Speaker 12

Liverpool Action Group, we are Incorporated, my position is Treasurer and the Environment Officer.
We do Environmental restoration work on the Georges River and we received grants from the Community Building Partnership Grant and the Liverpool City Council.

I will highlight on 5 topics:

- The Court Case
- Anzac Creek
- The Flooding of the Georges River
- Filling the site 600,000 for bulk earthworks
- River-flat Eucalyptus Forest

I attended the three day Court Hearing
The Qube barrister explained that this multi-million-dollar project has no master plan and the Minister has approved most of the events that will take place.
Qube are trying to fit the project into a residential area that will not be functional.
On the second day of the Court Hearing the cube barrister stated that only four trains per day would be using the spur line so it was not necessary to install sound barriers. The Commissioner then said that only four trains per day will be using the line, their barrister then agreed with the statement. After lunch the barrister then told the Commissioner that it was possible that more than four trains will be using the line so they put in a formula and the provision for noise barriers. The barrister then stated? "We are looking at the other line to bring in the freight". The only other line is a passenger line to Macarthur.
Noise level made from the site cannot be more than 43 db. All parties agreed. Now we have noise levels exceeding these agreed levels.

Anzac Creek Stormwater from site.
They should carry out the work as per army storage area site.
The site is higher than the creek embankment. The local residents will flood first.
Large detention basin.
The water coming from the site will be contaminated. How will this be treated?

Flooding of the Georges River

Filling the Site Stage 1. 600,000m3 Earth works
How much water will be going into Anzac Creek
The culvert under the M5 may back up and this will cause flooding
How will the water leave the site.(Go through Army land, do they have approval)
The site should be lower than ground level.

River-flat Eucalyptus Forest
Communities
Threatened fauna species
They used the Cumberland plan flora

Threatened species

Three threatened flora species were recorded within the Moorebank Avenue site: *Hibbertia puberula* subsp. *puberula*, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora* (Table 3). Three other threatened flora species were recorded during surveys the nearby Boot land between 2011 and 2017 (Table 3). The locations of threatened species recorded are shown in Figure 2 (above).

Table 3 Threatened flora species recorded within and around the Moorebank Avenue site

Scientific name	Common name	EPBC Act status	BC Act status	Distance between closest record and Moorebank Avenue site	No. within Moorebank Avenue site
Acacia bynoeana	Bynoe's Wattle	Vulnerable	Endangered	300 metres	N/A
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable	610 metres	N/A
Grevillea parviflora subsp. *parviflora*	Small-flowered Grevillea	Vulnerable	Vulnerable	occurs within Moorebank Avenue site	79 stems
Hibbertia fumana	-	Not listed	Critically Endangered (provisional listing)	77 metres	N/A
Hibbertia puberula subsp. *puberula*	-	Not listed	Endangered	occurs within Moorebank Avenue site	22 plants
Persoonia nutans	Nodding Geebung	Endangered	Endangered	occurs within Moorebank Avenue site	8 plants

A total of 23 threatened fauna species were derived from the PCTs identified on the Moorebank Avenue site as predicted ecosystem credit species. None of the predicted threatened fauna ecosystem credit species were recorded on the Moorebank Avenue site. Assessment of the potential presence of each species in the Moorebank Avenue site found that two species (Eastern Freetail-bat and Little Lorikeet) have a high likelihood of occurrence and 10 species have a moderate likelihood of occurrence.

No koalas or incidental observations of koala presence (i.e. scats or scratches) were identified during field surveys undertaken (between 2011 and 2016) in the MPW Stage 2 study area, which includes the Moorebank Avenue site. It was determined that the probability of koalas occurring within the Moorebank Avenue site is "unlikely", based on the lack of Core or Potential habitat for koala and barriers to koala movement . Only one koala feed species listed under Schedule 2 of SEPP 44, *Eucalyptus tereticornis* (Forest Red Gum) occurs in the Moorebank Avenue site. Koala feed trees for the Central Coast KMA that occur in the Moorebank Avenue site include two primary feed tree species, *Eucalyptus parramattensis* and *Eucalyptus tereticornis.* One secondary food tree species, *Eucalyptus baueriana,* also occurs in low densities. Accordingly, no further surveys for koalas within the Moorebank Avenue site were required, and no further assessment was required.

A number of species were identified in the credit calculator as predicted fauna species credit species. The likelihood of these predicted fauna species credit species is shown in Table 4.

Table 4 Fauna species credit species and their presence status on the Moorebank Avenue site

Predicted species credit species	Associated PCTs[7] found on Moorebank Avenue site	Habitat presence on Amended Proposal site?	Presence status	Can species withstand further loss?
Cumberland Plain Land Snail *Meridolum corneovirens* E-BC Act	ME002 ME003	Marginal habitat may be present in ME002 and ME003, however there was minimal leaf litter observed within the small area to be impacted	Unlikely.	Yes
Eastern Pygmy-possum *Cercartetus nanus* V-BC Act	ME003	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation.	Unlikely.	Yes
Green and Golden Bell Frog *Litoria aurea* E-BC Act V-EPBC Act	ME002 ME003	Marginal habitat present in basins and drainage lines. Infestation of *Gambusia holbrooki* (a predator of tadpoles) reduces the likelihood of occurrence.	Unlikely. Habitat is marginal and species not recorded during targeted surveys.	Yes
Koala *Phascolarctos cinereus* V-BC Act V-EPBC Act	ME002 ME003	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation. ME002 does not include potential feed trees.	Unlikely.	Yes
Regent Honeyeater *Anthochaera phrygia* CE-BC Act E-EPBC Act	ME002 ME003	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation. May forage sporadically on the site in winter but unlikely to breed locally.	Unlikely. The species was not found during targeted surveys. Species records within 10km are 20 years old or more.	Yes
Squirrel Glider *Petaurus norfolcensis* V-BC Act	ME002 ME003	No. Species requires abundant hollows. Hollows are a limited resource in the Amended Proposal site.	Unlikely. The species was not found during targeted surveys.	Yes

[7] Refer to PCTs listed above in Table 2.

