ECOLOGICAL SURVEY AND STATUTORY ASSESSMENTS

OF

PROPOSED CONSTRUCTED WETLAND AND FILLING & CONCEPT PLAN ON PART LOT 123 DP 1106943, & LOT 5 DP 25886, OCEAN DRIVE, LAKE CATHIE

FOR

Luke and Company Pty Ltd

Port Macquarie

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NOTE:

This report is presented on an objective basis to fulfil the stated legislative obligations, consideration and requirements in order to satisfy the client's instructions to undertake the appropriate studies and assessments. It is not directly intended to advocate the proponent's ambitions or interests, but is to provide information required in the determination of development consent by the decision-making authority for the subject proposal.

To the best of our knowledge, the proposal described in this assessment accurately represents the proponent's intentions when the report was completed and submitted. However, it is recognised and all users must acknowledge that conditions of approval at time of consent, post development application modification of the proposal's design, and the influence of unanticipated future events may modify the outcomes described in this document. Completion of this report has depended on information and documents such as surveys, plans, etc provided by the proponent. While checks were made to ensure such information was current at the time, this consultant did not independently verify the accuracy or completeness of these information sources.

The ecological information contained within this report has been gathered from field survey, literature review and assessment based on recognised scientific principles, techniques and recommendations, in a proper and scientific manner to ensure thoroughness and representativeness. The opinions expressed and conclusions drawn from this report are intended to be objective, based on the survey results and this consultant's knowledge, supported with justification from collated scientific information, references/citations or specialist advice.

Furthermore, it is clarified that all information and conclusions presented in this report apply to the subject land at the time of the assessment, and the subject proposal *only*.

This report recognises the fact, and intended users must acknowledge also, that all ecological assessments are subject to limitations such as:

- Information deficits (eg lack of scientific research into some species and availability of information)
- Influences on fauna detectability eg season in which survey is undertaken
- Influences on species occurrence eg stage of lifecycle, migratory, etc
- Time/financial budgets.

All users should take into account the above information when making decisions on the basis of the findings and conclusions of this report.

For and on behalf of DARKHEART Eco-Consultancy,

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SUMMARY

1. BACKGROUND INFORMATION

This report presents the results of an ecological survey and impact assessment, and *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) - Matters of National Environmental Significance (MNES) assessments of a proposed constructed wetland and associated filling of land on Part Lot 123 DP 1106943 and Lot 5 DP 25886 Ocean Drive, Lake Cathie. This survey and assessment forms part of an Environmental Assessment for two development applications under Part 3A of the *Environmental Planning and Assessment Act 1979* to the Dept of Planning (DoP), NSW, as follows.

The first application ("*Concept Plan*") seeks consent for:

- The delineation of the limits of the residential subdivision
- The delineation of the three intersections with Ocean Drive
- The delineation of the extent of the future school sites
- The general location of the Greater Lake Cathie/Bonny Hills Village Centre
- The delineation of the site for future eco-tourist development
- The delineation of the extent of the Open Space, Drainage and Wildlife Habitat Corridor

The second application ("*Project Application – Open Space Corridor and Constructed Wetland*") seeks consent for the following elements:

- Open Space, Drainage and Wildlife Habitat Corridors
- Earthworks required for Constructed Wetlands and to create filled reclaimed areas
- Storm Water Treatment and Management, and
- District Sporting Fields and Facilities

The Director has issued Director General's Requirements (DGRs) for the Concept Plan Application (CPA) and the Project Application (PA).

The following Concept Plan Application DGRs are addressed in this report:

CP 7.3: Outline measures for the conservation of flora and fauna and their habitats within the meaning of the Threatened Species Conservation Act 1995.	**Recommendations**: Sections 6.1, 6.2, 6.3
CP 7.4: Outline measures for the conservation or enhancement of existing wildlife corridors and/ or the connective importance of any vegetation on the subject land.	**Recommendations**: Sections 6.1, 6.2, 6.3

The following Project Application DGR's are addressed in this report:

PA 4.1: Outline potential impacts on flora and fauna and their habitats (within the meaning of the Threatened Species Conservation Act 1995 across the site and where relevant provide conservation measures.	**Impacts**: Section 5.0 **Recommendations**: Section 6.1, 6.2

The site is part of a larger parcel of land approximately 180ha located east of Ocean Drive between Lake Cathie and Bonny Hills which has been previously surveyed by the consultant in 2003, 2005 and 2006, and another consultant in 1983.

The section of land proposed for development is approximately 10.72ha for a constructed wetland, and another approximately 49ha for associated filling of land to the north, northwest and west for future urban development. The PA site is located roughly in the centre of the property, between the existing dwelling on the northern ridgeline and the largest currently existing lagoon to the south, and extends from the edge of the forested vegetation on the western boundary adjacent to Ocean Drive to the edge of Duchess Gully in the east.

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The property on which the Applications are proposed is situated at the southern outskirts of Lake Cathie village and is part of a currently rural area between expanding residential areas of Lake Cathie and Bonny Hills. The future development concepts in the UIA 14 Urban Design Structure Plan include residential development of the property including most of the proposed PA site where filling is proposed, with retention of some open spaces for drainage and habitat corridors/public reserves (where the wetland is proposed). The proposals are thus in line with this Plan.

The property has a very complex topography and geomorphological history, modified in some areas by previous developments. Topography ranged from broad flat poorly drained land, to a ridgeline in the north, a sandplain in the east, and two large lagoons which provided fill for previous residential development to the south. The property also includes the upper limits of Duchess Gully which drains to the sea just north of Bonny Hills. Drainage over the property and also characteristics of Duchess Gully have long been artificially modified via deep drains and partial construction of a golf course as part of a previous abandoned development proposal.

