

30 April 2018

Mr Craig Cosier
Assistant Development Manager
Masterplanned Communities
Residential Development
Mirvac Homes Pty Ltd
Level 28, 200 George Street
Sydney NSW 2000

Dear Craig

Re: Biodiversity assessment for the planning proposal at 146 Newbridge Road, Moorebank
Project no. 26419

Biosis Pty Ltd was commissioned by Mirvac Homes Pty Ltd (Mircvac) to complete a biodiversity assessment to support a planning proposal for the planning proposal at 146 Newbridge Road, Moorebank. The purpose of the biodiversity assessment is to describe the biodiversity values associated with the proposed development.

This report has been prepared to support the planning proposal for the subject site to allow a residential use in two parts. The first part being a rezoning of a portion of residue land from RE2 Private Open Space to R3 Residential to join the existing zoned R3 residential area subject to development under an application with Liverpool City Council. The second part is for the approval of an enabling clause for terraces and residential flat buildings over part of the existing zoned RE2

The objective of this biodiversity assessment is to determine the presence of any threatened flora, fauna, populations or ecological communities (biota) within the study area and, where applicable, assess the impacts of the project on any such species or their habitats, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *NSW Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act).

Background

The study area is approximately 11.8 hectares and is defined as 146 Newbridge Road, Moorebank (Lot DP1065574).

The study area is within the City of Liverpool Local Government Area (LGA) and is currently zoned RE1 – Public Recreation and RE2 – Private Recreation under the Liverpool Local Environmental Plan 2008.

The surrounding land use is dominated by residential development to the north and east, with semi-rural and areas of remnant bushland along the Georges River to the south. The site itself is bordered on the eastern margin of the study area by the Georges River.

Method

Database and literature review

Prior to completing the field investigation, information provided by Mirvac as well as other key information was reviewed, including:

- Commonwealth Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- NSW Office of Environment and Heritage (OEH) BioNet Atlas of NSW Wildlife, for items listed under the BC Act.
- The NSW Department of Primary Industries (DPI) Spatial Data Portal for FM Act listed threatened species, populations and communities.
- NSW DPI WeedWise database for *Biosecurity Act, 2015* listed Priority listed weeds for the Liverpool Local Land Services (LLS) area within the Greater Sydney region.
- OEH Vegetation Information System (VIS) mapping through the OEH data portal, defining the legislative framework for assessment.

The implications for the project were assessed in relation to key biodiversity legislation and policy including:

- *Environment Protection and Biodiversity Conservation Act 1999*.
- *Environmental Planning and Assessment Act 1979* (EP&A Act).
- *Biodiversity Conservation Act 2016*.
- *Fisheries Management Act 1994*
- *Local Land Services Act 2016*.
- *Biosecurity Act 2015* (Biosecurity Act).

Field investigation

A field investigation of the study area was undertaken on (11/01/2018) by Tony Cable (Senior Ecologist), Luke Stone (Field Aquatic Ecologist), Matthew Hyde (Field Zoologist). Vegetation within the study area was surveyed using the random meander technique (Cropper 1993) over 6 person hours.

A habitat-based assessment was completed to determine the presence of suitable habitat for threatened species previously recorded (OEH 2017) or predicted to occur (Commonwealth of Australia 2017) within 10 kilometres. This list was filtered according to species descriptions, life history, habitat preference and soil preference to determine those species most likely to be present within the study area.

An aquatic habitat assessment was conducted across the single large dredge pond that covers the majority of the study area. High levels of electrical conductivity recorded within the dredge pond precluded survey by backpack electrofishing. Fish community survey was instead conducted using seine netting across an approximately 890 m² section of the dredge pond to provide an indicative sample of aquatic fauna present within the dredge pond. Surface water quality readings were recorded within the dredge pond and within the Georges River using a Horiba U-52 multiparameter water quality probe. Water quality samples were also collected, both within the dredge pond and within the Georges River and transferred to a NATA accredited laboratory for analysis of a standard suite of nutrients, dissolved metals, standard and volatile hydrocarbons.

Previous assessment

Several ecological assessments have been undertaken for the study area on behalf of Benedict Industries Pty Ltd, the outcomes of these assessments are summarised below. A detailed summary of the previous assessments is provided in EMM (2015)

Total Earth Care completed a flora and fauna assessment of the study area in 2006 to support a rezoning application. The assessment included background research within a five kilometre radius of the study area and two days of field survey. No threatened species under the *Threatened Species Conservation Act 1995* (TSC Act) or EPBC Act were recorded. The report concluded that the ecological values within the study area presented low to moderate constraints to the proposed development.