Impact assessment (unavoidable impacts)

The MPE Concept Plan Modification Report (Executive Summary) provided the following conclusion for the potential impacts of the Modification Proposal on biodiversity impacts:

> *Clearing of a very small, isolated and fragmented area of native vegetation, comprising 0.1 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin would be required. This vegetation was not mapped as part of the MPE Concept Plan EA, but would require removal with or without the Modification Proposal. All other areas to be impacted are planted and disturbed vegetation. Any impacts to native vegetation would be offset and has been considered in the current Biodiversity Offset Strategy to be prepared for the Moorebank Precinct (under the MPE Stage 1 Conditions of Approval).*

The below impact assessment provides additional information with a specific focus on the vegetation clearing on the Moorebank Avenue site component of the Modification Proposal. This impact assessment has also been considered from a cumulative impact perspective in the context of the greater MPE Concept Plan Approval and the MPW Concept Approval Project for PCTs and threatened species as identified below.

Vegetation - Plant community types / threatened ecological communities

The threatened ecological communities to be directly impacted and the total areas of impact are listed in Table 5.

Table 5 Areas of direct impact to threatened ecological communities (estimates, subject to clarification within future Development Applications)

Plant Community Type	Equivalent TEC	Conservation status	Moorebank Avenue site
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (BC Act) Endangered (EPBC Act)	3.73 ha
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Swamp Woodland	Endangered (BC Act)	0.22 ha
Forest Red Gum - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered (BC Act)	0.59 ha
Total area of native vegetation clearance			**4.54 ha**

616 hectares left

5,446 left

As shown in Table 5, the total area of native vegetation to be cleared from the Moorebank Avenue site is 4.54 ha, however this would be clarified as part of future stages of approval. Ecosystem credits are required to offset the impacts to these threatened ecological communities. Relevant biodiversity offsets would be addressed as part of future stages of approval as required by Schedule 3, Condition 2 (Further Assessment Requirements), sub condition 2.1, 'Biodiversity' of the MPE Concept Plan Approval.

Groundwater dependent ecosystems

Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect adjacent areas of retained vegetation and habitat that may utilise the shallow groundwater aquifers present. Any impacts from the clearing of vegetation within the Moorebank Avenue site are expected to be minor given the limited scope of excavation. The detailed design process of future Development Applications stages of development would further consider potential groundwater impacts and effects on groundwater-dependent ecosystems.

Fauna habitats

The clearing of vegetation on the Moorebank Avenue site would result in the removal of fauna habitat from the Moorebank Avenue site including structurally intact woodland, highly disturbed areas with scattered trees and landscaped vegetation providing habitat for fauna. The clearing of vegetation within the Moorebank Avenue site would involve the removal of two hollow-bearing trees identified by PB (2014a).

Further, the clearing of vegetation within the Moorebank Avenue site would impact a narrow linear patch of trees that provides some connectivity for urban fauna in the road reserve, and allows for movement of some native fauna species across the greater MPW site and broader landscape (although much of the surrounding vegetation is fragmented, with the immediately surrounding vegetation to be removed as part of the MPW Project (MPE Stage 2 Proposal)).

Threatened species

The clearing of vegetation within the Moorebank Avenue site would have direct impacts on three threatened plant species: *Hibbertia puberula* subsp. *puberula*, *Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora*. The number of each species to be cleared is presented in Table 6. The number of plants/stems to be cleared within the Moorebank Avenue site has been compared with the total number of plants/stems in the Moorebank Avenue site plus the Wattle Grove Offset Area, as specified in the BAR prepared for the application for the Biobanking agreement (WSP Parsons Brinckerhoff, 2017).

Table 6 Impacts to threatened flora species in the Moorebank Avenue site (estimates, subject to clarification within future Development Applications)

Threatened Flora Species	Population in Moorebank Avenue site + Wattle Grove Offset Area	*Estimated total to be cleared[8] Moorebank Avenue site*	*Percentage of known/ estimated population on the Moorebank Avenue site + Wattle Grove Offset Area to be cleared*
Acacia bynoeana Endangered (EPBC Act) Vulnerable (BC Act)	33 plants	0	0%
Acacia pubescens Vulnerable (EPBC Act) Vulnerable (BC Act)	Estimated stem count of 100	0	0%
Grevillea parviflora subsp. *parviflora*	Estimated stem count of 13,679	79	0.58%

[8] Subject to clarification as part of future stages of development under the MPE Concept Plan Approval.

Threatened Flora Species	Population in Moorebank Avenue site + Wattle Grove Offset Area	*Estimated total to be cleared[8] Moorebank Avenue site*	*Percentage of known/ estimated population on the Moorebank Avenue site + Wattle Grove Offset Area to be cleared*
Vulnerable (EPBC Act) Vulnerable (BC Act)			
Hibbertia fumana Not listed (EPBC Act) Critically Endangered (BC Act)	370 individuals*	0	0%
Hibbertia puberula subsp. puberula Not listed (EPBC Act) Endangered (BC Act)	565 plants	22 plants	4%
Persoonia nutans Endangered (EPBC Act) Endangered (BC Act)	189 plants	8 plants	4%

**Additional investigations in September 2017 resulted in a population estimate of 14,270 individuals of this species (see Arcadis 2017).*

An assessment of the impact of the clearing of vegetation within the Moorebank Avenue site on threatened fauna species is provided above.

Cumulative impacts

Cumulative impacts of the Modification Proposal were addressed, as necessary, within the MPE Concept Plan Modification RtS. The clearing of vegetation within the Moorebank Avenue site has been assessed as part of the MPW Project (MPE Stage 2 Proposal), and therefore the cumulative impacts previously presented within the MPW Stage 2 Proposal / MPE Stage 2 Proposal documentation do not change. An update to the cumulative impacts has been re-presented in this supplementary information to identify and clarify the extent of impacts in the context of the MPE and MPW Projects (refer to Table 7).

