

Wetland Site Assessments

in
the Hawkesbury



Prepared for **Hawkesbury-Nepean Landcare Network**

By **applied ecology** Pty Ltd

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INTRODUCTION

PROJECT BACKGROUND

The project aimed to undertake site condition assessments for approximately 30 wetlands in the Hawkesbury area. Wetland condition was assessed using methodologies based on current best practice for this type of survey. As well, threats to wetlands were noted for future prioritisation of on-ground works to remediate these issues. Liaison was carried out with neighbours to the wetlands to increase awareness of the natural values of the selected sites. Community members were invited to accompany the project team on surveys, especially for the landholders with wetlands.

The project is the result of grant funding provided to the Hawkesbury-Nepean Landcare Network with help from the Hawkesbury Wetlands Working Group. The main aims of the project are to identify wetlands under threat and actions to assist with remediating these, and to increase the involvement of community members in proactive management of wetlands in the Hawkesbury region.

WETLANDS IN THE HAWKESBURY REGION

The Hawkesbury-Nepean floodplain wetlands were formed by a variety of fluvial processes where natural levee banks built up along the river tributaries cutting off low-lying back-swamps between the levee and the outer edge of the floodplain. The wetlands vary widely in size and water regime and range from seasonal wet meadows along floodways and backchannels of the river, to semi-permanent water bodies (inundated for most of the year), to permanent open water lagoons. All of the wetlands selected for assessment in the current study are located close to the edge of the river, mainly behind the levee.

Wetlands are subject to a wide range of pressures in the catchment such as grazing, land clearing and filling, and weed invasion, and the GSLLS and Hawkesbury-Nepean Landcare activities will assist in managing these impacts. However, natural hydrologic processes promote optimal wetland functioning, thereby preserving significant wetland values. As such, the management of wetlands often revolves around hydrologic or ecological processes that are linked to hydrology.

The hydrology of wetlands is complex but many in the catchment have altered hydrology from a range of factors including reduced flows as a result of water impoundments, water extraction, farm dams in the individual wetland subcatchments, altered hydrology associated with urban development, and groundwater extraction. An example of this complexity is the floodplain wetlands of the Nepean and Hawkesbury rivers. These wetlands have highly complex systems of water inflow and outflow, as well as significantly different frequencies of connectivity with the main channel.

A VARIETY OF FLUVIAL PROCESSES

Floodplain wetlands along the Hawkesbury River have been formed through a series of fluvial processes. Depositional processes forming levees have resulted in back swamps developing, along with ponded tributaries behind levees on aggrading floodplains. Soils in these floodplains also show the effects of a range of processes for soil development. The original floodplain has layered alluvial sands, loams and clays, but in areas that have undergone aggradation these have been stripped and redeposited in the levees or downstream areas. In the eroded areas the soils are poorly formed, while in the depositional areas the soils can be structured or unstructured, or even gleyed if frequently inundated. In some areas, such as Longneck Lagoon, saline groundwater has risen to the surface and created salt scalds that encrust the surface of the soils.

Stricker and Adam (1990) classified the Hawkesbury floodplain wetlands based on frequency of inundation into three types: permanent, semi-permanent, and seasonal wetlands. In reality, a single wetland can have varying water depths and may include all three wetland types. Inundation can also be from a variety of sources, including catchment watershed, backflooding from the river, overland flooding or flows, or groundwater sources. Permanent wetlands tend to have areas of open water and fairly stable vegetation in surrounding areas when in their natural state. Most semi-permanent wetlands tend to be inundated for much of the year. Permanent and semi-permanent wetlands are commonly characterised by Tall Spike Rush (*Eleocharis sphacelata*) as the dominant emergent species.

Many of the floodplain wetlands are low in species diversity. This has occurred as a direct result of clearing of vegetation from wetland margins, and to grazing and cropping of wetlands.



Figure 2 Blundells Swamp

LITERATURE REVIEW

PREVIOUS STUDIES ON HAWKESBURY FLOODPLAIN WETLANDS

Stricker and Wall (1991) summarised the results of a catchment wide assessment of wetlands along the Hawkesbury Nepean River. The wetlands in the current study were allocated to the Central Coast region, and within the Hawkesbury-Nepean Floodplain (which included the lower Colo and Macdonald Rivers). Wetlands were noted to be predominantly on the geomorphology of the Hornsby Plateau, with some of the southernmost wetlands at the northern end of the Cumberland Plain. The underlying geology is Hawkesbury sandstone and Narrabeen sandstone groups.

Smith & Smith (1994) compiled an assessment of wetlands in the Hawkesbury Nepean catchment. The wetlands of the Hawkesbury-Nepean River valley were surveyed as part of a review of the wetland protection clause of Sydney Regional Environmental Plan No. 20. A total of 159 significant wetlands were identified and mapped at a scale of 1:25000. The total area of the significant wetlands is 3417.5 ha. The estuarine and brackish wetlands downstream of Wisemans Ferry total 1831.2 ha, while the freshwater wetlands upstream total 1586.3 ha. The freshwater wetlands comprise 1017.4 ha of permanent and semi-permanent wetland, and 568.9 ha of ephemeral wetland. Areas of ephemeral wetland have been distinguished on the maps. Virtually all the significant wetlands occur downstream of Penrith, with only a single wetland of 2.1 ha mapped upstream. Each of the wetlands selected for the current study were on the list of 159 significant wetlands in this report.

A natural assets assessments project conducted for Baulkham Hills Shire in 2002 looked at a number of wetlands in the region, including Blundells Lagoon and Broadwater Swamp, which included Wheeny Lagoon and Bats Hollow Gully on the Little Cattai Creek catchment. At the time of survey these lagoons were found to be in fair to good condition due to the extent of retained or regenerating forest around each wetland.

An assessment was conducted on the condition of wetlands in the Hawkesbury Nepean region by DECCW in 2010. Overall, wetlands in the Hawkesbury–Nepean region were observed to be in very poor condition. The greatest pressure on wetlands in the region is from habitat disturbance caused by grazing, feral animals and roads crossing or adjoining wetlands. Increasing urbanisation and ongoing disturbance to catchments of wetlands has seen this situation fail to improve, and in many cases wetland condition has continued to decline.

Longneck Lagoon and Pitt Town Lagoon are listed on the Directory of Important Wetlands in Australia as seasonal freshwater lagoons on the Hawkesbury River floodplain. The Sydney Regional Environmental Plan (SREP) No. 20 protects significant wetlands of the Hawkesbury Nepean river valley. The Cattai CMC (now part of GSLLS) identified important wetlands in the subcatchment, including several from the current project:

- Blundells Swamp
- Broadwater Swamp
- Wheeny Lagoon
- Reedy Swamp
- Longneck Lagoon
- Pitt Town Lagoon

Most of these are now under the care of DPIE through NPWS.