Total Earth Care completed an updated flora and fauna assessment of the study area in 2011 to support a rezoning application. The updated background research and field survey identified areas of River Flat Eucalypt Forest and Swamp Oak Floodplain Forest, consistent with descriptions endangered ecological communities under the TSC Act. Assessment of Significance assessments under Section 5A of the EP&A Act were not undertaken for these communities. No threatened flora or fauna species were recorded during the field assessment. Potential habitat for seven threatened species was identified within the riparian zone of the study area. These species included the Cumberland Plain Land Snail *Meridolum corneovirens*, Eastern Bentwing Bat *Miniopterus schreibersii oceanensis*, Eastern Freetail bat *Mormopterus norfolkensis*, Greyheaded Flying Fox *Pteropus poliocephalus*, Southern Myotis *Myotis macropus* and Yellow-bellied Sheath-tail-Bat *Saccolaimus flaviventris*. An assessment of significance assessments were undertaken for these species and concluded that any potential impacts to these species as a result of the proposed development would not be significant. The updated flora and fauna assessment made recommendations to reduce potential impacts resulting from the planning proposal, concluding that the proposed development would not have a significant impact upon native flora and fauna within the study area.

EMM (2015) undertook an assessment of gaps within the previous ecological assessments and carried out updated background searches within a 10 kilometre radius of the study area. EMM (2015) undertook Assessment of Significance assessments for both the River flat Eucalypt Forest and Swamp Oak Floodplain Forest, concluding that no significant impacts to the communities were considered likely as a result of the proposed development. EMM (2015) concluded that the planning proposal would result in overall improvements to the condition and degree of available habitat within the study area.

Marine Pollution Research undertook an aquatic ecological assessment of the planning proposal in 2010. Marine Pollution Research (2010) concluded that no threatened aquatic species had been recorded in the locality or were expected to occur and that the proposed development could be constructed and operated without significant impacts to the water quality of the Georges River. Marine Pollution Research also provided an update to the report in 2015 following a further site assessment reporting that the while minor changes in conditions had occurred at the site, the conclusions of the 2010 report remain valid.

Results

Regional soil landscape mapping indicates that the majority of the study area occurs on the Richmond soil landscape, with parts of the northern and southern extent of the study area occurring on the Berkshire Park soil landscape Bannerman and Hazelton 1990. The Richmond soils landscape is a fluvial soil landscape comprised of quaternary terraces of both the Nepean and Georges Rivers. The soils within the landscape are characterised broadly by clay loams, clays and sands. The majority of trees have been cleared within the landscape, prior to clearing the vegetation of this landscape would have consisted of dry sclerophyll low open woodland. The Berkshire Park soil landscape is also a fluvial soil landscape comprised of low rises on the Tertiary terraces of the Hawkesbury Nepean River systems. Soils within this soil landscape comprise of clays and clay sandy clays and clay loams. The majority of trees within this soil landscape have been subject

to land clearing, however the Castlereagh State Forest contains substantial numbers of trees. The composition of the soil is highly influential on the vegetation communities observed.

The site is currently in a highly modified state and has been subject to extensive historical vegetation clearing and works within the dredge pond, associated with the prior land use as a sand and gravel quarry. At the time of the field investigations the dredge was inundated, and received the majority of water during flooding in June 2016, with prior aerial images (TEC 2011; Nearmap 2015) indicating that the dredge pond changes in depth and shape associated with active dredging and water levels vary, dependent on local flooding.

The area of land, which is the subject of the planning proposal, is devoid of native vegetation and contains no terrestrial ecological value. The dredge pond has been inundated in recent flooding, with common fish species of the Georges River having recently colonised the site.

Ecological values within the site are limited to riparian vegetation to the north of the study area and the south, along the Georges River. This is the only remnant native vegetation within the study, which occurs as a narrow strip 20 metres wide although this is patchy and is void of native vegetation for 130 metres.

Threatened species

Background searches identified 47 threatened flora species and 115 threatened fauna species recorded (OEH 2017) or predicted to occur (DEE 2017) within 10 kilometres of the study area.

Flora

Background research highlighted 46 threatened flora species as coming within a 10 kilometres radius of the site. This list reduced based on species' habitat requirements and broad habitat types assessed known to be present within the study area. Threatened flora species considered most likely to have suitable habitat present within the study area, include:

- Downy Wattle *Acacia pubescens* (Vulnerable EPBC Act and BC Act).
- Nettle Bottle Brush *Callistemon linearifolius* (Vulnerable BC Act).

