISE

A Noise Impact Assessment has been prepared by Spectrum Acoustics (see **Appendix Q**) to accompany the EA Report. The detailed analysis measured existing background noise levels and determined noise outputs for the proposed development. The potential impacts of the proposal in relation to site construction noise, operational noise, sleep disturbance, traffic noise and potential cumulative noise impacts were considered as part of the assessment.

The reporting was prepared in accordance with the following EPA documentation:

1. *NSW Industrial Noise Policy* (INP, 2000);
2. *Environmental Noise Control Manual* (ENCM, 1994);
3. *Interim Construction Noise Guideline* (ICNG, 2009); and
4. *Environmental Criteria for Road traffic Noise* (ECRTN, 1999).

Residential Receivers

The subject site is well located for an industrial subdivision given that it is separated from any significant residential areas and is within close proximity to well established industrial land use. There are however several residences located on school road, Tomago Road and Graham Drive to the north of the site. Historic Tomago House also contains an occupied manager's residence and is surrounded on three sides by the subject site. Figure 42 below identifies the location of the nearest (occupied) residences:

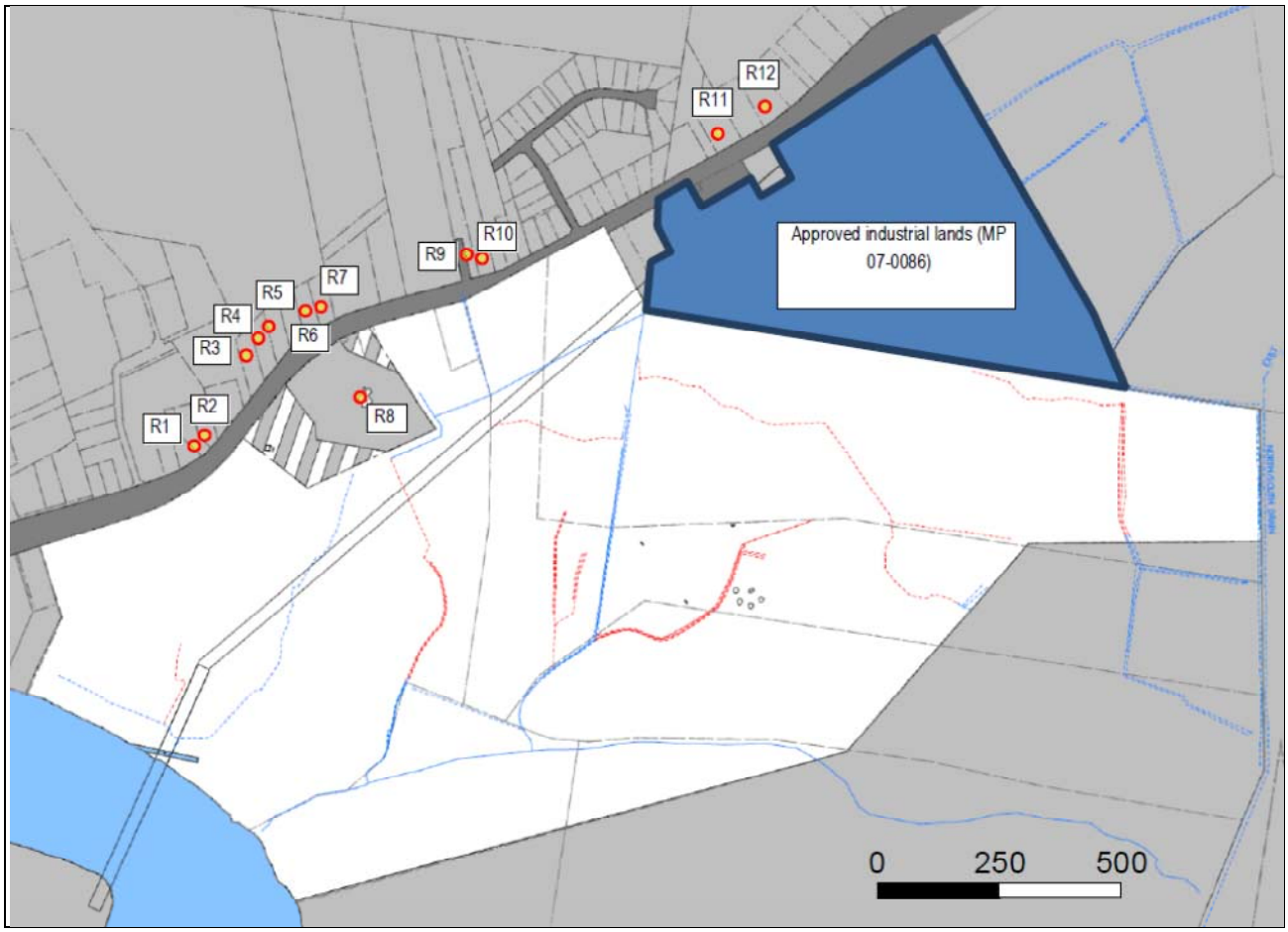

Figure 42 - Project Site & Residential Receivers.

Noise Criteria

This section derives construction, operational and traffic noise criteria from the relevant OEH guidelines. The construction and operational criteria for assessment of future industrial occupants of the site are based on measured background levels at 308 Tomago Road as shown as R11 in Figure 42 above. These levels are:

Day	40 dB(A),L_{90}
Evening	32 dB(A),L_{90}
Night	30 dB(A),L_{90}

Construction Noise

Construction activities on the site will initially involve earthworks to fill a portion of the site, and to construct roads, easements and drainage infrastructure. Once the site has been established, each prospective industrial occupier on the site will be required to prepare an acoustic assessment to ensure compliance with the governing criteria and the noise mitigation recommendations supplied below.

Construction noise criteria established for the approved industrial site which adjoins the project site on the east (Project Approval 07_0086) has been reviewed, along with relevant construction criteria for the current proposal and future industrial occupants.

Adjoining Development

Spectrum Acoustics established construction noise criteria for the approved industrial subdivision in 2007 by reference to the OEH (then DECCW) guideline applicable at that time. The relevant portion of the 2007 acoustic assessment is reproduced below.

> *Recommended construction noise criteria vary depending on construction duration, as outlined in Section 157 of the DECC Environmental Noise Control Manual (ENCM) and reproduced below:*
>
> - *Construction period less than 4 weeks:*
>   *level restricted to background (L_{A90}) + 20dB*
> - *Construction period more than 4 weeks but less than 26 weeks:*
>   *level restricted to background (LA_{90}) + 10dB*
>
> *DECC recommends construction during daytime hours only. For construction periods longer than 26 weeks, a construction noise criterion of background (LA_{90}) + 5dB is usually adopted.*
>
> *Construction activities (including land-fill and building construction) are expected to take longer than 6 months and the criterion of 'daytime background level + 5dB' or* ***43 dB(A).L_{10}*** *would apply.*

Current Development

The OEH (then DECCW) released an *Interim Construction Noise Guideline* (ICNG) in 2009. The essential difference between the old and new guidelines are summarised in **Table 7** below.

Table 7 - Comparison of Previous & Interim Acoustic Guidelines

PREVIOUS GUIDELINE	INTERIM GUIDELINE
Recommended standard hours	
Monday to Friday 7am to 6pm Saturdays 8am to 1 pm No work on Sundays or public holidays	No change from previous
Choice of assessment method	
No choice – only numeric criteria given	Choice of either qualitative assessment for projects under three weeks, or quantitative assessment for major projects
Noise levels	
Noise goal	**Noise management level**
0 to 4 weeks Background + 20 dB(A)	**Short-term infrastructure maintenance** Qualitative assessment – apply work practices in checklist at all times of day **Major construction projects** Recommended standard hours: Background + 10dB(A) and L_{Aeq} 75dB(A) Outside recommended standard hours: Background + 5dB
5 to 26 weeks Background + 10 dB(A)	
Greater than 26 weeks Background + 5 dB(A)	
Guidance on work practices	
No guidance	Extensive list of options for work practices, based on world-wide review of best approaches
Examples on applying guideline	
No examples	Six case studies based on real-life projects. Also worked examples throughout the guideline.
Ground-borne noise levels	
No guidance	Evening internal level L_{Aeq} 40 dB(A) Night internal level L_{Aeq} 35 dB(A)

The main difference in Table 7 above relevant to the current project is the introduction of a construction "noise management level" rather than a "noise goal". For normal daytime activities, the management level under the ICNG is background + 10dB. Based on the daytime background level of 40 dB(A) at 308 Tomago Road, the construction noise management level is **50 dB(A),L_{10}**.

Night time construction activities are permissible under the ICNG but it needs to be demonstrated that the activity is necessary for reasons other than convenience. Any proposal for night time construction must therefore by well supported and noise emissions must not exceed the night time operational criterion of **35 dB(A),$L_{eq(15minute)}$**.

Operational Noise

In setting operational noise goals for a particular project, the INP considers both Amenity and Intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source. The following Intrusiveness criteria were established for the adjoining approved development.

Intrusiveness Criteria:

45dB(A) $L_{eq\ (15\ min)}$	Day (7am – 6pm)
37dB(A) $L_{eq\ (15\ min)}$	Evening (6pm – 10pm)
35dB(A) $L_{eq\ (15\ min)}$	Night (10pm – 7am)

The above criteria are applicable for individual occupiers of the project site.

Residences near the Project site are defined as 'Suburban' in Section 2.2.1 of the INP. The INP recommends the following Acceptable Noise Levels (ANL). These ANL's are the amenity criteria applicable to the cumulative level of noise from all industrial sources.

Amenity Criteria:

55dB(A) $L_{eq\ (period)}$	Day (7am – 6pm)
45dB(A) $L_{eq\ (period)}$	Evening (6pm – 10pm)
40dB(A) $L_{eq\ (period)}$	Night (10pm – 7am)

Amenity criteria for an individual occupier of the site may be modified in accordance with the INP (which reproduced below as Table 8) depending on the total industrial noise level at the time.

Table 8 - Modification to Acceptable Noise Level's to Account for Existing Industrial Noise

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	Existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 3
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

Cumulative Noise

Cumulative noise emissions from the subject site and all nearby existing and approved industrial noise sources should not exceed the recommended industrial noise levels (ANL's) quoted above as "Amenity Criteria" and reproduced below.

Cumulative Noise Criteria (Industrial sources):

55dB(A) $L_{eq\ (period)}$	Day (7am – 6pm)
45dB(A) $L_{eq\ (period)}$	Evening (6pm – 10pm)
40dB(A) $L_{eq\ (period)}$	Night (10pm – 7am)

Sleep Disturbance

Initial earthworks associated with development of the site are expected to occur during normal daytime working hours. It is likely, however, that future occupiers of the site could operate 24 hours per day, and it is necessary to assess the potential for impact noises to cause disturbance to residents' sleep during night time hours. OEH considers that a $L_{A1(1\ minute)}$ level, effectively the maximum (L_{max}) noise level over a 15-minute assessment period, should generally not exceed the night time background noise level by more than 15 dB (ENCM). Based on the measured background level of 30dB(A),L_{90} the sleep disturbance criterion is 45dB(A),L_{max}.

The ENCM is an old document, and more recent findings referenced in the DECCW's *Environmental Criteria for Road Traffic Noise* lead to the following conclusions:

- *Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions; and*
- *One or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly.*

Since the main objective of the noise assessment is to determine potential noise impacts on amenity, rather than on health and wellbeing, it is conservatively assumed from the above conclusions that disturbance to sleep may be minimised by ensuring that internal maximum noise levels do not exceed 50 dB(A). It is also accepted by OEH, and generally, that the noise loss through an open window to the centre of a room is 10 dB. The maximum acceptable external noise level is therefore **60 dB(A),L_{max}** which is the sleep disturbance criterion included in Consent Condition 3.26 of Project Approval 07_0086 for the adjoining development.

Traffic Noise

Noise from vehicle movements on public roads is subject to criteria in the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN). The ECRTN recommends various criteria based on the functional categories of roads applied by the Roads and Maritime Services (RMS).

The RMS differentiates roads based on a number of factors including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options. Vehicles accessing the site would do so via Tomago Road, which is accessed from the Pacific Highway to the west and Masonite Road and Nelson Bay Roads to the east.

Since the Pacific Highway and Nelson Bay Road are arterials, this assessment will only consider potential traffic noise impacts at residences along Tomago Road, which is a 'collector' road with lower noise criteria. Table 9 below shows the noise criteria relevant to traffic on collector roads extracted from the ECRTN. For the assessment of traffic noise, the day time period is from 7am to 10pm, whilst night is from 10pm to 7am.

Table 9 - Road Traffic Noise Criteria

SITUATION	RECOMMENDED CRITERIA, $L_{eq(1\ hour)}$	
	Day (7am - 10pm)	Night (10pm - 7am)
Landuse developments with potential to create additional traffic on **collector** roads	60 dB(A)	55 dB(A)

The ECRTN also advises that, where criteria are already exceeded:

> *"In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB."*

Potential traffic noise from the project site has been assessed against the above criteria, taking previously calculated traffic noise levels from the adjoining approved development into account.

Assessment Methodology

Site Construction Noise

Construction would first involve depositing and levelling fill material over a four-stage process. The four stages are illustrated in Figure 2 and would involve the fill volumes and truck movements as shown below.

Table 10 - Construction (fill) stages – Duration, Fill Volume & Truck Movements

Stage	Duration	Fill volume (m3)	Truck Movements
Stage 1	18 months	1 577 110	105 140
Stage 2	18 months	594 752	39 650
Stage 3	18 months	815 173	54 270
Stage 4	18 months	741 677	49 316
TOTAL	**72 months**	**3.7 million**	**248 376**

Earthworks would involve the use of road-going tip-trucks delivering fill and then levelling with a small tracked dozer (CAT D8 or similar). The dozer would also be used to spread a sand ridge on the northern site frontage over the site. A typical sound power level of 108 dB(A) was used for the tip-trucks and 113 dB(A) for the dozer. Road construction works would typically require the use of the above equipment plus a grader (106 dB(A)) and roller (113 dB(A)).

An area incorporating the receivers shown in Figure 42 was digitised into the Environmental Noise Model (ENM v3.06) software to model noise emissions from the site. The above noise sources were entered as points and the point calculation mode was used to determine noise levels at the assessed receivers.

Noise modelling was undertaken for the atmospheric conditions defined in the assessment for the adjoining site, as described below:

Calm – 20^0C, 70% R.H., no wind (neutral atmospheric),

South East wind - 20^0C, 70% R.H., 3m/s wind from the south east, and

North West wind - 20^0C, 70% R.H., 3m/s wind from the north west.

Operational Noise

No information is available on activities or operating hours for future potential occupiers of the site. The assessment of operational noise uses the ENM model to establish limiting noise emission level that would produce a level equal to the operational noise criterion at the nearest residential receiver, for day, evening and night time operation. Acceptable noise level zones within the site are calculated in this way and presented graphically (see below).

Cumulative Noise

The noise contributions from existing and approved industrial developments were determined from either predicted/measured noise levels or (if these were not available) from approved noise criteria. These noise contributions were added together and compared with the cumulative noise criteria previously outlined above.

Sleep Disturbance

As with the operational noise assessment described above, the assessment of sleep disturbance uses the ENM model to establish the maximum noise emission level that would produce a level equal to the sleep disturbance criterion at the nearest residential receiver.

Traffic Noise

The potentially most affected residences with regard to traffic noise are near the site or on Tomago Road. Existing (as at 2007) traffic numbers on Tomago Road and proposed traffic numbers to be generated by the approved adjoining project during the landfill stage were sourced from the Traffic Management Plan prepared by Mark Waugh Pty Limited, dated June 2007 and a Project Design Note also by Mark Waugh Pty Limited (MWPL), dated September 2008.

Traffic numbers that would potentially be generated by the subject site were sourced from the Traffic Assessment Report prepared by TPK & Associates Pty Ltd (October 2011). Projected traffic noise levels from the adjoining approved development will be used as the basis for assessing potential future traffic noise levels from the subject site.

Noise Impact Assessment

Site Construction Noise

The ENM noise model was utilised to determine construction noise levels (covering all four fill stages) at the three receivers closest to the site (R1, R8 and R10 in Figure 42). Construction activities (dominated by the dozer on site spreading fill material and associated truck movements) were modelled at the nearest points to each receiver. The results of the point calculations for the four modelled scenarios are shown in Table 11 below. Inversion conditions were been modelled for completeness but are normally not considered for daytime activities.

Table 11 - Predicted Construction Noise Levels dB(A), $L_{10(15minute)}$

Location	Meteorological Condition				
	Distance, m	Neutral	SE wind	NW wind	Criterion[1]
R1	60	56	58	53	50
R8	90	53	55	53	50
R10	60	56	58	53	50

[1] Daytime Management Level since construction activities are generally only approved for daytime hours of 7am-6pm.

The results in Table 11 above show that the construction noise management level of 50 dB(A) will be exceeded when activities are close to residences. The Management Level is not a preclusive criterion, however, and simply defines a level at which some form of noise management must be applied.

Figure 43 below defines areas where management measures should be applied to construction works (including internal road construction). The set-back distance from residential receivers is approximately 180m.