Table 7 Cumulative impacts to native vegetation from the MPE Project as modified (MPE Stage 2 Proposal / MPE Stage 1 Project) and MPW Project (MPW Stage 2 Proposal) (estimates, subject to clarification within future Development Applications)

Plant Community Type	Equivalent TEC	MPE Project area of impact			MPW Project area of impact	Total area of impact
		MPE Stage 2 Proposal		**MPE Stage 1 Project**	**MPW Stage 2 Proposal**	
		MPE Stage 2 site[9]	Moorebank Avenue site[10]			
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion Endangered (BC Act) Critically Endangered (EPBC Act)	0.05 ha	0 ha	0 ha	0 ha	0.05 ha
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion Vulnerable (BC Act) Endangered (EPBC Act)	0.1 ha	3.73 ha	0.74 ha	13.54 ha	14.38 ha
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland Endangered (BC Act)	0 ha	0.22 ha	0.05 ha	0.68 ha	0.73 ha
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-	0 ha	0.59 ha	0.41 ha	28.47 ha	28.88 ha

5,446 hectares left

[9] The area within the MPE site which would be disturbed by the MPE Stage 2 Amended Proposal (including the operational area and construction area). The MPE Stage 2 site includes the former DSNDC site and the land owned by SIMTA which is subject to the MPE Concept Plan Approval.

[10] The MPW Stage 2 Proposal also includes the clearing of vegetation within the Moorebank Avenue site. As such, the Moorebank Avenue site impacts are not included in the 'total are of impact'.

Executive Summary

This Ecological Constraints Report has been prepared by *Travers bushfire & ecology* to identify the flora and fauna constraints of Lot 1 DP 581034 (30.97 ha) also known as Coopers Paddock which is a portion of the Warwick Farm Racecourse located at Warwick Farm in Sydney's south-west within the local government area (LGA) of Liverpool.

This report replaces previous ecological reporting for the site and in particular addresses the fauna survey matters as requested by the DECCW (now referred to as the Office of Environment & Heritage - OEH). It also reviews the proposed conservation area in the lands proposed for recreation zoned lands.

The Proposal

The proposal seeks to permit rezoning within the subject site lands which are currently zoned as RE2 Private Recreation. The proposed rezoning is proposed to be changed to IN1 General Industrial and RE1 Public Recreation.

Recorded Threatened Species and Endangered Ecological Communities

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

EPA Act 1979 & TSC Act 1995

In respect of matters required to be considered under the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995):

- Eight (8) threatened fauna species were recorded within or in close proximity to the subject site. Threatened fauna species recorded included: Powerful Owl (*Ninox strenua*), Varied Sittella (*Daphoenositta chrysoptera*), Little Lorikeet (*Glossopsitta pusilla*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Large-footed Myotis (*Myotis macropus*), Eastern Bentwing-bat (*Miniopterus orianae oceansis*), East-coast Freetail Bat (*Micronomus norfolkensis*) and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*). The Yellow-bellied Sheathtail-bat was recorded only to a 'possible' level of certainty. One (1) additional threatened fauna species - Black-chinned Honeyeater (eastern subspecies - *Melithreptus gularis gularis*) has been previously recorded on the other side of the Georges River as evident from the Atlas of NSW Wildlife Database records (OEH 2011) and likely utilised the subject site on these occasions;

- One (1) endangered ecological community was recorded, River-flat Eucalypt Forest on Coastal Floodplains; and

- No endangered populations were recorded on site or considered likely to occur.

EPBC Act 1999

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act* (1999):

- One (1) threatened fauna species - Grey-headed Flying-fox (*Pteropus poliocephalus*) - was recorded within the subject site;
- Two (2) protected migratory fauna species listed under the EPBC Act (1999) - Rufous Fantail (*Rhipidura rufifrons*) and Satin Flycatcher (*Myiagra cyanoleuca*) - were recorded within the subject site;
- No threatened flora species were recorded within the subject site;
- No endangered ecological communities under national legislation were recorded within the subject site; and
- No endangered populations were recorded on site or considered likely to occur.

FM Act 1994

In respect of matters relative to the *Fisheries Management Act 1994*, the adjacent Georges River provides no potential for threatened fish species occurrence. This river portion is not identified as critical habitat under the FM Act. It is assumed there will be no detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat from the proposed action. As such the provisions of this Act do not require any further consideration.

Ecological Constraints

The key ecological constraints are as follows:

Threatened fauna species habitat

The subject site provides:

- Recorded foraging, roosting and breeding habitat for the Powerful Owl.
- Recorded foraging and likely roosting and nesting habitat for the Varied Sittella.
- Recorded foraging habitat tor the Grey-headed Flying-fox and Eastern Bentwing-bat.
- Recorded foraging and possible roosting and breeding habitat for the East-coast Freetail Bat and Yellow-bellied Sheathtail-bat.
- Likely foraging and potential roosting/nesting habitat for the Little Lorikeet.
- Possible roosting and breeding habitat for the Large-footed Myotis.
- Potential for other threatened species such as the Black-chinned Honeyeater to pass through and utilise the available habitats, and
- Potential Green and Golden Bell Frog shelter, foraging and breeding habitat.

In respect to the broader area, the site is additionally constrained by the presence of:

- Connective open forest which continues as narrow riparian vegetated fringes along the Georges River which classed as a Vegetated Buffer under REP 2 – Georges River Catchment;

- The presence of hollows that provide prey species habitat and nesting habitat for Powerful Owl, and potential for use by threatened microbats; and

- Structural diversity for threatened microbat foraging.