A field assessment of the habitat values present within the study area was undertaken for the above listed species. Throughout the study area high densities of exotic vegetation was found to occur, predominantly present in the ground-layer, as a result of significant past soil disturbance. This dense exotic vegetation, and soil disturbance, precludes the occurrence of the above species, along with those remaining species highlighted during background research. However riparian habitats along the Georges River hold some habitat value for the above listed species, which are more robust, and do tolerate some level of site disturbance.

These species were searched for throughout all patches of remnant native vegetation within the study area. None of the threatened species identified above, or during background research, were identified during the field investigations. Based on the size of the study area and growth form of the target species, the survey effort is considered comprehensive for the flora species outlined above. Taking all of these factors into consideration, there is a low likelihood of occurrence for the above listed species.

Fauna

Threatened fauna species considered under previous assessments as likely to have habitat within the study area are:

- Cumberland Plain Land Snail *Meridolum corneovirens* (Endangered, BC Act).
- Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable, EPBC Act and BC Act).

- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* (Vulnerable, BC Act).
- Eastern Freetail bat *Mormopterus norfolkensis* (Vulnerable, BC Act).
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act).
- Yellow-bellied Sheath-tail-Bat *Saccolaimus flaviventris* (Vulnerable, BC Act).

Total Earth Care (2006, 2011) and EMM (2015) undertook background research for the study area, identifying a number of other species that have been recorded within five and 10 kilometres respectively. These other species are not considered likely to occur, which is largely consistent with the background research undertaken by Biosis with this assessment. While River-flat Eucalypt Forest typically provides suitable habitat for Cumberland Plain Land Snail, the highly disturbed vegetation and prevalence of Kikuyu precludes the occurrence of the species. Additional threatened fauna species identified during the background research for this assessment considered likely to occur are:

- White-bellied Sea-Eagle *Haliaeetus leucogaster* (Vulnerable, BC Act).
- Osprey *Pandion cristatus* (Vulnerable, BC Act and Migratory, EPBC Act).
- Spotted Harrier *Circus assimilis* (Vulnerable, BC Act).
- Eastern Great Egret *Ardea modesta* (Migratory, EPBC Act).
- Latham's Snipe *Gallinago hardwickii* (Migratory, EPBC Act).
- Common Sandpiper *Actitis hypoleucos* (Migratory, EPBC Act).
- Marsh Sandpiper *Tringa stagnatilis* (Migratory, EPBC Act).
- Sharp-tailed Sandpiper *Calidris acuminata* (Migratory, EPBC Act).
- Common Greenshank *Tringa nebularia* (Migratory, EPBC Act).

Table 1 Assessment of habitat for threatened fauna species

Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
Feed trees	Angophoras, Eucalypts and other flowering perennial species recorded in the study area may provide nectar resources suitable for a range of arboreal and flying fauna (such as gliders, Grey-headed Flying-fox and nectivorous bird species) whilst in flower.	Based on the transient nature of these species and surrounding resources within the landscape there is not likely to be an impact to the Grey-headed Flying-fox and Little Lorikeet.
Hollow-bearing trees	Six hollow-bearing trees and one stag were recorded in the study area (Appendix 1; Figure 1) These hollows may provide potential roosting and/or nesting habitat for microbats but is unlikely to provide roosting habitat for the Powerful Owl due to large hollow dimensions required by this species (at least 50 cm deep).	It is recommended that if possible, the hollow-bearing tree be retained as an important habitat feature in the landscape that may be used by threatened microbats, small avifauna such as the Little Lorikeet and Black-chinned Honeyeater as well as providing feeding and perching habitat for other common avifauna.

Habitat feature	Threatened fauna association	Likelihood of occurrence or impact
Riparian woodland	Angophoras, Eucalypts, Swamp Oak and other tree species recorded in the study area may provide sheltering, foraging and roosting habitat for avifauna including the Varied Sittella, Black-chinned Honeyeater and Dusky Woodswallow.	It is recommended that native vegetation be retained along the margin of the Georges River, with this section of vegetation providing the only patch of suitable vegetation for threatened bird species considered to likely to occur within the study area.
Waterbodies	Reed beds and shallow water sections fringing the dredge pond within the study area provide potential foraging habitat for a number of bird species, particularly waders or species with habitat associations including reed beds, freshwater and estuarine wetlands.	Migratory waders are considered as likely to occur on occasion within the study area potentially utilising the shallow northern section of the dredge pond for foraging during seasonal migrations. Productivity and habitat value within this section is marginal and utilisation of these habitats is considered to be minimal and sporadic, therefore the potential impact to these species is considered low.

The range of habitats present within the study area, although generally of low condition support potential hunting habitat for birds of prey, such as the White-bellied Sea-Eagle which was recorded during the field assessment. Given the birds of prey considered likely to occur within the study area are transient, the species are considered unlikely to be impacted by the proposed development.