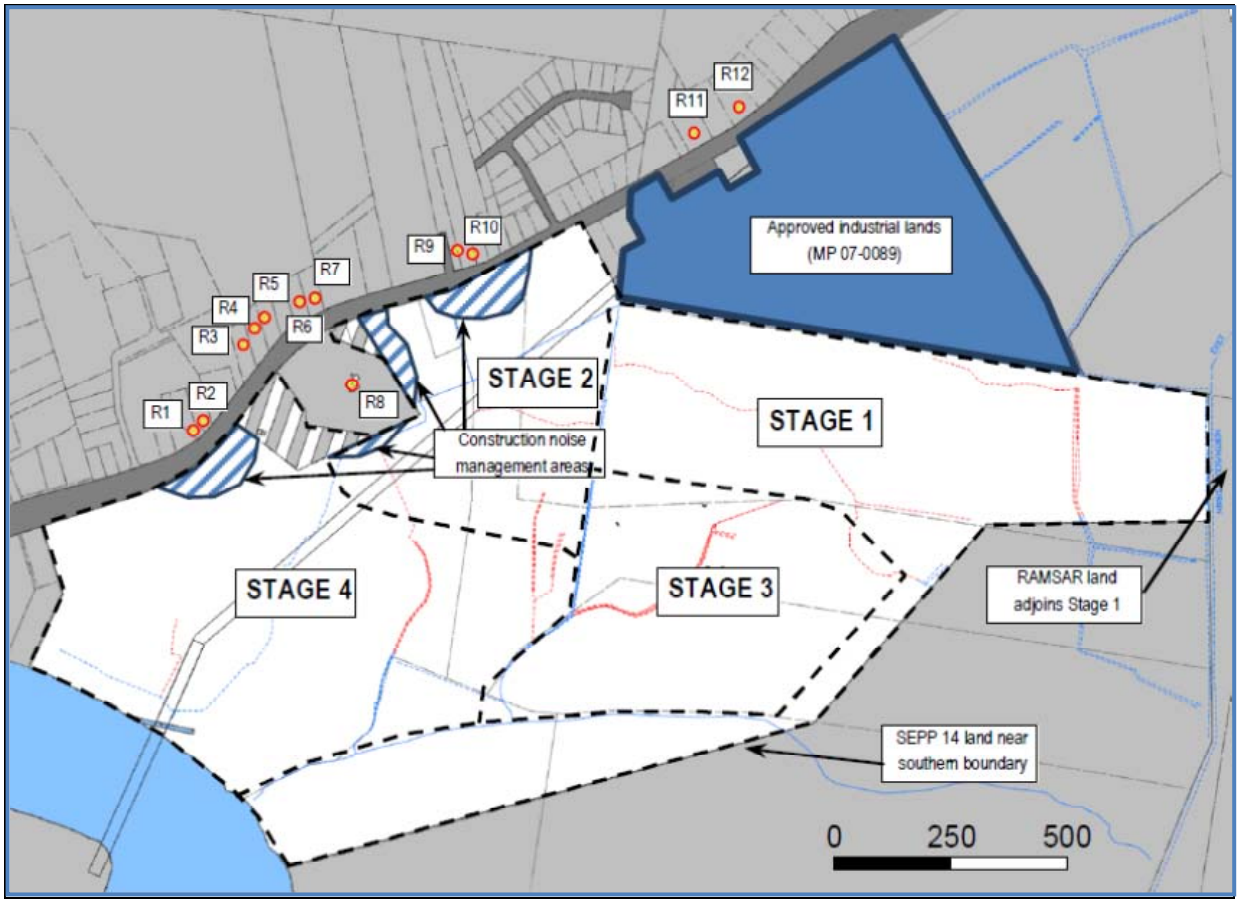

Figure 43 - Construction Noise Management Areas.

Stage 1

All on-site vehicular movements and fill works associated with Stage 1 would occur outside the Noise Management Areas, indicating that noise reduction and minimisation practices and methods are not required for this stage.

Stage 2

On-site vehicular movements and fill works associated with Stage 2 would occur within the Noise Management Areas near R9/R10 and R8 at some time. Noise reduction and minimisation practices and methods will be implemented during this stage.

It is recommended that the ICNG noise reduction and minimisation practices and methods (provided in the recommendations below) be incorporated, as appropriate, in a Construction Noise Management Plan for this construction phase.

Stage 3

All on-site vehicular movements and fill works associated with Stage 3 would occur outside the Noise Management Areas, indicating that noise reduction and minimisation practices and methods are not required for this stage.

Stage 4

On-site vehicular movements and landfill works associated with Stage 4 would occur within the Noise Management Areas near R1/R2 at some time. Noise reduction and minimisation practices and methods will be implemented during this stage.

It is recommended that the ICNG noise reduction and minimisation practices and methods (provided in the recommendations below) be incorporated, as appropriate, in a Construction Noise Management Plan for this construction phase. A single CNMP will be prepared for Stages 2 and 4.

Operational Noise

Figure 44 below shows acceptable operational noise emissions (equivalent point source sound power levels) from individual industries within the project site to achieve compliance with the night time intrusiveness criterion at residential receivers, considering up to five separate industries operating within each of the three noise emission zones. For evening operations, the values in **Figure 44** may be increased by 2dB and for daytime only operations, 10dB may be added. Modelling was conducted for all meteorological conditions as previously discussed.

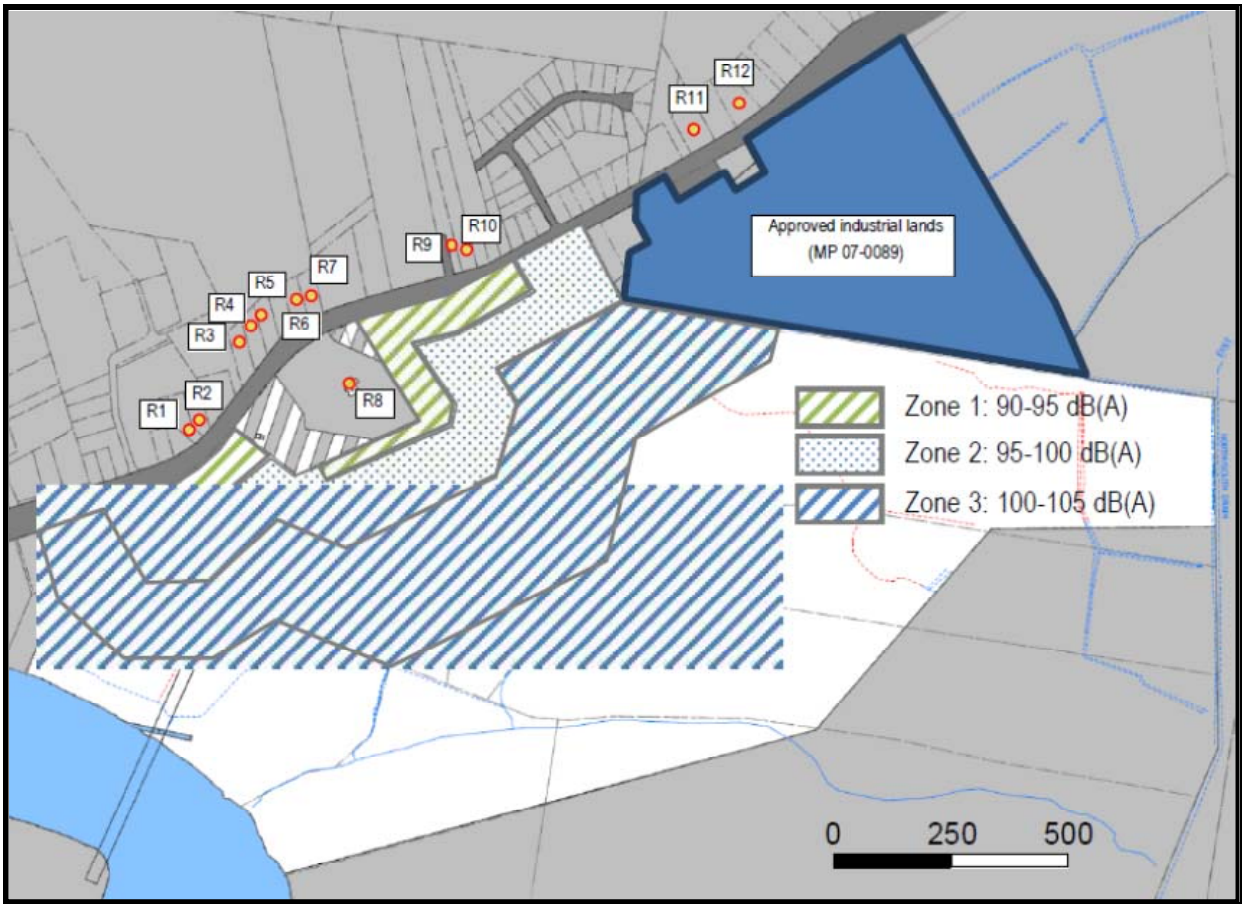

Figure 44 - Operational Noise Emission Zones to Achieve Night Time Noise Criterion.

Cumulative Noise

Noise emission levels from the proposal are taken as being equal to the 'Operational Noise' criteria outlined above, based on the noise emission zones in **Figure 44** above. These are the same criteria included in Consent Condition 3.26 of Project Approval 07_0086 for the adjoining development to the east and will be adopted as noise emission levels from that site.

Spectrum Acoustics personnel have previously conducted several noise assessments and noise monitoring in the vicinity of the project site for Tomago Aluminium (TA), the major industrial noise source in the area. The most recent noise contour modelling conducted by Spectrum Acoustics for TA in 2005 is reproduced in **Figure 45** below.

Figure 45 shows the 45 dB(A) noise contour extending approximately 300m beyond the eastern site boundary of TA. This level was confirmed at the time by attended measurements in the McIntyre Road industrial estate. Attended night time measurements in School Road near R4 (see **Figure 44** above) recorded industrial noise levels of 32 dB(A) from TA, with industrial noise levels not measurable during the day due to elevated traffic noise levels. Since TA is a relatively constant noise source, the level of 32 dB(A) will be assumed to be constant during the day, evening and night time periods.

Cumulative industrial noise levels at a typical receiver (R4) are summarised in **Table 12** below.

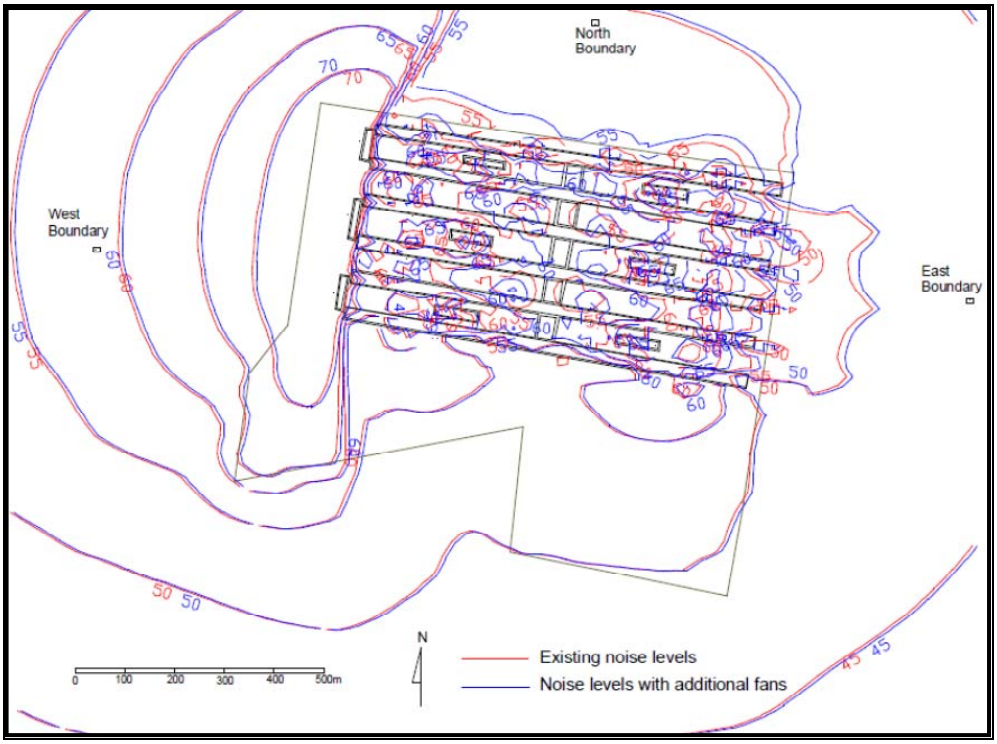

Figure 45 - Operational Noise Emission Contours for Tomago Aluminium.

Table 12 - Cumulative Noise Levels (dB(A), $L_{eq(15min)}$)

PROJECT/INDUSTRY	DAY	EVENING	NIGHT
Northbank Enterprise Hub	45	37	35
Adjoining Development	45	37	35
Tomago Aluminium	32	32	32
TOTALS	**48**	**40**	**39**
CRITERIA	**55**	**45**	**40**

The above results show that the proposed development could operate simultaneously with other approved and existing industries in the area without causing cumulating noise criteria to be exceeded.

Sleep Disturbance

Since the sleep disturbance criterion of 60dB(A) is 25dB greater than the night time operational noise criterion, limiting maximum noise levels can be approximated by adding 25dB to the noise emission zones in **Figure 44** above. Many industrial impact noises involve metal on metal contact

with maximum levels of 115dB(A) or more. Such events should not be approved to occur within Zone 1 unless adequate noise attenuation is incorporated to reduce impact noise levels to below 115 dB(A).

Traffic Noise

The traffic noise assessment for the adjoining approved development, conducted by Spectrum Acoustics, included correlation of (then) existing traffic noise levels with existing peak hour traffic volumes and calculation of future traffic noise levels based on projected traffic volumes provided by the traffic consultant (Mark Waugh Pty Ltd). The projected traffic volumes and corresponding noise levels for the fully occupied approved development provide a starting point for assessment of traffic noise generated by the current proposal.

Projected traffic volumes and noise levels at the most impacted receiver for the approved adjoining development are summarised in **Table 13** below.

Table 13 - Peak Hour Traffic Volumes & Noise Levels for Adjusting Approved Development

Project Stage	AM peak volume	Noise dB(A),L_{eq}	PM peak volume	Noise dB(A),L_{eq}
Stage 1 – WesTrac	265	--	265	--
Stage 2 – Industrial Subdivision	503	--	599	--
Stage 3 – Industrial Subdivision	678	--	807	--
TOTALS	**1446**	**65.7**	**1671**	**66.3**

The traffic noise levels in **Table 13** are above the daytime recommended traffic noise criterion in **Table 13** and therefore additional traffic noise that may be generated by the current proposal should not increase these levels by more than 2dB in accordance with the ECRTN.

Although the future traffic generation by the completed development is uncertain, it is likely that the large number of truck movements associated with the extensive fill activities would produce the highest traffic noise levels.

The TPK traffic assessment report (see Section 6.10 of this EA Report) quotes 301 vehicle movements between the subject site and the Pacific Highway during the AM and PM peaks based on a distribution of 85% of all vehicles movements connecting with the highway.

It is reasonable to assume that the composition of these vehicle movements (ie, heavy vehicle percentage) would increase slightly, compared with those considered in the earlier assessment of

the approved development. The potential noise increase in traffic noise level will therefore be estimated from doubling the proportionate increase in traffic movements (ie, 602, rather than 301 vehicle movements) as shown in **Table 14** below.

Table 14 - Cumulative Peak Hour Traffic Noise Levels

Project Stage	AM peak volume	Noise dB(A),L_{eq}	PM peak volume	Noise dB(A),L_{eq}
Approved development	1446	65.7	1671	66.3
Proposed development (Stage 1)	602	--	602	--
Total traffic volume	2048	--	2273	--
Percentage increase	42%	--	36%	--
Noise level increase	--	1.5	--	1.3
TOTAL potential noise level	**--**	**67.2**	**--**	**67.6**

The projected traffic noise level increase during Stage 1 earthworks is below the 2dB increase recommended in the ECRTN.

The traffic noise level increases during Stages 2-4 would be slightly lower than that for Stage 1.

Impacts on Migratory Birds

Figure 43 above shows that Stage 1 of the project adjoins RAMSAR lands to the east of the site. It is a requirement of the EPA that potential noise and vibration impacts on migratory bird populations be considered. There would be negligible vibration levels from both construction and operation activities, although **Table 11** and extrapolation of the operational noise zones in **Figure 44** suggest possible construction noise levels of up to 55-60 dB(A) and operational noise levels of up to 60-65 dB(A) in the RAMSAR lands. These noise levels will be considered in the context of noise studies at Sydney Airport which sought effective methods to remove unwanted bird colonies.

An article in the University of Sydney Science Alliance newsletter (September 2007) detailed the progress made by researchers aiming to reduce bird strikes at Sydney Airport by using 'ecological principles'. Professor Dickman (U Syd) notes that habitat around Sydney Airport is attractive to birds with the coast, nearby bushland and freshwater wetlands in abundance. Ecological control methods include controlling food sources (dispersing schooling fish), locking garbage bins, remaining vigilant to birds' migratory habits, mowing surrounding grasses to 20cm and netting the banks of local wetlands to stop "…a lot of species from coming in…".

It may be inferred from the above study that birdlife of all kinds thrives close to Sydney Airport (a major noise source), to the point where methods are needed to scare or encourage birds to move to safer, more distant locations. The noise level within 500m of Sydney Airport (at ground level) would regularly exceed the maximum level of 65 dB(A) likely to emanate from the project site.

Another relevant study presented at the 2001 Third Joint Annual Meeting of the Bird-Strike Committee-USA/Canada (2001) by Aimee Hutchinson of Birds Australia looked at the effectiveness of gas scare guns in dispersing birds near Sydney Airport. The study consisted of installing gas guns at 100m spacing along the seawall of runway 16L/34R. The guns were detonated in sequence every 10 minutes from 6:45 to 7:45 am for a week and bird dispersion rates/directions and number counts were compared with the weeks prior to and after the study. A pertinent finding was that birds in flight showed a greater aversion response than birds on the ground and most of the response was displayed by birds within 150m of the gas guns. This suggests that birds nesting greater than 150m from a series of gas guns fired regularly may not be particularly disturbed by the noise (and it is noted that gas gun noise levels are over 90 dB(A) at this distance). The study recommended the permanent placement of gas guns at Sydney Airport, so even this source of very high noise levels would need to occur constantly in the hope of dislodging the nearby bird colonies.

The above findings and the general proximity of Hunter wetland bird colonies to existing industry and infrastructure suggest that these existing colonies may be subjected to, and tolerant of, much higher man-made noise levels than those predicted to be emitted from the Tomago development. Regarding natural noise sources: maximum noise levels from within a bird colony itself; nearby birds such as galahs; frogs and insects such as crickets and cicadas would regularly exceed 65-70 dB(A) at the site of a nesting bird within the wetland habitat. Thunder claps are also known to be extremely loud but are not known to overly disrupt bird colonies (although other non-noise disturbance may result from an approaching storm).

These considerations suggest that 65 dB(A) is a relatively low level of noise impact compared with what might currently be experienced by birds within the RAMSAR lands, and is certainly much less than the level of noise that would be experienced by established bird colonies near coastal airports. It is unlikely that migratory bird colonies would be disturbed within the RAMSAR lands.

Recommendations & Conclusion

It has been confirmed that the project can proceed without impacting on the acoustical amenity of nearby residents.

