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Readymix Rooty Hill Regional Distribution Centre Aquatic Ecology Impact Assessment

14 June 2005

Matt Beitzel

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Natural & Cultural Heritage Consultants 15-17 Henrietta St Chippendale NSW 2008

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Project no: s4162

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ABBREVIATIONS

DEC	NSW Department of Environment and Conservation
DEH	Commonwealth Department of the Environment and Heritage
DIPNR	Department of Infrastructure, Planning and Natural Resources
DPI	Department of Primary Industry
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
FM Act	*Fisheries Management Act* 1994
KTP	Key Threatening Process
LGA	Local Government Area
LWD	Large Woody debris
MBD	Murray Darling Basin
SREP	Sydney Regional Environmental Plan
SIS	Species Impact Statement
TSC Act	*Threatened Species Conservation Act* 1995
sp.	species (singular)

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1.0 SUMMARY

Biosis Research was commissioned by NECS Pty Ltd on behalf of Readymix Holdings Pty Ltd to undertake an aquatic ecology assessment of the proposed development of the Kellogg Road Regional Distribution Centre (RDC) located on Angus Creek, Rooty Hill. Angus Creek is a tributary to Eastern Creek, 300 m to the east, in the South Creek drainage of the Hawkesbury-Nepean Catchment. The development includes the construction of a rail siding, conveyor belts, concrete batching, storage and distribution area. This will involve the bridging of Angus Creek in two locations, one with a 27 m wide rail siding and road and the other with a 15 m wide conveyor and road. This would result in the removal of approximately 0.2 ha of riparian woodland vegetation. This study focused on the aquatic habitat within the site, upstream and downstream of the proposed bridges, as well as in nearby Eastern Creek.

No threatened aquatic species, populations or endangered ecological communities were located during this survey. There are six threatened aquatic species, listed under the *Fisheries Management Act* 1994 and *Environment Protection and Biodiversity Conservation Ac*t 1999, known or with potential to occur in the Hawkesbury-Nepean Catchment. However, it is considered highly unlikely that Angus Creek would support any of these species.

The water quality, macroinvertebrate, habitat and fish assessments characterise Angus Creek as a disturbed urban creek, with moderate to good quality riparian vegetation along most of the study area. The major impacts on the creek were identified as high velocity stormwater flows, urban rubbish, and poor water quality. It is considered unlikely that the proposed developments will significantly affect the aquatic ecology values of Angus Creek if the following design and mitigation measures are incorporated:

- development of suitable sedimentation controls for the construction and operation of the plant, rail siding and conveyor;
- revegetation of impacted areas and regeneration of the riparian zone;
- establishment where possible of a 40 m buffer zone for the creek line;
- application of Department of Primary Industries, Fisheries policies on “Bridges Causeways and Culverts” and “Snag management”;
- the monitoring of Angus Creek and Eastern Creek during the construction and rehabilitation phases.

2.0 INTRODUCTION

2.1 Background

Biosis Research Pty. Ltd. was commissioned by National Environmental Consulting Service Pty Ltd on behalf of Readymix Holdings Pty Ltd to undertake an aquatic ecology assessment for the proposed development at Kellogg Road, Rooty Hill. This report assesses the conservation significance of the subject site in terms of threatened aquatic species, populations (and their habitats) or ecological communities that occur, or have the potential to occur, on the development site in accordance with the requirements of the *Environmental Planning and Assessment Act* 1979 (EP&A Act), *Fisheries Management Act* 1994 (FM Act), *Fisheries Management Amendment Act* 1999 (FMA Act) and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

2.1.1 Description and features of the Site

The development site is a 17.5 ha block that is bounded by Humes industrial area to the north, Main Western rail line and Blacktown Olympic Centre to the south, the OneSteel Mini Mill industrial area and construction of the M7 Motorway to the west and Nurragingy Reserve and Eastern Creek to the east (Figure 1). It ranges in altitude from 32.5 m to 45 m (AHD). The site is located within the Hawkesbury-Nepean Catchment and is crossed by Angus Creek, which flows through Nurragingy Reserve and into Eastern Creek (approximately 300 m from the eastern boundary of the site, Figure 1). Eastern Creek drains an area of reserve, urban and rural land to the west and north of Prospect Dam and flows north into South Creek, which then enters the Hawkesbury River at Pit Town, 25 km to the north.

This study concentrates on the development impact on Angus Creek within these portions and on potential downstream impacts on Eastern Creek.

2.1.2 Proposed Development Activity

Readymix proposes to construct and operate a RDC at Kellogg Road, Rooty Hill. Construction materials such as sand and aggregate would be transported by rail to the RDC from quarries outside of the Sydney Basin. These materials would be blended by equipment at the RDC as required to suit customer specifications, and distributed by road to the Sydney market. The proposed RDC would be capable of handling up to 4 million tonnes per annum (Mtpa) of product. It would commence operation handling 2 to 2.5 Mtpa increasing to a projected full capacity of about 4 Mtpa as dictated by the construction materials market. The

materials are typically used for the manufacture of Concrete and Asphalt. They also have a variety of other uses in civil and construction industries.

Readymix currently supply these materials through the company's Penrith Lakes Quarry however this resource is nearly depleted and the facility is due to wind down from 2008 with closure by 2011-2012. The location of the proposed RDC will allow the company to receive materials by rail using a siding off the Main Western Railway and to distribute the materials by road using the new M7 Motorway.

The RDC would be developed to include:

- A regional office building which incorporates a quarry materials and concrete testing laboratory;
- A rail siding with aggregate unloading facility;
- Storage bin area and load out facilities;
- Ground storage and reclaim facilities;
- Blending plant;
- A conveyor system linking the unloading station to the storage and truck load out facilities;
- Workshop, stores, and amenities facilities, truck washdown facilities, truck refuelling, weighbridges, truck and car parking;
- Concrete Batching Plant;
- Bridges at two locations over Angus Creek; and
- Realignment of North Parade.

The proposed RDC would be constructed over a two year period, with construction anticipated to begin in 2006.

Angus Creek will be bridged by the new rail siding and a road of 27 m wide at the southern border of the study area and a 15 m wide conveyor belt and service road approximately 50 m in from the eastern border . All bridges will be single-span concrete reinforced bridges, with at least 20 m separating the footings. The rail bridges will be 17 m wide with a small gap of 1.8 m to the road bridge which is an additional 8 m wide. The bridge will be over 2 m above the creek bed. Under the bridge the creek bed will be comprised of rock and widened to the width of the footings. The conveyor and road bridge will cross the creek over a gap from an old access track through an area of woodland. This bridge will be

triple span bridge set on 2 sets of four piles with a 20 m span over the creek channel and two smaller spans of 10 m from the centre piles to the abutments long and 15 m wide. The deck of the conveyor section will be constructed from gridmesh and there will be some limited concrete armouring to the abutments. The channel and bank will be left in its natural form under the bridge with a clearance of over 2 m from the creek bed.

Additional works as part of this development will include Concrete Batching Plant, storage and distribution areas workshops and associated structures, truck load out and associated facilities such as wash down and fuel sites and office buildings. These structures do not directly impact upon Angus creek however the construction and operation of these structures may have an indirect effect on the aquatic ecology of the area and have been considered in this study.

2.2 Aims

The general aim of this study was to undertake an aquatic ecology assessment of the subject site on Angus Creek and assess any indirect impacts on Eastern Creek, including the immediate surroundings to determine the impact of the proposed development on any matter of aquatic ecology.

The specific aims are to:

1. conduct a literature review and database search for the study area;
2. provide a brief assessment of the aquatic habitat values of the study site;
3. undertake targeted field surveys for threatened aquatic species, populations (and their habitats) or ecological communities listed under the schedules of the *Fisheries Management Act* 1994 (FM Act) and/or *Environment Protection and Biodiversity Conservation Ac*t 1999 (EPBC Act) that are known or likely to occur within the study area;
4. undertake Section 5A assessments 'eight part test' for threatened aquatic species, populations and ecological communities (listed on the FM Act) and/or Assessment of Significance for threatened and migratory species listed on the EPBC Act that are either directly or indirectly impacted by the proposal;
5. provide recommendations to minimise the environmental impacts of the proposed development;
6. provide baseline data and recommendations for ongoing monitoring during the construction.