Based on the size of the study area, the survey effort is considered comprehensive to assess habitat presence for the species outlined in Table 2. Taking all of these factors into consideration, there is a low likelihood of impact for the above listed transient species.

Vegetation communities

Prior to the field investigation, Biosis confirmed that various native vegetation communities Swamp Oak Floodplain Forest, River Flat Eucalypt Forest and Cumberland Plain Woodland have been mapped in the broader landscape (OEH 2013), these include:

- *Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, endangered ecological community (Swamp Oak Floodplain Forest [TSSC 2004]).*
- *River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions, endangered ecological community (River-flat Eucalypt Forest [TSSC 2011]).*
- *Cumberland Plain Woodland in the Sydney basin Bioregion, endangered ecological community (Cumberland Plain Woodland [TSSC 2008]).*

A key focus of the field investigation was to assess the vegetation of the study area against the final determinations for the above listed TECs to determine presence or absence.

The vegetation of the study area comprises three (PCTs); Cumberland Swamp Oak Riparian Forest (equivalent to River-flat Eucalypt Forest TEC), Estuarine Swamp Oak Forest (equivalent to Swamp Oak Floodplain Forest TEC), and Highly disturbed weeds and exotics. The structure, floristic composition and condition of these communities are described in Table 3, and a figure illustrating their distribution within

the study area is contained in Appendix 1. A list of flora and fauna recorded within the study area as well as associated plates are provided in Appendix 2 and Appendix 3.

Table 2 Threatened Ecological Communities within the study area

Community	Description
River-flat Eucalypt Forest	This vegetation community within the study area was characterised by Blue Box <i>Eucalyptus baueriana</i> , Rough-barked Apple <i>Angophora floribunda</i> , Swamp Oak <i>Casuarina glauca</i> and <i>Eucalyptus botryoides</i> x <i>saligna</i> dominating the canopy with scattered Prickly-leaved Tea Tree <i>Melaleuca styphelioides</i> . Some scattered Blackthorn <i>Bursaria spinosa</i> and juvenile Swamp Oak contributed to a sparse and patchy mid stratum, with a predominantly weedy ground cover and understorey comprised of Kikuyu <i>Pennisetum clandestinum</i> , Cobblers Pegs <i>Bidens pilosa</i> and African Lovegrass <i>Eragrostis curvula</i> .
Swamp Oak Floodplain Forest	This vegetation community within the study area is characterised by dense homogeneous stands of Swamp Oak bordering the Georges River estuary with scattered juvenile Grey Mangrove <i>Avicenna marina</i> on the margins abutting Georges River.

Hollow bearing trees

Six hollow bearing trees and one stag were recorded during the field assessment, shown in Appendix 1:Figure 1. A total of thirteen hollows were recorded among the six hollow bearing trees and stag recorded. Some hollows observed were small enough to provide potential roosting habitat for microbats, which may occur within the study area, however most hollows are considered more suitable for common fauna species including Common Brushtail Possum *Trichosurus vulpecula*. Moderate levels of coarse woody debris were also identified throughout the areas of River flat Eucalypt Forest EEC.

Priority weeds

The *Biosecurity Act 2015* (Biosecurity Act) came into effect as of 1 July 2017 and repeals the *Noxious Weeds Act 1993*. The Biosecurity Act outlines biosecurity risks and impacts, which in relation to the current assessment includes those risks and impacts associated with weeds. A biosecurity risk is defined as the risk of a biosecurity impact occurring, which for weeds includes:

- The introduction, presence, spread or increase of a pest into or within the State or any part of the State.
- A pest plant has the potential to:
 - Out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight.
 - Harm or reduce biodiversity.

Three Priority Weeds for the Greater Sydney LLS Region, which includes the City of Liverpool Council LGA, that have been recorded in the study area are listed in Table 1, along with their associated Duty.

Table 3 Priority weeds within the study area

Scientific name	Common name	Biosecurity duty
-	All plants	<i>All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.</i>
<i>Asparagus aethiopicus</i>	Ground Asparagus	Prohibition on dealings <i>Must not be imported into the State or sold</i>
<i>Lantana camara</i>	Lantana	Prohibition on dealings <i>Must not be imported into the State or sold</i>

Riparian corridors

The Georges River is a seventh order stream and runs along the eastern margin of the study area,. In addition, a single large man-made dredge pond associated with the Georges River is located in the southern half of the study area. An additional unnamed first order tributary is mapped as flowing into the dredge pond before running into the Georges River. No evidence of this tributary was observed on site. It is expected that this tributary no longer exists on site as a result of historic flow modification, water storage construction and earthworks.