A Construction Noise Management Plan (CNMP) will be prepared to manage noise emissions, and submitted, as required, prior to construction. Specifically, the following will be included in the CNMP:

- **Daytime Construction Noise** - In accordance with OEH recommendations (*Interim Construction Noise Guideline*) construction will be carried out during recommended standard hours (Monday – Friday 7am to 6pm; Saturday 8am to 1pm; and no work on Sundays or public holidays).

The construction noise management level is 50dB(A),L_{10} for daytime works. When works exceed this level, noise management and minimisation practices shall be applied (as outlined below).

Figure 43 above identifies the sections of the site (in Stages 2 and 4) that require construction noise management and minimisation practices to be applied. The following noise reduction and minimisation practices will be incorporated in the CNMP and undertaken, as appropriate:

Universal Work Practices

- Workers and contractors will be trained (such as at toolbox talks) to use equipment in ways to minimise noise.
- Site managers will check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Tenders, employment contracts, subcontractor agreements and work method statements will include clauses that require minimisation of noise and compliance with directions from management to minimise noise.
- Use of radios or stereos outdoors where neighbours can be affected will be avoided.
- Overuse of public address systems will be avoided.
- Shouting, talking loudly and slamming vehicle doors will be minimised.
- Truck drivers will be informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- A summary of approval or consent conditions that relate to relevant work practices, will be made available to a workplace noticeboard so that all site operators can quickly reference noise information.

Consultation & Notification

- Neighbours will be notified, within reasonable time, with information such as total expected building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For any works outside standard hours, inform affected residents and other sensitive land use occupants between five and 14 days before commencement.
- Information will be provided to neighbours before and during construction through media such as letterbox drops, meetings or individual contact.
- A website will be established for the project to provide information.
- A site information board will be established at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after hours emergency contact details.
- A toll-free contact phone number for enquiries during the works will be created.
- A complaints handling register will be established.

Plant & Equipment

- All machinery and equipment will be regularly inspected and maintained to ensure it is in good working order.
- Equipment will be turned off when not being used.
- Machinery and equipment idling will be limited as much as practicable.

On Site

- As much distance as practically possible between the plant or equipment and residences and other sensitive land uses will be implemented.
- Site vehicle entrances will be located away from residences and other sensitive land uses.
- The design will seek to avoid the use of reversing alarms by designing the site layout to avoid reversing, such as by including drive through for parking and deliveries.
- Where feasible and reasonable, alternatives to the typical 'beeper' alarms will be considered (taking into account the requirements of the Workplace Health and Safety legislation).
- In all circumstances, the requirements of the relevant Workplace Health and Safety legislation will be complied with.

Work Scheduling

- Work to be undertaken during the recommended standard hours where possible.
- Onsite parking will be provided for staff and on site truck waiting areas will be provided away from residences and other sensitive land uses.
- Deliveries will be scheduled to nominated hours only.

- **Evening Construction Noise (6pm – 10pm)** – Noise emissions shall not exceed 40dB(A),$L_{eq(15\ minute)}$.

- **Night Construction Noise (10pm – 7am)** – Noise emissions shall not exceed 35dB(A),$L_{eq(15\ minute)}$.

- **Operational Noise & Sleep Disturbance** – Future industries will be required to submit noise impact assessments as part of the Development Application / approval process.

- **Cumulative Noise** – Cumulative noise emissions will not exceed the following:

Cumulative Noise Criteria (Industrial Sources)

55dB(A)$L_{eq\ (period)}$	Day (7am – 6pm)
45dB(A)$L_{eq\ (period)}$	Evening (6pm – 10pm)
40dB(A)$L_{eq\ (period)}$	Night (10pm – 7am)

- **Traffic Noise** – Criteria, $L_{eq\ (1\ hour)}$ between 7am and 10pm (day) is 68.3dB(A) and between 10pm and 7am (night) is 55dB(A) will be adopted.

Provided that the above recommendations are implemented, it has been confirmed that the project can proceed without generating any adverse noise impacts.

6.16 AIR QUALITY & GREENHOUSE GAS

The proposed development has the potential for dust emission during the construction phase and from future site operations which are unknown at this time.

Dust will be controlled during the construction phase through the implementation of appropriate management measures. Filling operations will involve the use of larger or heavier types of material, thus minimising the opportunity for smaller particulates to be carried by wind. Dust control measures will be established through a comprehensive construction management plan that would be prepared prior to construction activity. Measures are expected to include the following:

- Covering loads where required;
- Amending of operations under excessive wind conditions including ceasing operations if required;
- Use of water tankers as required, to control dust;
- Rehabilitation through vegetation of surfaces to be left unsealed; and
- Truck wheel washes or other dust removal measures.

Given the nature of the proposal, the minimal sources of potential air emissions, and the controls that will be installed and implemented following the preparation of a detailed management plan, it is considered that no adverse impacts will result.

It is noted that future development on each allotment within the subdivision will be subject to separate project / development application. Air quality controls will form a consideration of each application.

Sulphur Dioxide

The proposed development is for subdivision only and will not generate any sulphur dioxide emissions. Furthermore, it is not the intention of the proponent to seek any significant air polluting industries for this site following construction of the Northbank Enterprise Hub business and industrial park.

The proponent acknowledges that other industries within the area already emit pollution at near capacity levels. In particular, it is acknowledged that Tomago Aluminium has an existing Environmental Protection License (EPL) limit of 11,900 tpa for sulphur dioxide. It is understood that sulphur dioxide emissions are at near capacity level and therefore there is little or no opportunity for further impacts to be accepted by the receiving environment.

Future development on each allotment within the Northbank Enterprise Hub will be subject to separate project / development application and air quality assessment and control will form an important consideration of each application.

Greenhouse Gas

The proposed subdivision development itself is not considered to be a heavy producer of Greenhouse Gas emissions. Management of Northbank Enterprise Hub has confirmed that they intend to retain full ownership of the project site (post subdivision) and will control what tenants are permitted to occupy land within the subdivision (subject to relevant Project / Development Application and Approval). Northbank Enterprise Hub have confirmed that heavy polluting industrial development will not be invited to establish a premises within the subdivision.

As noted above, future development on each allotment within the proposed subdivision will be subject to separate Project / Development Application. Greenhouse Gas emissions will form a consideration of each individual application.

The likely direct and indirect emissions of Greenhouse Gas associated with this project include the following:

Direct Emissions

- Emissions from onsite combustion of fuel generated by construction vehicles and machinery.
- Emissions from onsite combustion of fuel generated by vehicles transporting fill to the site.

Indirect Emissions

- Use of purchased electricity at the project site.
- Employee travel to the project site.
- Emissions from solid waste sent to landfill.

The following practices will be adopted to assist in the reduction of Greenhouse Gas emissions from operations at the project site:

Relating to diesel / petroleum consumption:

- Emissions from construction / transport vehicles and on site machinery will comply with the relevant Australian Standards.
- All vehicles and machinery will be regularly maintained to ensure proper and efficient working order and therefore minimise emissions.
- Optimum vehicle / equipment tire pressures will be maintained.
- The finished site topography will ensure that no excessive engine use is required.
- Construction / fill transport vehicles will be managed to reduce vehicle idling time on the site.
- Optimisation of incline / decline of roads within the construction area on the project site will be considered to reduce transport distances for vehicles entering / exiting the project site.

Relating to electricity consumption:

- Use of efficient construction equipment technology.

- Continued monitoring of site electricity usage and review of techniques to reduce usage (if possible).

Given the nature of the proposed subdivision development, the minimal sources of Greenhouse Gas emissions and the mitigation measures proposed to be implemented, it is considered that the proposal is acceptable in terms of Greenhouse Gas emissions.

6.17 WASTE MANAGEMENT

All waste or recyclable material generated from works associated with the proposed development will be:

- *Recyclable Material* – Removed by a licensed contractor and transported to an approved facility; and

- *Non Recyclable Material* – Removed by a licensed contractor and disposed of at an approved facility.

Future occupants of the subdivision will be required to submit a waste management plan for approval during the project / development application for establishment on the site.

6.18 HAZARDS AND RISK (SEPP 33)

The proposed development represents the development of a subdivision only and does not involve the use or storage or any hazardous materials.

Future industrial development within the subdivision that may involve the use and storage of hazardous material will be required to address SEPP 33 Hazardous and Offensive Development. It is noted that future development within the subdivision will be subject to separate development / project approval.

In relation to specific sources of waste, quantities and storage and handling, it should be noted that building construction waste that will be generated includes waste associated with road construction; piped drainage and sewer.

This waste will be stockpiled on site by the relevant construction contractor and removed from the site and transported to a waste / recycling facility by an appropriately qualified contractor. All works will be undertaken in accordance with relevant Australian Standards and WorkCover requirements.

The anticipated quantities of waste and the location of waste stockpiles is unknown at this time and as such it is considered appropriate that this detail be confirmed through a Construction Management Plan (that addresses Waste Management) prior to any construction works commencing.

6.19 LIGHTING

Given the nature of the subdivision works proposed, work will be undertaken during daylight hours.

Future development within the proposed subdivision will be subject to separate development application. It is considered that this process will ensure that each individual development adequately addresses this matter including any need for lighting management achieved through direction and shielding of lighting as necessary.

6.20 SOCIAL & ECONOMIC

The proposal will complete the development of the Tomago Employment Lands as identified in the Lower Hunter Regional Strategy.

The Northbank Enterprise Hub will provide quality industrial lands and the subdivision design will be attractive to a wide range of industrial and business enterprise from major employment generators (for example WesTrac on the adjoining Part 3A approved land) to smaller scale supporting operations. The proposal will generate numerous positions of employment both during the construction of the subdivision and following establishment of business enterprise within the estate.

The following addresses more specific social aspects of the proposed development:

Access and Mobility

Future development within the subdivision will comply with the requirements of the Building Code of Australia in terms of access and mobility.

Accommodation and Housing

The proposal will not result in a loss of low – moderate rental housing stock. Rents are not likely to increase as a result of the proposed development.

ADW Johnson has made enquiries with Ponderosa Caravan Park (located on Tomago Road, Tomago), which is a provider of affordable housing for the local area, in relation to the impact on vacancy rates within the park associated with the construction of the WesTrac facility (approximately 183 construction workers to date) on the adjacent land to the subject site (Project Approval 07_0086). ADW Johnson was advised that the occupancy rates have not undergone any significant change as a result of the ongoing construction of the WesTrac facility. It is considered that the construction of the current proposal will also not lead to a change in occupancy rates at the Ponderosa Caravan Park.

No special accommodation needs are likely to be required for any temporary workforce associated with the development.

Community Services and Facilities

The proposed development will not require any specific on site community facilities or support services.

Community Structure

The development will not decrease the community's capacity to act cooperatively and will not cause divisions within the community.

The proposal does not physically separate one part of a community from another.

Crime and Public Safety

The proposed development is not a high risk development requiring extensive measures to be incorporated to provide security outside of the common-sense practice of controlling access to the site via fencing and locked gates.

Future development within subdivision will be required to address Crime Prevention Through Environmental Design provisions.

Interaction Between New Development and Existing Community

The proposed development will remain consistent with the established surrounding industrial area. The proposal will not detract from any densely populated residential area.

Needs of Social Groups

The gender mix of the population will not be affected by the proposed development.

The proposed development requires no additional services primarily affecting women.

No special needs group will need to be catered for as a result of the proposed development.

Recreation Facilities

No recreation area or facility will be lost as a result of the proposed development. The proposal incorporates a number of public park areas and as such the development will increase the availability of recreation facilities.

Social Equity

The proposed development will not disadvantage any social group.

Investment

The proposed development will make a significant contribution through investment dollars to the local economy in the short, medium and long terms. The future development of the proposed industrial subdivision will provide ongoing opportunity for investment for an extended period of time.

6.21 CUMULATIVE IMPACTS

The key potential cumulative impacts associated with the proposed development taking into consideration other industrial developments in the locality are considered to be the following:

- Traffic;
- Water Management;
- Noise; and
- Air Quality.

As discussed above, each of these matters can be addressed appropriately by the proposed development to ensure that no adverse cumulative impacts are generated for the locality. In particular the following is noted:

- **Traffic** – The proposal has been demonstrated to be suitable in terms of traffic management (see Section 6.10 above and **Appendix L**). The development of two new signalised intersections on Tomago Road providing access into the Northbank Enterprise will ensure the efficient and safe management of traffic in the locality.

  Future road upgrades to Tomago Road will be catered for by the State Infrastructure Contribution Process. These works will significantly improve road access from the Pacific Highway to Newcastle Airport. These future upgrades will also significantly improve Tomago Road and benefit all existing and approved industrial development in the locality.

- **Water Management** – The proposed development will be beneficial to the locality in terms of water quality management. As discussed above, the proposed water management strategy for the proposal has been designed with specific regard to ensure that no adverse impacts are generated on the wetlands to the south and south east of the site.

  In terms of cumulative impact, this will have no impact on or be affected by existing industrial development in the locality. It is noted however that the proposed drainage strategy has been designed to incorporate the approved subdivision on adjacent land to the north (Part 3A Approval 07-0086). The integrated drainage scheme will ensure that the entire Northbank Enterprise Hub has an optimal environmental outcome in terms of water quality management.

- **Noise** – It has been demonstrated in Section 6.15 above and **Appendix Q** that the proposal is acceptable in terms of cumulative acoustic impacts. The acoustic reporting considered the cumulative noise emissions from the proposed development and all nearby existing and approved industrial noise sources and found that they will not exceed the cumulative industrial noise criteria.

- **Air Quality** – Given that the proposed development is for a subdivision, dust and greenhouse gas emissions associated with construction of the subdivision are required to be appropriately controlled. It is considered that implementation of the recommendations as

noted in Section 6.16 above and committed to by the proponent in Section 7.13 of this EA Report will ensure that any potential cumulative air quality impacts can be appropriately mitigated.

It is further noted that future end user operations within the Northbank Enterprise Hub will be subject to separate development application. Air quality controls will form a consideration of each application.

Overall it is considered that the proposed development has very little risk of contributing to adverse cumulative impacts.

6.22 WETLANDS INTERFACE STRATEGY

Wetlands lie within the Lot 1001 site boundaries, adjacent in Lot 1002 and in the Tomago Wetland Rehabilitation Project (TWRP) of the RAMSAR site within the NSW National Parks Estate. The wetlands environmental assessment for the business and industrial park development of Lot 1001 is based on the outcomes from disciplines of groundwater (Environ Australia and Douglas Partners), surface water (BMT WBM), flora and fauna (Ecobiological) and aquatic ecology (Coast Ecology) assessments.

Development of Lot 1001 provides a unique opportunity for *enhancement* of the saltmarsh restoration project that is the TWRP, targeted at improving habitat of the RAMSAR site for migratory shorebirds.

This assessment is to provide development details of the proposed wetland interface strategy for the development of Lot 1001, adaptive management controls, management and monitoring, opportunities for TWRP expansion and addressing the assessment guidelines considerations for Migratory Shorebird Species.

It will be demonstrated that the key outcomes of each discipline, the assessment and proposal align to the objectives of the adjacent conservation areas of Lot 1002, SEPP14 and rehabilitation project - TWRP.

Objectives

The objectives are to demonstrate the following:

- Mitigated or no impacts on the wetland EEC's being maintained within site.
- Mitigated or no impacts on SEPP 14 wetlands within the site and adjacent in Lot 1002.
- Mitigated or no impacts on wetlands in Lot 1002. The wetlands potentially affected are classified as swamp oak rushland forest (wet swamp forest).
- Mitigated or no impacts on RAMSAR TWRP.
- Mitigated or no impacts on Migratory Shorebird Species of the RAMSAR site.
- Management and Monitoring for mitigated or no impact.
- Flexibility for adaptive management on potential future conservation projects.

Methodology

Vegetation is used as the primary determinant and ultimately remains the indicator of changes to a wetland. Hydrological impacts potentially lead to impacts or changes of vegetation in wetlands and the focus of this section is to assess and demonstrate how the post development flow regime will mimic the pre development flow regime for mitigated or no impact on the adjoining wetlands. The approach has been based on background research, historical aerial photography, site experience and previous reporting. Monitoring and management is proposed for the ongoing protection of the adjoining wetlands. Site design is to mimic post development hydrological pathways and flow regimes to be the same as pre development conditions. Contingency and adaptability to have options for the future conservation has also been included in the report.

Existing Environment

Description of Lot 1001

The site area comprises approximately 240 hectares. The land is flat, generally grading downslope from Tomago Road to the Hunter River and eastern edge. Site elevations are consistently 1mAHD, with protection provided by the levee to the river bank with a crest level of approximately 1.7-1.8mAHD. The land contains long man made deeply incised drains which convey the majority of stormwater and groundwater to the Hunter River. The drains were installed to effectively drain the site to enable farming landuses of the past.