WETLAND FUNCTIONS AND VALUES

A wetland boundary, as the interface between land and water, and in the absence of clearly defined banks or shores, can be difficult to determine. It may vary seasonally and over time to change a wetland's relative size thereby altering the habitat for flora and fauna. The shallow margin of a wetland may be botanically determined by where the 'wetland indicator' plants are replaced by dry land species. Most Australian wetlands are classified on the basis of climate, geomorphology, vegetation structure and floristics, and hydrology (water salinity, depth and permanence). Most schemes employ a mixture of these criteria, the choice depending on the scale and purpose of the study.

Wetlands perform many valuable functions. These can be broadly classified as physiological, ecological, cultural and economic (Table 1).

Table 1 Wetland functions and values (CCMC, 1998)

Functions and Values	Main Components
Physiological Functions	<ul style="list-style-type: none"> • Hydrologic regulation and erosion control • Geochemical storage • Water filtering and nutrient recycling
Ecological Functions	<ul style="list-style-type: none"> • Local microclimatic stabilisation • Flora and fauna habitat • Breeding and nursery areas
Cultural Values	<ul style="list-style-type: none"> • Visual amenity • Aboriginal cultural significance • Non-Aboriginal cultural significance • Recreation • Environmental research and education • Nature conservation
Economic Values	<ul style="list-style-type: none"> • Resource use and economics

CATCHMENT NUTRIENT LOADS AND FLOW REGIMES

The Hawkesbury Nepean catchment is currently seeing a massive growth in development and local population numbers. The catchment is planned to be Sydney's next largest urban growth area with the majority of this growth in the South Creek catchment. Increasing urbanisation will not only result in a significant increase in demand for potable water, but will also result in changes in point and diffuse sources of pollution to the Hawkesbury-Nepean River and tributaries.

To enable a holistic understanding of the potential impact of this growth on the local waterways, Sydney Water led the development of a catchment-wide hydrodynamic and water quality model for the Hawkesbury-Nepean River system. Over 130 scenarios have been run through the model, testing a combination of population growth, wastewater treatment quality and discharge location, land use, diffuse source management, and environmental flows.

The HN model has been built for the express purpose of providing guidance on the likely quantitative differences in water quality and quantity when contrasting different catchment and environmental flow, wastewater and land use scenarios over time. Key outcomes include the modelling of flows, freshes¹ and floods. Changes to flow regimes are likely to affect the floodplain connectivity and connection to the main channel for lowland wetlands along the Hawkesbury River. Modelled

¹ medium flows, or 'freshes', that move through the river system from the upper catchments.

nutrient loads have the capacity to significantly affect the health of Hawkesbury’s freshwater wetlands, especially under a scenario that has increasing connectivity with the main channel.

WETLAND VEGETATION

AMBS described the different vegetation types found in wetlands in the Cattai subcatchment, specifically focusing on Broadwater Swamp, Blundells Swamp, Long Swamp and Pitt Town Lagoon, many of which are included in the current study (Table 2).

Table 2 Wetland vegetation classification (AMBS, 1996)

Wetland type	Structure	Main species
Tree Swamp	Well-developed tree layer, with understorey dominated by wetland plants (as described by Sainty and Jacobs,1981.)	Snow-in-Summer, occasionally Swamp Mahogany and Cabbage Gum.
Shrub Swamp	Well-developed shrub layer, with understorey dominated by wetland plants.	Mainly Swamp Paperbark.
Open Herb Swamp	Wetland dominated by open water - limited emergent vegetation, floating or submerged plants may be extensive.	Herbaceous plant species.
Dense Herb Swamp	Dense growth of herbaceous wetland plants.	Common Reed, Tall Spike Rush, Cumbungi, Bull-rush, Club-rush, March Club-rush, River Club-rush, Water Couch, Water Ribbons, Water Primrose and Woolly Frogmouth.
Ephemeral Herb Swamp (Flooding less frequent than in dense herb swamp)	Dense growth of herbaceous wetland plants.	Common Rush, Water Pepper and Knotweed, Tussock Sedge, Common Couch, Slender Mudgrass and Blackseed Panic.

In reality, many wetlands have areas of different vegetation, influenced by differences in inundation regimes, and creating a mosaic of vegetation types with open water.

MANAGEMENT OF WETLANDS

In 2007 the Hawkesbury-Nepean CMA released the Hawkesbury Nepean River Health Strategy. Theme Three in this strategy dealt with management of wetlands.

Relevant on-ground HNCMA wetland management activities related to the protection and rehabilitation of wetland function through activities such as fencing, weed control and revegetation and erosion control works.

The program includes a number of projects using a range of techniques to protect and restore wetlands including partnership with councils, incentives funding through the river restoration project, development and implementation of management plans for targeted wetlands. Key locations were Wetlands of national significance outside of national parks, wetlands identified as important communities or mapped in regional plans. The two Wetlands of National Significance in the Hawkesbury region have both been transferred to NPWS.

Table 3 Actions for wetland management (Hawkesbury Nepean River Health Strategy, HNCMA, 2007)

Management Theme - Riparian Wetland Management			
Management Action Group	Specific Management Actions	CMA Activity supporting CAP targets	Action Type
Develop action plans for wetlands	• Develop action plan for priority wetland	✓	P
Removal of exotic wetland vegetation	• Willow control in floodplain wetlands • Removal of exotic vegetation from floodplain wetlands	✓ ✓	W W
Revegetation of wetland with indigenous vegetation	• Revegetate areas of wetland with indigenous vegetation	✓	W
Management of stock and human impacts in wetlands	• Fence floodplain wetlands • Provision of off-wetland stock watering	✓ ✓	W W
Wetland erosion control works	• Structural works to address erosion in wetlands	✓	W
Wetland drainage management	• Remove floodgates to reconnect wetland with river channel • Block wetland drainage channels	- -	P,W,I P,W,I
Key to action types	W: Works on ground P: Planning I: Institutional E: Education M: Monitoring ✓ CMA activity • Complementary activity (non CMA lead)		

To achieve the goals for this theme, the HNCMA developed River Health Targets and Catchment Targets through its Catchment Action Plan (CAP) 2007-2016. One of the three priority programs was the River Health Program, which included the Estuary Program and the Wetlands Program.

COUNCIL'S ROLE IN WETLAND MANAGEMENT

The stated long term goal for the LGA wetlands from Council's perspective is that they are self-managed. While Council has excellent environmental staff they are limited in capacity and it is unrealistic that Council will be able to afford an increase in staff numbers to manage the Wetlands as everybody would like. Council also has only a small number of Compliance Officers and their area of responsibility extends far beyond the wetlands. Council is working with the Compliance officers to assist them to employ an approach that focuses more strongly on prevention, early intervention and education.

A workshop was run by The Miller Group (undated) to develop appropriate management strategies for wetlands in the Hawkesbury LGA. A model was developed that prioritised two overarching elements:

- Climate (both natural variation and climate cycles and climate change – a potentially increasing future impact)
- Flooding

Climate variation and flooding are the two natural elements that were identified by workshop participants as having the greatest impact at all times on wetlands. Four key interrelated areas of management were identified:

- Physical restructuring
- Pollution

- Invasive species
- Over harvesting

The workshop acknowledged that there are positive and negative impacts, and these included the key issues or specific actions that either led to degradation or vitalisation of wetlands.