The Riparian corridors within the study area have been assessed in relation to the *Water Management Act 2000* (WM Act). The Department of Primary Industries (DPI) Water recommends riparian widths based on watercourse order under the Strahler method. The watercourse within the study area was classified as a seventh order stream, which requires a riparian corridor width of 40 metres from the 'top of bank' on either side respectively.

The section of land identified as the subject site of the planning proposal does not occur within 40 metres of the Georges River, and as such a controlled activity permit would not be required.

The overall condition of the riparian area was determined to be moderately poor. The foreshore of the study is subject to bank in a limited number of sections, with anthropogenic materials (bricks, concrete slabs, piping) placed as bank armouring along the foreshore to protect against erosion. Approximately 50 scattered mangrove individuals, less the 1 metre in height are located along the riparian corridor of the study area. The riparian vegetation occurs in two strips of the Georges River at the northern and southern ends of the study area, broken in the middle by clearing associated with a dirt track across the closed entrance of the dredge pond to the Georges River. The riparian vegetation is comprised of three vegetation communities.

Aquatic habitat values

A large dredge pond 5.7 hectares, closed to the Georges River under base flow conditions, covers the majority of the study area. Anecdotal evidence indicate the dredge pond becomes connected to the Georges River during high flow periods. The northern section of the dredge pond edge is fringed by beds of Common Reed *Phragmites australis*. Where the Common Reed is absent the dredge pond margins are generally vegetated by terrestrial understory species rather than emergent macrophytes.

Water quality results recorded from the dredge pond and the Georges River during field are provided in Appendix 3:Table 5. Also presented are the NSW Water Quality and River Flow Objectives for the Georges River catchment, based on the ANZECC (2000) guidelines. The ANZECC (2000) guidelines 80% protection criteria are presented to identify exceedances for dissolved metals and hydrocarbons. No criteria have been

developed for estuarine systems, therefore the freshwater values have been used given the linear nature of the Georges River.

The fish community survey within the dredge pond recorded the presence of Sea Mullet *Mugil cephalus*, Sand Mullet *Myxus elongates*, Sandy Sprat *Hyperlophus vittatus* and Eastern Long-necked Turtle *Chelodina longicollis*. A number of fish species were observed from the bank schooling within the Georges River, including Sea Mullet, Black Bream *Acanthopagrus butcheri*, Luderick *Girella tricuspidata* and Longfin Eel *Anguilla reinhardtii*. No threatened aquatic species were observed within the study area. Eastern Gambusia *Gambusia hobbrookii* were observed in vegetated shallows within the dredge pond. The fish species recorded from the dredge pond are typical of the estuarine fish community expected to occur within the Georges River and are indicative of colonisation of the dredge pond by species from the Georges River, when the waterbodies are connected during high flows. These species are now disconnected from the Georges River and are unable to complete their life cycles, therefore the ongoing viability of this fish community is very poor.

Ecological values

The ecological values within the study area are provided in Figure 1. These constraints are ranked as high, moderate or low, based on the criteria outlined in Table 4.

Table 4: Ecological constraints in the study area

Constraint	Value	Justification	Recommendations
High	- Low condition River-flat Eucalypt Forest, listed under the BC Act. - Low condition Swamp Oak Floodplain Forest.	- Vegetation communities listed as critically endangered under BC Act. - Contains hollow bearing trees. - Provides potential roosting and foraging habitat for threatened fauna species.	- Impact to these areas should be avoided where feasibly possible. - Impacts to River-flat Eucalypt Forest or Swamp Oak Floodplain Forest, listed under the BC Act hectares must be offset. - Clearing of this vegetation would also require a permit to undertake a controlled activity on waterfront land from DPI Water.
Moderate	Man-made dredge ponds and remaining riparian corridor.	- Provides potential roosting and foraging habitat for threatened fauna species. - Does not provide potential habitat for threatened flora. - Habitat for a range of estuarine fish species.	- Impacts to areas should be minimised where possible. - Assess feasibility of maintaining shallow wetland environment within northern section of dredge pond.
Low	Disturbed weeds and exotics.	- Does not form part of an ecological community. - Does not contain any hollow bearing trees. - Is unlikely to provide potential habitat for threatened flora or fauna.	Development suitable in these areas.