3.0 METHODS

The subject site was inspected on 17 and 18 February and 2 March 2005 by two aquatic ecologists. The general condition of the site was assessed and observations made of species and communities (as detailed below). Targeted surveys were undertaken at two sites on Angus Creek and one site on Eastern Creek. During the site visit the weather was overcast on 17 February, dry and sunny on the 18 February and hot and windy on 2 March. There had been no significant rain for seven days prior the field assessments.

3.1 Taxonomy

The plant taxonomy (method of classification) used in this report follows Harden (1990, 1992, 1993, 2002) and subsequent advice from the National Herbarium of NSW. Names of vertebrates follow the Census of Australian Vertebrates (CAVs) maintained by the Department of Environment and Heritage (DEH). Fish were identified to species level following (McDowell 1996) and (Allen *et al.* 2002). Names of fish follow the Census of Australian Aquatic Biota (CAAB) maintained by DEH.

Macroinvertebrates were identified to family level with the exception of Oligochaeta (to class), Polychaeta (to class), Ostracoda (to subclass), Nematoda (to phylum), Nemertea (to phylum), Acarina (to order) and Chironomidae (to subfamily) as outlined in the NSW AUSRIVAS Sampling and Processing Manual (Turak *et al.* 2004). All macroinvertebrates were identified using the taxonomic keys and names listed in Hawking (2000).

In the body of the report fish and invertebrates are referred to by both common and scientific names. Common and scientific names are included in the Appendices.

3.2 Legislation

Commonwealth and State Acts and Policies that apply to the study area with regard to aquatic ecology are listed below, further information on these legislations is provided in Appendix 5.

- *Environmental Protection and Biodiversity Conservation Act* 1999 (Commonwealth)
- *Fisheries Management Act* 1994 (NSW) and *Fisheries Management Amendment Act* 1997 (NSW) and *Environmental Planning and Assessment Act* 1979 (NSW)

- *Water Management Act* 2000 and *Rivers and Foreshores Improvement Act* 1948

- *SREP 20 Hawkesbury-Nepean River No 2.* 1997

3.3 Literature and Database Review

A list of documents used to prepare this report is located in References. Records of potential fish species were obtained from the NSW Resource Atlas and the Department of Primary Industries (DPI) FishFiles database for the Hawkesbury-Nepean Catchment. Records for threatened aquatic species, populations and communities listed on the EPBC Act were obtained from the Department of Environment and Heritage (DEH) EPBC Online Database within a 10 km radius of the study area. Database searches were conducted in February 2005.

3.4 Aquatic Survey

Aquatic habitats were surveyed by undertaking visual assessment as well as recording incidental observations. Targeted surveys for macroinvertebrates were undertaken at each site, following AUSRIVAS sampling protocols. Onsite analysis of water quality parameters were taken at each site. Fish surveys included dip netting and gee trapping in Angus Creek and dip and seine netting for Eastern Creek. The fish species observed in this study, or predicted to be within this catchment, are listed in Appendix 2. The fish sampling effort and recorded species are also provided in Appendix 2. Macroinvertebrate observed during this study are listed in Appendix 3.

3.4.1 Aquatic Habitat Assessment

The aquatic habitats were classified according to the DPI Fisheries Fish Habitat Scheme, which assesses the waterway on their potential for fish habitat. The waterways class is used to determine the appropriate type of bridge required and whether the inclusion of a fishway is required within a development (NSW Fisheries 1999b). The habitat classes are defined as:

- *Class 1 - Major fish habitat* Large named permanently flowing stream, creek or river. Threatened species habitat or area of declared "critical habitat" under the threatened species provisions of the FM Act. Aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.

- *Class 2 - Moderate fish habitat* Smaller named permanent or intermittent stream, creek or watercourse. Clearly defined drainage channels with semi-permanent to

permanent waters in pools or connected wetland areas. Marine or freshwater aquatic vegetation present. Known fish habitat and/or fish observed inhabiting the area.

- *Class 3 - Minimal fish habitat* Named or unnamed watercourse with intermittent flow, with potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). No to minimal defined drainage channel. Semi-permanent pools, ponds, farm dams or wetlands nearby, or form in the watercourse after a rain event. Watercourse interconnects wetlands or stream habitat.

- *Class 4 - Unlikely fish habitat* Named or unnamed watercourse with intermittent flow during rain events only, little or no defined drainage channel, little or no free standing water or pools after rain (e.g. dry gully, shallow floodplain depression with no permanent wetland aquatic flora present). No aquatic or wetland vegetation present.

3.4.2 RCE Assessment

At each survey site an assessment of the waterways and riparian condition was undertaken following a modified Riparian Channel Environment (RCE) assessment (Chessman *et al.* 1997). RCE assessments take into account riparian land use and vegetation condition, channel structure and modification, as well as instream habitat features and impacts. Each category is given a score from 0-4, with the total sum giving an indication of the condition of the waterway and riparian vegetation on a score between 0 and 52. Scores of 40 + indicate and relatively undisturbed habitat where as scores <20 indicate a highly disturbed riparian habitat. The descriptors and categories for the RCE assessment are in Appendix 4.

3.4.3 Water Quality Survey

Water quality measurements were taken onsite with a Horibia U-22 Water Probe. Measurements were taken ~30 cm below the surface. Parameters recorded include:

- ph
- Dissolved Oxygen (DO) (mg/L)
- Temperature (^{o}C)
- Electrical Conductivity (EC) (µs/cm)
- Turbidity (NTU)

3.4.4 Macroinvertebrate Survey

Macroinvertebrates were collected from each site. Collection was undertaken following AUSRIVAS protocols for edge habitat, using a 250 µm sweep net (Turak *et al.* 2004). Samples were picked over at the site by one aquatic ecologist and preserved for later identification. A SIGNAL2 score for the macroinvertebrate families recorded at each site was undertaken. SIGNAL2 is an index of water pollution based on tolerance or intolerance of biota to pollution. The output is a single number, reflecting the degree of water pollution. Families of aquatic invertebrates are allocated sensitivity scores, according to their tolerance or intolerance to various pollutants (the lower the number the lower the sensitivity and the higher the tolerance). The SIGNAL2 index is calculated by summing the grades allocated and then dividing by the number of families present to give an average grade per site. The resulting score can vary from 1 to 10, and can be used to assess a site's status in terms of water quality. A site with typically high water quality would have a high SIGNAL value (>6) and a site with probable severe pollution would have a low value (<4) (Chessman 1995).

3.4.5 Fish Survey

The fish survey included 5 minutes of active dip netting of likely habitat at each site using a 3 mm dip net. At Angus Creek, four Bait/Gee Traps, small rectangular 1 mm mesh traps with 40 mm entrance funnels, were baited with glow stick and set over night. Fish captured in each trap are combined and assessed as a single sample. At Eastern Creek, three, 5 m seine net drags were undertaken with a 5 m long 3 mm seine net.

Fish captured by these techniques were identified in the field. Large numbers of schooling fish, encountered during trapping, such as *Gambusia holbrooki* are recorded as observed and not measured or counted. If there are large numbers of one species (>60 individuals) the first 20 are sub-sampled and the total number recorded to prevent over handling. Eels are also listed as observed, with the species identified, numbers counted but no individuals measured.

3.5 Limitations

This study was a preliminary habitat assessment and was conducted in accordance with methodology that would be employed for an assessment in accordance with Section 5A of the EP&A Act. Macroinvertebrate sampling and fish sampling were undertaken at each site. Due to the very high turbidity in Eastern Creek and high electrical conductivity in Angus Creek, electrofishing which is a visual technique was not carried out at any sites. Some aquatic

processes, such as migration of fish and hatching of invertebrates, are dependent on seasonal and flow conditions therefore may be missed by a brief assessment.

Threatened amphibious fauna such as frogs and tortoises are not assessed in this study as they are classified as terrestrial and not listed under the FM Act. Details on the assessment of these species can be found in (NECS 2003b) and Biosis (2005).

4.0 RESULTS

Lists of the aquatic flora and fauna species recorded during the survey are provided in Appendix 1 and Appendix 2 respectively. A list of the macroinvertebrates, identified to family level, is provided in Appendix 3.

4.1 Soil and Ground Water

The site is gently sloping towards Angus Creek with a large flat flood-prone area between Angus Creek and Eastern Creek. A geological and groundwater assessment of the site was undertaken by Douglas Partners Pty Ltd in 2003. The site is predominantly shale clay soils, with alluvial deposits from the Eastern Creek flood plain. The soil testing indicated low probability of acid sulphate soils and moderate soil salinity. The groundwater, however, was highly saline, which is typical of groundwater in western Sydney (NECS 2003a). Highly saline groundwater can cause degradation in water quality and salinity problems for aquatic animals and surrounding vegetation if water tables rise (Nielsen & Hillman 2000).