Council then aimed to develop a Draft Implementation Plan for management of wetlands. This Draft Plan identifies the Key Focus Areas on which Council and all other stakeholders will need address to achieve the objectives and desired outcomes with respect to revitalisation and/or good practice management of the Wetlands in the HCC LGA. It also includes what will need to be done in each of those focus areas to achieve ‘good practice management’ of the wetlands across the LGA.

Although Council is not the only stakeholder with responsibility for delivering this Plan it is important to note that the Draft Plan is aligned with Council’s Strategic Plan (Hawkesbury 2036..... It’s our Future). The workshop acknowledged the following examples and opportunities:

CURRENT GOOD PRACTICE EXAMPLES

1. Bushells Lagoon

a.

- Meeting of landowners
- Three Community Plantings
- \$\$ from Green Army
- Results included:
 - Fencing(removed horse access)
 - Vegetation flourished
 - Expansion of strategy to other areas

Strengths: landowners did not have to pay for anything
 Challenges: 1. Dependent on one person initiating and driving the work
 2. Dependent on volunteers

b. Smart Farm Funding for education of working volunteers
 (still awaiting result of funding application)

c. Landcare: \$\$ for local land holder education

d. Streamwatch – volunteers (also at APV Lagoon)

2. Pitt Town Lagoon
 Established Bird Hide (re-adjusted water level/established Island to bring birds in)

3. HCC
 Community Nursery - builds social inclusion and plant knowledge

4. Local Land Services

- Pitt Town Lagoon
- Bakers Lagoon
- Polo ground (working with local landholders)

5. Hawkesbury and Penrith
 Joint Environmental Network (continued after the grant finished.)
 Meets 4x year.

6. Pugh’s Lagoon
 Community planting

OPPORTUNITIES

- Wetlands theme at Hawkesbury Show
- Potential to increase bird numbers and make wetlands one of the best bird watching areas in Sydney
- Stronger connection and coordination with HRCC

WHAT PARAMETERS TO ASSESS

The Index of Wetland Condition is an example of a wetland assessment methodology that collects information that can then be used to gain an understanding of the health of the wetland. Core parameters recommended are: Wetland Catchment, Physical Form, Hydrology, Water Properties, Soils, and Biota.

Table 4 Core parameters recommended for assessment of wetlands (DELWP, 2018)

IWC sub-index	Key ecological component	Measure	Measure type
Wetland catchment	Wetland catchment	Land-use intensity adjacent to the wetland	Threat
	Wetland buffer	Average width of the buffer	Component
		Percentage of wetland perimeter with a buffer	Component
Physical form	Area of the wetland	Percentage reduction in wetland area	Component
	Wetland form	Percentage of wetland where activities have resulted in a change in bathymetry	Threat
Hydrology	Water regime	Severity of change to the water regime expected from activities identified as altering the water regime	Threat
Water properties	Nutrients	Severity of nutrient enrichment	Threat
	Salinity	Severity of change in salinity	Threat
Soils	Soil physical properties	Severity and extent of wetland soil disturbance	Impact
Biota	Wetland plants	Critical life forms	Component
		Presence of weeds	Impact
		Indicators of altered processes	Impact
		Vegetation structure and health	Component

THREATS TO WETLANDS

Over half of Australia's wetlands have vanished since European settlement and those that remain are under increasing pressure from land and water development and from poor catchment management practices.

Table 5 Typical threats to wetland functions and values (CCMC, 1998)

Direct Threats	Indirect Threats
• Hydrologic alteration	• Erosion and sedimentation
• Vegetation clearance	• Salinisation
• Agriculture	• Pollution
• Grazing	• Nutrient enrichment and eutrophication
• Burning	• Climate change
• Extractive industries	• Inappropriate landuse zoning
• Dredging	• Poor catchment management
• Urban development	• Lack of knowledge
• Inappropriate recreational activities	• Community attitudes
• Weed invasion	
• Introduced animals	
• Invasion by pathogens	
• Insect control measures	

Current threatening processes identified during AMBS's CCMC study include grazing, sand and other extraction industries, nutrient enrichment and introduced species. One or more of these threats is operating to varying degrees, at each of the wetlands in the current study.

The Hawkesbury Nepean CMA developed a factsheet for wetlands in the catchment (HNCMA, 2007). They identified the main threats to wetlands as:

- Changes to the quantity and behaviour of water
- Vegetation clearing
- Landuse in and around wetlands
- Changes in available nutrients
- Pest animals and plants

Any change to the natural flow of water through the wetland system can cause irreversible damage. This may occur as a result of:

- attempts to make the wetland hold more water
- attempts to make the wetland into a less damp part of the property (draining)
- upstream stormwater drainage delivering more water
- upstream dams or extraction points removing large amounts of water
- extraction of water from the wetland
- disturbance to groundwater by users.

WETLAND TYPE	DEPTH (M)	DURATION OF INUNDATION (PER YEAR)
<i>Freshwater wetlands are usually separated into those that are deep and relatively permanent (floodplain wetlands and upland lakes) and those that are more shallow and associated with creek flows (Peat and Hanging Swamps) and those more ephemeral shallow depressions (herblands and sedgelands).</i>		
Forested wetlands - floodplain, freshwater e.g swamp sclerophyll, swamp oak sedge forests	<20 m	Periodic - seasonal
Floodplain wetlands	<6m	Permanent or ephemeral
Upland lakes	<6m	Permanent or ephemeral
Peat swamps	<1m	Permanent or seasonal - rainfall related
Hanging swamps	<1m	Permanent or seasonal - rainfall related
Herb/Sedge lands	<2m	Periodic - annual/seasonal

Thus modifying the regime of inundation for a wetland can permanently alter the type of vegetation it will support, and therefore the type of ecosystem that is sustained.

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METHODOLOGY

SITE SELECTION

Sites selected for survey were chosen by the Wetlands Working Group and provided to the consultant (Applied Ecology P/L). These were described as being within the immediate riverine floodplain. Wetlands were predominantly in the Hawkesbury LGA, with a few located in The Hills Shire LGA (which included areas from Baulkham Hills Shire that were merged with The Hills).

There was some turnover of landholders with wetlands, and this had an influence on which wetlands were actually surveyed. If wetlands were no longer available to survey, a similar wetland in the vicinity was selected as the first preference for substitution. A total of 35 wetlands were surveyed and assessment reports were completed for these locations. Most (24/35) of these are privately owned by one or more landholders. Changes to the list of wetlands surveyed were approved by the Wetlands Working Group/Hawkesbury-Nepean Landcare Network.