Conclusion and recommendations

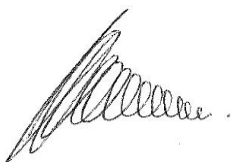
The flora and fauna constraints assessment has highlighted limited values and constraints within the study area and subject site. Due to the nature and location of these constraints the following recommendations have been made regarding the potential impact area for the project, with the proposed rezoning considered to result in no impact to ecological values occurring within the subject site.:

- The rezoning of the land from RE2 to R3, and subsequent developments, will not result in any ecological impacts as the subject site is highly disturbed and devoid of native vegetation and fauna habitat features.
- River-flat Eucalypt Forest and Swamp Oak Floodplain Forest occurring along the foreshore of the Georges River is to be the subject of a voluntary planning agreement (VPA) with Council and as such any impacts to these vegetation communities is not proposed by Mirvac. If impacts to these vegetation communities are proposed in the future, a 5-part test is required for each, would be subject to offset requirements during the application for Development Approval phase and a permit to undertake a controlled activity.
- No ecological values occur within the area that is the subject of the planning proposal, except the now inundated dredge pond following from recent flooding which now contains landlocked estuarine fish populations.
- Consider the preparation of a weed management plan to reduce the spread of weed propagules during the proposed development, which and should be prepared during the application for Development Approval or be incorporated into a vegetation management plan.
- All but one of the hollow bearing trees occur within patches of TEC, and are recommended to be retained. The single hollow-bearing tree occurs on the foreshore is also to be subject of the VPA with Council.

Following the observation of two White-bellied Sea Eagles within the study area during the field assessment. A five-part test is recommended to be undertaken for this species during the application for development approval to comply with the BC Act.

I trust that this advice is of assistance to you however please contact me if you would like to discuss any elements of this ecological advice further.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Anthony Cable', with a stylized, cursive script.

Anthony Cable

Senior Ecologist

References

Bannerman, S and Hazelton, P 1990. *Soil Landscapes of the Penrith 1:100 000 Sheet*. Soil Conservation Service of NSW, Sydney.

DEE 2018. Protected Matters Search Tool.

DPI 2018a. NSW WeedWise database by Local Land Services area for the Greater Sydney region.

DPI 2018b. Fisheries Spatial Data Portal.

EMM 2015. Proposed Georges Cove Marina – terrestrial ecological assessments. Author: Cassandra Thompson.

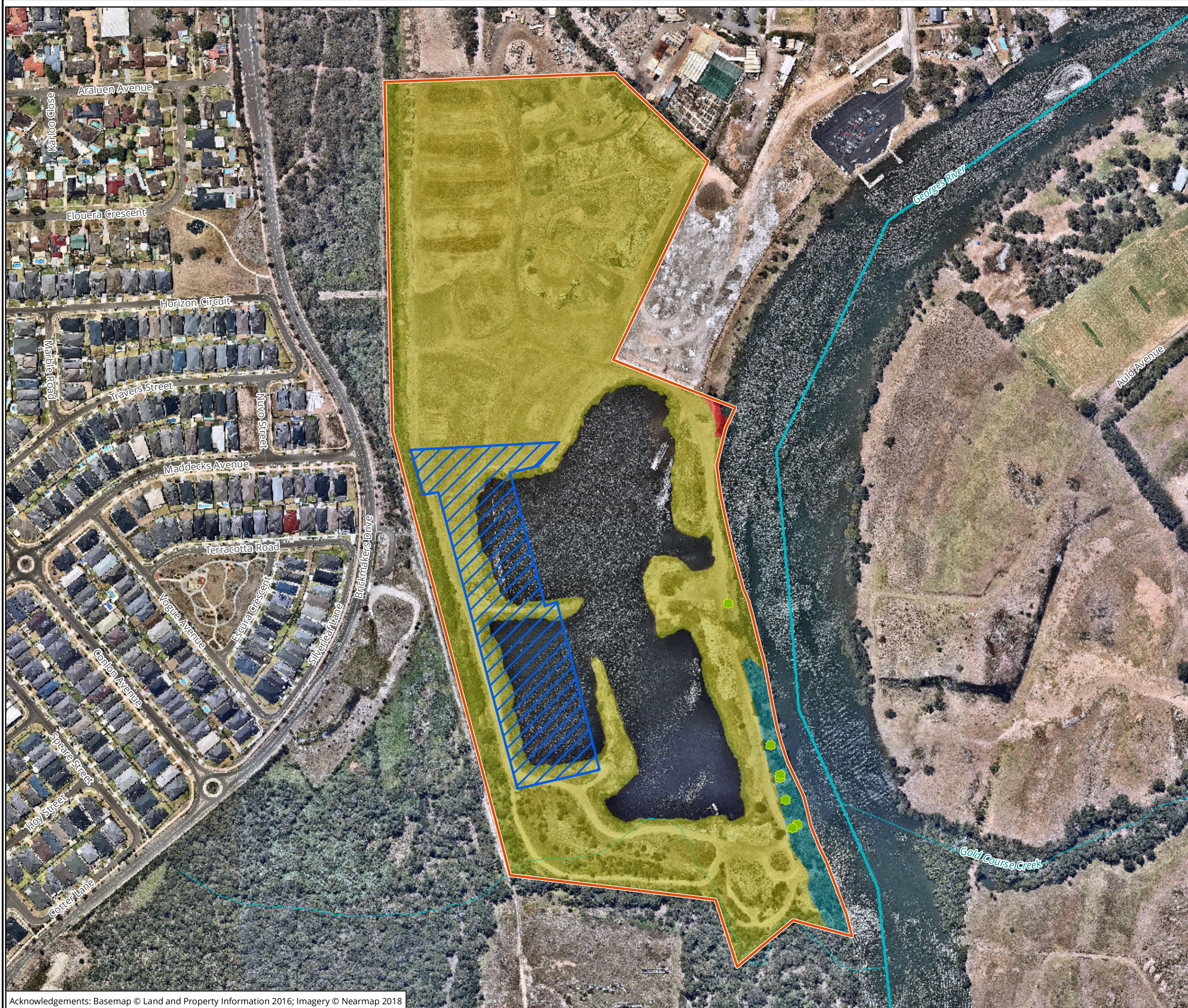
Marine Pollution Research 2015. Aquatic ecology aspects & environmental assessment of marina concept design. Author: Paul Anink.