Impact on recorded EEC's and Threatened Species

EEC - River-flat Eucalypt Forest on Coastal Floodplains

The proposed rezoning will remove 3.226 ha of the EEC – *River-flat Eucalypt Forest on Coastal Floodplains*. The level of offsetting afforded by the proposed rezoning is considered from the perspective of the EEC – *River-flat Eucalypt Forest on Coastal Floodplains*. We note that the critically endangered ecological community - Cumberland Plain Woodland, is not present in Coopers Paddock. The recommended adjustment to the zoning boundary, as proposed for protection of the Powerful Owl, increases the vegetation offset ratio (area restored/conserved to area removed) from 2.84:1 with the current proposed boundary to 5.2:1 with the new boundary. The total conservation area has been increased to 16.95 ha.

Powerful Owl

As a result of additional fauna surveys, the level of protection has been increased in the southern portion of the site. This affords conservation of the identified Powerful Owl roosting and nesting area as well as increasing the amount of existing habitat on site for the recorded threatened species.

Varied Sittella

Target surveys for Varied Sittella indicate that the family grouping is likely to utilise adjacent habitats to the subject site. The survey and habitat mapping also provide evidence that competitive pressures from other species such as Bell Minor and Noisy Minor restrict the available habitat that is currently available to Varied Sittella.

Varied Sittella has previously been reported to have weakly defended territories of 13-20 hectares. The proposed conservation area is 16.95 ha. Based on target survey the Varied Sittella is actively utilising the high quality habitat area of 9.5 ha which is likely to be the core activity area (Figure 3). The majority of high quality habitat areas (84 % conserved - 1.56 ha loss) is being retained within the conserved lands. There is another 9.2 ha of habitat available for use by Varied Sittella outside of the subject site. Areas of suitable habitat that have a dominance of Bell Minor and Noisy Minor (two very territorial species) have been excluded from the area of suitable habitat. The total available habitat of varying quality for Varied Sittella within the proposed conservation area and adjoining the subject site is estimated to be 17.12 ha post development. This indicates that there is sufficient habitat available for Varied Sittella post development to support the existing population.

Removal of habitat within the subject site will cause a shift in the habitat usage patterns of all birds utilising proposed development areas. Varied Sittella is likely to retain a secure hold on its high quality habitat area because it contains vegetation that favours Varied Sittella. Noisy Miners may spread out into other fragmented remnants of land surrounding the site, whilst Bell Miners will remain in a united colony dominating the tall gully forest remnant within the conserved lands.

To compensate for the loss of higher quality habitat for Varied Sittella and competitive pressures between bird species, the restoration works within the conservation area should provide habitat for Varied Sittella which will discourage establishment by miners. Restoration

of habitat in the south western portion of the conserved lands will also provide habitat connectivity to the adjoining STP lands. This is an important mitigating strategy to address key threatening process that Bell Minors represent for Varied Sittella.

Given that 84 % of the high quality habitat area for Varied Sittella is being conserved and a total of 17.12 ha of suitable habitat is available post development, *Travers bushfire & ecology* concludes that sufficient habitat is present within the conserved portion of the foreshore to continue to support the Varied Sittella population insitu.

Green & Golden Bell Frog

The proposed conservation area fully protects potential habitat for the Green and Golden Bell Frog. The habitat for this species is adequately conserved.

Conclusions

A proposed conservation area is illustrated in comparison with the currently proposed RE1 boundary (Figure 6). The proposed conservation area considers the habitat requirements of the Powerful Owl and Varied Sittella, adequately conserves the existing native vegetation and provides foraging and roosting habitat for the recorded threatened species.

A total of 10.7ha of open forest retention areas will be protected. 5.68 ha of disturbed landscapes will be restored to compensate for partial loss of vegetation and habitat within the proposed development area. The restoration areas occur just to the north of the Powerful Owl sightings and around/within the circular track in the south-western portion of the subject site. A total of 16.95 ha will be protected and restored.

The level of habitat protection has been increased in the southern portion of the site. This affords conservation of the identified Powerful Owl roosting and nesting area as well as increasing the amount of existing habitat on site for the recorded threatened species.

Adequate buffers have been provided in accordance with REP 2 – Georges River Catchment and alternative measures are proposed to compensate for edge effects where buffers are compromised.

Characteristic Species List

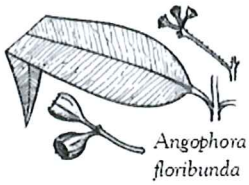
River-flat Eucalypt Forest is characterised by the species listed below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire and logging) history. Note that NOT ALL the species listed below need to be present at any one site for it to constitute River-flat Eucalypt Forest.

Scientific Name	Common Name (Range)
Tree Canopy Species (>6m)	
Angophora floribunda	Rough-barked Apple
Angophora subvelutina	Broad-leaved Apple + (N-Sho)
Casuarina cunninghamiana subsp. cunninghamiana	River Oak
Casuarina glauca	Swamp Oak
Eucalyptus amplifolia ✓	Cabbage Gum +
Eucalyptus baueriana	Blue Box (S-Haw)
Eucalyptus benthamii	Camden White Gum (R)
Eucalyptus botryoides ✓	Bangalay (S-Hun)
Eucalyptus elata	River Peppermint (S-Haw)
Eucalyptus grandis ✓	Flooded Gum (N-Hun)
Eucalyptus longifolia ✓	Woolybutt (S-Hun)
Eucalyptus moluccana ✓	Grey Box (N-Sho)
Eucalyptus ovata	Swamp Gum (S-Syd)
Eucalyptus saligna	Sydney Blue Gum (N-Syd)
Eucalyptus tereticornis ✓	Forest Red Gum +
Eucalyptus viminalis	Ribbon Gum (S-Syd)
Livistona australis	Cabbage Tree Palms
Melia azedarach	White Cedar (N-Ulla)
Small Trees & Shrubs (~1.5-6m)	
Acacia parramattensis	Parramatta Wattle
Acmena smithii	Lily Pilly
Acacia floribunda	White Sally Wattle
Backhousia myrtifolia	Grey Myrtle
Bursaria spinosa	Sweet Bursaria / Boxthorn +
Cayratia clematidea	Native Grape (N-Sho)
Melaleuca decora	(N-Sho) A Paperbark
Melicytus dentatus (formerly Hymenanthera dentata)	Tree Violet
Melaleuca linariifolia	Flax-leaved Paperbark (N-Ulla)
Melaleuca styphelioides	Prickly-leaved Tea Tree (N-Sho)
Ozothamnus diosmifolius (formerly Helichrysum diosmifolius)	Ball Everlasting
Tristaniopsis laurina	Water Gum
Phyllanthus gunnii	Scrubby Spurge
Plectranthus parviflorus	Cockspur Flower
Trema aspera	Native Peach
Groundcover (~0-1.5m), Vines & Scramblers	
Herbs / Ferns	
Adiantum aethiopicum	Maiden Hair Fern
Centella asiatica	Indian Pennywort (N-Illa)
Cheilanthes sieberi subsp. sieberi	Mulga Fern
Commelina cyanea	Commelina (N-Nar)
Desmodium gunnii	Slender Trefoil +
Dichondra repens	Kidney Weed +
Doodia aspera	Prickly Rasp Fern
Einadia hastata	Berry Saltbush +
Einadia trigonos	Fishweed +