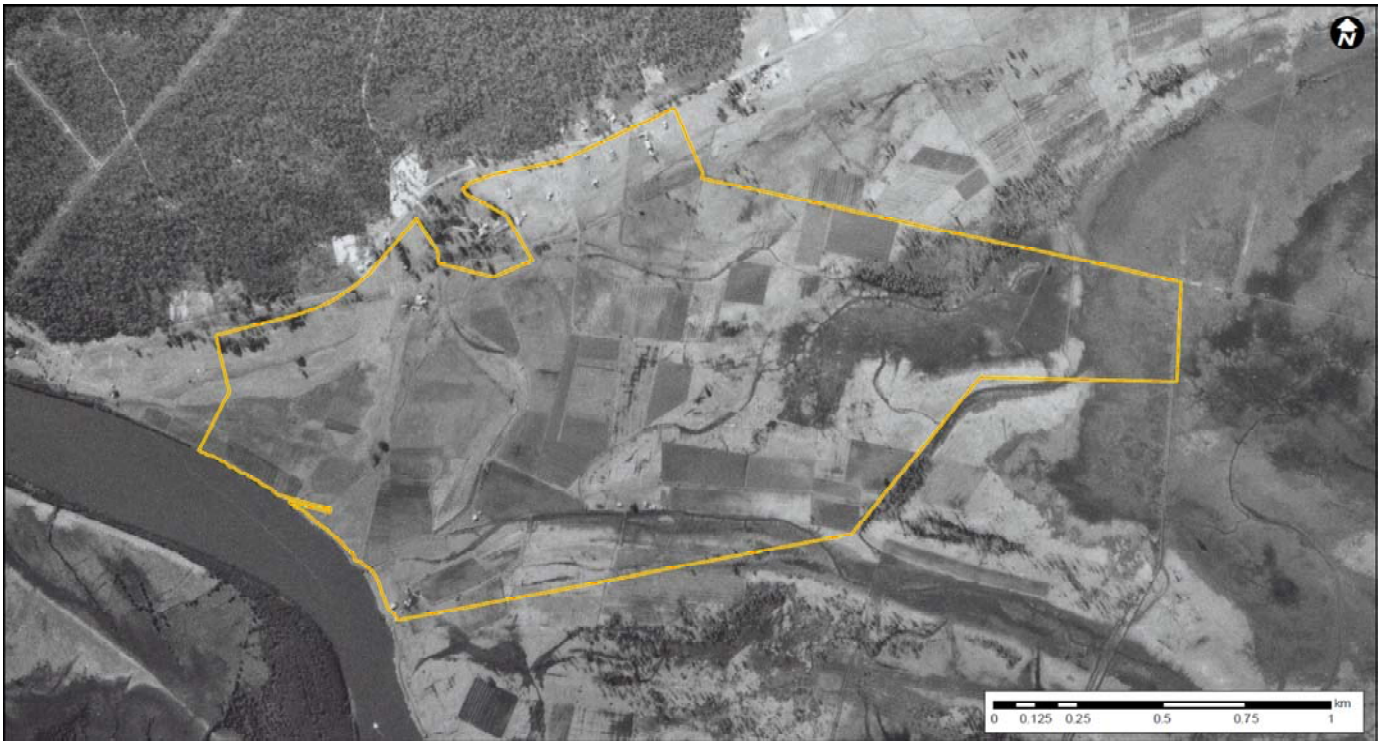

Figure 46 - 1954 Aerial Image of Subject Site.

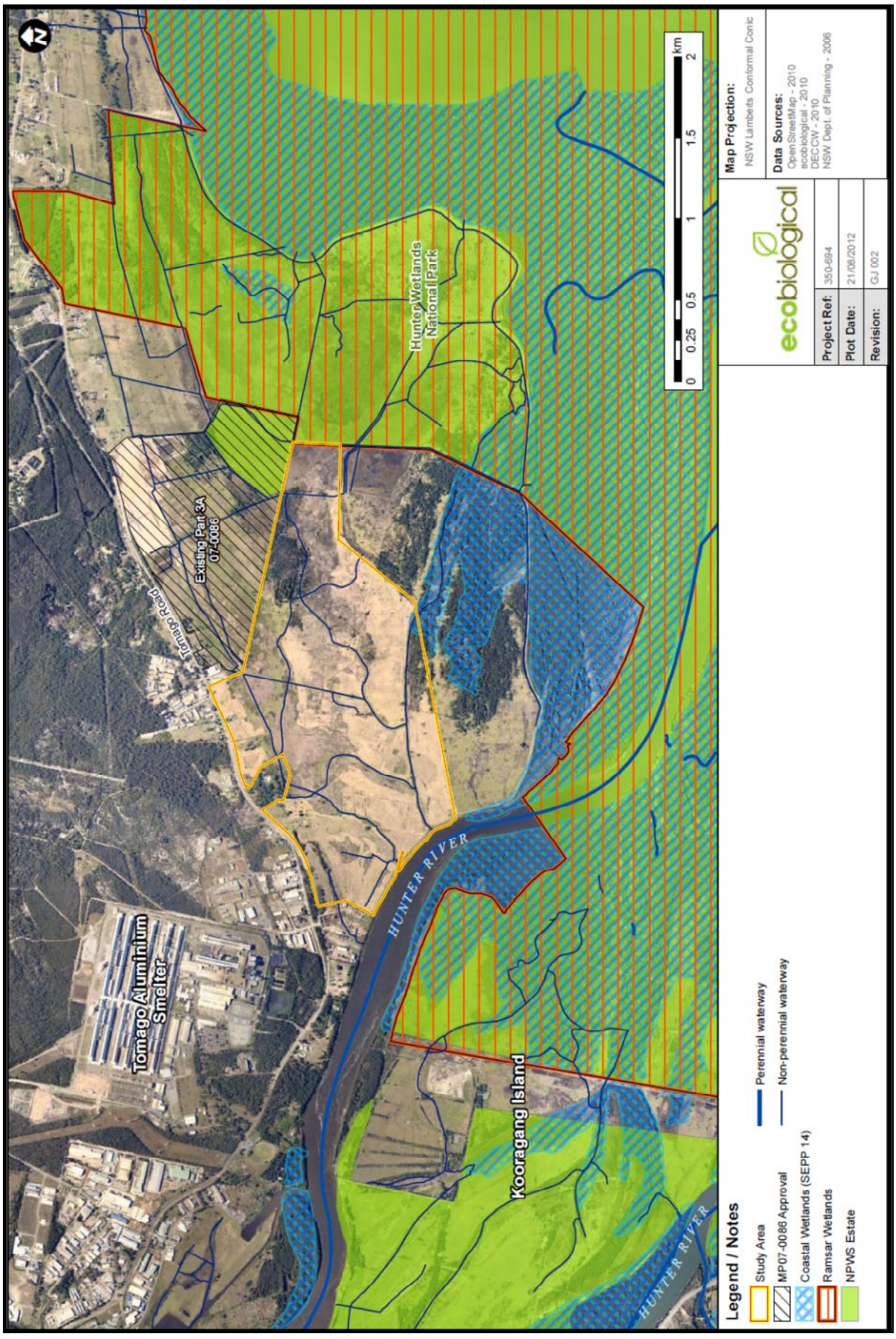

Figure 47 - Study Area & Surrounding Landscape.

Ecobiological has mapped the vegetation in detail. In broad terms, the vegetation comprises approximately 145 hectares of pasture grass, 75 hectares of freshwater wetlands and 20 hectares of swamp oak forest and similar.

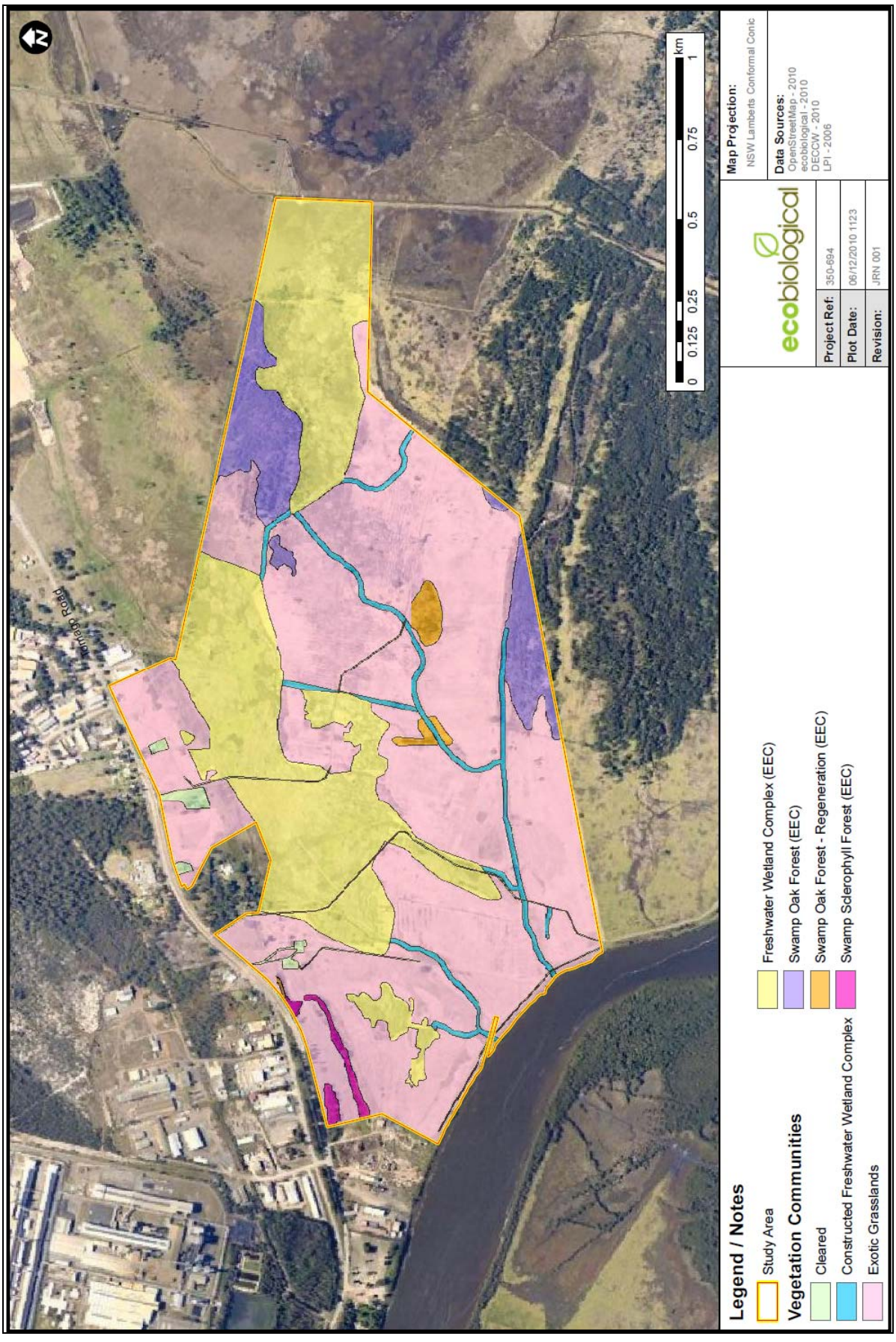

Figure 48 - Vegetation Communities.

The existing surface water hydrology has been based on catchment analysis, LIDAR and topographical survey data from ADW Johnson. Most importantly, catchments, drain/overbank flows and discharge points over boundaries have been ground truthed during periods of dry weather, wet weather, following short rainfall events and prolonged rainfall events. This is critical to determining flow patterns and the hydrological pathway links of the site with wetlands downstream.

There are four (4) existing aboveground discharge points for surface water to Lot 1002. Two (2) of the points are in the north east corner of Lot 1001, the retained freshwater wetland, south toward an area known as the 'Rice Paddy' and the other to an old creek line within Lot 1002. This conveys mostly catchment area from the MP07_0086 development approved lands. The third discharge point is midway along the eastern boundary. This is strictly for overflows as a result of ponding levels within Lot 1001 reaching a storage capacity and discharging into Lot 1002. This connection is usually dry. The fourth discharge point is an easterly continuation of the southern most man made drain. The southern most drain is connected to the Hunter River and contains a floodgate. The eastern end however, drains into Lot 1002. During times of high tide, rainfall and/or increased groundwater levels, there is existing discharge from Lot 1001 into Lot 1002 at this location.

Groundwater modelling indicates an existing steady flow of groundwater from Lot 1001 into Lot 1002. The groundwater flow from Lot 1001 has no connection to RAMSAR as a result of interception by the North South Drain but also due to a southerly flow direction toward the river from the eastern most extents of Lot 1001.

Coast Ecology assessed the aquatic ecology of the man made open drains to be dominated by the exotic species of Eastern Gambusia and some hardy native species. Fish habitat of the drainage lines within Lot 1001 was considered to be low to moderate habitat. Drainage layout provides for no net loss of fish habitat. No threatened aquatic species (pursuant to the Fisheries Management Act) would be impacted by the proposal and no mangroves or saltmarsh species would be removed as a result of the proposal. This is because mangroves occur outside of the development area and no saltmarsh communities were mapped within Lot 1001. The relative contribution of the PDA to food availability (i.e. particulate organic carbon) to aquatic detritus/filter feeders in the local aquatic area is considered minimal due to the large catchment area of the Hunter River and the many sources of organic carbon available (both autochthonous and allochthonous).

Ecobiological has assessed that there are no migratory shorebirds using Lot 1001.

Description of Lot 1002 adjacent conservation lands

Lot 1002 is a conservation lot acquired by Port Waratah Coal Services (PWCS) from Hunter Development Corporation. PWCS bought Lot 1002 in 2012 as offset lands to their T4 proposed coal loader project on Kooragang Island. The site area of Lot 1002 is approximately 239.1 hectares.

Lot 1002 contains vegetation comprising Swamp Oak Rushland Forest, Saltmarsh and Mangrove-Estuarine Complex. SEPP14 delineation is over the Swamp Oak Rushland Forest and Mangrove-

Estuarine Complex. Saltmarsh within Lot 1002 does lie adjacent to the freshwater wetland of Lot 1001, the 'Rice Paddy'. The 'Rice Paddy' however does not have the species which TWRP is aiming to restore, however it appears to be a work in progress. The separation between the freshwater wetland of Lot 1001 and the 'Rice Paddy' has diminished over time and there is exchange of surface water between the 2 areas depending on the fresh/brackish water interface. Other than some smaller isolated pockets of saltmarsh, the large majority of saltmarsh on Lot 1002 lies outside of the Hunter Valley Flood Mitigation Scheme levee bank, isolated from any potential connection to Lot 1001.

The Swamp Oak Rushland Forest receives direct groundwater and surface water inundation from Lot 1001. Surface water is restricted to three of the four discharge locations. The Swamp Oak Rushland Forest does constitute Groundwater Dependent Ecosystem (GDE) however due to the presence of predominantly deep alluvial clays, ponding on the surface is the major hydrological pathway to this vegetation. Aerial photo history indicates that this ecosystem has expanded from previous years. It also understood that this forest is also detrimental to providing migratory shorebird habitat.

TWRP NPWS site description/objectives

Stage 1 of the TWRP on the NPWS Estate through 2006-2007 included installation of SmartGates, to permit tidal exchange into the North-South Drain. A 1.8km levee was installed at the upstream boundary, floodgates and culverts, successfully restoring approximately 248 hectares of salt marsh habitat. This is known as the western component of the TWRP. The western component has also extended into the 'Rice Paddy of Lot 1002 via existing floodgates.

Stage 2 currently under construction during August 2012 involves further floodgate modification and minor earthworks to reinstate tidal exchange to a further 55 hectares of salt marsh to the RAMSAR/NPWS Estate. The REF for the Tomago East Wetland Rehabilitation Project (March 2011) describes:

"In Kooragang Nature Reserve 65% of saltmarsh has been lost, while mangrove forest has expanded by 400%, and brackish marsh increased from 0-240 hectares. These vegetation changes have had detrimental environmental impacts, on shorebirds in particular (see Winning 2000)."

And

"Existing freshwater wetlands will be returned to coastal saltmarsh habitat after tidal inundation."

And

"The aim of this project is to rehabilitate the hydraulic condition at Tomago Wetland in the Hunter estuary in order to provide valuable saltmarsh habitat, and rehabilitate the ecological character of this part of the RAMSAR Wetland."

The restoration of coastal saltmarsh habitat and fish habitat objective is to encourage and increase populations of migratory shorebirds back to the area.

Whilst Lot 1001 shares a common boundary with RAMSAR/NPWS Estate, the deeply incised man made open channel known as the North South Drain on the common boundary is a degree of separation, disconnecting the sites in terms of groundwater and groundwater expression as surface water. The drain means that there is no direct connection of stormwater runoff from Lot 1001 inundating the TWRP/RAMSAR site. This is because the outlet of runoff from Lot 1001 is via a floodgate discharging into the North South Drain. The floodgate is adjacent to the main North South Drain floodgates and only discharges at low tides. At low tides, the floodgate discharge of the Lot 1001 runoff is too low elevation to enter TWRP, bypassing the TWRP entry point (eastern bank midway down the North South Drain) and discharges out through the Smart Gates. Following tidal inundation of flow from the river back up the North South Drain from the SmartGates, there is potential for residual freshwater left in the drain to reach the TWRP site. The residual freshwater is from many upstream drains via the main floodgate of the North South Drain. As a result of no direct stormwater discharge from Lot 1001 to RAMSAR, potential impacts from Lot 1001 development are reduced.

Hydrology

Background Data

The background data of hydrological elevations and water quality for Lot 1001 and the immediate surrounds is extensive. The sources include:

- Monitoring round from September 2011 by Douglas Partners on Lot 1001;
- Monitoring rounds of the MP07_0086 project adjacent by Coffey Geotechnics (2007), Enviropacific (2010-2011);
- NPWS (2008-2011);
- Hunter Water Corporation (1987-2006) (requested only from the same side of the Tomago Sandbeds groundwater divide); and
- Tomago Aluminium (2010-2012).

In total this background data represents groundwater and surface water quality coverage for the groundwater catchment of approximately 10km^2 coverage, which includes Lot 1001 within. The test wells and bore locations as well as surface water sampling locations that have been used by each of the above organisations are shown in the figure below. A summary of the main water quality testing is provided below.