4.2 Water Quality

The results of the water quality analysis from this study can be seen in Table 1. Also provided are the results from the NECS water testing in autumn 2003 and the ANZECC guideline values. A scunge and oily film was also present at the lower end of all sites, which is a general indicator of low flow. Additional water quality measurements were taken by NECS in Autumn 2003 which included metal and chemical analysis at 2 sites, which corresponds closely to the Angus creek sites in this study (NECS 2003a).

	Angus Crk Upper (ANG02)	Angus Crk Lower (ANG01)	Eastern Crk (EAS01)	NECS Site 1 Angus Crk Upper (3/03)(4/03)(5/03)	NECS Site 2 Angus Crk Lower (3/03),(4/03),(5/03	ANZECC
pH	7.9	7.49	7.09	7.4 7.9 8.0	7.3 7.8 7.9	6.5-8
DO (mg/L)	3.55	0.71	4.04	4.3 10.3 6.3	7.4 9.8 6.5	>6
Temp. (^{o}C)	20.1	20.7	21.7	19.9 16.6 15.5	21.0 17.1 15.4	
EC (µS/cm)	1760	1390	718	392 555 595	405 398 682	125-2200
Turb. (NTU)	7.9	9.7	371	15 2 7	26 2.6 3	20-50

Table 1: Water quality data from at Angus and Eastern Creeks

Blacktown City Council tests a variety of water quality parameters in a number of creeks within the council, including Eastern Creek approximately 2-5 km down stream of the study site. However, there were no previous records available for Angus Creek.

In general the water quality exhibits low levels of dissolved oxygen (DO) and high conductivity. Low DO concentrations are not unusual in urban streams during times of low flow and are an indicator of poor water quality, low levels of submergent aquatic vegetation and the breakdown of detritus. There has been a significant increase in the electrical conductivity (EC) at both Angus Creek sites since the NECS testing in 2003. The cause for the increase in EC is unknown, however, it may be due to upstream effects, seasonal changes, or a shift in ground water levels. Blacktown City Council results for EC taken between September 2004 and February 2005 were broadly similar to this study's results for Eastern creek with an average of 831 µS/cm (Blacktown City Council 2005). There has also been an increase in turbidity in comparison to the testing in 2003, which is probably due to upstream effects or stream flow. It should also be noted that Eastern Creek was extremely turbid at 371 NTU which is above ANZECC guideline values. The turbidity recorded in this study for Eastern creek is also higher than that recorded by Blacktown Council monitoring downstream between January and February 2005, which averaged of 61 NTU (Blacktown City Council 2005). The reason for the turbidity in Eastern Creek is unknown and prevented the use of some aquatic survey techniques such as electrofishing.

There was little difference between the upstream and downstream sites except for dissolved oxygen, which is lower at the downstream location. This is probably due to the shaded nature of the channel, lower levels of aquatic vegetation at the lower site as compared to upstream and lack of flow.

4.3 Aquatic Habitats

The aquatic habitat types within the study area are consistent with a disturbed lowland urban creek. However, the riparian vegetation within the study site is in relatively good condition and the site is heavily impacted from upstream disturbances including high velocity stormwater flows and urban rubbish. A DPI Fish Habitat Scheme assessment and a Riparian Channel Environment (RCE) inventory were undertaken for the upper and lower Angus Creek sites (ANG01) and (ANG02) and the Eastern Creek site (EAS01) (see Figure 2).

4.3.1 Angus Creek (ANG01)

Down stream of the proposed conveyor crossing, site ANG01 and across most of the development site, Angus Creek is relatively sinuous with long narrow pools

with occasional constrictions and glides. Flow was low at the time of the survey. The creek was an average width of 1.5 m (maximum 3 m, minimum 0.8 m). There was a large amount of rubbish throughout the riparian zone, which is presumably carried down by high flow events associated with stormwater discharge. This is deposited in large debris dams with woody debris which is scattered throughout the site. The banks are very steep, slightly incised, clay with some vegetation cover comprising of moss, and aquatic vegetation. The depth was generally 0.5m with approximately 90% shading from riparian and overhanging vegetation. The substrate was comprised of clay and gravel sediment covered with a little detritus in the pools. There was some large woody debris (LWD) submerged at low flow and available at periods of high flow. These were comprised of large debris dams, roots and tree trunks as well as urban rubbish, which was present along the water course.

Within the development site Angus creek is characterised by a well vegetated riparian zone comprised of native *Casuarina glauca*, *Bursaria spinosa* *Angophora* sp. and *Eucalyptus* sp. with a large number of exotic weed species, particuarly *Lingustrum* sp. and extensive ground cover of *Commelina cyanea*, *Tradescantia fluminensis* and *Microlaena stipoides*. Aquatic vegetation through the site includes *Juncus acutus*, *Eleocharis acuta, Lomandra longifolia*, with patches of submergent *Triglochin procera* and *Potamogeton* sp. and some algae present.

The lower sites on Angus Creek (ANG 01) were classified as Class 2-3 Moderate-Minor fish habitat due to the continuous nature of the drainage channel and the presence on connected habitat and refuges under low flow condition. The downstream survey site on Angus Creek (ANG 01) scored an RCE of 33 or 64% which relates to moderate to lightly disturbed habitat. In general the RCE reflected the relatively intact riparian zones and poor condition of the channel and substrate due to the water velocity during periods of high discharge.

4.3.2 Angus Creek (ANG02)

Upstream of the development site, Angus Creek flows under two concrete bridges (~12 m wide) of the Main Western rail line and North Parade, which marks the upper section of the development, site ANG 02, and into an open grassy area, where the proposed rail siding bridge is to be constructed. A small drainage line enters the creek from the west below the OneSteel site just inside the woodland approximately 30 m downstream. The road bridge consists of four angled concrete columns in the channel with a sediment base with water depth of 0. 3 m. Three large storm drains enter the creek from the west under this bridge. There is a small gap of 3 m from the road bridge to rail bridge, approximately 15 m long, single span, with a concrete base, covered with sediment and gravel. There is a 0.5 m wide channel cut into the base for very low flow passage. This channel has

been filled with sediment and the water depth under the bridge is 0.4 m. On either side of the rail bridge, the water depth is >1 m and rock/concrete armouring is present on the banks. The banks were covered by grass and not as steep as the lower sections of the creek. The creek averages 1 m wide (maximum 15 m, minimum 0.3 m) and is only moderately shaded. The substrate consists mainly of gravel pebble and silt with concrete under the bridges. The riparian zone upstream of the rail bridge is characterised by scattered native and exotic trees and shrub including *Casuarina glauca* and *Eucalyptus* sp and *Ligustrum* sp with dense exotic pasture grasses such as *Cynodon dactylon. Phragmites australis* and *Typha* sp forms a dense thicket with isolated patches of, *Juncus usitatus*, *Cyperus eragrostis* and *Eleocharis sphacelate* along the banks. The upstream survey site on Angus Creek (ANG 02) was assessed as fish habitat Class 2-3 Moderate – minor and scored an RCE of 28 or 54%. The RCE is less than the ANG01, downstream at the conveyor crossing, due to a lower quality of riparian vegetation above the rail bridges.

4.3.3 Eastern Creek (EAS01)

Eastern Creek was also surveyed to assess the potential for off site impacts. Eastern Creek is a lowland turbid creek that has generally suffered the effects of urbanisation of the catchment. The survey site, EAS01 is upstream of the rail bridge opposite the Kareela west oval. Within the study site, the channel appears to have been straightened and the creek varies in width from 3 m to 20 m in width and is fairly deep (1->1.5 m). The substrate is generally clay and gravel with some large woody debris present. There was little flow at the time of survey and the creek was extremely turbid. The banks are stepped and vegetated with regenerating native trees including *Cassurina sp., Acacia sp.* and *Eucalyptus sp.* trees up to 10m high and scattered exotic shrubs. The understorey is predominantly exotic pasture grasses such as *Paspalum sp.* The lower section of the survey site was dammed by a large patch of *P. australis* and *Typha sp* and the bank side vegetation includes *P. australis*, *Cyperus eragrostis* and *J. usitatus* and small amounts of *Lemna sp.* were also present. Eastern Creek was classified as Class 2 Moderate fish habitat due to the size of the waterway, the availability of deep habitat and the presence of native fish species. The survey site on Eastern Creek (EAS01) was assessed as having an RCE value of 32 or 61% which was improved by the channel structure and revegetated banks but impacted due to the surrounding land use. The RCE assessments can be seen in Appendix 4.