The soils on the property are part of the Cairnscross landscape on the lower sections, and Moripo landscape on the higher ground. The lower section was comprised of broad drainage plains with alluvial soils and slope-wash clays/silts, with poorly drained Gleyed Podzolic soils and Sodosols present. These soils are characterised by strong acidity, potential aluminium toxicity, poor drainage, seasonal waterlogging and low fertility. Field texture was a dark loam with high silt content. The higher ground was based on metadolerites and dacites, with moderately well drained, stony, brown and yellow Dermosols and Brown Chromosols. These are stony soils, neutral to moderate alkalinity, with localised seasonal waterlogging. The field texture was a fine sandy loam, consisting largely of fine sand and silt with little clay.

Deep below the soils on the poorly drained land, are Potential Acid Sulfate Soils which have not been activated despite previous extensive lowering of the watertable and modification of surface water flow patterns by artificial drainage which occurred at least around the middle of the last century as evidenced by historical photos.

2. FLORA RESULTS:

2.1 Vegetation Communities

i) Vegetation Communities:

In broad overview of the vegetation communities of the total property, it is noted (especially via reference to historical aerial photos) that the property has been subject to a significant level of disturbance at various times, mostly for pastoralism and establishment of the previous abandoned development proposal in the 1980's. Appraisal of photos from the 1960's to present show various episodes and extents of clearing and regrowth over the property.

All of the property's vegetation has been subject to some form of disturbance, with some communities derived from this disturbance of previous communities or via colonisation of new habitat eg pasture/pastoral woodland and probably most of the Swamp Oak swamp forest. Most of the vegetation communities currently present have been mapped as part of the UIA 14 Koala Plan of Management, and their approximate area are illustrated below.

Table A: Types and extents of vegetation communities on the property.

Vegetation Community/Habitat	Total Area (ha)
Blackbutt-Tallowwood-Needlebark Dry Sclerophyll Forest	1.98
Brushbox Wet Sclerophyll Forest	0.72
Blackbutt Dry Sclerophyll Forest	2.11
Grey Ironbark-Grey Gum Dry Sclerophyll Forest	2.39
Paperbark-Swamp Mahogany-Swamp Oak Swamp Forest/Woodland	10.4
Pasture/Pastoral Woodland	150.12
Dune Scrub	1.19
Swamp Oak	4.3
Aquatic	5.75
	179ha (Approx)

ii) Threatened Flora Species:

This and previous surveys failed to detect the presence of any threatened flora species on the property despite targeted searches in generically suitable habitat. The property has been subject to a range of disturbances at various intensities including clearing, drainage, earthmoving and cattle grazing. These threatening processes over time are considered likely to have significantly reduced the suitability of the subject land to support threatened species, or resulted in their elimination. In this regard, the property is considered to have at best minimal potential to possess a threatened flora species and none were considered likely potential occurrences.

iii) Endangered Ecological Communities:

Two low to medium quality Endangered Ecological Communities listed under the *Threatened Species Conservation Act* (TSCA) *1995* occur on the property (previously mapped in the UIA 14 KPoM), comprising about 14.74ha in extent.

- ***Swamp Sclerophyll Forest on Coastal Floodplains***: This EEC is considered to constitute the Paperbark/Swamp Mahogany/Swamp Oak swamp forest in the mid southwest, northwest and southeast of the property. Overall, all examples of this EEC on the property were considered to only qualify as low to medium quality examples due to the extent of disturbance and modification. Collectively the EEC – *Swamp Sclerophyll Forest* occurs over approximately 10.4ha of the property.

- ***Swamp Oak Floodplain Forest***: This EEC was considered to constitute the portion of Swamp Oak located in the northeastern section of the property which actually occurred on the poorly drained land. The community occupies 4.29ha of the property.

3. HABITAT EVALUATION:

The habitats/habitat components on the property are summarised as follows:

(a) Aquatic habitat:

The most significant habitat on the property appears to be a drain in the southwest that was found to support a small population of Wallum Froglets, and an artificial wetland formed by an unfinished excavation which supported a larger population of this threatened species. The Black-Necked Stork/Jabiru may also periodically forage in these areas. Other habitat on the property was not considered likely to support any other threatened frogs due to disturbance, isolation, trampling and grazing by cattle, and presence of Plague Minnow.

The two lagoons offered some known and potential non-breeding foraging habitat for EPBCA listed migratory species and perhaps the threatened Black-Necked Stork/Jabiru, Osprey and Bitterns. Duchess Gully offered some non-breeding foraging potential for Bitterns and some EPBCA migratory bird species (more so in downstream portions off-site). Most of these habitats were also considered suitable for foraging by the Southern Myotis.

(b) Terrestrial habitat:

Overall due to disturbance history and grazing management, the property did not contain significant quantities of logs and fallen branches. Most occurred in the limited areas of dry sclerophyll forest in the southeast of the property. These logs had varying levels of decay and at times reasonable amounts of debris piled up against them, hence offered some limited habitat potential for forage and refuge.

Groundcover vegetation was generally sparse throughout most of the property due to periodic slashing for pasture management and generally it did not provide significant potential habitat for rodents, other smaller terrestrial species, or for macropods. The exception was in some less accessible forested sections in the southwest of the property adjacent to the dry sclerophyll; the east-southeast patch of dense Swamp Oak swamp forest; and the native grassland to the east of Duchess Creek which provided a relatively dense cover up to 1m high (average 30-50cm), when not slashed. Two of these areas were found to support very small populations of the TSCA 1995 listed Eastern Chestnut Mouse and one recorded a single Common Planigale.