Marine Pollution Research 2015. Update of aquatic ecology impact report for Georges Cove Marina. Author: Paul Anink.

OEH 2018. OEH Vegetation Information System (VIS) mapping through the OEH data portal.

Appendices

Appendix 1 Figure 1



Legend

- Study area
- Planning proposal subject site

Vegetation communities

- Cumberland Swamp Oak Riparian Forest (River Flat Eucalypt Forest EEC)
- Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion (Swamp Oak Floodplain Forest EEC)
- Highly disturbed weeds and exotics
- Hollow-bearing trees

Figure 1: Ecological values of the study area

0 50 100
Metres

Scale: 1:3,250 @ A3
Coordinate System: GDA 1994 MGA Zone 56



Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 26419
Date: 27 April 2018,
Checked by: APC, Drawn by: ARL, Last edited by: alongmire
Location: P:\26400s\26419\Mapping\26419_F1_EcoValues

Appendix 2 Plates



Plate 1: Swamp Oak Floodplain Forest



Plate 2: River flat Eucalypt Forest



Plate 3: Hollow bearing tree



Plate 4: Juvenile mangrove plants



Plate 5: Dredge pond facing north



Plate 6: Dredge pond facing south



Plate 7: *Phragmites australis* beds within the dredge pond



Plate 8: Coarse woody debris



Plate 9: Bank of the Georges River along the study area facing north



Plate 10: Sand Mullet captured during fish community survey

Appendix 3 Water quality data

Table 5 **Water quality results recorded by Biosis**

Physicochemical parameter	NSW Water Quality and River Flow Objectives: Lowland rivers	NSW Water Quality and River Flow Objectives: Freshwater lakes and reservoirs	NSW Water Quality and River Flow Objectives: Estuaries	80% trigger values for freshwater (µg/L)	Georges River River	Dredge pond edge (breach point) Dredge pond	Dredge pond edge (eastern centre) Dredge pond
Field measurements							
pH (pH units)	6.5-5.5	6.5-8.0	7.0-8.5	-	7.89	7.94	7.90
Dissolved Oxygen (% Saturation)	85-110	90-110	80-110	-	135.3	132.6	145.0
Electrical Conductivity (µS/cm)	125-2200	-	-	-	23400	19300	9100
Temperature (°C)				-	27.0	26.6	25.8
Turbidity (NTU)	6-50	1-20	0.5-10	-	8.4	16.3	10.7
Nutrients (µg/L)							
Total Phosphorous	25	10	30	-	20	60	-
Total Nitrogen	350	350	300	-	300	400	-
Total Kjeldahl Nitrogen	-	-	-	-	300	300	-
Total Ammonia as N	-	-	-	2300 (Ammonia)	20	80	-
Total Nitrite and Nitrate as N	-	-	-	1700 (Nitrate only)	20	140	-
Dissolved metals (µg/L)							
Sulfate as SO ₄	-	-	-	-	920000	999000	-
Aluminium	-	-	-	150	10	<10	-
Arsenic	-	-	-	140 (Arsenic as V)	3	<1	-
Cadmium	-	-	-	0.8	<0.1	<0.1	-
Copper	-	-	-	2.5	<1	<1	-
Lead	-	-	-	9.4	<1	<1	-
Manganese	-	-	-	3600	212	93	-