4.4 Aquatic Fauna

The results of sweep netting, gee trapping, seine netting and observations of aquatic species at the survey sites are listed in Appendix 2. The results of the macroinvertebrate assessment can be found in Appendix 3. Two reptiles, Eastern Long-necked tortoise *Chelodina longicollis* and the Eastern water skink *Eulamprus quoyii* were observed along the creek line. The Eastern Water Skink being particularly common in sunny areas.

4.4.1 Fish

The fish fauna was dominated by Gambusia, *Gambusia holbrooki,* an alien species, which was captured at all sites in large numbers. *Gambusia holbrooki* produces live young and prefers open warm water and is know to harass and predate small and juvenile native fish and tadpoles (Webb 1997). Only one native fish was observed at Angus Creek: the Short-finned Eel *Angullia australis.* Two species of native fish were caught in Eastern Creek: Stripped Gudgeon *Gobiomorphus australis* and Flat-headed Gudgeon *Philypnodon grandiceps*. These two fish species are common in east-coast drainages and feed on aquatic insect and small fish including *G. holbrooki*. The low diversity of fish species collected and the high biomass of *G. holbrooki* is an indicator of a degraded urban waterway.

There are potentially fourteen species of fish, eleven native and three alien, which are known to occur on the Hawkesbury River at the confluence with South Creek (to which Eastern Creek is a tributary) approximately 20 km north of the site (NSW FishFiles see Appendix 2). Some of these species would have potential habitat within Eastern Creek and potentially Angus Creek, particularly the smaller gudgeon, eels and other small native fish. These fish include important recreational angling targets and migratory species such as Australian Bass *Macquaria novemaculeata.*

4.4.2 Macroinvertebrates

The macroinvertebrates collected during this study indicate that the macroinvertebrate communities of Angus Creek and Eastern Creek are low in diversity and are dominated by pollution tolerant taxa. The communities are typical of that expected of an urban waterway. Dragonfly larvae, damselfly larvae, leeches and water bugs (waterboatmen, backswimmers and water striders) were the dominant predators, whilst snails and worms were the dominant herbivores/detritivores.

The upstream site on Angus Creek (ANG02) had a SIGNAL2 score of 3.5, while the downstream site (ANG01) had a score or 2.8 and Eastern Creek (EAS01)

scored 1.7 (Appendix 3). SIGNAL2 results suggest that the water quality in Angus Creek sites may be slightly better than at the Eastern Creek sites, however all sites indicated a severe pollution problem.

4.4.3 Significant Fauna

There are three threatened species of freshwater fish and two threatened species of invertebrate, listed on the FM Act, which are known or have potential to inhabit the Hawkesbury-Nepean Catchment. Of these two species are concurrently listed on the EPBC Act as having potential to inhabit the catchment. One fish species, listed as Vulnerable under the EPBC act and having potential to occur in the catchment, is listed as protected under the FM act. There are no known threatened aquatic populations or aquatic Endangered Ecological Communities (EEC) listed under the FM or EPBC acts for the Hawkesbury-Nepean Catchment.

Table 2: Threatened species in the Hawkesbury-Nepean Catchment.

Common Name	Scientific Name	FMA Act	EPBC Act	Habitat	Potential habitat within study area
Fish					
Silver perch	*Bidyanis bidyanis*	V		Fast flowing waters in ripple and run but not in the upper reaches as well as slower sluggish rivers with LWD and dams.	No Not naturally occurring in East Coast drainages. Introduced to dams in the upper catchment.
Macquarie Perch	*Macquaria australasica*	V	E	Cool clean water preferring deep slow flowing pools and lakes. Eastern populations are genetically distinct from MDB populations.	No Absence of suitable habitat.
Trout Cod	*Maccullochella macquariensis*	E	E	Inhabit fast flowing zones often associated with cover such as LWD, rock outcrops, boulders and deep holes.	No Absence of suitable habitat. Introduced to dams in upper catchment.
Australian Grayling	*Prototroctes maraena*	P	V	Clear gravely coastal streams and rivers from the sea to the first barrier, up to 1000 m. Spawn in April after upstream movement, larvae migrate to marine waters and return as juveniles.	No Generally found further south and in clear flowing streams.
Invertebrate					
Adams emerald dragonfly	*Archaeophya adamsi*	V		Shallow shaded grave and sand riffles with extensive vegetation.	No Absence of clear riffle habitat and substrate.
Sydney Hawk Dragonfly	*Austrocordulia leonardi*	V		Deep cool pools on slow flowing rocky rivers with steep sides	No Absence of clear habitat and substrate.

Key TSC Act E = Endangered V= Vulnerable P= Protected
EPBC Act E = Endangered V = Vulnerable

No threatened aquatic species, populations or endangered aquatic ecological communities were recorded during this study. None of the threatened species listed in Table 2, with known or with potential distribution in the Hawkesbury-Nepean Catchment, have potential habitat in the study area of Angus or Eastern creeks. The degraded and lowland character of Eastern and Angus creeks make it unlikely that the area would support threatened species of fish.

5.0 IMPACT ASSESSMENT AND MITIGATION

The proposed development will impact on a number of areas of the aquatic habitat within the site and include listed key threatening processes. However, many of these impacts can be mitigated, thus greatly reducing or eliminating the potential impacts. The recommendations for mitigation measures are discussed for each impact.

5.1 Eight Part Test and Assessment of Significance

The Eight Part Test is a statutory mechanism under Section 5A of the EP&A Act for assessing whether a proposed development activity may have a significant impact on threatened species, populations or ecological communities or their habitats. The results of this test are used to determine if a Species Impact Statement (SIS) is required for each species potentially occurring within the study area. Under the EPBC Act, if the proposed development has the potential to have a significant impact on a threatened species, population or ecological community listed on the Act, the proposal may be a controlled action must be referred to the Commonwealth Minister for the Environment.

When a threatened species known to occur within the vicinity of a study area is not recorded during a survey, the presence of potential habitat for this species is used to determine the need to undertake an Eight Part Test. Where there is no potential habitat in the study area for threatened species, there is unlikely to be any impact on these species and therefore Eight Part Tests are not required for these species.

No threatened species, populations or Endangered Ecological Communities were found during the field survey and there are no threatened aquatic species, populations or Endangered Ecological Communities listed in the FM and EPBC Acts, with potential habitat within the study area. Therefore, no Eight Part Tests or Assessments of Significance have been undertaken and an SIS or a referral to the Commonwealth Minister for the Environment is not required.

5.2 Key Threatening Processes

A Key Threatening Process (KTP) is an impact listed under the FM Act that could cause a species, population or ecological community to become threatened or is identified as an impact for two or more listed threatened species, population or EECs.

5.2.1 Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams

Instream structure such as dams, water extraction can impact upon the riverine environment causing a wide variety of changes to the habitat and flow conditions often creating barriers to fish passage. Bridges and roads that have minimal impact of flow are generally exempt from this process. The rail siding and conveyor bridges of the proposed work will have a minimal impact on the flow conditions of Angus Creek and therefore this KTP doesn't apply to the proposed development.

5.2.2 Removal of large woody debris from New South Wales rivers and streams

Large woody debris (LWD) or snags provide important habitat structure, refuges from high flow, cover from predators and breeding sites for fish and other aquatic fauna. A snag is any woody debris that is greater than 30 cm in diameter or a rock larger than 50 cm in two directions. Although Angus Creek has limited LWD, there are a large number of debris dams and smaller woody debris. All attempts should be made to preserve the existing LWD and the riparian vegetation that is the source of the LWD (see below). DPI Guidelines for the protection and management of LWD should be followed for any snag or smaller woody debris under the development footprint. This policy aims to protect the retention of snags in riverine environments and the habitat value and hydrological aspects of LWD. Snags should be retained wherever possible under the conveyor bridge. If a snag is within the development footprint and will be impacted upon, the impacted part should be lopped, retaining the majority of the snag. If the snag cannot be lopped then it should be re-aligned, or relocated a short distance downstream of the development. The removal of the snag is a last resort (NSW Fisheries 1999b). The removal of a concrete pipe in Angus creek under the conveyor route would not be considered snag removal. Although the pipe may be providing some habitat for fish, such as eels, other refuges, in the form of overhanging banks, debris dams and vegetation, are available.