Leaf litter was present throughout the forested areas, particularly in the Swamp Oak and southern area of the dry sclerophyll where it was often the dominant ground cover. Generally the litter was up to 5cm deep. Throughout most of the forested areas, undergrowth was absent or present only as a sparse cover of shrubs and Lantana which provided limited habitat for passerine

birds.

(c) Arboreal habitat:

Tree hollows are limited in distribution, abundance and diversity on the property due to historical disturbance.

The area of scattered isolated trees located in the pastoral woodland in the centre and mid-north of the property contained the most hollows on the property. Within the PA alone, some 14 hollow-bearing trees with entrances ranging in diameter from approximately 5-35cm occurred. However, the utilisation of these hollows by arboreal species is likely to be significantly limited due to the small size of the habitat in which they occur, lack of other habitat components (eg understorey, groundcover, logs, etc), and most of all the effective isolation from similar (ie forest) habitat. Consequently, apart from highly mobile threatened fauna such as some Microchiropteran bats, only common woodland birds were considered or observed facilitating these hollows and no threatened arboreals are considered likely to facilitate these hollows.

The small area of dry sclerophyll at the northern boundary of the property also contained six hollows with entrances 5-10cm diameter. Other small hollows may be present but were not visible from below. Hollows were also observed in the southeast dry sclerophyll. In total these hollows provided good potential roost/nest habitat for *Antechinus*, possums, gliders (eg Squirrel Glider), other mammals (eg Brushtail Phascogale) and Microchiropteran bats.

(d) Foraging resources:

Overall, the property contains a potential year round arboreal flowering foraging resource and this foraging resource may contribute to the presence of birds, insects and other dependant fauna including threatened species such as the Grey-Headed Flying Fox or Squirrel Glider. However, this may not be a reliable year round resource due to variations in climatic factors and seasonal flowering incidences, and the limited extent, poor interconnectivity and dispersed distribution of this habitat on the large property.

The property contains a relative abundance of *Casuarina glauca*, predominantly in the Swamp Oak complex but also found in various communities throughout the property. The species preferred by the Glossy Black Cockatoo are reported to be Black Oak (*Allocasuarina littoralis*) and Forest Oak (*Allocasuarina torulosa*) and thus the Swamp Oaks on the property were considered only likely to provide at best a marginal secondary foraging resource. Black Oak was found in relatively low abundance on the property in the northern section of dry sclerophyll/swamp forest on the western boundary of the property. The species occurred as immature understorey specimens and were considered in their current form to provide low potential as a foraging resource.

The Swamp Mahogany, Forest Red Gum, Tallowwood and Small Fruited Gum on the site are preferred Koala browse species in the mid-north coast of NSW. Potential Koala Habitat as defined by SEPP 44 occurs on the property, and Core Koala Habitat has been identified in the southeast corner by the UIA 14 Koala Plan of Management and confirmed by this survey.

(e) Bat habitat:

The property offered some good potential for foraging by the nationally threatened Grey-Headed Flying Fox, but did not offer suitable roost sites for the species. Only limited potential occurred in specific areas for foraging by the Eastern Blossom Bat and no significant potential roosting habitat for this species, which has been recorded roosting in adjacent littoral rainforest.

The property provided areas of continuous canopy forest suitable for aerial intercept species flying over the canopy (termed the 'supra canopy zone'). These include threatened species such as the Common Bent-Wing Bat and Yellow-Bellied Sheathtail Bat. Potential opportunities for foraging at the border between forest communities and open pasture, grass or sedge land and beneath the canopy of forested habitat also occurred on the property. This potential foraging resource is considered suitable for threatened species such as the Greater Broad-Nosed Bat, Eastern Freetail Bat, Common Bent-Wing Bat and Little Bent-Wing Bat which have been observed in similar situations. The lagoons and Duchess Gully were considered structurally suitable for foraging by the Southern Myotis.

As noted above, tree hollows of varying sizes provide good potential roost sites for these bats but no caves or similar structures occur on the property. The peeling bark of Forest Red Gums and Blackbutts on the property also offers seasonal temporary roosts for the smaller Microchiropteran bat species.

(f) Wildlife Corridors and Habitat Linkages:

Internal linkage between forested habitats on the property is best described as tenuous. Limited and at times fragmented riparian vegetation along Duchess Gully provides the most defined link from the northwest dry sclerophyll and Swamp Oak swamp forest to the southeast dry sclerophyll and swamp forest, and beyond to the southeast. An even more tenuous link is provided by the Paperbark/Swamp Mahogany swamp forest around the western lagoon and associated drain to the ribbon of dry sclerophyll and swamp forest in the far west. Overall, species dependant on continuous forest/woodland or dense groundcover would have significant difficulty moving across the property.

The eastern and western sides of the property is mapped by the DECC as part of the Lake Cathie-Camden Haven Regional Corridor which links Lake Innes Nature Reserve to the Grants Beach area (as well as being part of the Habitat Corridors designated in the Lake Cathie – Bonny Hills Structure Plan 2004). This regional link is fragmented by cleared private land, a main road, and ongoing residential development. No DECC sub-regional corridors were mapped in close proximity to the property. However, due to the current habitat fragmentation, the area designated as regional corridor is more likely to function as a sub-regional corridor. No portion of the property is mapped as Key Habitat.