Scientific Name	Common Name (Range)
Groundcover (~0-1.5m), Vines & Scramblers	
Herbs / Ferns	
Euchiton sphaericus	Cudweed
Eustrephus latifolius	Wambat Berry
Galium propinquum	Maori Bedstraw +
Geranium solanderi	Native Geranium
Hydrocotyle peduncularis	Native Pennywort
Hypolepis muelleri	Harsh Ground Fern
Opercularia diphylla	Stinkweed
Oxalis perennans	Native Sorrel +
Persicaria decipiens	Slender Knotweed
Poranthera microphylla	Small Poranthera
Pratia purpurascens	Whiteroot +
Pteridium esculentum	Bracken
Sigesbeckia orientalis subsp. orientalis	Indian Weed
Solanum pinnatifidum	Forest Nightshade + (N-Nar)
Vernonia cinerea	Trailing Speedwell +
Veronica plebeia	Ivy Leaved Violet
Viola hederacea	Bluebell +
Rushes / Grasses	
Austrostipa ramosissima	Stout Bamboo Grass
Cymbopogon refractus	Barbed Wire Grass
Dichelachne micrantha	Shorthair Plume Grass
Digitaria parviflora	Small-leaved Finger Grasss
Echinopogon caespitosus var. caespitosus	Bushy Hedgehog Grass +
Echinopogon ovatus	Forest Hedgehog Grass +
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Eragrostis leptostachya	Paddock Love-grass
Imperata cylindrica var. major	Blady Grass
Lomandra filiformis	Wattle Mat Rush
Lomandra longifolia	Ribbon Grass
Lomandra multiflora subsp. multiflora	Many-flowered Mat Rush
Microlaena stipoides	Weeping Grass +
Oplismenus aemulus	Basket Grass +
Paspalidium distans	Spreading Panic Grass
Themeda australis	Kangaroo Grass
Vines	
Clematis aristata	Old Mans Beard
Clematis glycinoides	Headache Vine
Geitonoplesium cymosum	Scrambling Lily
Glycine clandestina	Twining Glycine +
Glycine microphylla	Small-leaved Glycine
Glycine tabacina	Slender Sweet Root
Hardenbergia violacea	Purple Coral Pea +
Pandorea pandorana	Wonga Wonga Vine
Rubus parvifolius	Native Rasberry
Stephania japonica var. discolor	Snake Vine

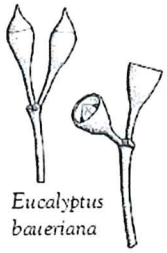
+ = Key indicator species; N = North of; S = South of; Haw = Hawkesbury; Hun = Hunter; Illa = Illawarra; Nar = Narooma; Sho = Shoalhaven; Syd = Sydney; Ulla = Ulladulla; (R) = Restricted to lower Nepean River.

For further help with plant identification see plantNET.rbgsyd.nsw.gov.au/search/simple.htm

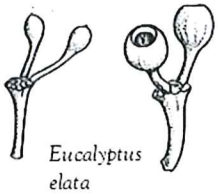


Angophora floribunda

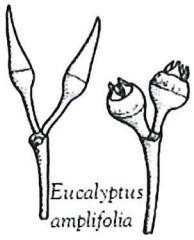
Angophora subvelutina



Eucalyptus baueriana

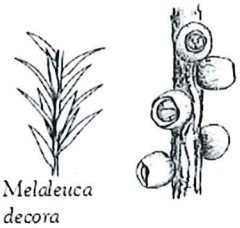


Eucalyptus elata



Eucalyptus amplifolia

Eucalyptus tereticornis



Melaleuca decora

Melaleuca styphelioides

Illustrations © Botanic Gardens Trust

EECs that may adjoin or intergrade with River-flat Eucalypt Forest

This community occurs with, would have previously occurred with, or closely resembles other Coastal Floodplain vegetation types which are also listed as EECs. Collectively, these EECs cover all remaining native vegetation on the coastal floodplains of NSW. These EECs are:

1. *Sub-tropical Coastal Floodplain Forest* north of Port Stephens. They may be distinguished by the presence of Brush Box (*Lophostemon suaveolens*) and Pink Bloodwood (*Corymbia intermedia*);
2. *Swamp Oak Floodplain Forest* where there is increasing estuarine influence;
3. *Swamp Sclerophyll Forest on Coastal Floodplains* where soils become more waterlogged;
4. *Freshwater Wetlands on Coastal Floodplains* where they adjoin more permanent standing water; and
5. *Lowland Rainforest on Floodplain* on more basaltic type soils in the NSW North Coast bioregion.