Table 6 Wetlands surveyed, LGA and ownership of wetlands

WETLAND NAME	LGA	OWNERSHIP	ORIGINAL?
Bakers Lagoon	Hawkesbury	private	yes
Bats Hollow Gully	The Hills Shire	private	no
Blundells Swamp	The Hills Shire	private	yes
Bradleys Creek Swamp	Hawkesbury	private	yes
Broadwater Swamp	The Hills Shire	private	no
Browns Lagoon	Hawkesbury	private	yes
Bushells Lagoon	Hawkesbury	private	yes
Charles Kemp Reserve	Hawkesbury	public	no
Currency Wetland	Hawkesbury	private	yes
Deep Lagoon	Hawkesbury	private	yes
Driftway East	Hawkesbury	public	yes
Driftway West	Hawkesbury	public	yes
Halls Swamp	Hawkesbury	private	yes
Irrigation Dam/Fishing Club Dam	Hawkesbury	public	no
Jubilee Vineyard Creek Wetland	Hawkesbury	private	yes
Kallawatta	Hawkesbury	private	yes
Long Arm Swamp	The Hills Shire	private	no
Longneck Lagoon	Hawkesbury	public	yes
Mcgraths Hill Wastewater Treatment Ponds	Hawkesbury	public	yes
Mckenzie's Swamp East	Hawkesbury	private	yes
Mckenzie's West/Killarney Chain Of Ponds	Hawkesbury	private	yes
Pitt Town Ferry Rd A	Hawkesbury	private	yes
Pitt Town Ferry Rd B	Hawkesbury	private	no
Pitt Town Lagoon	Hawkesbury	public	yes
Pughes Lagoon	Hawkesbury	public	yes
Reedy Swamp	Hawkesbury	public	yes
Rickabys Creek Lagoon	Hawkesbury	public	yes
Teales Swamp	Hawkesbury	private	no
Teatree Swamp	Hawkesbury	private	yes
Upper Howes Creek Wetland	Hawkesbury	private	no

WETLAND NAME	LGA	OWNERSHIP	ORIGINAL?
Uworra Lagoon	Hawkesbury	private	no
Wheeny Lagoon	The Hills Shire	private	yes
Yarramundi Lagoon	Hawkesbury	private	yes
Yarramundi Paddocks East	Hawkesbury	public	no
Yarramundi Paddocks West	Hawkesbury	public	no
Cattai Wetlands	Hawkesbury		Not surveyed
Richmond Lowlands	Hawkesbury		Not surveyed
Sackville South	Hawkesbury		Not surveyed
Howes Creek	Hawkesbury		Not surveyed
Tizzana North	Hawkesbury		Not surveyed
Tizzana South	Hawkesbury		Not surveyed
Halls Irwin Swamp	Hawkesbury		Not surveyed
Portland Head Rd South	Hawkesbury		Not surveyed
Turnbulls or Hayes	Hawkesbury		Not surveyed
Mud Island Rd	The Hills Shire		Not surveyed

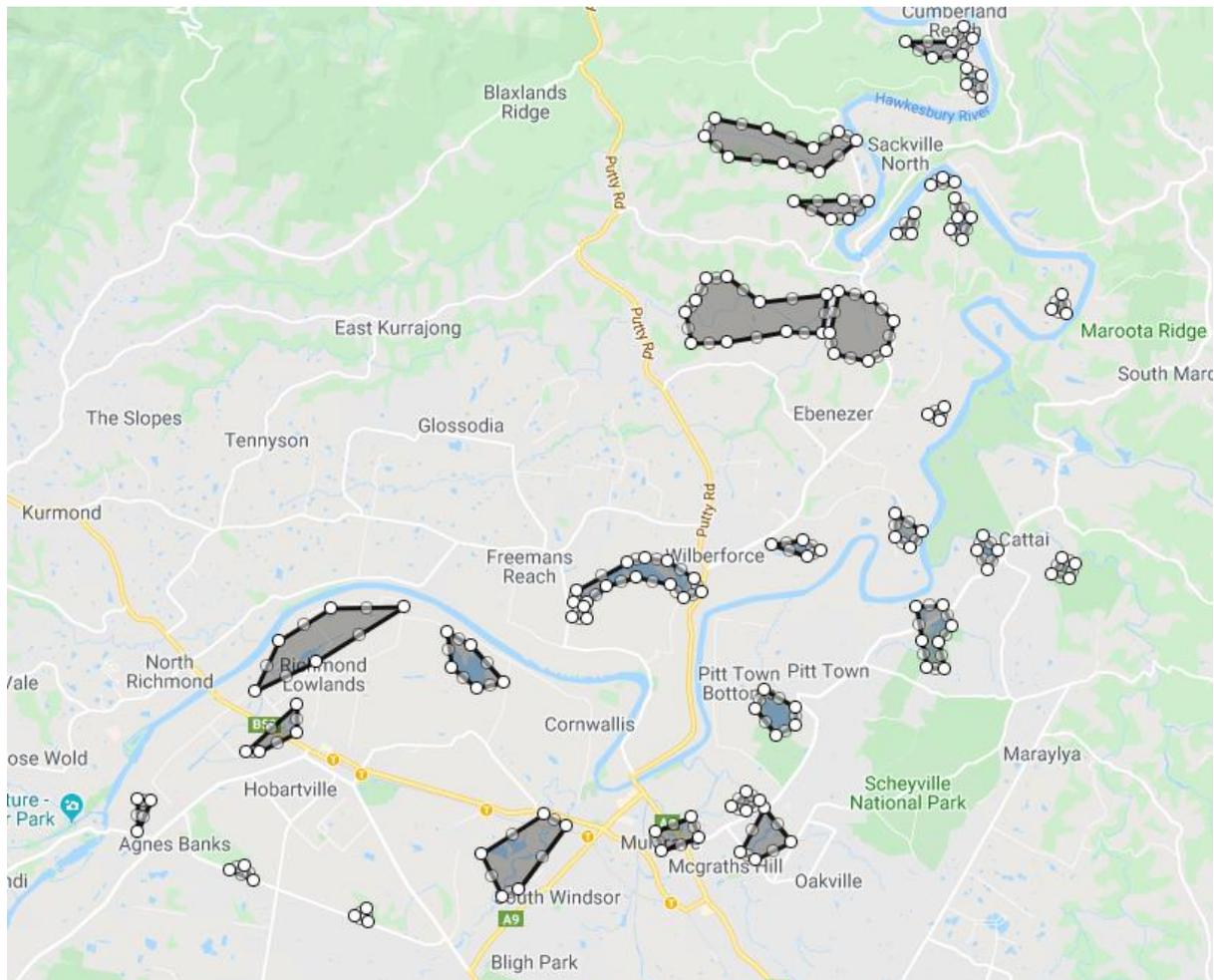


Figure 3 Locations of wetlands nominated in the original grant application/tender documentation

PARAMETERS ASSESSED

Data collected and collated during surveys included a number of desktop parameters and those assessed through field surveys. The following data was collected:

Wetland details (desktop):

- Name, address of wetland
- address of survey location, latitude and longitude
- Size of wetland, size of catchment
- Location(s) of surface inflow and outflow waterways

Natural assets (desktop):

- Mapped vegetation
- Threatened species records
- Migratory species records

Site features off site (field investigation):

- Landuse categories present
- Water extraction, excavation, sewer/pop top, stormwater discharge, litter count, upstream land use, onsite littering, onsite dumping, odour, turbidity

Site features on site (field investigation):

- Livestock present
- Slashing to edge
- Fencing through wetland
- Visible pugging
- Ownership category
- Inundation regime
- Location of inflows and outflows
- Riparian buffer width

Vegetation characteristics (field investigation):

- Macrophyte species diversity and cover extent
- Vegetation structure
- Trees, shrubs, grasses and groundcover species present
- Weed density
- Weed species present, including priority control weeds

Habitat features – surrounds (field investigation):

- Remnant trees
- Trees with hollows
- Standing dead trees
- Midstorey vegetation
- Dense ground cover
- Organic detritus
- Fallen logs
- Rock outcrops

Habitat features – wetlands (field investigation):

- Overhanging vegetation
- Natural bed detritus
- Woody debris count
- Woody debris size (max size)
- Woody debris type
- Native macrophytes

Soils and water (field investigation):

- Bank undercutting
- Bank collapse
- Water quality

Water quality (field investigation):

- pH
- temperature
- salinity
- conductivity
- dissolved oxygen
- turbidity
- evidence of contamination/spills



Figure 4 McGraths Hill Wastewater Treatment Wetlands

ANALYSIS OF DATA – DEVELOPMENT OF SCORING

Each parameter surveyed was allocated a scoring system that aligned with the following rankings: very poor, poor, fair, good, very good. This enabled wetlands to be ranked according to a range of criteria, and can be used to facilitate targeted applications for grants and targeted expenditure of funding. The resulting ranked scores were then collated into an overall wetland condition score for each wetland, enabling wetlands to be ranked against each other to determine those in the best, and worst, conditions.

Table 7 provides a list of the parameters that were scored for the analysis, and Table 8 provides information about how these subscores were summarised into the final overall score for each wetland. Some information was collected but not scored, including flora and fauna lists, and inundation levels. These were not scored due to the snapshot nature of the data collected. Water quality was assessed against trigger threshold values for freshwater wetlands in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018; [Water Quality Guidelines Home](#)). Ranking used in this wetland assessment is based on the number of trigger values that were exceeded (see Parameter #36, Table 7).

Prior to the surveys commencing, the Hawkesbury floodplain has been affected by drought over several years to January 2020. Surveys were largely conducted between a minor flood in February 2020 and a major flood in March 2021. Previous researchers have noted that water levels can vary considerably within wetlands and between wetlands even after the same rainfall events, depending on their primary source of water and their main mechanism for discharge. Similarly, vegetation complexity for these wetlands has been described as ranging from comparatively simple with few species present to quite complex, with wetlands comprising mosaics of vegetation forms and a diverse range of species as a result. The unscored information is provided on the spreadsheet for each wetland, and has generally been reproduced on each wetland's report card.



Figure 5 Bats Hollow Gully after the 2021 floods

Table 7 Category of data collected and the score/ranking given to each potential response

Parameter	Category	formula	Category values	Category values	Category values	Category values	Category values	Category values
1	Landuse (1-10)	=sum of each category score x % cover (for each category)	bushland =10	pasture/grazing, peri-urban mixed =5	sportfield/park =3	residential, commercial =2	market gardens, road =0.5	industrial, construction =0
2	Water extraction	= category score	present = 0	absent =10				
3	Excavation	= category score	present = 0	absent =10				
4	Sewer/pop top	= category score	present = 0	absent =10				
5	Stormwater discharge	= category score	present = 0	absent =10				
6	Litter count	= category score	Absent = 10	1-5 =7	6-20 =3	20-50 =1	>50 =0	
7	Upstream land use	= category score	Bushland =10	Peri-urban=6	Rural =5	Urban=0		
8	Onsite littering potential	= category score	low=10	high=0				
9	Onsite dumping potential	= category score	low=11	high=1				
10	Odour	= category score	none=10	anoxic = 5	petrochem = 0	sewage = 0		
11	Turbidity	= category score	High = 0	medium = 5	low = 10	no flow = 5		
12	Livestock present	= category score	Absent = 10	1-5 =5	6-20 =2	20-50 =0	>50 =0	
13	Slashing to edge	= category score	Yes=0	no=10				
14	Fencing through wetland	= category score	Yes=0	no=10				
15	Visible pugging	= category score	Yes=0	no=10				
16	Ownership	= category score	private=0	public=10				
	Inundation regime (land holder identified)	not scored						
	Inflow 1	not scored						
	Inflow 2	not scored						
	Outflow 1	not scored						
	Outflow2	not scored						
16	Riparian buffer width	= category score for each aspect	0-10m =0	10-20m =5	20-40m =7.5	>40m =10		

Parameter	Category	formula	Category values	Category values	Category values	Category values	Category values	Category values
17	Macrophyte species	=sum of scores for each species/10	<10% =5	10-25%=13	25-50% =35	50-75%=75	>75%=100	
18	Vegetation structure	=sum of each category score x % cover (for each category)/10	forest/woodland, waterway/wetland/swamp, mangrove/salt marsh, littoral complex=10	derived native shrubland, grassland, native landscaped mature, wsud wetland=7	underscrubbed forest/woodland, native landscaped immature=5	mown grass/park, urban yards=3 pasture, exotic landscape=2	derived exotic shrubland =1	weed/exotic, absent/concrete/earth = 0
19	Weed density	= category score for each aspect	Absent = 10	1-5 =10	6-20 =5			
20	Remnant trees	= category score	present = 10	absent =0				
21	Trees with hollows	= category score	present = 10	absent =0				
22	Standing dead trees	= category score	present = 10	absent =0				
23	Midstorey vegetation	= category score	present = 10	absent =0				
24	Dense ground cover	= category score	present = 10	absent =0				
25	Organic detritus	= category score	present = 10	absent =0				
26	Fallen logs	= category score	present = 10	absent =0				
27	Rock outcrops	= category score	present = 10	absent =0				
28	Overhanging vegetation	= category score	absent =0	<30=5	30-60=7			
29	Natural bed detritus	= category score	present = 10	absent =0				
30	Woody debris count	= category score	absent = 0	=1-3=5	4-10 = 7.5			
31	Woody debris size (max size)	= category score	>300mm diameter, >3m length =10	>300mm diameter, <3m length =10	<300mm diameter or 3m length =7			
32	Woody debris type	= category score	natural =10	fence = 5	both = 7			
33	Native macrophytes	= category score	present = 10	absent =0				
34	Bank undercutting	= category score	present = 0	absent =10	not visible = 5			
35	Bank collapse	= category score	present = 0	absent =10	not visible = 5			
36	Water quaility	Pass if within ANZECC guidelines (pH, Conductivity, Dissolved Oxygen%, Turbidity) "very poor" if nil "passes", "Poor" if 1 "pass", "fair" if 2 passes, "OK" if 3 "passes", "Good" if 4 "passes"						

The data described in Table 7 above was collated and consolidated into a category subscore based on the process described below in Table 8.