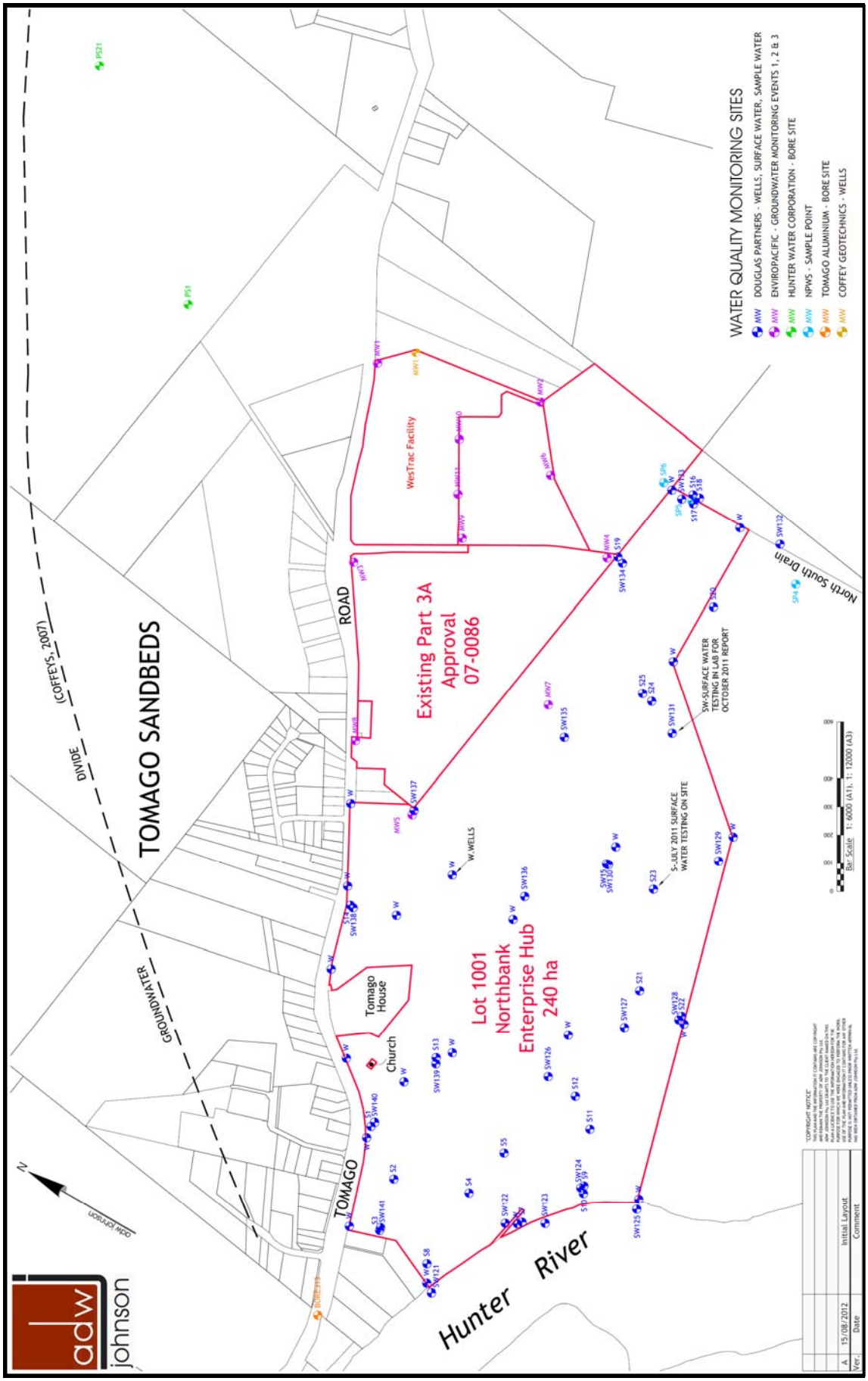

Figure 49 - Water Quality Monitoring Sites.

Groundwater from monitoring wells closest to Fullerton Cove and NPWS Estate were found to be characterised by high EC and chloride and sodium concentrations. Groundwater in all wells was slightly acidic to acidic and below the criteria for drinking water of pH 6.5. Groundwater in wells closest to Fullerton Cove had elevated levels of EC, anions and cations (due to the interaction of groundwater with seawater). Groundwater from all wells was found not potable because of elevated TDS concentrations. Ammonia concentrations in groundwater often exceed the ANZECC Guidelines. Elevated concentrations of TKN and phosphorous mostly exceed ANZECC (2000) Irrigation Water Guidelines for moderately sensitive crops / long term use. Elevated heavy metal spikes also present in results is regionally consistent due to rutile nature of the sandbeds and low pH of groundwater.

The Douglas Partners 'Stage 2' testing within Lot 1001 was undertaken at the end of 2011 and consisted of 25 groundwater wells to depths between 3m and 13.5m and sampling of surface water undertaken at 21 different locations. 21 groundwater wells were screened in the upper aquifer and four in the lower aquifer. The groundwater results indicated exceedances of ANZECC values for pH, total phosphorous, ammonia, total nitrogen, NOx and metals. The surface water results indicated exceedances of ANZECC values for pH, total phosphorous, total nitrogen, NOx and metals. Elevated fluoride levels were also found in both groundwater and surface water. In addition to the laboratory testing during the site investigations in July 2010 and July 2011 pH and Electrical conductivity were tested at 25 locations with the surface water found to be generally neutral to slightly acidic. Douglas Partners testing of Lot 1001 is consistent with that undertaken of nearby, adjacent external sources prior to 2011.

Data loggers for groundwater elevations have been downloaded by Douglas Partners after recording groundwater elevations every 20 minutes from 5 September 2012 to 12 July 2012 over a period of a La Nina weather pattern. The data has also been related back to elevations on MP07_0086 lands adjacent, which have elevation history back to 2007. The data loggers provide sound data to be used for calibration of the groundwater model of the existing groundwater regime.

Impact Assessment

Potential Impacts

HCCREMS identifies the following potential impacts on wetlands downstream of development:

- Alterations to hydrology – volume of runoff;
- Physical disturbances as a result of altered hydrology – flood damage of vegetation, erosion and/or deposition of substratum;
- Alterations to chemical and physical properties of substratum – wetting and drying pattern, water quantity, quality, pH, redox potential, dissolved oxygen, nutrients, toxicants, salinity and suspended solids;
- Direct encroachment on biotic ecosystems – land clearing, filling; and
- Loss of individual species and biodiversity or changes to species composition.

In addition to the impact assessment completed by Ecobiological addressing EPBC Act, from DEWHA assessment guidelines 2009, there are four principal threats most relevant to judgements on significance of impact assessment for migratory shorebirds;

- Habitat loss;
- Habitat degradation;
- Disturbance; and
- Direct Mortality.

Development Description

Development Buffer Zone

Whilst Lot 1001 shares a common boundary with RAMSAR NPWS estate, a significant buffer zone has been provided between the development of Lot 1001 and the RAMSAR boundary. In the north east corner, this measures approximately 380m to the riparian zone and approximately 415m to the edge of the perimeter road of the development. This buffer distance increases to 540m to the riparian zone and 575m to the perimeter road at the southern extent of the common boundary with RAMSAR. At the southern boundaries, the buffer distance between Lot 1001 and RAMSAR significantly increases to approximate range of 1-2km.

From the Significant Impact Guidelines for Migratory Shorebird Species, recommended buffer zones are quoted at ranging from 165m to 255m. It is demonstrated above that Lot 1001 development significantly exceeds this buffer, for the majority 2-10 times the recommended minimum buffer distance.

Development Type

The development of Lot 1001 is for a business and industrial park. The focus of the development will be to avoid development that would have an adverse impact on the surrounding environment. NEH propose to own all lands within the site and lease to operators, ensuring a high level of control over the nature of activities. Any future development of the land would of course also require separate authority approvals and environmental assessment adding a further layer of protection to the environment.

Wetlands Interface Strategy: Development of Lot 1001 adjacent to Lot 1002 conservation & TWRP

Review was undertaken of the TWRP project objectives, SEPP14 wetland objectives and mostly informal consultation with both NPWS and WRL (hydrological and hydraulic engineers to the TWRP project) that freshwater discharge to the wetlands downstream needs to be limited or even reduced if possible for enhancement of the TWRP efforts to restore the type of coastal saltmarsh as habitat for migratory shorebirds. WRL identify the potential for stormwater runoff volumes from proposed development to increase to the wetland via existing drains having direct connection to the wetland. Furthermore, the regional groundwater catchment of approximately 6 km^2, emanating from within the Tomago Sandbeds upslope of the TWRP project, also produces freshwater to the drainage system downstream. The groundwater commonly expressing as surface water at the lower end of the catchment also detrimentally pushes the boundary of

fresh/brackish water further downstream reducing the potential tidal inundation area extents necessary for the coastal saltmarsh restoration. The groundwater flows are dependent on climatic conditions, rainfall and the pumping regime of Hunter Water Corporation in the Tomago Sandbeds.

During master planning of Lot 1001, it was evident that a continuation of the NPWS levee system from Stage 1 of the TWRP could be continued along the boundary of Lot 1001. The NPWS levee was installed adjacent to the North South Drain as Stage 1 of the TWRP, providing a limit to landward tidal inundation/salt water so as not to enter adjoining private property. Located close to boundaries, it also maximised the extent of tidal inundation/saltmarsh restoration area. It also however served purpose to restrict and limit groundwater expressing as surface water runoff from upstream entering the TWRP, having controlled release via floodgates through existing open drainage networks from the upslope properties essentially bypassing the project draining at low tides. The perimeter berm (levee) to Lot 1001, would provide benefit by increasing the scope and opportunity for further coastal saltmarsh extension work. Whilst wetland management would be to replicate, at least initially, the same freshwater discharge regimes into the retained freshwater wetland and Lot 1002, the curtailing of excess freshwater discharge to the Hunter River estuary would be beneficial for any potential assessment of future extension of the TWRP across Lot 1002. Furthermore the opportunity for assessment of TWRP extending over the retained freshwater wetland portion of Lot 1001 via the floodgate on the North South Drain appears to be an option.

The interface strategy with the adjoining wetlands has the following key points:

1. Buffer zone setback from RAMSAR ranging from a minimum of 380m to approximately 2km;
2. Maintain hydrological pathways, post development mimicking existing conditions;
3. A freshwater wetland (currently brackish) area of approximately 12.5 hectares conserved as undisturbed area within Lot 1001 adjacent to the development layout;
4. Future opportunity, for assessment by others, to add part of Lot 1001 to the area of the TWRP via tidal inundation from the North South Drain. This will increase the coastal saltmarsh habitat by a further 13.2 hectares (current Stage 2 works at the time of writing is a further 55 hectares with floodgate installation).
5. An additional 10 hectares of overflow wetland rehabilitation area (freshwater wetland) within Lot 1001 replacing existing pasture grass of no environmental value;
6. Creation of frog habitat and other species associated within all freshwater wetlands of Lot 1001. This area may be of benefit located on the fringe to the TWRP providing frog relocation opportunity from the areas being tidally inundated with saline conditions not suiting frogs;
7. Enhancement of the TWRP, allowing restoration of the coastal saltmarsh and control over freshwater inundation of groundwater and surface water from the upstream catchment.
8. Discharge Points to remain through the levee at all existing discharge locations to Lot 1002. Initially proposed to be set in the position of continuing stormwater discharge matching pre to post development flow regimes. The discharge points will include pits installed with adjustable valve outlets for adaptive management options in the future.
9. Existing SEPP 14 wetland of Swamp Oak Rushland forest marginally encroaching the south eastern boundary of Lot 1001 site to be retained undisturbed.

10. Retain groundwater regime over the boundary of Lot 1002 to the Groundwater Dependent Ecosystems.
11. Majority, any excess overflow freshwater (stormwater and groundwater) discharge to the Hunter River Estuary.
12. The perimeter berm along the boundary shall be a crest level of approximately 2mAHD adjacent to the filled development area for conveyance and the crest reduce to approximately 1.2mAHD along the southern boundary where there is no filling works adjacent. Open drainage shall be excavated on the internal edge. The total width comprising approximately 35m riparian zone width of the setback from Lot 1001 boundary, perimeter berm, open drain excavation, overbank channel width and fill embankment to a minimum road verge height of 2.5mAHD.
13. A clear delineation point for TWRP consistent with NPWS aligning to private property boundaries;
14. Soil and Water Management Plan, including erosion and sediment control as part of the Construction Environmental Management Plan (CEMP) required with each stage of development.
15. Acid Sulphate Soils Management Plan by Douglas Partners to be included in the CEMP.

Numbering from the above points have been represented on the figure below.

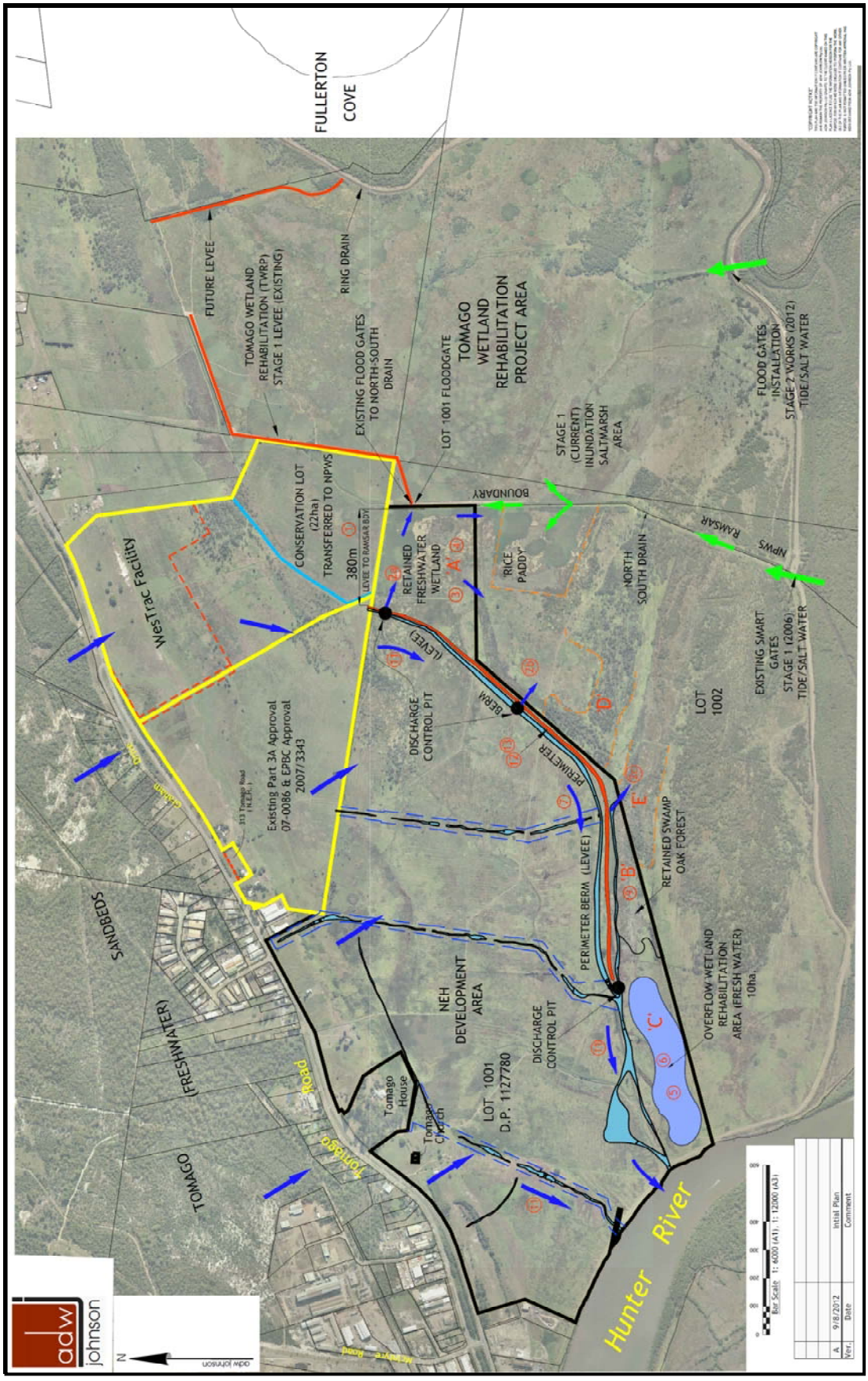

Figure 50 - Interface Strategy Tomago Wetland Rehabilitation Project & Lot 1001 NEH Business & Industrial Park.

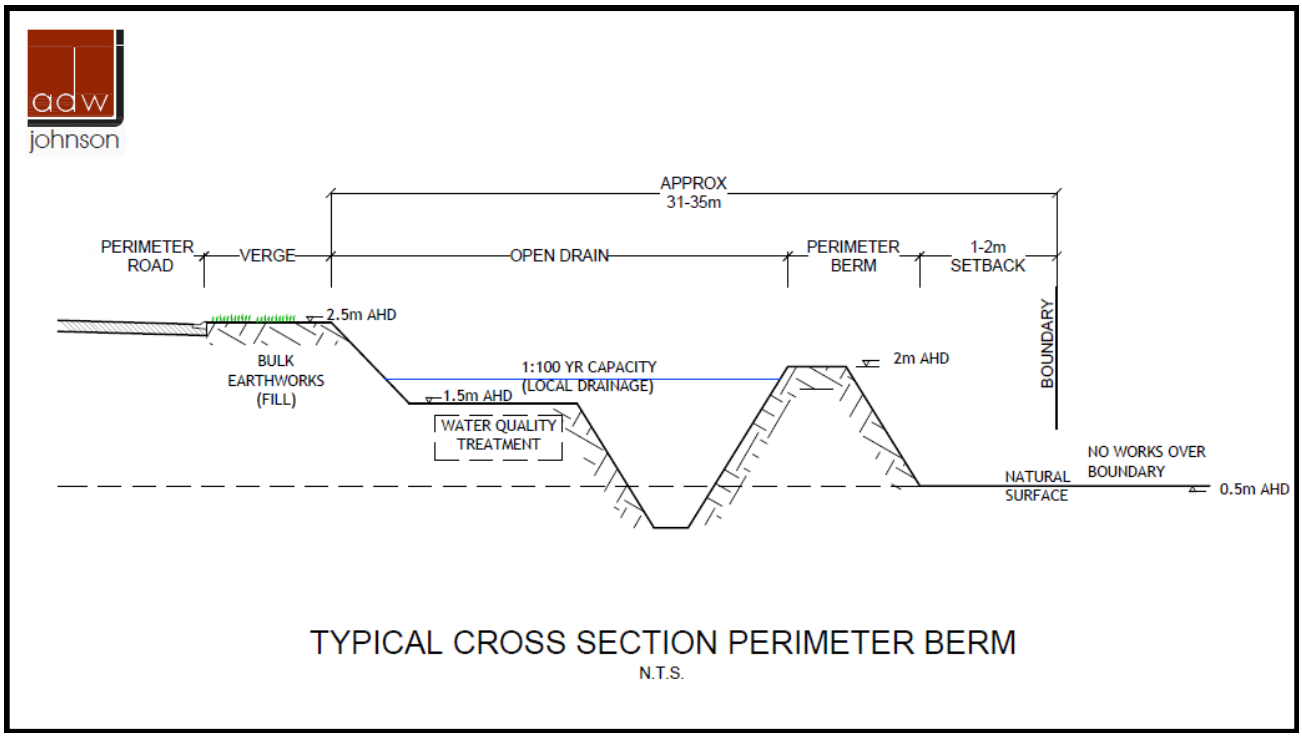

Figure 51 - Typical Cross Section Perimeter Berm.