Determining the conservation value of remnants

The degree of disturbance (i.e. the site condition) of any remnant of River-flat Eucalypt Forest may vary depending on past land use, management practices and/or natural disturbance and this should be considered at the time of assessment. Whilst not exhaustive, the following are a number of variations of River-flat Eucalypt Forest you may encounter:

1. Tree canopy present with limited native vegetation in the understorey, due to under-scrubbing, stock grazing pressure, too-frequent fire or invasion by weeds;
2. Tree canopy generally absent due to prior clearing or fire, with occurrence of regrowth of native trees and shrubs and possibly weeds;
3. Some characteristic tree canopy species absent due to past selective clearing;
4. As a fragmented remnant of Eucalypts, due to clearing of adjoining vegetation; or
5. As a remnant that no longer floods due flood mitigation or drainage works.

Even where a remnant is considered to be heavily degraded and in poor condition, it may still meet the criteria of being an EEC and have conservation value for a number of reasons including:

1. Being part of a wildlife corridor that has connective importance at local and/or regional scales;
2. Providing important winter feed trees for arboreal mammals and birds;
3. Providing a 'stepping stone' for fauna in an otherwise cleared landscape;
4. Providing significant habitat components such as hollow bearing trees important to the life cycle of migratory, non-migratory and/or nomadic species;
5. Containing threatened flora; and/or
6. Maintaining a healthy native seed bank, which is very important in a highly cleared landscape.

It is important to take these factors into account when determining the conservation significance of remnants.

For further assistance

This and other EEC guidelines are available on DECC Threatened Species website threatenedspecies.environment.nsw.gov.au/

The references listed below also provide further information to aid in identifying EECs.

- Botanic Gardens Trust plant identification assistance: rbgsyd.nsw.gov.au/information_about_plants/botanical_info/plant_identification
- Botanic Gardens Trust PlantNET: plantnet.rbgsyd.nsw.gov.au/search/simple.htm
- Brooker, M. and Kleinig, D. (1990) *Field Guide to Eucalypts of South-eastern Australia*, Vol 2. Inkata, Melbourne.
- Harden, G. (ed) *Flora of NSW Vols 1 – 4* (1990-2002). NSW University Press.
- Harden, G., McDonald, W. and Williams, J. (2006) *Rainforest Trees and Shrubs – A Field Guide to their identification*. Gwen Harden Publishing, Nambucca Heads.
- NSW Scientific Committee Determinations: nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations
- Thackway, R, and Cresswell, I. (1995) (eds) '*An interim biogeogeographic regionalisation of Australia: a framework for establishing the national system of reserves.*' (Australian Nature Conservation Agency: Canberra).

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Have we forgotten about the flooding on the Georges River and the most important part of the River is its floodplain area. (Riparian zone).

The Georges River is one of the most populated urban catchments in Australia, with over 1 million people living in the catchment.

The Georges River runs adjacent to the CBD of Liverpool and is over 100 kilometres long, from its headway near Appin, the River flows north towards Liverpool, through Chipping Norton Lake scheme, and then through Bankstown to Botany Bay. It has a number of major branches, Cabramatta Creek, Prospect Creek, Harris and Williams Creeks.

The Georges River has a catchment area of 890 square kilometres.

Flood History: The Georges River has a long history of flooding and most of the flood data has been recorded at the Liverpool weir.

The weir was constructed in 1836 as a causeway crossing of the River and a source of fresh water for Liverpool.

To reach a one in 100 year flood the water rises 9 metres above the weir.
This event occurred 4 times from 1873 -1900. That's 4 times in 27 years.

From 1900 we have reached 6 metres above the weir 15 times.

The largest flood ever recorded at the weir was in 1873, 10.3 metres above the weir. The water came to the steps of St Luke's Church
The largest flood in the past 100years was in 1956 when the flood water was 8.2 metres above the weir.

The last significant floods occurred in 1986 and 1988 when the flood water was 7.2 and 7.3 metres above the weir.

Chipping Norton Lakes

The Lakes Scheme was part of an overall rehabilitation program following extensive sand extraction from the Georges River at Chipping Norton.
The scheme, which was developed in 1977, resulted in a series of 150 hectares of Lakes connected within the River.
Although rehabilitation of the area was a major objective of the scheme, it still proved a positive flood mitigation benefit to the area.

Like most river systems in New South Wales, the Georges River has more than its share of flooding problems.
At times it has been the subject of perhaps more flooding investigations than any other area in Australia.

It also has a wonderful showcase of different types of floodplain management measures that have been undertaken by different Councils in an attempt to reduce flooding problems.

The Georges River around the Liverpool Area:
There are times when flooding issues appear to have been given a low priority, or possibly overlooked.

More recently, the Federal Government owned land and some 2 million tons of fill has been proposed within the floodplain area, apparently without any assessment of its impact on flooding. That is equivalent to 2 billion litres of additional water to be displaced in the Georges River to raise the flood levels.

The Floodplain Area or (Riparian Zone)
This is the area when the water goes over the banks of the River or Creek.
This water is then held with the Floodplain Area to stop flooding of residential homes.
When the water breaks out from the Floodplain Area it then becomes a major problem and flooding occurs.
One ton of fill displaces 1000 litres of water.

Summary
I am reminding everyone in this room the Flooding problems existing and will always exist on the Georges River and its creeks.
The most important thing I can say now is that our floodplain areas are our protection from flooding and they should never be filled.

Thank you for giving me the time to express my concerns about future flooding of Liverpool.

1986 Flood on the Georges River

7 ANZAC CREEK FLOODPLAIN MODELLING

Anzac Creek is within the larger Georges River catchment and a sub-catchment of the Liverpool District catchment. The creek is 4 kilometres long, forming in the (former) Royal Australian Engineers Golf Course, owned by the Department of Defence, and flowing northward past the suburb of Wattle Grove and underneath the M5 at the intersection with Heathcote Road. From there the creek continues northwards through Ernie Smith Recreation Reserve, flanked by the Moorebank Industrial Area to the west and the suburb of Moorebank to the east, under Newbridge Road, through McMillan Park, and into Lake Moore at Chipping Norton.