5.2.3 Degradation of native riparian vegetation along New South Wales water courses

The removal of riparian vegetation is listed on the FM Act as a KTP, including the removal of vegetation in the catchment zones. Riparian vegetation provides shading, is a source of LWD, food for fish and other inputs to the river system, and provides bank stabilisation and protection from sediment and runoff.

The proposal will result in the removal of approximately 0.2 ha of good–moderate quality riparian vegetation. However, this is not considered a

significant proportion of the total area of riparian vegetation on the site. The area of cleared riparian vegetation should be kept to minimum, particularly the sections of woodland (Site ANG 01). A riparian buffer of 40 m from Angus Creek should be maintained wherever possible except for the two creek crossing. Encroachment on this buffer would require approval of DPI Fisheries and development within 40 m of the Angus Creek would require a Part 3A permit under the *Rivers and Foreshore Improvement Act* 1948.

The impact of the vegetation removal should be mitigated by the development of a revegetation plan of disturbed areas, with appropriate native species. Rubbish removal and bush regeneration of the entire area should be incorporated into an ongoing vegetation management plan.

5.3 General Impacts

5.3.1 Water Quality

Angus Creek is highly impacted by stormwater discharge, which results in short periods of high velocity flow, associated bank erosion, water quality degradation and large amounts of rubbish being deposited in debris dams and creek line. The influx of the storm water within the study site is from the upper catchment and through three large concrete pipes located under the North Parade bridge. The rubbish should be removed from the site carefully, to avoid disturbance to the banks and stream structure. The incorporation of offline gross pollutant traps for the discharge pipes should be investigated to reduce the impact of rubbish and high velocity water flows.

Sedimentation and runoff can cause significant degradation in water quality and can affect fish breeding through the smothering of eggs and nesting (McDowell 1996). Sedimentation and reduction in water quality are both listed as threatening processes by the Australian Society of Fish Biology (ASFB). During construction and operation of the proposed development, the control of sediment, dust and water flow from the rail siding, conveyor and batching plant will be required. It is recommended that the following measures be undertaken:

- development of sedimentation and vegetation management plans;
- silt fencing along all stream side and runoff areas during construction and rehabilitation;
- siting of fuel storage and wash down areas away from riparian area;
- maintaining, where possible, a minimum 40 m riparian buffer zone;

- construction of sediment/dust and runoff controls for the rail siding, batching plant, access road and conveyor belt; revegetation with appropriate native species and stabilisation of impacted riparian areas and banks.

5.3.2 Salinity

The increase in salinity since initial testing (NECS 2003a) is cause for some concern. Although still within ANZECC guidelines, electrical conductivity has more than doubled since the initial testing by NECS in 2003. This increase is probably related to effects outside the scope of this development and may be a natural cycle. However, in order to avoid contributing additional pressures to the salinity problems the following measures should be taken:

- vegetation be maintained and enhanced though a vegetation management plan and bush regeneration;
- monitoring of the water quality including EC should be undertaken regularly;
- testing of ground water be undertaken to monitor the level and salinity of ground water during the construction and rehabilitation phase.

5.3.3 Fish Passage

A number of other fish in the Hawkesbury catchment migrate up and downstream to breed, including the Short-finned Eel *A. australis*, Australian Bass *M. novemaculeata* and the Common Galaxias *Galaxias maculatus*. Newly hatched Stripped Gudgeon *G. australis* are washed down stream into the estuaries and then migrate back upstream as juveniles (McDowell 1996). The presence of instream barriers can be a significant threat to these fish populations and prevent the re-colonisation of areas affected by stochastic events. Fish passage can be restricted by a number of factors including changes in flow velocity and depth, lack of light, and the presence of a drop or cascade on the upstream or downstream end of a road crossing and is listed as a threatening process by the ASFB.

The construction of the rail siding, conveyor and vehicle bridges should be guided by DPI Fisheries Policies and Guidelines on Bridges Culverts and Causeways and should be designed not to impede river flow and fish passage. The rail bridge and North parade bridge proposed in this development are single span crossings with a span of 20 m between the footings. The combined width of these bridges is 27 m wide, including a 1m gap between the road and rail bridge and a least 2 m clearance above the creek bed. The conveyor bridge has a span of 40m with a span over the creek channel of 20 m. The piles are located well outside the creek channel and the bridge is 12.5 m wide. The roadway section is

9 m wide with the 3.5 m conveyor section adjoining the western side of the road. The conveyor section is constructed from grid mesh which allows light to pass through to the creek bed. These type of crossings are the preferred type for maintaining the fish passage (NSW Fisheries 1999a) in Class 1 fish habitat. There should be no change in natural water height, velocity or major change in depth profiles across the bridge. Bridges are constructed well above the waterline and have gaps, to allow light through to the creek. Natural creek sediment should be used to line the crossing to encourage fish to move under the bridge (NSW Fisheries 1999a). Fish may avoid the area during construction however given the limited timeframe of the construction the impact is not considered to be significant if rehabilitation works are conducted.

The conveyor and vehicle access route crosses a section of the flood prone area. Provision should be made in the design of the conveyor and road to ensure that there is no disruption to the natural drainage.

5.3.4 Pest species

The predation of *G. holbrooki* on frog and fish eggs and larvae has been documented (Webb 1997). The introduction of or the alteration of habitat which make available new areas for *G. holbrooki* has been listed as a threatening process under the TSC Act as it relates to frogs. *Gambusia holbrooki* was the most common fish species sampled and was found in large number at all sites. This species is prolific in open shallow sunny pools within the study area. The protection of the riparian and aquatic vegetation, instream structures and depth profiles is important to reduce the availability of ideal habitat for this species and provide adequate nesting sites and protection from predation for native fish.

6.0 MONITORING

Monitoring should be undertaken over the construction and rehabilitation period (expected to be approximately two years). The proposed survey locations include, Angus Creek above and below the development site and Eastern Creek above and below the entrance to Angus Creek. Monitoring should include:

- onsite water quality monitoring every quarter;
- visual site assessment of habitat condition and aquatic vegetation;
- macroinvertebrate monitoring should be undertaken following AUSRIVAS protocols used in this study in spring and autumn;
- every six months a brief fish monitoring should be undertaken including bait trapping and sweep netting at Angus Creek and Eastern Creek, Fyke and seine netting at Eastern creek and electrofishing if conductivity and turbidity improve could be considered.

These surveys have been chosen to monitor indicators of habitat quality and water quality because they provide information on a number of different parameters. Parameters measured will include:

- changes in water quality including, pH, Turbidity, Temperature, DO, and Electrical Conductivity. Values exceeding ANZECC Guidelines or variations of greater than 30% from upstream site, will trigger further investigation such as assessment of conditions, laboratory testing or review of mitigation measures;
- diversity of macroinvertebrates families;
- SIGNAL2 score for macroinvertebrate families;
- native /alien fish diversity;
- fish abundance and recruitment;
- RCE inventories
- riparian vegetation condition.

The survey sites on Angus creek above and below the development have been chosen to mirror the sites assessed in this survey and previous water quality monitoring efforts. Since Angus Creek is in an urban, industrial catchment that is undergoing some change the upper and lower sites will allow the isolation of impacts from the development site rather than from a source or impact higher in

the catchment. The sites on Eastern Creek have been proposed to assess any off site impacts on downstream habitats.

The monitoring program should be in place prior to construction and continue during rehabilitation of the site. The need for periodic monitoring would be assessed at each stage of the project.