Essentially the Lot 1001 development through the above described management has a freshwater wetland established along its downstream perimeter (south eastern boundary) as a sacrificial benefit to the TWRP and conservation of wetlands downstream in Lot 1002.

Significant monitoring and management plans based on ecology (terrestrial flora and fauna and aquatic), stormwater and groundwater assessments are proposed. The relevant areas of Lot 1001 and Lot 1002 have been labelled 'A'-'E' matching the ADWJ Interface Plan figure. Details of management and monitoring for areas 'A' – 'E' are described below.

'A' – Retained Freshwater Wetland Complex, Lot 1001

The Retained Freshwater Wetland Complex provides the significant buffer to the RAMSAR boundary as previously discussed. This area is immediately upslope of Lot 1002 and within Lot 1001 boundaries for management and monitoring. The post development discharge point from the development area through the perimeter berm will match invert levels and dimensions through a pit structure to mimic the pre development flow regime. Any excess flows will continue downstream along the berm. The pit provides sufficient adjustment for increasing or decreasing flow into the freshwater area, depending on monitoring outcomes and providing flexibility for future conservation management. Best practice stormwater management treatment for stormwater runoff will be in place prior to outlet at this point. This will be a stormwater monitoring outlet point. A groundwater monitoring well located adjacent will be used to track groundwater elevations. Refer to Ecobiological Management and Monitoring Plan for this area including vegetation and weed monitoring transects and Flora Monitoring Quadrats.

The key hydrologic management objective to the freshwater wetland complex is drying hydrology. This has been facilitated post development with an open excavated drain adjacent to the perimeter berm, taking dry weather flows past the discharge point to the Hunter River, so there is no continuous run on of base flows. This mimics pre development discharge regimes whereby previously this water ponded and waterlogged within Lot 1001. Due to development extents, excess discharges along the riparian zone of the perimeter berm to the Hunter River. The Hunter River is considered 'deep open water' of the wetland classification and under the HCCREMS guidelines not subject to hydrologic management objectives (although subject to water quality improvement best management practices). It is considered that for contingency, constructed pit inverts are still built in at lower invert levels similar to the open drain, however remain closed based on the preferred initial setting of no change to the flow regime.

'B' – Retained Swamp Oak Forest, Lot 1001

The retained Swamp Oak Forest of Lot 1001 is fed by overflows from the southern most existing man made drain of Lot 1001. This drain will remain intact post development to continue this function. The perimeter berm will be constructed upslope adjacent to this existing drain. The key hydrologic management objective to the 'wet swamp forest' (HCCREMS classification) is drying hydrology. This has been facilitated with an open excavated drain adjacent to the perimeter berm, taking dry weather/base flows past the discharge point and the overflow wetland rehabilitation area. This mimics pre development discharge regimes whereby previously this water ponded and waterlogged within Lot 1001. Pit control will be in place to mimic pre development discharge distribution. The overflow wetland rehabilitation area will provide ponding area for any excess stormwater runoff during high tides. The pit control will be adjustable in design. Best practice stormwater management treatment for stormwater runoff will be in place prior to outlet at this point. This will be a stormwater monitoring outlet point. A groundwater monitoring well located adjacent will be used to track groundwater elevations. Refer to Ecobiological Management and Monitoring Plan for this area including vegetation and weed monitoring transects and Flora Monitoring Quadrats.

'C'-Overflow Wetland Rehabilitation Area, Lot 1001

The Overflow Wetland Rehabilitation Area has no water quality management function. It is making good of an area having only minimal environmental value, containing only pasture grasses. The area is an opportunity to create a freshwater wetland. Following a strip depth of approximately 300mm thick for removal of the existing exotic grass seed bank, elevations will be suitable for freshwater wetland establishment. The area will provide for ponding during high tide and/or high river levels, without discharge to Lot 1002. The area is considered likely to be suitable habitat for amphibians. Flora Monitoring transects will be completed.

'D'-Swamp Oak Forest North, Lot 1002

The Swamp Oak Rushland Forest adjacent to Lot 1001 is a waterlogged area. Groundwater crosses the boundary from Lot 1001 into Lot 1002 at this point. The groundwater modellers indicate this groundwater accounts for only 5% of the total wetland recharge. Minor stormwater overflows enter the area midway along the south eastern boundary from Lot 1001. These are overflows from an internal freshwater wetland, ponding in Area D.

The post development discharge point from the development area through the perimeter berm will match invert levels and dimensions through a pit structure to mimic the pre development flow regime. Any excess flows will continue downstream along the berm. The pit provides sufficient adjustment for increasing or decreasing flow into the freshwater area, depending on monitoring outcomes and providing flexibility for future conservation management. Best practice stormwater management treatment for stormwater runoff will be in place prior to outlet at this point. This will be a stormwater monitoring outlet point. A groundwater monitoring well located adjacent will be used to monitor groundwater elevations. Refer to Ecobiological Management and Monitoring Plan for this area including vegetation and weed monitoring transects and Flora Monitoring Quadrats. All monitoring will be restricted to be within Lot 1001.

The key hydrologic management objective to the 'wet swamp forest' (HCCREMS classification) is drying hydrology. This has been facilitated with an open excavated drain adjacent to the perimeter berm, taking dry weather/base flows past the discharge point. This mimics pre development discharge regimes whereby previously this water ponded and waterlogged within Lot 1001. Due to development extents, this is replaced by discharging this excess to the Hunter River. The Hunter River is considered 'deep open water' of the wetland classification and under the HCCREMS guidelines not subject to hydrologic management objectives (although subject to water quality improvement best management practices). It is considered that for contingency, constructed pit inverts are still built in at lower invert levels similar to the open drain, however remain closed based on the preferred initial setting.

'E'-Swamp Oak Forest South, Lot 1002

The Swamp Oak Rushland Forest adjacent to Lot 1001 is a waterlogged area. Groundwater crosses the boundary from Lot 1001 into Lot 1002 at the southern boundary corner. The groundwater modellers indicate this groundwater accounts for only 5% of the total wetland recharge. Minor stormwater overflows enter the area as overflows from the upstream end of the southern most open drain.

The post development discharge point from the development area through the perimeter berm will match invert levels and dimensions through a pit structure to mimic the pre development flow regime. Any excess flows will continue downstream along the berm. The pit provides sufficient adjustment for increasing or decreasing flow into the freshwater area, depending on monitoring outcomes and providing flexibility for future conservation management. Best practice stormwater management treatment for stormwater runoff will be in place prior to outlet at this point. This will be a stormwater monitoring outlet point. A groundwater monitoring well located adjacent will be used to monitor groundwater elevations. Refer to Ecobiological Management and Monitoring Plan for this area including vegetation and weed monitoring transects and Flora Monitoring Quadrats. All monitoring will be restricted to be within Lot 1001.

The key hydrologic management objective to the 'wet swamp forest' (HCCREMS classification) is drying hydrology. This has been facilitated with an open excavated drain adjacent to the perimeter berm, taking dry weather/base flows past the discharge point. This mimics pre development discharge regimes whereby previously this water may have evaporated or evapotranspired from the land of Lot 1001. Due to development extents, this is replaced by discharging this excess to the Hunter River. The Hunter River is considered 'deep open water' of

the wetland classification and under the HCCREMS guidelines not subject to hydrologic management objectives (although subject to water quality improvement best management practices). It is considered that for contingency, constructed pit inverts are still built in at lower invert levels similar to the open drain, however remain closed based on the preferred initial setting.

Management and Monitoring Plans for Wetland Protection

The management and monitoring plans have been specified by Ecobiological, refer to **Appendix D**. Groundwater contingencies have been specified by Environ Australia, refer to **Appendix U**. Stormwater Management and Monitoring specified by BMT WBM, **Appendix G**.

Addressing Potential Impacts

HCCREMS identifies the following potential impacts from development upstream of wetlands:

- *Alterations to hydrology – volume of runoff;*

The plan for stormwater flow is to maintain the same hydrology. This includes maintaining all four (4) locations of aboveground stormwater discharge for the same flow regime. Excess volume of runoff diverted along the perimeter berm to the Hunter River.

- *Physical disturbances as a result of altered hydrology – flood damage of vegetation, erosion and/or deposition of substratum;*

The same hydrology will be maintained post development as described above. Soil and Water Management Plan including erosion and sediment controls such as and sediment fencing will be installed along the boundary of works to minimise any potential for erosion or deposition during construction. Following completion of the berm and outlet protection works at this discharge connection points, the potential for this to occur has been minimised. Barrier fencing will be installed during construction to define the 'no-go' area over the retained freshwater wetland of Lot 1001.

- *Alterations to chemical and physical properties of substratum – wetting and drying pattern, water quantity, quality, pH, redox potential, dissolved oxygen, nutrients, toxicants, salinity and suspended solids;*

Groundwater monitoring will be used to indicate that drying patterns are being achieved post development. Flexibility of the adaptive management system allow for ongoing adjustment. There is no change to the potentiometric contours at the boundary following development, so the potential chemical/physical changes listed are unlikely.

- *Direct encroachment on biotic ecosystems – land clearing, filling;*

Filling and clearing is limited to within Lot 1001, so there is no direct encroachment on Lot 1002 or RAMSAR from filling.

- *Loss of individual species and biodiversity or changes to species composition;*

By maintaining, managing and monitoring the same flow regimes pre and post development, no vegetation changes are anticipated as a result of the development on Lot 1001.

Habitat Loss

Ecobiological in their ecological assessment has concluded that there is no direct loss of migratory shorebird habitat in the development of Lot 1001. Groundwater and surface water modelling, management and monitoring have all been part of the assessment and commitment proposed in place to maintain the same groundwater and surface water flow regimes post development. Flora and Fauna monitoring and Weed monitoring will be undertaken at discharge points within Lot 1001. Adaptive management strategies are in place if monitoring proves otherwise. This strategy provides confidence that the potential for indirect loss of habitat downstream on Lot 1002 is significantly low risk.

Habitat degradation

From DEWHA 2009, shorebirds and their wetland habitats can be very sensitive to changes to hydrology or water quality, fragmentation of sites and exposure to acid sulphate soils. The assessment guidelines further suggest implementation measures to manage issues such as runoff, water pollution, water table changes and invasive species.

Hydrology is being managed, maintaining the current discharge points for stormwater. No change is proposed, however development will be setback minimum 380m from the RAMSAR boundary and the freshwater wetland area adjacent within Lot 1001 remain undisturbed. Hydrologic pathways and flow regimes are being matched post development. Water quality is being managed with best management practices of gross pollutant traps and biofiltration swales constructed in the fill profile and being monitored at the outlets prior to discharge.

Hydrogeology has been addressed with groundwater modelling. Groundwater modelling has been undertaken to confirm existing levels and response to rainfall together with flow directions for groundwater dependent ecosystems. A post development scenario has then been modelled to predict responses to filling of the land and development with impervious surfaces. Potentiometric contours of groundwater remain the same as they cross the Lot 1002 boundary following development. Irrespective of the modelling, the groundwater modellers indicate that groundwater recharge of Lot 1002 wetlands attributable from Lot 1001 is less than 5% of total wetland recharge, making any potential risk of change on groundwater quantities and levels minor.

Adaptive Management controls remain in place at the discharge locations. This provides flexibility for changes based on monitoring outcomes and future management of the wetlands adjacent.

Outline of Weed Management Plan is described by Ecobiological.

Acid Sulphate Soils Management Plan for all excavations is provided by Douglas Partners.

The development boundaries of Lot 1001 are adjacent to the fringe of the wetland and Tomago Road and existing industrial development, not fragmenting the RAMSAR wetlands in any way. As described earlier, buffer zone distances range from a minimum of 380m to 2km.

Disturbance

Mitigating impacts from disturbance include a significant buffer exceeding recommended buffer zones. The buffer distance from the nearest edge of development to the RAMSAR boundary is a minimum of 380m to a maximum of approximately 2km. From DEWHA 2009, recommended buffer zones are quoted from others ranging from 165m to 255m.

The perimeter berm and associated swale along the south eastern and eastern boundaries provide a physical limitation to discourage access. The width of the berm and swale is approximately 35m. The swale will be mostly wet, inundated with surface or groundwater. Berm construction is appropriately controlled with sediment and barrier fencing, making Lot 1002 and the conservation area 'No-go' areas to contractors during construction of the berm.

Allocation of an existing access road to Lot 1002 boundary has been maintained within the development proposal leading off from the main perimeter road to the south east corner. This will be gated and padlocked as per the current system. The gate is used by NPWS, RAMSAR – TWRP staff, Hunter Bird Observers Club and DECCW.

Direct Mortality

Monitoring of stormwater discharge is proposed as an additional safeguard. Domestic pets are more associated with residential development.

Conclusion

Existing hydrological pathways have been identified and will be mimicked post development of Lot 1001. Site design and wetland interface strategy has been completed so as not to have a direct impact or indirect impact on the retained freshwater wetland EEC, retained Swamp Oak Rushland Forest EEC and Swamp Oak Rushland Forest EEC (SEPP14) on adjoining Lot 1002. It has been demonstrated through the buffer zone setback of minimum 380m, the existing proximity of the North South Drain for the development of Lot 1001 to not be impacting the RAMSAR TWRP. Guidelines for impact assessment on Migratory Shorebird Species has been satisfactorily addressed, indicating no potential impacts. Management and Monitoring is proposed for the ongoing review of outcomes vs target objectives. Flexibility for adaptive management on potential future conservation projects adjacent to the land.

7.0 Draft Statement of Commitments

The following section outlines the proponent's commitment to implement construction and operational strategies relating to environmental management and mitigation measures. The section details how the proposal and its environmental safeguards will be implemented and managed in an integrated and feasible manner.

7.1 PLANS, DOCUMENTS AND APPROVALS

The proposed development will be completed in accordance with the submitted plans and descriptions of the proposed development provided in this Environmental Assessment Report.

Any changes to the proposed development will require further approval of the relevant authorities.

The proposed development will be carried out in accordance with all approvals granted by relevant authorities.

7.2 SUMMARY OF MANAGEMENT PLANS

The following management plans will be prepared prior to commencement of construction for each stage:

- Construction Environmental Management Plan (CEMP);
- Vegetation Management Plan;
- Plan of Management for Control of Noxious Weeds;
- Pre Clearing Survey;
- Soil and Water Management Plan (including stormwater, erosion and sediment control and monitoring);
- Wetland Management & Monitoring Plan (WMMP);
- Groundwater Management Plan (including monitoring);
- Construction Noise Management Plan (CNMP);
- Aboriginal Heritage Management Plan;
- European Heritage Management Plan;
- Construction Traffic Management Plan;

- Acid Sulphate Soils Management Plan (attached to EA Report as **Appendix V**);
- Landscape Management Plan;
- Waste Management Plan; and
- Vector Management Plan.

7.3 ECOLOGY

7.3.1 Flora & Fauna

- The proponent is committed to conservation of suitable offset lands in perpetuity, consistent with OEH's offsetting principles. An appropriate mechanism will be confirmed with OEH in due course.
- A Vegetation Management Plan will be prepared by a suitably qualified and experienced bush regeneration company prior to clearing.
- A Plan of Management for the control of noxious weeds will be prepared prior to the commencement of work.
- Pre clearing surveys and supervision of habitat tree felling will be undertaken by an appropriately qualified and experienced ecologist.
- Use of insecticides and herbicides on the subject site will be avoided where possible.
- 15 suitably sized nest boxes for insectivorous bats will be attached to trees on Lot 1001 or 1002. These boxes will be installed and certified by an appropriately qualified fauna ecologist. A copy of the certification will be supplied to the Principal Certifying Authority prior to the commencement of works.
- Surface water connections between Lot 1001 and Lot 1002 will be maintained at the same discharge points as existing conditions to maintain the hydrological pathways and flow regime post development.
- A Wetland Management and Monitoring Plan (WMMP) will be prepared. This document will contain the monitoring requirements for:
    - The boundary interfaces with the Ramsar wetland and Lot 1002;
    - Retained Freshwater Wetland Complex and Swamp Oak Forest habitat;
    - The Overflow Wetland Rehabilitation Area; and
    - Proposed landscaped watercourses and rehabilitation areas for the adjacent Ramsar wetland (Hunter Wetlands National Park).

The below figure shows the monitoring locations.

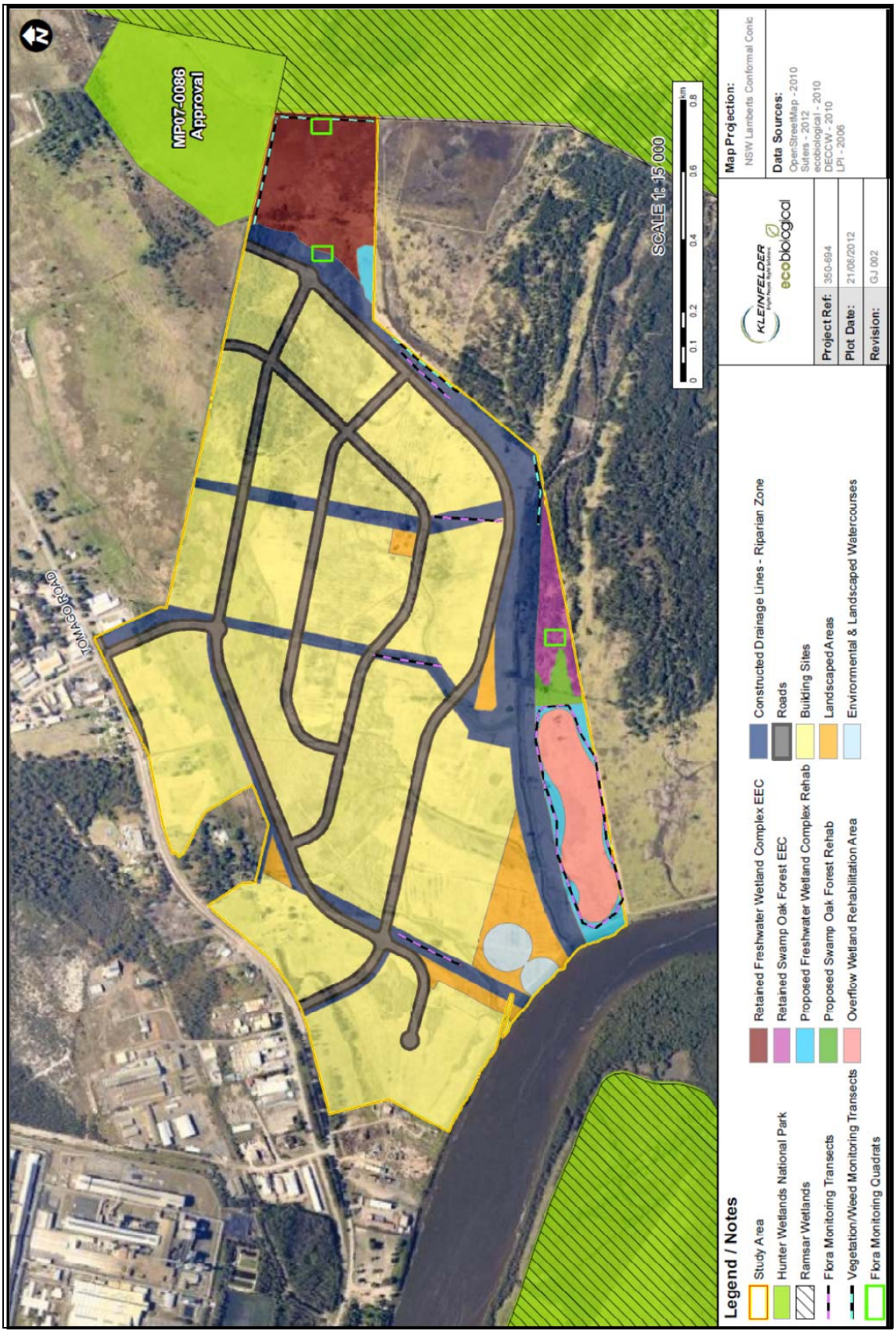

Figure 52 - Proposed Monitoring Locations.