The upper limits of Duchess Gully and Swamp Oak community in the northeastern corner of the property is identified in the UIA 14 Structure Plan as part of a northern corridor, and the broad drainage line running from the southwest to the east across the property to Duchess Gully is identified as a major east-west link to the dune vegetation and to Bonny Hills. Current habitat in these corridors however offers limited potential suitability due to fragmentation, immaturity and limited diversity. Hence an effective corridor through these areas is likely to require that existing forest habitats be significantly augmented by assisted regeneration of habitats with a diversity of structure and composition (eg dry and wet sclerophyll forest, sclerophyll swamp forest, sedgelands) and with continuous wooded cover linking to existing remnants.

The revised Structure Plan has also removed the previously mapped northernmost section of the northern corridor (ie from Ocean Drive to Lake Cathie) which linked to Lake Innes Nature Reserve. Consequently, this constricts the northern corridor's effectiveness to only highly mobile fauna such as birds and bats, with limited value to terrestrial/arboreal species such as the Koala.

4. FAUNA RESULTS:

Survey of the property by this consultant from 2003-2006 as well as an earlier study in 1983 recorded the following threatened species:

(i) Wompoo Fruit-Dove: Previous study observed this bird roosting in a tree in the southwest of the property, and as a few individuals flying along the littoral rainforest off the eastern boundary of the property in 2003. The property does not offer any significant habitat for this species (ie no significant foraging habitat), hence its occurrence on the property is merely incidental.

ii) Square-Tailed Kite: This species was not detected on the property during the surveys but has been anecdotally recorded flying over the southern end by the consultant, as well as within 2km both north and south of the property. A limited potential foraging resource of passerines is present in the forest remnants on the property. No nests were observed and nesting is considered unlikely on the property due to the limited forest area, presence of another nesting raptor, and paucity of potential nest trees. At the least, the property overall is likely to fall within the home range of a local pair, hence the Square-Tailed Kite was considered at least a fair chance of occurrence on the property as an occasional forager.

iii) Eastern Chestnut Mouse and Common Planigale: These species were not detected in the PA area, but were recorded in 2003 in two separate portions of the property:

- East of Duchess Gully (Eastern Chestnut Mouse only) in native grassland which is a localised area created by disturbance (maintenance slashing), and dominated by dense Matrush, Bracken Fern and Bladey Grass. This area of habitat is adjacent to dune scrub and southeast dry sclerophyll, but does not link to any similar habitat.
- Narrow drain dominated by *Babingtonia pluriflora* and sedges, adjacent to a small patch of rank Bladey Grass in the southwest corner, adjacent to the southwest patch of dry sclerophyll. This area of habitat is highly constricted by periodic slashing of adjacent pasture.

Due to the history of disturbance over the property and current management (ie slashing); the (at best) tentative connectivity; small population size; and the limited/restricted extent of dense groundcover/habitat; the populations of these species on the property are currently considered to have marginal long term viability.

iv) Little Bent-Wing Bat: This species was recorded foraging in the southeast most likely along the fire trail along the southeast boundary fence to the sewage treatment plant; and in the PA area. The property forms part of the extensive non-breeding foraging range of at most a few individuals of this species, with limited potential to roost in tree hollows.

v) Wallum Froglet: The Wallum Froglet has been recorded in two locations in the southern end of the property during previous surveys:

- At least 50 individuals in an apparently constructed depression just north of the eastern large lagoon (just outside the proposed wetland and filling area).
- At least 2 individuals in a drain dominated by heath in the southwest corner of the property adjacent to the southwest dry sclerophyll (where the Common Planigale was also recorded).

vi) Koala: Koala scats indicating an Area of Major Activity were found in swamp forest in the southeast of the property adjacent to the Bonny Hills sewage treatment plant (STP), but nowhere else on the property despite searches. This correlated previous sightings and scats in this area by another consultant, and complimented historical records of the Koala on the property. The southeast corner of the property was considered to form part of Core Koala Habitat.

vii) Grey Headed Flying Fox: Several individuals were recorded foraging on flowering trees on the property. Overall, the property has capacity only to form a small part of the very large foraging range of this species which varies according to incidences of flowering and fruiting.

In addition to the above, the DECC Atlas of Wildlife shows a record of the Swift Parrot on the northern part of the property. The property overall offers rather marginal potential and at most may form a minute fraction of the potential non-breeding foraging range of this Winter migrant.

The following Migratory species listed under the EPBCA 1999 were observed by this consultant or have been previously recorded foraging on the property:

- Great Egret
- Cattle Egret
- White-Breasted Sea-Eagle
- Fork-Tailed Swift
- Rufous Fantail

A number of other threatened and migratory fauna species were also considered potential occurrences on the site and/or larger property.

5. IMPACTS OF THE DEVELOPMENT:

A comprehensive review was undertaken of the potential ecological impacts the proposal may have, with specific focus on threatened species recorded on and near the site, or considered to have potential to occur.

(a) General Impacts:

As per the DGRs, impacts on threatened species are assessed for the Project Application. The broad impacts of the Concept Plan Application are considered in terms of the relevant DGRs (CP 7.3 & CP 7.4). As specific designs for each element of the Concept Plan are not currently known, then a more specific assessment of the Concept Plan elements will be required with future applications.

The following tables illustrate the estimated loss per vegetation community and EEC.

Table B: Estimated areas of loss per vegetation community.