7.0 CONCLUSION

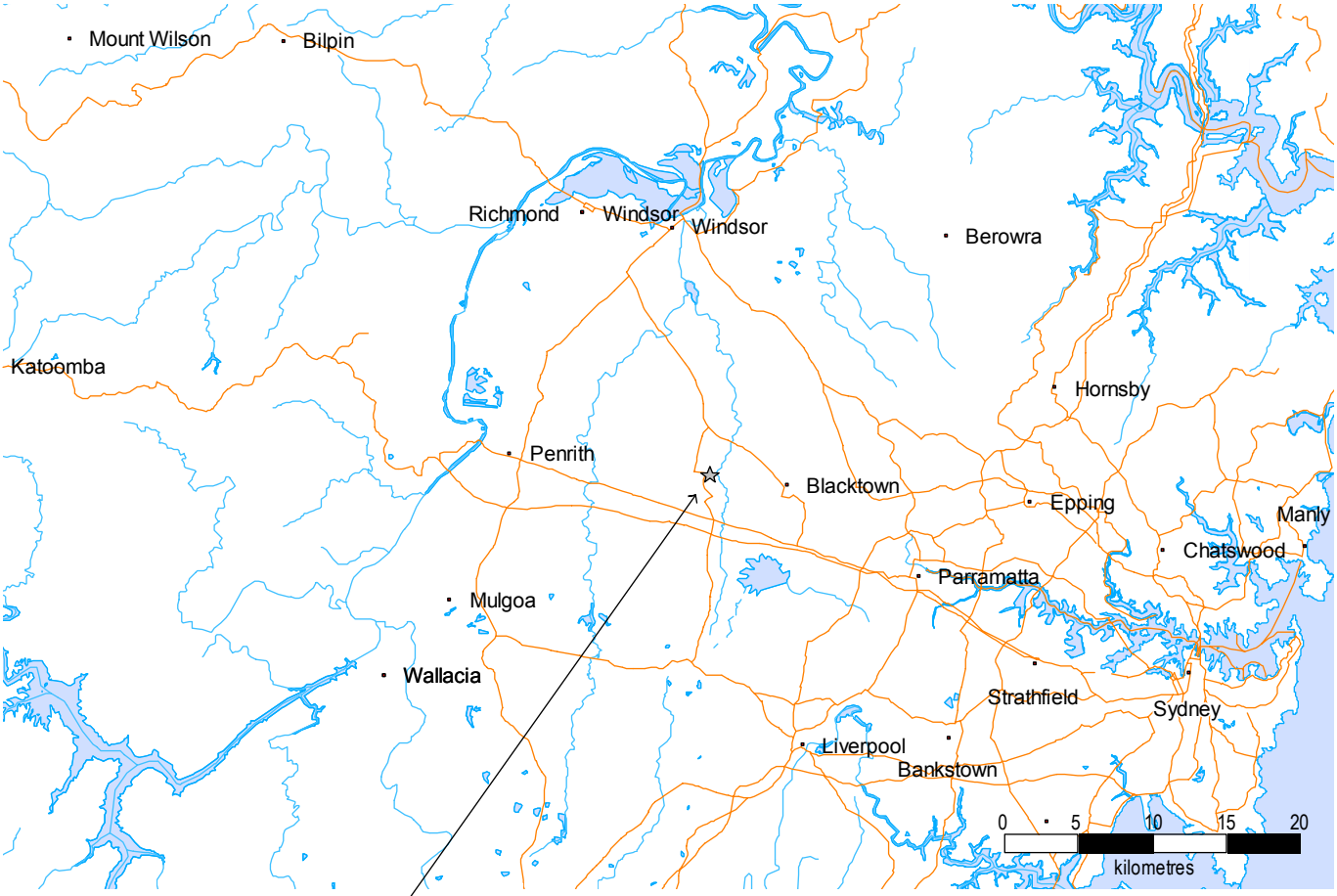
Angus Creek displays characteristic aquatic fauna and flora for a moderately degraded urban creek. The riparian zone within the study area is relatively intact however the creek is impacted by storm water runoff, rubbish, alien fish species and poor water quality. Eastern Creek also displayed characteristic of a degraded urban creek. It had a lower diversity or macroinvertebrates but better quality fish habitat than Angus Creek. This was reflected in the capture of two small native fish species at Eastern Creek.

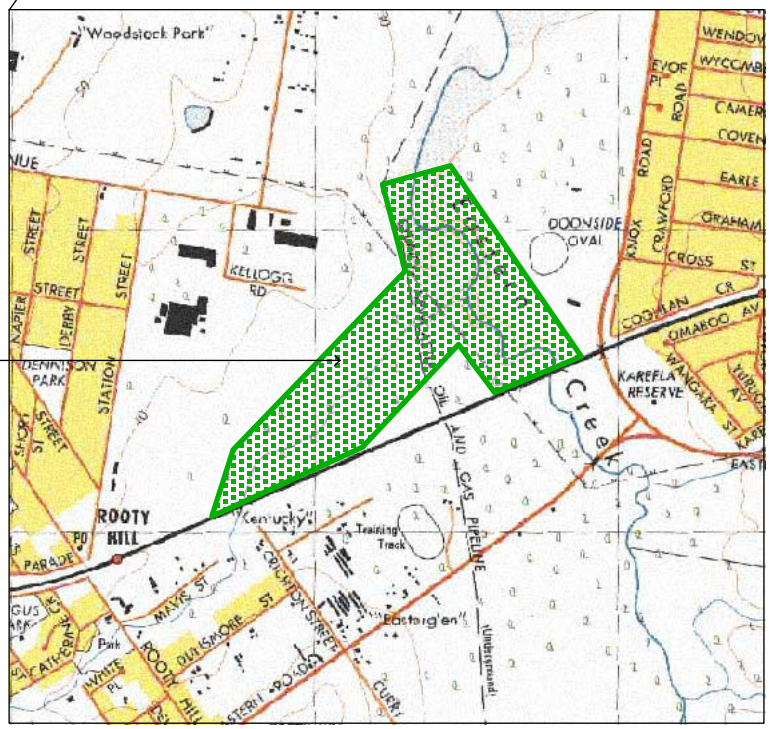
There were no threatened aquatic species, populations or endangered ecological communities listed under the FM Act or the EPBC Act found during this study. It was concluded that there are no known threatened aquatic species, population or endangered ecological communities listed under the FM Act or the EPBC Act likely to be present in Angus creek or Eastern Creek. Therefore no Eight Part Tests and no Assessments of Significance have been performed and a SIS or Referral are not recommended.

Consideration of relevant Key Threatening Processes listed on the FM ACT and other threats to the aquatic habitat values of Angus and Eastern Creek indicate that the proposal will potentially have a negative impact on the aquatic habitats in the study area. In order to minimise these impacts for the initial inundation area, it is recommended that the following measures are implemented:

- development of sedimentation and vegetation management plan;
- silt fencing during construction and rehabilitation;
- construction of sediment/dust and runoff controls for the rail siding conveyor belt, batching plant and access road;
- siting of fuel storage and wash down areas away from the creek line and constructed with appropriate bunding to prevent runoff into drainage lines;
- maintaining where possible a minimum 40 m riparian buffer zone on both sides of the creek;
- revegetation of impacted areas with appropriate local species and stabilisation of impacted riparian areas and banks;
- riparian vegetation should be maintained and enhanced though a vegetation management plan, bush regeneration, and rubbish removal;
- undertake the monitoring program outlined in Section 6 during the construction and rehabilitation phases.

FIGURES





Study area

Acknowledgement: Geoscience Australia (1:250000 - SI/56 - 5) and Lands and Property Information (1:25000 - 9030 - 2N)

BIOSIS RESEARCH Pty Ltd

15 - 17 Henrietta Street
Chippendale
NEW SOUTH WALES 2008

Figure 1: Location of the study area in a regional context.