7.3.2 Aquatic Ecology

- Proposed road culvert crossings where the drainage lines cut in below natural surface will be designed in accordance with "Why do fish need to cross the road? Fish passage requirements for waterway crossings, NSW Fisheries" (Fairfull & Witheridge, 2003);
- Areas of Mangroves to be clearly marked on the ground and no unauthorised clearing or stockpiling of materials is to occur within the mangroves during works;
- Where possible, construction works on the existing drainage lines are to commence upstream and move downstream to allow fish an escape path downstream;
- The Wetland Management Plan is to include landscaping of the vegetated channels and linked pond, design providing for fish refuge where possible; and
- Water quality monitoring of the Overflow Wetland Rehabilitation Area including 3 quadrats with a minimum area of 20 x 20m per quadrat within the area, 3 within an environmental zone. Contractors will be made aware of the location of the mangroves and the ecological importance, including the legal ramifications of damage or removal of mangroves.

7.4 TRAFFIC & ACCESS

The construction of:

- Central Intersection - A traffic signal controlled intersection;
- Western Intersection – A traffic signal controlled intersection; and
- Internal road network.

Detailed traffic assessments of each of the four (4) stages of the development will be undertaken prior to development to determine:

- Required timing of construction of the Central and Western intersections;
- Capacity and design needs of the proposed intersections (internal and with Tomago Road); and
- Appropriate traffic control measures.

Intersections with Tomago Road will need to be undertaken in consultation with NSW Roads & Maritime Services (RMS), entering into the Works Authorisation Deed (WAD) process for approval and construction.

All internal road construction works will be undertaken in accordance with Port Stephens Council standards.

7.5 WATER QUALITY – GROUNDWATER AND STORMWATER

During the detailed design phase of each stage, a Stormwater Management Plan will be prepared. This will be to demonstrate that the water quality target objectives of the design stage meet the load-based reduction stormwater quality targets of 85%-90% for Total Suspended Solids, 60-65% for Total Phosphorus and 45-50% for Total Nitrogen.

Water quality monitoring will be undertaken once the proposed stormwater management strategy is implemented. The monitoring will provide data regarding the pollutant export rate of the site and performance of stormwater treatment measures constructed within the site. The management plan will include maintenance and inspection guidelines for all stormwater management measures that will address:

Monitoring Locations

Water quality monitoring sites will be established in accordance with the BMT WBM figure below, subject to adjustment with detailed design of the stage.

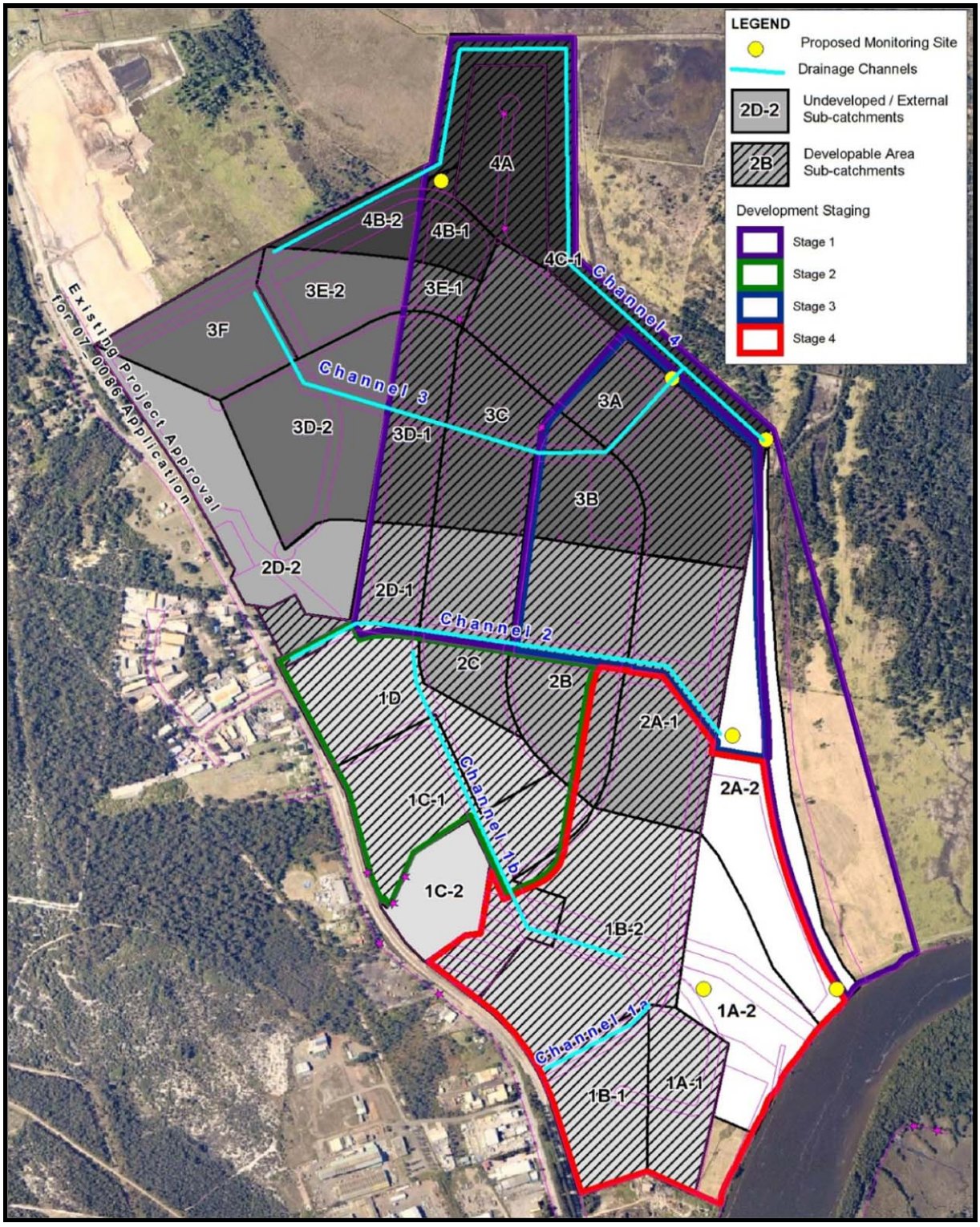

Figure 53 - Surface Water Quality Monitoring Sites.

Monitoring Frequency

Baseline water quality monitoring will be undertaken every three months for a period of 12 months. Following completion of the baseline monitoring and construction activities, regular surface water quality monitoring will be undertaken at the following intervals:

- Category 1 – 3 monthly sampling;

- Category 2 – 6 monthly sampling; and
- Category 3 – yearly sampling.

Flow Monitoring

Flow monitoring will be undertaken in the channel adjacent to the perimeter berm.

Monitoring Parameters

Key parameters to be monitored include:

- Category 1 Parameters – pH, temperature, electrical conductivity, salinity and turbidity;
- Category 2 Parameters – cations, anions, suspended solids, nutrients; and
- Category 3 Parameters – heavy metals, TPH, PAHs, BTEX, pesticides, PCB, hydrogen cyanide, phenols.

Observations of gross pollutants (i.e. manufactured material greater than 5mm in any dimension), coarse sediment deposits, visible oil/ grease and odour will also be noted during the monitoring.

Monitoring & Analysis Standards

The sampling of surface waters will be undertaken in accordance with AS/NZS 5667.1:1998 Water Quality-Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples. Analysis of water samples will be undertaken at a NATA accredited Laboratory. Sample preservation and handling techniques will be undertaken as specified by the Laboratory or by AS/NZS 5667.1:1998 Water Quality-Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.

The relevant water quality criteria will initially be established by reference to the ANZECC Guidelines and default trigger values for protection of estuarine aquatic ecosystems. Locally specific criteria/targets will be established in accordance with appropriate statistical methods outlined in the ANZECC Guidelines referencing all available background data and on site water quality monitoring results.

- Monitor three of the existing groundwater monitoring wells shown on the ADWJ Groundwater Monitoring Plan Figure below and located on the south eastern boundary providing that these wells are immediately down-hydraulic gradient of the proposed perimeter berm (ie, on the wetlands side). If in the event that the perimeter berm is installed on the eastern (wetlands) side of the existing wells, installation of three new groundwater monitoring wells immediately down-hydraulic gradient of the proposed perimeter berm (ie, on the wetlands side), along the perimeter will be undertaken;

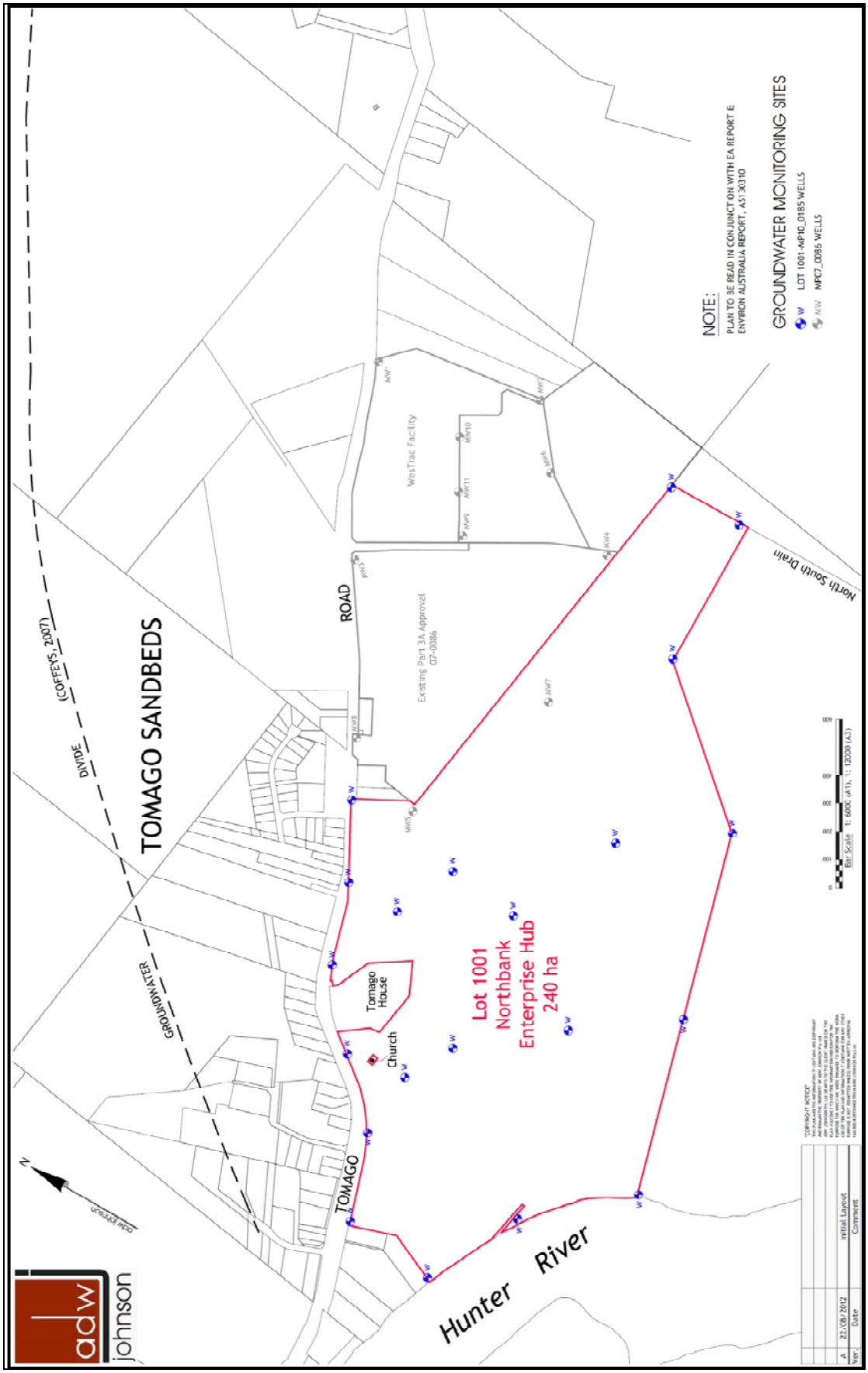

Figure 54 - Groundwater Monitoring Plan.

- Monitoring of groundwater levels in these wells to be undertaken, prior to development, to establish baseline conditions; (ie, groundwater level fluctuation, based on seasonal and regular tidal cycles), with at least one of the wells instrumented with a data logger; and

- Monitoring of water levels in these three new wells be included in the groundwater monitoring programme undertaken over key site development/construction periods.

Maintenance Plans

Maintenance inspection forms and plans will be developed for all the proposed stormwater management measures during the detailed design phase of the development and will include the following information:

- Inspection frequency; and

- Maintenance frequency;

Data collection/storage requirements (e.g. information collected during inspections):

- Work method statements covering aspects such as:

    - Equipment needs;
    - Maintenance techniques;
    - Occupational health and safety;
    - Public safety;
    - Environmental management considerations;
    - Disposal requirements (polluted water and solid waste);
    - Access issues;
    - Stakeholder notification requirements; and
    - Data collection requirements (if any).

7.6 SOIL EROSION & SEDIMENTATION

The following will be undertaken:

- A Soil & Water Management Plan will be required at detailed design stage with each new stage of the development. The plans will outline the temporary control measures for the protection of the downstream receiving waters during earthworks and construction. Sediment fencing will be installed to boundaries and work areas. The plan will form part of the Construction Environmental Management Plan; and

- Stockpiles will be protected by sediment fencing.

The above measures will be installed prior to commencement of earthworks. All controls will be designed in accordance with *'Managing Urban Stormwater – Soils & Construction Volume 1'* (Landcom, 2004) – 'Blue Book'.

Where works are proposed adjacent to the southern and eastern boundaries, the National Parks Areas and retained freshwater wetland area adjoining the development will be temporarily fenced off with barrier fencing so that there are no works disturbance to these adjoining areas.

Sediment basin sizing will be dependent on the size of the stage and fill import material characteristics. Sizing will be undertaken in accordance with the 'Blue Book' at detailed design stage, specified in a Soil & Water Management Plan for a development stage. Standard monitoring techniques for Total Suspended Solids will be required during construction.

7.7 ACID SULPHATE SOILS

The Acid Sulphate Soils Management Plan by Douglas Partners (August 2012) for the proposed Northbank Enterprise Hub Business and Industrial Park will be included in the Construction Environmental Management Plan for each stage.

7.8 EUROPEAN HERITAGE

The following will be undertaken:

- Reveal WWII Heritage Items

  Clear the overgrowth for further physical assessment of each identified heritage item on site, including draining of the flooded battery command post.

- Assess and Interpret the Fabric of the WWII Heritage Items

  Review the assessment of significant fabric that remains hidden, against criteria for state and national heritage significance and incorporate such findings into an overall heritage interpretation strategy for the site. The Heritage Interpretation Strategy must be undertaken by an experienced heritage interpretation specialist and must be in place within five (5) years of project approval.

  Amendments to the proposed subdivision layout as the design concepts develop will continue to respect the significance of the WWII fabric as a group of items.

- Magazines (Ammunition Bunkers)

  Dedicate the curtilage of the anti-aircraft artillery site as a public park, to be known as Gunner Heritage Park in commemoration of the wartime role of the artillery battery.

  Prior to burial of the magazines, a conservator experienced in in-situ conservation will be contacted for advice regarding the optimum way to conserve the fabric of the magazines (ammunition bunkers) once buried in fill. The sites will be marked and interpreted in their individual contexts as well as in their wider relationship with the gun position. Each magazine will be suitably marked at ground level. These markers will, within a military theme, reflect the design and fabric of the structures while providing information as to their function, significance and role.

- Gunner Heritage Park

  The development will conserve and maintain the fabric of the gun position itself, including the gun emplacements, Command Post and Director Post. The site will be cleared of undergrowth; gun pintle lugs and their base plates will be stabilised and conserved; the emplacements themselves will be stabilised, repaired as necessary and conserved.

  Access steps and disabled access will be made safe for public use in providing access to the relics. A central interpretative marker will be placed near the Command Post, the design and fabric of which will reflect an artillery theme. This will provide information on the history and nature of the entire site, including the relationships between all the extant visible and invisible relics.

- Monitor the Effects of Development

  Future development within the Tomago House curtilage area will be subject to Heritage Impact Assessment at the DA stage.

  The below plan demonstrating an extended curtilage of Tomago House and outbuildings to incorporate its chapel and the site of its stables to create a buffer zone will be adopted. Suitable development in this area will be permitted if the Development Application is supported by a Heritage Impact Assessment prepared by a suitably qualified expert.