Table 8 Breakdown of the development of category subscores and the development of the overall score for each wetland

Parameter	Subcategory score	Score components
	Overall Score	sum of parameters 37-42+sum of (43-44)/2
	Wetland category	from data
	Water quality	=36
37	Site features Landuse	=sum of scores for landuse categories
38	Site features offsite issues	=sum of scores(parameters 2-11)/10
39	Site features onsite issues	=sum of scores(parameters 12-16)/5
40	Vegetation	=sum of scores(parameters 16-19)/4
41	Habitat features - surrounds	=sum of scores(parameters 20-27)/8
42	Habitat features -wetland	=sum of scores(parameters 28-33)/6
43	Bank undercutting	=score
44	Bank collapse	=score

RESULTS

WETLAND REPORT CARDS

Report cards were developed for each wetland to provide a snapshot overview of the condition of that wetland at the time of survey (see example report card for The Driftway West wetland, (Figure 6 to Figure 9, overleaf). Colour coding was used for individual scores and overall scores to give a quick visual ranking of wetlands (and particular parameters) against each other, using:

- dark green = very good
- green = good
- yellow = fair
- orange = poor
- red = very poor

Page 1 of the report card (Figure 6) has the date of survey, the address of the property and the location of the survey, the overall score (includes colour coding), category subscores (with colour coding), area and extent of catchment and the catchment context. A brief description of the wetland is provided with a summary of surrounding land use.

Page 2 of the report card (Figure 7) has site photos, landholder identified issues, weeds (including priority control weeds), lists of native flora species by plant form, fauna species observed on the day, and a list of recommended remediation works and actions. Page 3 (Figure 8) has a detailed breakdown of the surrounding land use and the latest vegetation mapping (with date and source). Page 4 (Figure 9) has the mapped distribution of threatened species and migratory species within the catchment for each wetland, as reported in the Wildlife Atlas of NSW (BioNet) at the time of preparation.

THE DRIFTWAY WEST

Overall Score (0-10) **7.7**

Latitude	-33.619243
Longitude	150.731409
Address	WESTERN SYDNEY UNIVERSITY HAWKESBURY CAMPUS DP39768 Lot 181
Catchment (ha)	464

Wetland category	natural
Water quality	 fair
Site features Landuse	 7.6
Site features offsite issues	 9.1
Site features onsite issues	 5.0
Vegetation	 7.2
Habitat features -surrounds	 8.8
Habitat features -wetland	 7.8
Bank undercutting	 10.0
Bank collapse	 10.0

The wetland is a shallow sedge swamp surrounded by forested wetland that floods rapidly and dries rapidly. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location

Figure 6 Example report card page 1

ASSESSMENT 04/02/2021



IMAGE 1 Site 04/02/2021

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Rubus fruticosus aggregate species</i>	<10
<i>Lactuca serriola</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Sida rhombifolia</i>	<10
<i>Bidens pilosa</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Maintain existing overall good condition

Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY	
Macrophytes present	Density
<i>Philydrum lanuginosum</i>	<10
<i>Ranunculus inundatus</i>	<10
<i>Isotoma fluviatilis</i>	<10
<i>Ludwigia peploides</i>	<10
<i>Juncus usitatus</i>	<10
Other native vegetation	
Trees	Grasses
<i>Melaleuca decora</i>	<i>Lachnagrostis filiformis</i>
<i>Eucalyptus amplifolia</i>	<i>Glyceria australis</i>
<i>Eucalyptus tereticornis</i>	<i>Paspalum distichum</i>
Shrubs	Ground covers
<i>Callistemon citrinus</i>	<i>Centella asiatica</i>
<i>Persicaria decipiens</i>	<i>Juncus usitatus</i>
	<i>Velleia lyrata</i>
	<i>Hydrocotyle tripartita</i>
	<i>Alternanthera denticulata</i>
	<i>Juncus prismatocarpus</i>

Fauna noted: Spotted Marsh Frog, Common Froglet, Superb Fairywren

Figure 7 Example report card page 2

ASSESSMENT 04/02/2021

VEGETATION MAPPING AND LAND USE

Observed land use	%
Bushland	50-75
Peri-Urban Mixed	10-25
Pasture/Grazing	10-25



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Mapped Vegetation

- Alluvial Woodland
- Freshwater Wetlands
- Shale Plains Woodland
- Shale/Gravel Transition Forest

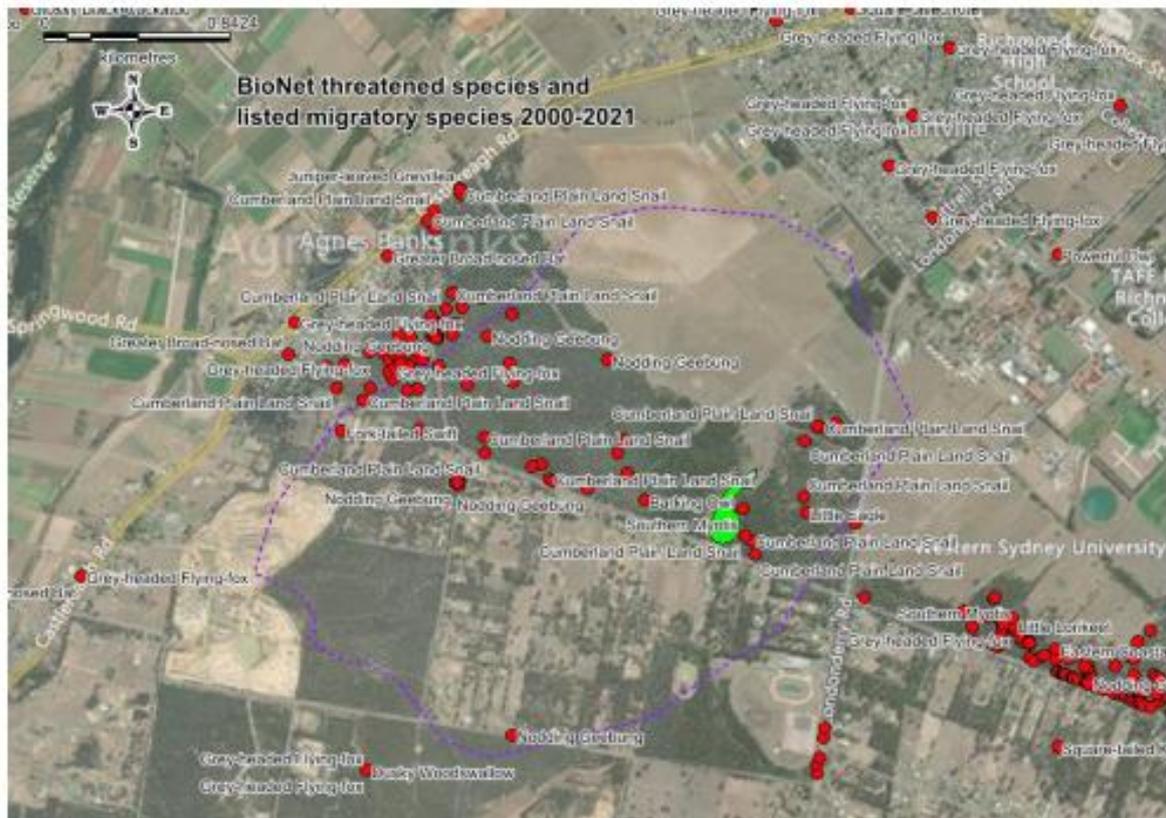
**VEGETATION MAPPING
HAWKESBURY LGA 2007 E3958**