Physicochemical parameter	NSW Water Quality and River Flow Objectives: Lowland rivers	NSW Water Quality and River Flow Objectives: Freshwater lakes and reservoirs	NSW Water Quality and River Flow Objectives: Estuaries	80% trigger values for freshwater (µg/L)	Georges River River	Dredge pond edge (breach point) Dredge pond	Dredge pond edge (eastern centre) Dredge pond
Selenium	-	-	-	34	<10	<10	-
Zinc	-	-	-	31	<5	5	-
Iron	-	-	-	-	<50	<50	-
Mercury	-	-	-	5.4 (inorganic Mercury)	<0.1	<0.1	-
BTEXN (µg/L)							
Benzene	-	-	-	2000	<1	<1	-
ortho-Xylene	-	-	-	640	<2	<2	-
Naphthalene	-	-	-	85	<5	<5	-

Appendix 4 Flora and fauna species recorded

Flora species recorded from the study area

Flora species recorded by Biosis, 11/01/2018

Status	Scientific name	Common name
Native species		
	<i>Acacia pycnantha</i>	Golden Wattle
	<i>Angophora floribunda</i>	Rough-barked Apple
	<i>Avicennia marina</i>	Grey Mangrove
	<i>Acacia decurrens</i>	Black Wattle
	<i>Bursaria spinosa</i>	Blackthorn
	<i>Casuarina glauca</i>	Swamp Oak
	<i>Eucalyptus botryoides</i> <--> <i>saligna</i>	
	<i>Eucalyptus baueriana</i>	Blue Box
	<i>Eucalyptus tereticornis</i>	Forest Red Gum
	<i>Melaleuca styphelioides</i>	Prickly-leaved Paperbark
Exotic species		
	<i>Araujia sericifera</i>	Moth Vine
	<i>Asparagus aethiopicus</i>	Asparagus Fern
	<i>Bidens pilosa</i>	Cobbler's Pegs
	<i>Brassica</i> sp.	Mallow
	<i>Cardiospermum grandiflorum</i>	Balloon Vine
	<i>Cirsium vulgare</i>	Spear Thistle
	<i>Cynodon dactylon</i>	Couch
	<i>Eragrostis curvula</i>	African Lovegrass
	<i>Lantana camara</i>	Lantana
	<i>Malva parviflora</i>	Small-flowered Mallow
	<i>Pennisetum clandestinum</i>	Kikuyu Grass
	<i>Ricinus communis</i>	Castor Oil Plant
	<i>Verbena bonariensis</i>	Purpletop

Fauna species recorded from the study area

Terrestrial fauna species recorded by Biosis, 11/01/2018

Status	Scientific name	Common name
Birds		
	<i>Acanthiza pusilla</i>	Brown Thornbill
	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler
	<i>Anas castanea</i>	Chestnut Teal
	<i>Anas gracilis</i>	Grey Teal
	<i>Anas superciliosa</i>	Pacific Black Duck
	<i>Anhinga novaehollandiae</i>	Australasian Darter
	<i>Aythya australis</i>	Hardhead
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike
	<i>Corvus coronoides</i>	Australian Raven
	<i>Fulica atra</i>	Australasian Coot
V	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle
	<i>Malarus cyaneus</i>	Superb fairy Wren
	<i>Malarus lamberti</i>	Variegated Fairy Wren
	<i>Nymphicus hollandicus</i>	Cockatiel
	<i>Pelecanus conspicillatus</i>	Australian Pelican
	<i>Phalacrocorax carbo</i>	Great Cormorant
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant
	<i>Podiceps cristatus</i>	Great Crested Grebe
	<i>Porphyrio porphyrio</i>	Purple Swamphen
	<i>Sturnus tristis</i>	Common Myna
	<i>Todiramphus sanctus</i>	Sacred Kingfisher
	<i>Vanellus miles</i>	Masked Lapwing
	<i>Zosterops lateralis</i>	Silvereye
Reptiles		
	<i>Chelodina longicollis</i>	Eastern long-necked turtle
Fish		
	<i>Acanthopagrus butcheri</i>	Black Bream
	<i>Anguilla reinhardtii</i>	Long-finned Eel
	<i>Girella tricuspidata</i>	Luderick

Status	Scientific name	Common name
	<i>Hyperlophus vittatus</i>	Sandy Sprat
	<i>Mugil cephalus</i>	Sea Mullet
	<i>Myxus elongatus</i>	Sand Mullet