Vegetation Community/Habitat	Total Area (ha)	Area Removed (ha)	Area Retained (ha)
Blackbutt-Tallowwood-Needlebark Dry Sclerophyll Forest	1.98	0	1.98
Brushbox Wet Sclerophyll Forest	0.72	0	0.72
Blackbutt Dry Sclerophyll Forest	2.11	0	2.11
Grey Ironbark-Grey Gum Dry Sclerophyll Forest	2.39	0.04	1.99
Paperbark-Swamp Mahogany-Swamp Oak Swamp Forest/Woodland	10.4	0.4	10.0 (14.5ha regenerated)
Pasture/Pastoral Woodland	150.12	62.85	87.27
Dune Scrub	1.19	0	1.19
Swamp Oak	4.3	0.4	3.9 (0.6ha regenerated)
Aquatic	5.75	0	5.75
	179ha (Approx)	64ha(Approx)	113ha(Approx)

Table C: Estimated areas of loss, regenerated and retained per EEC

Endangered Ecological Community	Total Area (ha)	Area Cleared (ha)	Area Regenerated (ha)	Area Retained (ha)
Swamp Oak Floodplain Forest	4.3	0.4	0.6	4.5
Swamp Sclerophyll Forest	10.4	0.4	14.5	24.5

The development will generally have the following direct **negative** potential impacts:

- Loss of 64 ha area of pasture/woodland, drain vegetation and swamp forest regrowth as a result of excavation and filling the land with clean fill to establish future urban development.
- Loss of 0.4ha of *Swamp Oak Floodplain Forest* EEC.
- Loss of 0.4ha of *Swamp Sclerophyll Forest* EEC
- Loss of about 14 hollow-bearing trees within the pastoral woodland.
- Loss of two small dams which provide limited foraging habitat for some migratory birds and potentially the Jabiru.
- Loss of an area of seasonally waterlogged grassy poorly drained land which offers potential foraging habitat for the Jabiru, several migratory birds (eg Latham's Snipe, Great Egret, Cattle Egret, etc) and perhaps Microchiropteran bats.
- Relatively minor reduction in current terrestrial east-west connectivity due to placement of a large waterbody and clearing of scattered woodland trees.

The construction of the wetland and open space corridor will also have the following **positive** impacts:

- Creation of a relatively large area (about 13ha including the two small constructed wetlands) of potential habitat for waterfowl including a number of threatened species (eg Black Bittern, Australasian Bittern, Osprey), migratory species (eg Great Egret and White-Bellied Sea-Eagle); potential foraging habitat for the Southern Myotis; fish; and a range of potential habitats for frogs (most likely common species tolerant of water with residues from roads, etc).
- Increased buffering to Duchess Gully from urban and agricultural runoff from the future urbanised catchment.

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- Increased linkages and habitat for a range of threatened fauna (eg Koala, Squirrel Glider, etc) due to habitat creation via landscaping/bushland regeneration with native species including food species (eg Tallowwoods, Forest Red Gum and Swamp Mahogany); reinforcing linkages from the southeast dry sclerophyll to the central patch of swamp forest.

- Creation of about 53.82ha of habitat (mostly swamp forest) via current and ongoing bush regeneration works and landscape works.

- Regeneration of 0.6ha of *Swamp Oak Floodplain Forest* EEC, and 14.5ha of *Swamp Sclerophyll Forest* EEC to offset the above losses.

(b) Other Issues:

The following are other issues associated with the specific type of development:

1. Acid Sulfate Soils (ASS): A specialist consultant's report has determined that temporary lowering of the watertable (currently around 3.5m AHD) by the waterbody (which will have an average surface level around 3.0m) should not expose ASS which are located at about 2.0 AHD on the western shoreline, and 1.0m on the eastern shoreline no more than the current invert effect created by Duchess Gully. This is further evidenced by lack of evidence of activation despite extensive historical drainage. Furthermore, filling on top of areas mapped as underlain by ASS is not considered likely to significantly result in the effect known as "sponging".

2. Temporary lowering of the watertable effects: The temporary lowering of the watertable by the new major constructed wetland will reportedly have no effect on the hydrological regime of the adjacent Wallum Froglet habitat due to the localised range of the effect, and that the habitat in question depends upon direct rainfall and adjacent runoff, not the watertable due to isolation via a clay substrate.

3. Groundwater quality issues: The specialist consultant reports that based on their modelling, the proposal will not:
    - Expose ASS to oxidation.
    - Significantly affect net groundwater outflows.
    - Significantly affect the operation of the STP exfiltration.

4. Runoff: With full urbanisation of the property, it is anticipated that runoff will increase. Connection via a weir to the existing constructed wetland system to the south to the new major waterbody, and twin connections to upper Duchess Gully (one in the northern end of the new waterbody, and the existing overflow off the western lagoon) will distribute this increase in net streamflow, with most flow directed to the upper creek discharge point, which will reportedly have the benefit of increasing flushing of tertiary treated effluent deposited downstream by the STP. The specialist consultant predicts this will not have any adverse impacts on the character of Duchess Gully.

5. Erosion and sedimentation: Erosion and sedimentation may be an issue associated with the following areas:
    - Construction of access roads/tracks.
    - Erosion of the fill.
    - Fill storage areas.
    - Erosion of the wetland walls/edges via wave action post-development.

    Statutory requirements, environmental management plans (EMPs) and design features are expected to mitigate these potential impacts.

(c) Secondary Impacts*:*

Secondary potential impacts of the development include:

1. Noise: Likely to be relatively high during construction phases but generally not considered a significant threat, and contained generally within the site.