Following the initial DRAINS modelling of on-site detention (OSD) the post development site flow hydrographs were used as inputs into a TUFLOW model of Anzac Creek to identify potential flood impacts extending along Anzac Creek, and if necessary revised OSD requirements. This assessment process and findings are discussed as follows.

7.1 Background

Existing condition flow regimes along Anzac Creek have been previously determined by Liverpool City Council in the process of conducting their Anzac Creek Floodplain Risk Management Study and Plan (by BMT WBM Pty Ltd, 30 May 2008), and the Georges River Floodplain Risk Management Study & Plan (by Bewsher Consulting, May 2004). The Council modelling indicates that only the 100 year ARI and larger events along Anzac Creek impact on the Proposal site, as such only the 100 year ARI and PMF events have been assessed. no impact on site as the Residents will flood.

The RAFTS catchment rainfall runoff model files developed for the abovementioned studies were obtained from Council. The provided files were re-run by Arcadis and the hydrographs for both the 100 year ARI nine-hour event and PMF one hour event used in the studies were replicated.

Council also provided to Arcadis the 100 year ARI nine hour event and PMF one hour event TUFLOW model files. The provided files were re-run by Arcadis and the Council's 100-year nine hour results were reproduced. PMF TUFLOW results were not provided by Council, nonetheless the provided files were used in developing an adjusted 'existing conditions' Anzac Creek model.

Council provided a number of TUFLOW run files incorporating various degrees of blockage for structural elements across the system. For the purposes of this regional assessment the 25 per cent blockage scenario was adopted for existing conditions.

Specific refinements incorporated into the Council model has involved modification to the digital elevation model (DEM) to include the:

- recent redevelopment of the Defence Joint Logistics Unit (DJLU), neighbouring the north-east corner of the Proposal site.
- MPE Stage 1 operational area (assumed completed)
- MPE Stage 1 rail across the Anzac Creek floodplain.

7.1.1 Hydrology

Council's RAFTS model catchments were adjusted to exclude the Proposal site, which has been more accurately defined in the site drainage assessment DRAINS software (as discussed in the earlier sections of this report). Hence hydrographs generated from the RAFTS and DRAINS models have been used as flow inputs for TUFLOW modelling to define flow regimes as discussed below. RAFTS model input data and output are included in **Appendix B**.

7.1.2 Flow regimes

The 100 year ARI nine hour duration hydrographs from the DRAINS and adjusted RAFTS models have been used to assess flow regimes along Anzac Creek, in accordance with the files provided by council, in TUFLOW. Similarly, an adjusted existing conditions PMF one hour event model has also been assessed in TUFLOW using DRAINS and adjusted RAFTS hydrograph inputs.

The adjusted existing condition TUFLOW model flow regime figures (for 100 year and PMF conditions) are included in **Appendix B**. The 100 year results were compared with that of Council's and flood level variations found to generally vary by less than 0.025 metres.

The adjusted existing conditions model has been adopted as a base for comparing potential impacts in Anzac Creek due to the Proposal site development.

7.2 Post Development Conditions

7.2.1 Hydrology

Hydrographs generated from the Proposal site development conditions DRAINS model of the site have been used as input into the TUFLOW modelling, in conjunction with existing conditions RAFTS model hydrographs which represent the Anzac Creek catchment areas external to the subject site.

7.2.2 Flow regimes

Using the 100 year ARI nine hour event hydrographs, and PMF one hour event hydrographs from the proposed conditions DRAINS modelling, TUFLOW modelling indicates that with respect to potential flood impacts:

- There is no increase in flood levels in the100 year ARI nine hour event.
- For the PMF one hour event, the Proposal would:
  - generally result in no increase in flood levels along the broader Anzac Creek floodplain; however
  - result in localised flood level increases adjacent to the proposal area of approximately 0.2 metre immediately south of the site, and approximately 0.3 metre increase in the area to the north-east of the proposal area (i.e. the vicinity of DJLU).

The modelling results for these assessments are included in **Appendix B**.

7.3 Comments

Potential adverse flood impacts have been adequately mitigated along the Anzac Creek floodplain up to 100 year events, and generally along the overall floodplain for events greater than the 100 year.

However, the TUFLOW modelling indicates that there may be local flood level increases impacting on the neighbouring (DJLU) property immediately to the north-east of the proposal area. Such impacts would appear to be limited to open vehicular parking areas, and only in extremely rare events (of greater than 100 year ARI).

It is recommended that future design stages carry out refined TUFLOW flood modelling (with improved waterway, local drainage and surface level definition) of the north-eastern Proposal area and neighbouring site, so as to more adequately define the local area flow regimes of extreme event flooding, and determine whether further flood mitigation measures are necessary.

To facilitate the refined flood modelling, traditional ground survey of the neighbouring areas and associated waterway structures is anticipated.

8 MITIGATION MEASURES

Measures to avoid, minimise and mitigate potential stormwater and flooding impacts during construction and operation of the Proposal are summarised in **Section 8.1** and **Section 8.2** below.

8.1 Construction

During the construction phase the provision of flooding and stormwater mitigation measures incorporated into the Proposal is to include:

- A Soil and Water Management Plan (SWMP) and Erosion and Sediment Control Plan (ESCP), or equivalent, would be incorporated into the CEMP for the construction of the Proposal. The SWMP and ESCPs would be developed in accordance with the principles and requirements of Managing Urban Stormwater – Soils & Construction Volume 1 ('Blue Book') (Landcom, 2004) and Volume 2 (DECC 2008) and consider the Preliminary ESCPs (Appendix P of this EIS). The following aspects would be addressed within the SWMP and ESCPs:
  - Construction traffic restricted to delineated access tracks, and maintained until construction complete
  - Appropriate sediment and erosion controls to be implemented prior to soil disturbance
  - Stormwater management to avoid flow over exposed soils which may result in erosion and impacts to water quality
  - Location of stockpiles outside of flow paths on appropriate impermeable surfaces as well as outside of riparian corridors
  - Inspection of all permanent and temporary erosion and sedimentation control works prior to and post rainfall events and prior to closure of the construction area
  - Wheel wash or rumble grid systems installed at exit points to minimise dirt on roads.
- To minimise potential flood impacts as a result of construction of the Proposal, the following measures would be implemented and documented in the SWMP:
  - The existing site catchment and sub-catchment boundaries would be maintained as far as practicable
  - To the extent practicable, site imperviousness and grades should be limited to the extent of existing imperviousness and grades under existing development conditions.
- A Flood Emergency Response and Evacuation Plan, or equivalent, would be prepared and implemented for the construction phase of the Proposal to allow work sites to be safely evacuated and secured in advance of flooding occurring at the Proposal site.