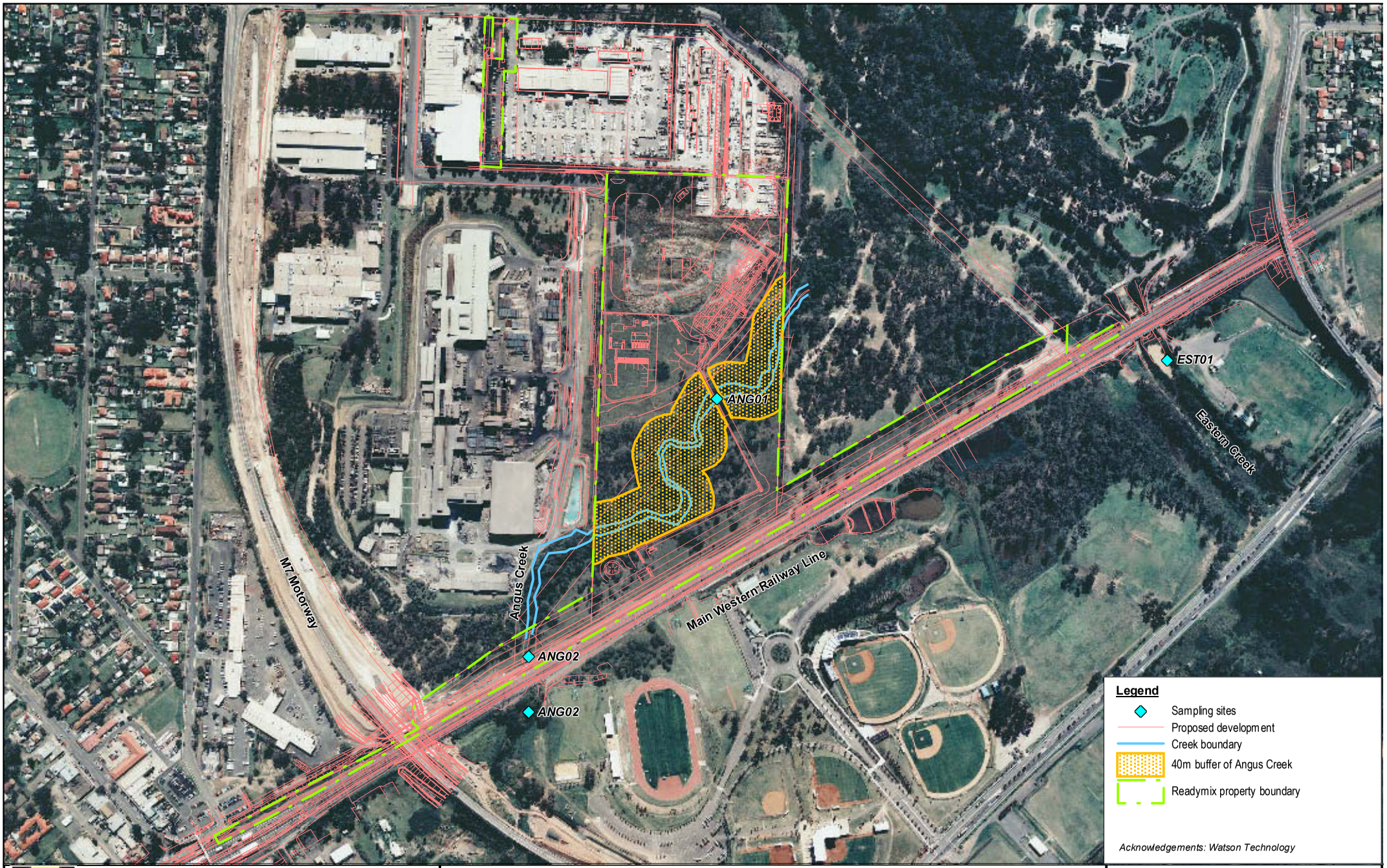
DATE: 7 February 2005

Checked by: MB | File number: S4162

Location:... \projects\4000\4100s\4162\Mapping\S4162 Fig 1.wor

Scale: 0 250 500 750 1000 metres

N W E S



BIOSIS RESEARCH Pty Ltd
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Chippendale
NEW SOUTH WALES 2008

Figure 2: Location of sampling sites over plan of proposed development

DATE: 15 June 2005
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Scale: 0 50 100 150 200 250 metres

Figure 2: Location of sampling sites over plan of proposed development

PLATES

Plate 1: Angus Creek at the downstream sampling site ANG01

Plate 2: Angus Creek upstream sampling site ANG02

Plate 3: Rail and Road bridge over Angus Creek at the upstream site ANG02

Plate 4 Eastern Creek at Kareela Reserve West EAS01

APPENDICES

APPENDIX 1

Aquatic Flora Results

Family Name	Scientific Name	Common Name	Native	ANG01	ANG02	EAS01
Cyperaceae						
	Cyperus eragrostis	Umbrella Sedge	No	S	S	S
	Eleocharis gracilis		Yes	S	S	S
	Eleocharis sphacelata	Tall Spike Rush	Yes		S	S
Juncaceae						
	Juncus acutus		No	S	S	S
Juncaginaceae						
	Triglochin procerum	Water Ribbons	Yes	S	S	-
Lemnaceae						
	Lemna sp.		Yes	S	S	S
Lomandraceae						
	Lomandra longifolia	Spiny-headed Mat-rush	Yes	S	S	S
Poaceae						
	Phragmites australis	Common Reed	Yes		S	S
Potamogetonaceae						
	Potamogeton sp.		Yes	S	-	-
Typhaceae						
	Typha sp.	Cumbungi	Yes		S	S

APPENDIX 2

Aquatic Fauna Results

Fish known to occur in the Hawkesbury Catchment at Pit Town and likely to exist in Eastern Creek Catchment.

Family	Common Name	Scientific Name	Source
Native Fish			
Anguillidae	Long-f inned Eel	*Anguilla reinhardtii*	F
	Short-finned Eel	*Anguilla australis*	F, O
Eleotridae	Striped Gudgeon	*Gobiomorphus australis*	F, O
	Cox's Gudgeon	*Gobiomorphus coxii*	F
	Empire Gudgeon	*Hypseleotris compressa*	F
	Firetailed Gudgeon	*Hypseleotris galii*	F
	Western Carp Gudgeon	*Hypseleotris klunzingeri*	F
	Flathead Gudgeon	*Philypnodon grandiceps*	F, O
	Dwarf Flathead Gudgeon	*Philypnodon* sp.	F
Percichthyidae	Australian Bass	*Macquaria novemaculeata*	F
Retropinidae	Australian Smelt	*Retropinna semoni*	F
Alien Fish Species			
Cyprinidae	Goldfish	Carassius auratus	F
	Common Carp	Cyprinus carpio	F
Poeciliidae	Gambusia	Gambusia holbrooki	F, O

Key **O** Observed in this study

F DPI FishFiles records for the Hawkesbury River at Pit Town

Fish survey data.

Site	Equipment	Survey effort	Scientific name	Common Name	Length (mm)	No.
ANG01	Sweep Net	5:00min	*Gambusia holbrooki*	Gambusia	X	X
			Anguilla australis	Short- finned Eel	X	1
	Bait Traps with Glow sticks	4 x 15 hours overnight.	*G holbrooki*	Gambusia	X	48
ANG02	Sweep Net	5 min	*Gambusia holbrooki*	Gambusia	X	X
			Anguilla australis	Short-finned Eel	X	1
EAS01	Sweep netting	5:00 min	*Gambusia holbrooki*	Gambusia	X	X
	5m 3mm Seine net	3 x 5m sections	*Gambusia holbrooki*	Gambusia	X	X
			Philypnodon grandiceps	Flathead Gudgeon	61	1
			Philypnodon grandiceps	Flathead Gudgeon	59	1
			Gobiomorphus australia	Stripped Gudgeon	48	1
			Gobiomorphus australia	Stripped Gudgeon	135	1

X= Large numbers of species were observed or no individuals were measured

APPENDIX 3

Macroinvertebrates Results

Phylum, Order or Class	Family/ Subfamily	Common Name	SIGNAL2 Grade	Site Codes		
				EAS01	ANG01	ANG02
Turbellaria	Dugesiidae	Flatworms	2	✓	✓	
Nematoda	N/A	Round worms	3		✓	
Oligochaeta	N/A	Segmented worms	2		✓	✓
Hirudinea	Glossiphonidae	Leeches	1	✓	✓	
Diptera	Chrironominae	Non-biting midges	3	✓	✓	✓
Diptera	Orthocladinae	Non-biting midges	4			✓
Diptera	Stratiomyidae	Soldier flies	2		✓	✓
Collembola	N/A	Springtails	N/A	✓		
Gastropoda	Physidae	Snail	1	✓		
Gastropoda	Bithyniidae	Snail	3		✓	
Ostracoda	N/A	Seed Shrimp	N/A		✓	
Hemiptera	Corixidae	Waterboatmen	2	✓	✓	
Hemiptera	Notonectidae	Backswimmers	1	✓		
Hemiptera	Gerridae	Water Striders	4			✓
Hemiptera	Veliidae	Small Water Striders	3			✓
Coleoptera	Hydrophilidae	Beetles	2	✓		
Coleoptera	Hydraenidae	Beetles	3		✓	
Emphemeroptera	Baetidae	Mayflies	5			✓
Zygoptera	Coenagrionidae	Damselflies	2	✓	✓	✓
Zygoptera	Megapodagrionidae	Damselflies	5		✓	✓
Epiproctophora	Aeshnidae	Dragonflies	4		✓	✓
Epiproctophora	Hemicordulidae	Dragonflies	5		✓	✓
SIGNAL2 scores				**1.7**	**2.8**	**3.5**