2. Dust: Statutory controls and an EMP should ensure this potential impact is controlled.

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3. Pollution: Minor risk via fuel spillage, etc, but is a potential threat to aquatic habitats especially the eastern Wallum Froglet population. Statutory controls, an EMP and standard provisions should be effective.

4. Eutrophication: May potentially occur via runoff into the wetland, Duchess Gully and Wallum Froglet habitat in the long term from urbanisation of the catchment. Engineering measures, the stormwater treatment system and chain, and the primary design function of the major new wetland must ensure this impact does not become significant.

5. Altered Bushfire Regime: The proposal should not have any substantial impact on the current bushfire regime.

6. Fences: The proposal will have the positive impact of removing internal and most of the boundary fences which are a physical barrier and injury/mortality threat. As only temporary construction fences may be implemented and will not enclose any habitat, no fences associated with the proposal should have any adverse impact.

7. Increased human presence: Human presence and associated impacts will significantly increase during construction which may deter usage of the adjacent lagoons by some shy waterbirds. Establishment of bushland and screening landscaping may counter this effect.

8. Exotic species: Increased activity of exotic fauna is not considered likely as a result of the proposal, though as such species are already present, they could colonise the proposed bush regeneration/landscaping. Measures are to be undertaken and proposed to minimise this threat.

9. Direct mortality of resident fauna during clearing operations: This is a genuine risk to hollow-obligate fauna that may be using tree hollows in the pasture during construction, and also to a Whistling Kite which has a nest in this area. Appropriate measures are to be undertaken.

7. RECOMMENDATIONS AND AMELIORATIVE MEASURES:

7.1 Open Space/Drainage/Habitat Corridor:

The major ameliorative measure proposed by the proponent is the Open Space/Drainage/Habitat Corridor which was a measure designated in the UIA 14 Structure Plan. The Open Space Management Strategy (OSMS), which forms part of both Applications, details the specific measures (eg via a Vegetation Management Plan) that will be undertaken to formally establish and improve the ecological functioning of this area (which will encompass some 53.82ha), with the aim to:

- enrich the current native biodiversity of existing vegetation within the Open Space Corridor;
- enhance the existing corridor values of vegetation along Duchess Gully;
- create better movement opportunities in an east-west direction for native wildlife;
- reduce the extent of existing weed infestations within the Open Space Corridor;
- protect and enhance aquatic habitat values within existing and to be constructed waterbodies within the Open Space Corridor; and
- provide an appropriate interface between native vegetation and wildlife habitats within the Open Space Corridor and adjacent areas of urban development.
- Restore some 15.1ha of Coastal Floodplain EECs an offset to loss of 0.8ha of these EECs.

In addition to having positive impacts on the biodiversity of the property, the Open Space/Drainage/Habitat Corridor and OSMS will have positive impacts on the adjacent vegetation communities and nearby SEPP 26 area via:

- establishment of the Open Space Corridor will provide appropriate vegetated spatial buffers between residential development and littoral rainforest vegetation to the east;
- stormwater control devices will be implemented within the development footprint and Open Space Corridor in order to control the quality and quantity of storm water run-off generated by the development and minimise its potential impact on surrounding environments.

7.2 Project Application Recommendations and Ameliorative Measures

The following primary recommendations and ameliorative measures are provided to ameliorate potential impacts. They are integral to the basis of later assessment and conclusions, as it is assumed they will be implemented in some form, such as a condition of consent.

(a) Primary Recommendations:

(i) Protection and Maintenance of the Wallum Froglet Habitat: The population of Wallum Froglets in the depression to the southwest of the constructed wetland is to be retained as per design of the proposal, and protected during construction and operational phases via a range of measures detailed in this report. Measures are provided to ensure the natural vegetation is protected and recovers and mechanisms are emplaced to deal with any threat.

(ii) Constructed Wetland Design: The following are measures the proponent has incorporated into the design and unless specified, are not recommendations of this assessment:

- The wetland contains some 10.72ha of open water, with depth ranging from 0.25m to 2m. The current design shows that a band along the western bank will consist of macrophytes in a constructed water treatment cell, and it is also expected that species such as Giant Spikerush and waterlilies which can grow to around a depth of 1m and at times deeper, will colonise most of the remainder of the wetlands. As water in most of the new wetland is expected to be high quality, this will result in a significant increase in local habitat for waterfowl, frogs and invertebrates, and hence a substantial positive impact on the property and local biodiversity.

- The design includes two overflows to Duchess Gully. The northern one is intended to restore the natural flow regime and is expected to improve the water quality of the watercourse. Another will link the new wetland to the two large existing lagoons to complete the treatment chain. Both structures will generally be dry at most times, hence will not be a barrier to small terrestrial species movement, and may also contain structures to aid movement of fish/aquatic organisms. Recommendations are made to plant the edges to resemble a natural riparian zone, and also to include structures such as large rocks and logs.

(iii) Erosion and Sedimentation Control: As per planning controls, an Erosion and Sedimentation Plan will be implemented for the construction phase of the proposal. This is expected to be implemented effectively by the construction contractors with follow-up compliance enforcement. Measures are most important to be implemented to protect Duchess Gully, adjacent EECs and the Wallum Froglet habitat from sedimentation from erosion of tracks, fill storage or spreading areas, and dewatering areas.

(iv) ASS Management: An ASS Management Plan has been developed for monitoring, control and management of any exposed PASS, and a construction plan to minimise risk of excessive watertable lowering and PASS exposure. This is expected to be implemented effectively by the construction contractors with follow-up compliance enforcement. These measures must protect the Wallum Froglet habitat, existing lagoons, EECs, the constructed wetland and Duchess Gully.