0 50 100
Meters

MAP 3 Mapped vegetation communities

Figure 8 Example report card page 3

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Fork-tailed Swift	<i>Apus pacificus</i>	P	C,J,K	1
Aves	Little Eagle	<i>Hieraaetus morphnoides</i>	V,P		1
Aves	Barking Owl	<i>Ninox connivens</i>	V,P,3		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum carneavirens</i>	E1		19
Flora		<i>Dillwynia tenuifolia</i>	V		3
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	27
Flora		<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	1

Figure 9 Example report card page 4

SUMMARY DATA AND MAPS

A total of 35 wetlands were assessed and scored based on the results. This included 30 wetlands in Hawkesbury City Council and 5 in The Hills Shire (Figure 10). Wetlands were grazed (8), partly grazed (14) or ungrazed (13); surrounding vegetation was cleared (14), mostly cleared (8), partly cleared (6), or uncleared (7).

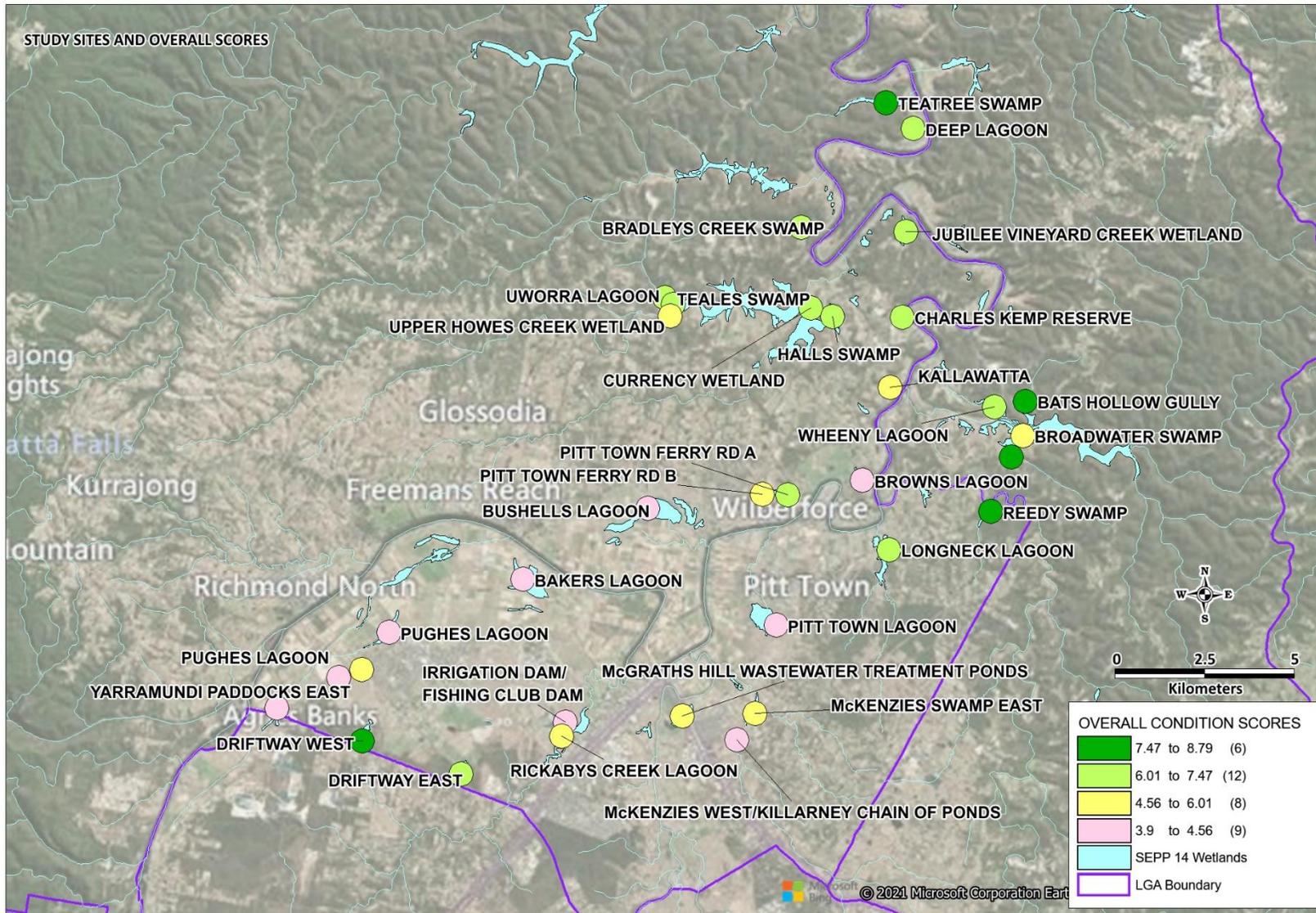


Figure 10 Locations of wetlands surveyed as part of the current assessment

Table 9 Alphabetical list of wetland survey results, including overall scores and subscores