8.2 Operation

Under operational conditions, the provision of flooding and stormwater mitigation measures incorporated into the Proposal site development is to include:

- On-site detention (OSD) storages which capture, convey and adequately control site discharges to the existing downstream waterways.
- Stormwater quality improvement devices would be designed to meet the performance targets identified in Georges River Estuary and would include:
  - Gross Pollutant Traps (GPTs)
  - Raingardens, or equivalent, in the base of the OSD channels

- A water quality monitoring program for the operational phase of the Proposal would be prepared as part of the OEMP for the Proposal and would detail:
  - The frequency and duration of sampling
  - Background water quality conditions
  - Sampling methodology
  - Reporting requirements

  Water quality monitoring would be undertaken for both Anzac Creek and the Georges River and would include the following parameters:
  - Total suspended solids (TSS)
  - Total phosphorous (TP)
  - Total nitrogen (TN)
  - Oils and grease.
- A Flood Emergency Response Plan (FERP) would be developed for operational phase of the Proposal. The FERP would take into consideration, site flooding and broader flood emergency response plans for the Georges River and Anzac Creek floodplains and Moorebank area. The FERP would also include the identification of an area of safe refuge within the Proposal site that would allow people to wait until hazardous flows have receded and safe evacuation is possible.

9 CONCLUSION

This Stormwater and Flooding Assessment has been prepared for approval of the MPE Stage 2 Proposal (the Proposal). This report has been prepared to support a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and in accordance with the Secretary's Environmental Assessment Requirements (SEARs, ref: SSD 16-7628 and dated 27 May 2016).

The following conclusions and recommendations have been made within this report:

- The DRAINS and TUFLOW analysis indicate that the proposed drainage systems and OSDs would provide adequate system capacities and mitigate potential adverse flood impacts that may otherwise result from the Proposal site works.
- Approval is required from neighbouring land owner(s) for proposed drainage works to be carried out, including:
  - Areas adjacent to the southern MPE Stage 2 boundary.
  - Drainage outlet works to the east of MPE Stage 2.
- It is recommended at future design stages to carry out refined TUFLOW flood modelling (with improved waterway, local drainage and surface level definition) of the north-eastern Proposal area and neighbouring site, to more adequately define the local area flow regimes of extreme event flooding, and determine whether further flood mitigation measures are necessary.
- The water quality modelling has demonstrated that the water quality targets for the site can be met.

The stormwater and flood analysis, design and management summarised in this report for the Proposal site addresses the necessary stormwater and flooding environmental assessment requirements and demonstrates compliance with the SEARs and the Concept Plan Conditions of Approval and Statement of Commitments relevant to this study (as listed in **Table 1-1** and **Table 1-2** respectively).

			Total	Low Level	High Level							
Store A2	15.48	58022.3	15.312	0	15.312							
Store A1	15.04	23554.2	22.084	0	22.084							
Ex Sto C1	19.12	33401.8	52.484	0	52.484							
CONTINUITY CHECK for 15min PMP												
Node	Inflow	Outflow	Storage Char	Difference								
	(cu.m)	(cu.m)	(cu.m)	%								
Ex SimtaChann	95595.51	95595.51	0	0								
Ex Combined SIMT	65446.86	65446.84	0	0								
EX G SIM	73215.45	73211.96	0	0								
EX S1	25915.93	25915.93	0	0								
MPW	5320.32	5320.32	0	0								
EX DNSDC	8810.89	8809.8	0	0								
EX dummy DNSDC	2335.61	2335.61	0	0								
Ex Mo HW 1	73208.51	72973	0	0.3								
Ex Top Chan	95805.73	95802.09	0	0								
Carpark HW	3419.83	3419.88	0	0								
EX Carpark	141.95	141.95	0	0								
Store A2	43720.34	30865.18	12857.77	0								
Store A1	33923.74	33929.96	0	0								
EX A2	30860.1	30860.1	0	0								
EX A1 E	35328.69	35328.7	0	0								
Ex Sto C1	67782.46	66744.65	1039.49	0								
E Moore	3465.66	3465.65	0	0								
EX E S1	15957.33	15957.33	0	0								
EX A1	35328.7	35328.7	0	0								
W Moore	2996.32	2996.32	0	0								
N621911	11331.58	11331.58	0	0								
N621913	19922.14	19921.93	0	0								
Run Log for SIMTA2_Exg_160819.drn run at 16:31:10 on 12/10/2016												
The maximum water level in the following storages exceeds the maximum elevation you specified: Ex Sto C1, Store A1.												
DRAINS has extrapolated the Elevation vs Storage table to a higher Elevation. Please provide accurate values for higher elevations.												
No water upwelling from any pit. Freeboard was adequate at all pits.												
The maximum flow in the following overflow routes is unsafe: OF542838, F Ex G06, F Ex Carpark Bypass, F W Moore, F EX A1 E, F EXE S1, F E Moore, F EX DNSDC, Ex Channel, F EX OVE												
The following overflow routes carried water uphill (adding energy): F Ex Sto 3 F EX DNSDC F EX A2												
These results may be invalid. You should check for water flowing round in circles at these locations. You may need to reformulate the model.												

2 These results may be invalid. You should check for water flowing roand in circles at these locations. You may need to reformulate the model.

1 The maximum water level in the following storage exceeds the maximum elevation you specified.