(v) Groundwater and Water Quality: Groundwater and Surface Water Monitoring and Management Plans for monitoring, control and management of groundwater and surface water throughout the construction period and for at least 5yrs post-development have been provided to ensure the predictions of the geotechnical report are validated ie no significant adverse impacts will occur. This is expected to be implemented effectively by follow-up compliance enforcement, and will allow early identification of any issues which require amelioration. It is recommended that a monitoring station be established in the Wallum Froglet habitat to ensure the hydrological regime and water quality of this habitat is not adversely affected as per predictions, and also to provide feedback to managers eg to initiate remedial action such as addition of suitable freshwater to the wetland.

(vi) Artificial lighting: Artificial lighting is utilise innovative technology and designed to avoid the risk of spillage onto the wetland, retained vegetation and Wallum Froglet habitats due to the potential impacts it may have ie disturbing roosting and foraging behaviour, exposure to predation, etc.

(vii) Weed Management:

- During the site survey, the portion of identified Core Koala Habitat in the southeast adjacent to the STP was noted to have at times a very high constitution of lantana. This may inhibit Koala access to preferred food species, and hence limit realisation of the full potential of the habitat. This lantana infestation was recommended to be removed and ultimately eliminated by standard bush regeneration techniques, and to date, this has almost been effectively achieved by pre-emptive works. This action will most likely also be requested under the provisions of the UIA 14 Koala Plan of Management when finalised.

- Disturbance of the study site's soils has potential to encourage weed invasion. Hence, it is recommended that:
    - Machinery to be used for the work should be cleaned to remove seeds (ie on wheels, tracks, guards etc) prior to transport to and from the site.

    - Measures should be taken to inhibit the establishment of weeds following the work especially in fill storage and spread areas ie via a weed management plan.

(viii) Landscaping/Assisted Bush Regeneration: The following are provided for incorporation within landscaping/bush regeneration provisions, and also guidance:

- Plantings around the wetland should generally mimic natural structure ie combine trees with shrubs, etc to form a forest or woodland structure depending on location and aesthetic aims of the landscape/vegetation plan.

  The Vegetation Management Plan has allowed for the total width of plantings to be around 30-50m wide (incorporating facilities such as pathways) around the western edge to minimise human intrusion to provide a refuge for waterfowl, and also to provide a good linkage with the southeast forest and Duchess Gully to the east, and corridor plantings along the southern end linking to the east-west corridor.

  Plantings in the emergent zone are to occur not only in the specific water treatment areas but around the majority of the wetland's periphery to maximise water treatment and habitat creation, as well as protect the banks from wave action. Planting zones should be maximised in width where practical though it is appreciated that natural colonisation of suitable habitat will occur in a relatively short time. Some of these species are also likely to colonise shallow zones in the deeper portions of the wetland over time which will increase habitat complexity (as noted above).

(ix) Wetland Habitat Enhancement: Some of the trees fallen during future urban development of the remainder of the property (particularly the large Forest Red Gums in the pastoral woodland) should be laid (eg via crane if the wetland has been constructed) in the other areas of the wetland to provide roosts for Water Dragons, tortoises and waterfowl, as well as to provide refuge for fish and other aquatic organisms. Location can be selected according to maintenance requirements to avoid any problems. Provision of large rocks along some sections (eg around the Duchess Gully linkage to the east) would also enhance habitat opportunities.

(b) Secondary Recommendations:

The following are provided for optional consideration by the determining authority and proponent as measures to enhance general biodiversity. It is not assumed that these recommendations are adopted as conditions of consent or in the conclusions of this report, but it is desired that proponents at least be advised to consider adopting them to protect and enhance biodiversity.

1. *Other Koala habitat enhancement:* The hill off the southeast of the wetland is largely cleared. This area provides excellent potential for regeneration of the adjacent dry sclerophyll. To increase the Koala habitat values of the site and provide for expansion of the local population, it is recommended that plantings of Tallowwood and Forest Red Gum be made on or around this hill as part of a bushland regeneration project to re-establish forest on or around this hill.

2. *Other measures:*

    - The perimeter of the wetland and all adjacent habitat areas where pedestrian paths may pass through are to be designated leashed dogs only. This is required to prevent dogs harassing wildlife and swimming.

- Swimming, recreational boating and model boats should not be encouraged in the wetland again to minimise disturbance to fauna.

- Signage will be required to ensure compliance with these restrictions.

- Hollow-bearing trees are to be removed via a method which minimises risk of mortality/injury of occupants. The Whistling Kite nest tree should also be removed when inactive. An approved animal welfare officer is to be on site during removal of these habitat components to aid any injured fauna.

7.2 Concept Plan Application Recommendations

The following recommendations are provided for consideration for the long term development of the property as per the UIA 14 Structure Plan and the Concept Plan Application:

(i) Duchess Gully: Duchess Gully is intended to form the northern corridor in the Structure Plan. It is recommended that the present vegetation along this creek be expanded via stock exclusion, weed eradication and bushland regeneration. The majority of the riparian vegetation should be a wet sclerophyll forest to maximise habitat potential and extend on limited resources currently available in this habitat, though some areas may better be suited to swamp forest and dry sclerophyll forest. Primary preferred Koala food trees should also be included in suitable edaphic conditions eg Tallowwoods, Forest Red Gums and Swamp Mahogany. The value of this area as habitat could also be enhanced via erection of nest boxes, and placement of some hollow logs (derived from the Forest Red Gums in the pastoral woodland which will eventually be cleared).