  The proponent will make formal application under the NSW Heritage Act 1977 to the NSW Heritage Council to extend the curtilage of Tomago House as shown in the below figure within one (1) month of the project approval.

Figure 55 - Proposed Heritage Curtilage Area around the Tomago House, Chapel and Stables site.

- Historic Landscape

  Any embankments created by the filling of the site to the 1 in 100 year flood level will be treated to disguise the sides of the embankment with appropriate plantings.

7.9 HISTORICAL ARCHAEOLOGY

The following will be adopted:

- In the event that historical archaeological relics (not previously assessed or anticipated) are found during the works, all works in the immediate vicinity are to cease immediately and a qualified archaeologist be contacted to assess the situation and consult with the Heritage Branch of the OEH regarding the most appropriate course of action, as required by the *NSW Heritage Act* 1977.

- In the event that Aboriginal archaeological material or deposits are encountered during earthworks, all work within a 50 to 100m radius must cease immediately to allow a suitably qualified archaeologist to make an assessment of the find. If required, the archaeologist will consult with the Regional Archaeologist in the Office of Environment and Heritage (OEH) and the relevant Aboriginal stakeholders, regarding the find.

- Should the proposed development be altered significantly from the proposed concept design, then a reassessment of the heritage / archaeological impact will be undertaken.

- Should any Historical Archaeological excavation be required, the Excavation Director will demonstrate that works are able to satisfy the Heritage Council endorsed excavation criteria.

7.10 ABORIGINAL ARCHAEOLOGY

General

- The persons responsible for the management of works on site will ensure that all staff, contractors and others involved in construction and maintenance related activities are made aware of the statutory legislation protecting sites and places of significance. Of particular importance is the National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation 2010, under the National Parks and Wildlife Act 1974;

- The involvement of the registered Aboriginal stakeholders in the ongoing management of the Aboriginal cultural materials within the project study area (specifically the low dune) will be promoted and included in the Environmental Management Plan and / or the Aboriginal Heritage Management Plan; and

- A cultural awareness program will be included as part of the site induction program and developed with the registered Aboriginal stakeholders and form part of the Environmental Management Plan and / or the Aboriginal Heritage Management Plan.

PAD & Sites

- If the identified Tom/PAD1 will be impacted upon by any future development an archaeological subsurface investigation will be required in accordance with the Code of Practice for Archaeological Investigations of Aboriginal Objects in NSW prior to works starting; and

- If sites Tom/1 and/or Tom/2 will be harmed by any future development an Aboriginal Heritage Impact Permit (AHIP) for the surface collection will be required prior to works starting.

7.11 UTILITIES

The proposed development be undertaken in accordance with the requirements of the relevant utility authorities, and evidence of the necessary approvals will be provided to the Department prior to construction works.

7.12 ACOUSTICS

A Construction Noise Management Plan (CNMP) will be prepared to manage noise emissions, and submitted, as required, prior to construction.

Specifically, the following will be included in the CNMP:

- **Daytime Construction Noise** - In accordance with OEH recommendations (*Interim Construction Noise Guideline*) construction will be carried out during recommended standard hours (Monday – Friday 7am to 6pm; Saturday 8am to 1pm; and no work on Sundays or public holidays).

  The construction noise management level is 50dB(A),L_{10} for daytime works. When works exceed this level, noise management and minimisation practices shall be applied (as outlined below).

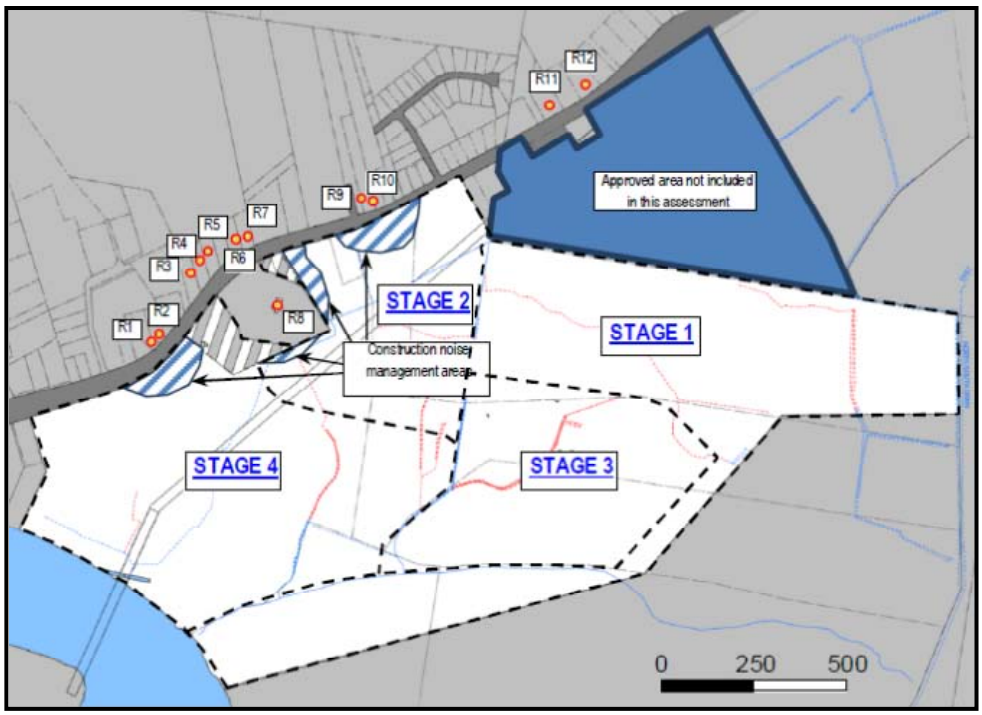

Figure 56 - Construction Noise Management Areas.

The above figure identifies the sections of the site (in Stages 2 and 4) that require construction noise management and minimisation practices to be applied. Practices will include, as appropriate:

Universal Work Practices

- Workers and contractors will be trained (such as at toolbox talks) to use equipment in ways to minimise noise.
- Site managers will check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied.
- Tenders, employment contracts, subcontractor agreements and work method statements

will include clauses that require minimisation of noise and compliance with directions from management to minimise noise.

- Use of radios or stereos outdoors where neighbours can be affected will be avoided.
- Overuse of public address systems will be avoided.
- Shouting, talking loudly and slamming vehicle doors will be minimised.
- Truck drivers will be informed of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (for example, minimising the use of engine brakes, and no extended periods of engine idling).
- A summary of approval or consent conditions that relate to relevant work practices, will be made available to a workplace noticeboard so that all site operators can quickly reference noise information.

Consultation & Notification

- Neighbours will be notified, within reasonable time, with information such as total expected building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. For any works outside standard hours, inform affected residents and other sensitive land use occupants between five and fourteen days before commencement.
- Information will be provided to neighbours before and during construction through media such as letterbox drops, meetings or individual contact.
- A website will be established for the project to provide information.
- A site information board will be established at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include after hours emergency contact details.
- A toll-free contact phone number for enquiries during the works will be created.
- A complaints handling register will be established.

Plant & Equipment

- All machinery and equipment will be regularly inspected and maintained to ensure it is in good working order.
- Equipment will be turned off when not being used.
- Machinery and equipment idling will be limited as much as practicable.

On Site

- As much distance as practically possible between the plant or equipment and residences and other sensitive land uses will be implemented.
- Site vehicle entrances will be located away from residences and other sensitive land uses.
- The design will seek to avoid the use of reversing alarms by designing the site layout to avoid reversing, such as by including drive through for parking and deliveries.
- Where feasible and reasonable, alternatives to the typical 'beeper' alarms will be considered (taking into account the requirements of the Workplace Health and Safety legislation).
- In all circumstances, the requirements of the relevant Workplace Health and Safety legislation will be complied with.

Work Scheduling

- Work to be undertaken during the recommended standard hours where possible.
- Onsite parking will be provided for staff and on site truck waiting areas will be provided away from residences and other sensitive land uses.
- Deliveries will be scheduled to nominated hours only.

- **Evening Construction Noise (6pm – 10pm)** – Noise emissions shall not exceed 40dB(A),$L_{eq(15}$ minute).

- **Night Construction Noise (10pm – 7am)** – Noise emissions shall not exceed 35dB(A),$L_{eq(15}$ minute).

- **Operational Noise & Sleep Disturbance** – Future industries will be required to submit noise impact assessments as part of the Development Application / approval process.

- **Cumulative Noise** – Cumulative noise emissions will not exceed the following:

Cumulative Noise Criteria (Industrial Sources)

55dB(A)$L_{eq\ (period)}$	Day (7am – 6pm)
45dB(A)$L_{eq\ (period)}$	Evening (6pm – 10pm)
40dB(A)$L_{eq\ (period)}$	Night (10pm – 7am)

- **Traffic Noise** – Criteria, $L_{eq\ (1\ hour)}$ between 7am and 10pm (day) is 68.3dB(A) and between 10pm and 7am (night) is 55dB(A) will be adopted.

7.13 AIR QUALITY

A Construction Management and Environmental Management Plan will be prepared to manage potential air and greenhouse gas emissions and submitted as required prior to construction.

Dust Control

Dust control measures will include the following:

- Covering loads where required;

- Amending of operations under excessive wind conditions including ceasing operations if required;

- Use of water tankers as required, to control dust;

- Rehabilitation through vegetation of surfaces to be left unsealed; and

- Truck wheel washes or other dust removal measures.

Greenhouse Gas

The following practices will be adopted to assist in the reduction of Greenhouse Gas emissions from construction activity at the project site:

Relating to diesel / petroleum consumption:

- Emissions from construction / transport vehicles and on site machinery will comply with the relevant Australian Standards.
- All vehicles and machinery will be regularly maintained to ensure proper and efficient working order and therefore minimise emissions.
- Optimum vehicle / equipment tire pressures will be maintained.
- The finished site topography will ensure that no excessive engine use is required.
- Construction / fill transport vehicles will be managed to reduce vehicle idling time on the site.
- Optimisation of incline / decline of roads within the construction area on the project site will be considered to reduce transport distances for vehicles entering / exiting the project site.

Relating to electricity consumption:

- Use of efficient construction equipment technology.
- Continued monitoring of site electricity usage and review of techniques to reduce usage (if possible).

Future development on each allotment within the proposed subdivision will be subject to separate Project / Development Application and Air Quality and Greenhouse Gas emissions will form a consideration of each individual application.

7.14 GEOTECHNICAL

Prior to construction, further geotechnical investigation and design to proceed with detailed earthworks and ground treatment design will be undertaken. This will include:

1. Undertake additional geotechnical investigation to fill in the data gaps and target the proposed development area. This would comprise a combination of bores and CPTs (Cone Penetrometer Tests) and include revision of clay thickness contours and design parameters.

2. Assess alternative ground improvement measures for each part of the site and recommend most suitable options. This will include preload design, optimal wick drain spacing and typical requirements for other suitable ground improvement methods.

3. Undertake a geotechnical review of suitable fill materials and sources. Proposed materials should be classified in accordance with OEH Waste Classification Guidelines as ENM (excavated natural material) or VENM (virgin excavated natural material), or obtain specific OEH exemption / approvals.

The proposed excavated natural material to be used as fill on site will comply with "Protection of the Environment Operations (Waste) Regulation 2005 – General Exemption under Part 6, Clause 51 and 51A, The excavated natural material exemption 2008". The excavated natural material will be sourced from a compliant processor and will be applied to the land in a reasonable period of time with relevant records held for three years. Fill specification by geotechnical engineers and volumes associated with staging will be reviewed for compliance prior to undertaking any earthworks import.

4. If preload is adopted, refine the preload design, comprising heights, batter slopes and staging (sequencing) to minimise the amount of imported fill required, and prepare preload and earthworks plans.

5. If preload is adopted, prepare a plan of geotechnical instrumentation – numbers, locations and depths. For other ground treatment measures, prepare inspection and test plan (ITP) and verification procedures.

6. For proposed pavements and structures, determine the likely applied foundation pressures and tolerable total and differential settlements. This can include generic geotechnical pile designs for typical structural loads to assist development of individual allotments.

7. Prepare pavement thickness designs for internal roads, including material quality and compaction specifications.

7.15 CONTAMINATION

Localised remediation of soils will be undertaken to address the localised presence of hydrocarbon and asbestos contamination. This will include the removal of remnant effluent disposal systems and remnant building structures (i.e. tanks, slabs and footings).

These activities will be undertaken in conjunction with construction activities, subject to a Remediation Action Plan (RAP) that would set out remediation procedures and clean-up criteria.

7.16 WASTE MANAGEMENT

All waste or recyclable material generated throughout construction will be handled as follows:

- *Recyclable Material* – Removed by a licensed contractor and transported to an approved facility; and

- *Non Recyclable Material* – Removed by a licensed contractor and disposed of at an approved facility.

Future occupants of the subdivision will be required to submit a waste management plan for approval during the project / development application prior to establishment on the site.

7.17 HAZARDOUS MATERIAL

Any future end user development within the proposed subdivision that will involve the use of hazardous materials will be required to comply with the provisions of SEPP 33 Hazardous and Offensive Development.

7.18 OUTDOOR LIGHTING

All outdoor lighting associated with future development within the subdivision will be designed to comply with the requirements of AS 4282, Control of Obtrusive Effects of Outdoor Lighting.

7.19 LANDSCAPING

All landscaping will be carried out in accordance with the landscape plans prepared by Terras Landscape Architects included with the Project Application documentation.

A detailed landscape plan will be required to be prepared for each individual end user development within the subdivision and submitted with Construction Certificate applications.

7.20 VECTOR MANAGEMENT PLAN

A Vector Management Plan will be prepared for any constructed creeks and water detention systems.

7.21 WETLANDS INTERFACE

- Construct a perimeter berm along the eastern edge of development with a crest level of approximately 2mAHD, subject to detailed design and conveyance capacities. The crest will reduce to approximately 1.2mAHD along the southern boundary where there is no filling works adjacent. Open drainage will be excavated on the internal edge of the perimeter berm.

- Provide Discharge Points through the berm at locations consistent with existing discharge points. The discharge points will include pits installed with adjustable valve outlets or similar adjustable controls for adaptive management options in the future.

8.0 Conclusion

The proposed development is located within a State Significant Site, consistent with the Lower Hunter Regional Strategy that identified the site as employment lands. The proposed development will provide for employment opportunities now and into the future as well as make a positive contribution to the economy.

The proposed development is a permissible use within the IN1 zoning under SEPP Major Development and will be assessed under Part 3A of the Act on the basis of transitional arrangements.

The site is strategically located relative to the Port of Newcastle, major road connections, Williamtown Airport and existing industry north-west of the site. The site has good access to workforces, being centrally located to Newcastle, Maitland and Port Stephens. The site is separated from any significant residential area.

The proposed development requires removal of a relatively small amount of significant vegetation and offsets will be provided to satisfy NSW DoPI requirements. A minimum buffer zone of 380m is provided at the common boundary with Ramsar, exceeding minimum published distances. Site design and wetland interface strategy has been assessed and completed, acknowledging the importance of the wetlands and Hunter River adjacent to the site. Fill material will be of high quality to avoid the potential for contamination of water. Water quality will be treated for improvement in accordance with best management practices, meeting standard targets. Ongoing management and monitoring is proposed in the disciplines of flora and fauna, aquatic ecology groundwater and stormwater for protection of the wetlands. Additionally, an adaptive system is proposed to have the flexibility and option to respond to any changes over time.

Important heritage items adjoining the site have been considered, being the Tomago House and Chapel as well as features discovered as part of the on-site studies that were otherwise generally unknown, specifically the presence of a former WWII gun emplacement and command post which are proposed for retention within a public park.

This Environmental Assessment has identified and addressed the key issues relevant to the proposed development, including those outlined in the Director General Requirements. It is considered that the site and the receiving environment is appropriate for the intended development. A range of management measures have been recommended to ensure that no significant adverse impacts will result. Northbank Enterprise Hub Pty Ltd already has significant experience in managing their existing project and lands adjoining the subject site to the north east.

Overall it is considered that the proposed development will make a positive contribution to the locality whilst appropriately addressing and managing site constraints and environmental issues.

Appendix A

DIRECTOR – GENERAL'S MAJOR PROJECT CONFIRMATION

Appendix B

COPY OF DIRECTOR – GENERAL'S REQUIREMENTS AND COMPLIANCE TABLE

Appendix C

DEVELOPMENT PLANS

Appendix D

FLORA AND FAUNA REPORT – ECOBIOLOGICAL

Appendix E

AQUATIC ASSESSMENT – COAST ECOLOGY

Appendix F

FLOOD REPORTS – BMT WBM PTY LTD

Appendix G

STORMWATER ASSESSMENT – BMT WBM PTY LTD

Appendix H

CONCEPT CIVIL ENGINEERING & INFRASTRUCTURE SERVICING REPORT – ADW JOHNSON PTY LTD

Appendix I

HERITAGE IMPACT STATEMENT & ADDENDUM LETTER DATED 23 APRIL 2012 – EJE ARCHITECTURE

Appendix J

HISTORICAL ARCHAEOLOGICAL ASSESSMENT – AUSTRAL ARCHAEOLOGY

Appendix K

ARCHAEOLOGICAL ASSESSMENT – MCCARDLE CULTURAL HERITAGE

Appendix L

TRAFFIC IMPACT ASSESSMENT – TPK & ASSOCIATES

Appendix M

LANDSCAPE REPORT – TERRAS LANDSCAPE ARCHITECTS

Appendix N

DEVELOPMENT CONTROLS AND GUIDELINES FOR FUTURE DEVELOPMENT OF THE SITE

Appendix O

CONTAMINATION REPORTS – DOUGLAS PARTNERS

Appendix P

PRELIMINARY GEOTECHNICAL REPORT – DOUGLAS PARTNERS

Appendix Q

ACOUSTIC REPORT – SPECTRUM ACOUSTICS

Appendix R

PUBLIC & AUTHORITY CONSULTATION

Appendix S

CERTIFICATE OF TITLE AND DEPOSITED PLAN

Appendix T

DESIGN ALTERNATIVES – SUTERS ARCHITECTS

Appendix U

GROUNDWATER MODELLING REPORT – ENVIRON AUSTRALIA PTY LTD

Appendix V

ACID SULPHATE SOILS MANAGEMENT PLAN – DOUGLAS PARTNERS PTY LTD

Appendix W

BACKGROUND WATER QUALITY DATA