APPENDIX 4

RCE descriptors and categories

Descriptor	Category	Value	ANG01	ANG02	EAS01
Land-use pattern beyond immediate riparian zone	Undisturbed native vegetation	4			
	Mixed native vegetation and pasture/exotics	3			
	Mainly pasture, crops or pine plantation	2			
	Urban, some vegetation	1	1	1	1
	Industrial, little vegetation	0			
Width of riparian strip-of woody vegetation	More than 30 m	4	4		
	Between 5 and 30 m	3		3	3
	Less than 5 m	2			
	No woody vegetation	1			
	No Vegetation	0			
Completeness of riparian strip of woody vegetation	Riparian strip without breaks in vegetation	4	4		4
	Breaks at intervals of more than 50 m	3			
	Breaks at intervals of 10-50 m	2		2	
	Breaks at intervals of less than 10 m	1			
	No riparian strip at all	0			
Vegetation of riparian zone within 10 m of channel	Native tree and shrub species	4			
	Mixed native and exotic trees and shrubs	3	3	3	3
	Exotic trees and shrubs	2			
	Exotic grasses/weeds	1			
	No vegetation at all	0			
Stream bank structure	Banks fully stabilized by trees, shrubs, concrete	4			
	Banks firm but held mainly by grass and herbs	3			3
	Banks loose, partly held by sparse grass, rubble	2		2	
	Banks unstable, mainly loose sand or soil	1	1		
	Banks actively eroding	0			
Bank undercutting	None, or restricted by tree roots or man-made	4			
	Only on curves and at constrictions	3		3	3
	Frequent along all parts of stream	2	2		
	Severe; bank collapses common	1			
	Total bank collapse	0			
Channel form	Deep; width:depth ratio less than 8:1	4			4
	Medium; width:depth ratio 8:1 to 15:1	3	3	3	
	Shallow; width:depth ratio greater than 15:1	2			
	Artificial; concrete or excavated channel< 8:1	1			
	Artificial; concrete or excavated channel > 8:1	0			
Riffle/pool sequence	Frequent alternation of riffles and pools	4			
	Long pools with infrequent short riffles	3	3		
	Natural channel without riffle/pool sequence	2		2	2
	Artificial channel; some riffle/pool sequence	1			
	Artificial channel; no riffle/pool sequence	0			
Retention devices in stream	Many large boulders and/or debris dams	4			
	Rocks/logs present; limited damming effect	3	3		
	Rocks/logs present but unstable; no damming	2			
	Stream or channel with few or no rocks/logs	1		1	1
	Artificial channel; no retention devices	0			
Channel sediment accumulations	Little or no accumulation of loose sediments	4			
	Some gravel bars but little sand or silt	3	3	3	3
	Bars of sand and silt common	2			
	Braiding by loose sediment	1			

	Complete in-filled muddy channel	0			
Stream bottom	Mainly clean stones with obvious interstices	4			
	Mainly stones with some cover of algae/silt	3			
	Bottom heavily silted but stable	2	2	2	2
	Bottom mainly loose and mobile sandy sediment	1			
	Bottom mainly loose and mobile muddy sediment	0			
Stream detritus	Mainly unsilted wood, bark, leaves	4			
	Some wood, leaves, etc. with much fine detritus	3			
	Mainly fine detritus mixed with sediment	2	2		
	Little or no organic detritus, mainly sandy	1		1	1
	No organic detritus, mainly mud	0			
Aquatic vegetation	Little or no macrophyte or algal growth	4			
	Substantial algal growth; few macrophytes	3			
	Substantial macrophyte growth; little algal growth	2	2	2	2
	Substantial macrophyte and algal growth	1			
	Total cover of macrophytes plus algae	0			
RCE Score (Total)			33	28	32
RCE %age			63%	54%	61.5%

APPENDIX 5

Relevant legislation

Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Under the provisions of the EPBC Act any action (activity or development) that requires Commonwealth approval is deemed a controlled action. This is usually the case when an action is likely to have a significant effect on the environment of Commonwealth land or any 'Matter of National Environmental Significance' (MNES) listed below:

- World Heritage areas;
- National Heritage places;
- Wetlands protected by international treaty (Ramsar Convention);
- Nationally listed threatened species and ecological communities;
- Internationally listed migratory species- Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) & Bonn Convention;
- All nuclear actions; and,
- The environment of Commonwealth marine areas.

Where an impact is of potential significance then those affected species or habitats must be referred (Referral) to Department of Environment and Heritage for assessment in accordance with specific criteria outlined in the Guidelines for Significance Assessment. These guidelines provide separate criteria for Extinct, Vulnerable, Endangered and Migratory species against which the significance of the impact can be assessed and whether a referral is required. The purpose of the referral stage is to determine whether a proposed action requires approval under the EPBC Act. If the Minister determines that an approval is required, the proposed action will proceed through the assessment and approval process.

Fisheries Management Act 1994 and *Fisheries Management Amendment Act* 1997

The *Fisheries Management Act* 1994 was amended by the *Fisheries Management Amendment Act* 1997, to relate to the EP & A Act, with respect to threatened species conservation, commercial fisheries management, recreational freshwater fishing, special fisheries trust funds, and charter fishing boats.

The FM Act provides for the protection of all threatened fish and marine vegetation native to NSW waters and aims to conserve fish and aquatic habitats, promote ecological sustainable development, viable commercial fishing, aquaculture and recreational fishing. Provisions in Part 7A of the *FMA Act* cover the identification, assessment and proclamations of threatened species, populations and ecological communities and key threatening processes. They also provide for the identification of critical habitat, mandatory impact assessment in the land use planning process and active recovery management.

Under the Fisheries Management Act 1994, a person may be required to provide fish passage, generally through the installation of a fishway, when altering, modifying, or constructing a dam, weir or floodgate. Any proposal that requires construction, modification or alteration of a dam or weir, that requires some approval process by a public authority (including local government) must be referred to DPI Fisheries for determination.

Environmental Planning and Assessment Act 1979 and *Threatened Species Conservation Act* 1995

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) is the principal legislative tool governing land use in NSW. One object of the EP&A Act is to encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats. A second object is to encourage the principles of ecologically sustainable development, including the precautionary principle as defined under the *Protection of the Environment Administration Act* 1991. The *Threatened Species Conservation Act* 1995 protects all threatened plants and animals native to NSW (with the exception of fish and marine plants). It provides for the identification, conservation and recovery of threatened species and their populations and communities. It also aims to reduce the threats faced by those species.

If a planned development or activity will have an impact on a threatened species, this must be taken into account in the development approval process. If the impact is likely to be significant, a Species Impact Statement must be prepared and the Director-General of Department of Environment and Conservation and/or Department of Primary Industries must agree to the development approval. In some cases, the Minister for the Environment will also need to be consulted.

Section 5A of the EP&A Act, Section 94 of the TSC Act and Section 220ZZ of the FM Act lists eight factors (Eight Part Test) which are used to assess the likely impact of a development on a threatened species, population (including their habitats) or Endangered Ecological Community

Water Management Act 2000 and *Rivers and Foreshores Improvement Act* 1948 (NSW)

The *Water Management Act* 2000 (WM Act) provides for the integrated and sustainable management of the State's waters, including those provisions previously included in the *Rivers and Foreshores Improvement Act* 1948 (RFI Act). Whilst proclamation commenced most of the provisions of the WM Act on 1 January 2001 (NSW Government Gazette No. 168, December 2000), matters relating to licences and approvals still continue to be dealt with by the RFI Act and the *Water Act* 1912. The Department of Infrastructure, Planning and Natural Resources (DIPNR) is currently developing the administrative procedures to operate the approvals provisions (Chapter 3 Water management implementation, Part 3 Approvals) of the WM Act, however it is not known when these provisions will commence.

When assessing developments that require a Part 3A permit, the DIPNR considers whether the proposal is consistent with State Government policy including the NSW State Rivers and Estuaries Policy. Conditions of consent for a Part 3A permit, may as a result, include the establishment of a native vegetation riparian zone along a waterway. Given State Government policy, it is unlikely that a Part 3A permit would be issued for works that degrade watercourses and their environment.

Sydney Regional Environmental Plan No 20 Hawkesbury- Nepean River No. 2

SREP 20 provides framework for planning in the Hawkesbury Nepean River excluding National parks, water catchment areas of Sydney and the Penrith Lakes. It aims to identify and protect significant wetlands and fauna and flora habitats in the Sydney region. Under the plan the Hawkesbury Nepean Trust must be consulted by councils and DIPNR prior to approval of developments which come under Schedule 3 of the EPA Act and developments that impact on aquatic systems.

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