(ii) Restoration and Habitat Enhancement of the East-West Corridor: The proposed east-west corridor includes a significant area of degraded "*Swamp Sclerophyll Forest on Coastal Floodplains*" EEC, with condition ranging from pasture with scattered trees to immature regrowth forest. Restoration of this area will require some active plantings to supplement the low rate of natural recruitment, and weed control to see elimination of the established pastoral species. This will take a number of years to be established. Preliminary works have commenced ie weed control, plantings, cessation of slashing and exclusion of grazing. Exclusion of stock and slashing will allow some natural regeneration from seed banks and possibly allow some colonisation of habitat by threatened species in the area (eg Eastern Chestnut Mouse) which may increase their potential viability.

In the medium term, subject to flooding constraints, large fallen logs from other portions of the property could be positioned as single trees and small piles of logs to provide shelter for a range of fauna eg rodents, reptiles and the Spotted-Tail Quoll given such key habitat components will take hundreds of years to naturally develop. Nest boxes may also be viable to place in the immature swamp forest just west of the main lagoon to provide potential dispersal/den site opportunities for Squirrel Gliders which may use the habitat in the medium term (eg when a woodland or young forest has been established).

(iii) Habitat Creation: Given the majority of the proposed east-west corridor is a broad, flat drainage line, periodic storm events are likely to wash down fauna which may occupy swamp forest and wetland habitats. Regeneration of this area should aim to cater for these species, as should habitat creation measures.

(iv) Proposed Southern School Site: The current delineated area for this site includes the densely vegetated drain adjacent to the southwest patch of dry sclerophyll which is known to support a small population of Common Planigale, Eastern Chestnut Mouse and Wallum Froglet. It is recommended that this habitat area (the entire drain and a vegetated buffer zone to the east) be excluded from any filling, etc, within the school footprint. This area should be collectively fenced off with southwest dry sclerophyll/swamp forest, and the total area regenerated and managed appropriately for these species to maximise the currently limited potential viability of these small populations.

(v) Proposed Eco-Tourism Site: The southern half of the generally native grassland falling within the proposed eco-tourism site was found to support the Eastern Chestnut Mouse in 2003, but subsequent routine agricultural practices (including slashing) since this time places doubt on whether this species has remained viable in this area and/or in adjacent vegetation.

The development footprint of the Eco-Tourism site is not known at this stage. However, the buffer to the STP ensures that the residential component of the development is restricted to the northern half of Lot 5, subject to setbacks for

APZs from Duchess Gully and the dune vegetation to the east.

Any future applications for development of the Eco-Tourism Site must ensure either the population is extinct (in which case ecological constraints are limited), or is not placed at risk of extinction. In the latter, development and management must ensure:

- Sufficient habitat is retained to support a viable population.
- No barriers to movement/dispersal are emplaced.
- Fire/slashing is managed as required per the species ecology.

8. EPBCA 1999 – MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE:

The provisions of the EPBCA require determination of whether the proposal has, will or is likely to have a significant impact on a "*matter of national environmental significance"*. These matters are listed and addressed as follows:

i) **World Heritage Properties**: The site is not listed as a World Heritage area nor does the proposal affect any such area.

ii) **Ramsar Wetlands of International Significance**: No Ramsar wetland occurs on the site, nor does the proposal affect a Ramsar Wetland.

iii) **EPBCA listed Threatened Species and Communities**: No EPBCA listed threatened flora species or community, etc, was found on the site or property, nor considered a significant likelihood of occurrence. The Grey Headed Flying Fox and Swift Parrot are the only EPBCA listed threatened fauna species detected on the property, and no other species was considered a significantly likely potential occurrence. Assessment under the MNES guidelines determined the PA proposal would not significantly reduce the value of the property and the potential for these species to occur and subsequently the impacts were not considered likely to be a sufficient order of magnitude to be considered significant. The proposed Open Space/Drainage/Habitat Corridor bush regeneration and landscaping based on native species was considered likely to create new habitat for these species which could off-set losses and potentially increase the carrying capacity.

iv) **Migratory Species Protected under International Agreements**: Five migratory species listed under the EPBCA have been detected on the property and several others are considered at least a fair chance of potential occurrences (eg Rainbow Bee-Eater, Fork-Tailed Swift and White-Throated Needletail). Assessment under the MNES guidelines determined the proposal would not significantly reduce the current value of the property, and the potential for these species to occur and subsequently the impacts were not considered likely to be a sufficient order of magnitude to be considered significant. Furthermore, creation of the wetland, bush regeneration/corridor and landscaping will provide additional habitat for these species and may increase their local occurrence.

v) **Nuclear Actions**: The proposal is not a nuclear action.

vi) **The Commonwealth Marine Environment (CME)**: The site is not within the CME nor does it affect such.

vii) **National Heritage**: The site is not listed on the National Heritage List.

The proposal was not considered to require referral to the Dept of Environment, Water, Heritage and the Arts for approval under the EPBCA 1999.

9. CONCLUSION:

Overall, the PA proposal will have relatively minimal negative impacts on the current capacity of the property to support the recorded and potentially occurring threatened species and the viable EECs. The net effect of the proposal is considered likely to be an overall increase in biodiversity in the long term with a benefit to the biodiversity values of the locality as opposed to a net loss which is typically associated with urban developments, provided the appropriate ameliorative measures are implemented.

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