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank undercutting	Bank collapse
BAKERS LAGOON	4.2	natural modified	fair	5.0	4.7	2.0	4.0	2.5	6.5	5.0	5.0
BATS HOLLOW GULLY	7.5	natural	poor	10	7.8	4.0	7.5	10.0	7.8	5.0	5.0
BLUNDELLS SWAMP	8.8	natural	fair	10	9.5	4.0	10.0	10.0	9.1	5.0	5.0
BRADLEYS CREEK SWAMP	6.7	natural modified	very poor	8.3	7.5	2.4	6.9	8.8	7.7	5.0	5.0
BROADWATER SWAMP	5.8	natural	poor	6.6	9.1	6.0	3.5	6.3	6.2	10.0	10.0
BROWNS LAGOON	4.1	natural	fair	5.3	8.5	2.4	3.0	8.8	4.2	0.0	0.0
BUSHHELLS LAGOON	3.9	natural	good	2.3	6.5	0.4	3.8	8.8	5.8	0.0	0.0
CHARLES KEMP RESERVE	7.3	natural modified	no testing	10	7.1	10.0	5.8	7.5	5.3	10.0	10.0
CURRENCY WETLAND	6.6	natural	no testing	5.3	9.0	8.0	4.3	10.0	6.2	10.0	10.0
DEEP LAGOON	6.6	natural modified	fair	6.3	9.5	3.0	7.9	5.0	6.2	5.0	5.0
DRIFTWAY EAST	6.9	natural	fair	10.0	9.0	5.0	5.0	8.8	6.2	10.0	10.0
DRIFTWAY WEST	7.7	natural	fair	7.6	9.1	5.0	7.2	8.8	7.8	10.0	10.0
HALLS SWAMP	6.9	natural modified	fair	5.3	8.0	8.0	6.0	10.0	6.2	5.0	10.0
IRRIGATION DAM/FISHING CLUB DAM	4.3	artificial or retrofitted	poor	5.8	6.1	5.0	4.3	2.5	1.7	5.0	5.0

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank undercutting	Bank collapse
JUBILEE VINEYARD CREEK WETLAND	7.3	impoundment	poor	5.3	6.0	6.0	8.2	10.0	7.8	0.0	10.0
KALLAWATTA	5.0	natural	fair	5.9	7.5	0.4	3.7	8.8	5.0	5.0	10.0
LONG ARM SWAMP	8.6	natural	poor	9.4	9.5	3.0	9.1	10.0	7.5	10.0	10.0
LONGNECK LAGOON	7.2	natural modified	fair	10	7.3	10.0	5.4	8.8	9.0	5.0	5.0
McGRATHS HILL WASTEWATER TREATMENT PONDS	5.1	WSUD	no testing	3.3	3.5	8.0	5.3	3.8	6.2	5.0	5.0
McKENZIES SWAMP EAST	5.9	natural modified	poor	5.5	5.8	0.4	7.8	3.8	7.3	5.0	5.0
McKENZIES WEST/KILLARNEY CHAIN OF PONDS	4.4	natural modified	poor	4.2	7.3	1.0	4.1	5.0	5.0	5.0	5.0
PITT TOWN FERRY RD A	6.4	natural	fair	5.5	9.1	3.0	7.5	5.0	6.5	5.0	5.0
PITT TOWN FERRY RD B	4.9	natural modified	fair	6.6	8.1	3.0	3.3	6.3	7.3	5.0	5.0
PITT TOWN LAGOON	4.5	natural modified	very poor	2.1	5.6	0.0	5.3	3.8	7.0	5.0	5.0
PUGHES LAGOON	4.3	natural modified	fair	3.8	2.8	3.0	4.3	6.3	7.7	0.0	5.0
REEDY SWAMP	8.5	natural	fair	10.2	8.1	10.0	7.5	10.0	7.0	10.0	10.0
RICKABYS CREEK LAGOON	4.7	natural modified	poor	3.7	5.3	1.0	4.7	6.3	7.3	5.0	5.0

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank under-cutting	Bank collapse
TEALES SWAMP	6.5	natural	poor	5.9	9.5	3.0	6.9	6.3	7.7	5.0	5.0
TEATREE SWAMP	8.0	natural	fair	9.4	8.5	3.0	11.1	7.5	2.5	5.0	5.0
UPPER HOWES CREEK WETLAND	6.4	natural	poor	7.0	8.1	0.4	7.7	5.0	7.7	5.0	5.0
UWORRA LAGOON	5.2	natural	poor	6.2	7.1	0.4	5.2	6.3	6.0	5.0	5.0
WHEENY LAGOON	6.2	natural	fair	9.4	9.0	6.0	3.7	10.0	7.5	0.0	10.0
YARRAMUNDI LAGOON	4.2	natural modified	fair	3.3	7.0	6.0	3.0	6.3	7.4	0.0	0.0
YARRAMUNDI PADDOCKS EAST	5.5	natural modified	poor	5.3	6.2	3.0	7.5	2.5	3.3	5.0	5.0
YARRAMUNDI PADDOCKS WEST	3.9	natural modified	very poor	5.0	7.5	2.4	2.5	2.5	1.7	10.0	10.0

Table 10 Prioritised list of wetland survey results, including overall scores and subscores

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank under-cutting	Bank collapse
BLUNDELLS SWAMP	8.8	natural	fair	10.3	9.5	4.0	10.0	10.0	9.1	5.0	5.0
LONG ARM SWAMP	8.6	natural	poor	9.4	9.5	3.0	9.1	10.0	7.5	10.0	10.0
REEDY SWAMP	8.5	natural	fair	10.2	8.1	10.0	7.5	10.0	7.0	10.0	10.0
TEATREE SWAMP	8.0	natural	fair	9.4	8.5	3.0	11.1	7.5	2.5	5.0	5.0
DRIFTWAY WEST	7.7	natural	fair	7.6	9.1	5.0	7.2	8.8	7.8	10.0	10.0

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank under-cutting	Bank collapse
BATS HOLLOW GULLY	7.5	natural	poor	10.3	7.8	4.0	7.5	10.0	7.8	5.0	5.0
CHARLES KEMP RESERVE	7.3	natural modified	no testing	10.3	7.1	10.0	5.8	7.5	5.3	10.0	10.0
JUBILEE VINEYARD CREEK WETLAND	7.3	impoundment	poor	5.3	6.0	6.0	8.2	10.0	7.8	0.0	10.0
LONGNECK LAGOON	7.2	natural modified	fair	10.3	7.3	10.0	5.4	8.8	9.0	5.0	5.0
DRIFTWAY EAST	6.9	natural	fair	10.0	9.0	5.0	5.0	8.8	6.2	10.0	10.0
HALLS SWAMP	6.9	natural modified	fair	5.3	8.0	8.0	6.0	10.0	6.2	5.0	10.0
BRADLEYS CREEK SWAMP	6.7	natural modified	very poor	8.3	7.5	2.4	6.9	8.8	7.7	5.0	5.0
DEEP LAGOON	6.6	natural modified	fair	6.3	9.5	3.0	7.9	5.0	6.2	5.0	5.0
CURRENCY WETLAND	6.6	natural	no testing	5.3	9.0	8.0	4.3	10.0	6.2	10.0	10.0
TEALES SWAMP	6.5	natural	poor	5.9	9.5	3.0	6.9	6.3	7.7	5.0	5.0
PITT TOWN FERRY RD A	6.4	natural	fair	5.5	9.1	3.0	7.5	5.0	6.5	5.0	5.0
UPPER HOWES CREEK WETLAND	6.4	natural	poor	7.0	8.1	0.4	7.7	5.0	7.7	5.0	5.0
WHEENY LAGOON	6.2	natural	fair	9.4	9.0	6.0	3.7	10.0	7.5	0.0	10.0
McKENZIES SWAMP EAST	5.9	natural modified	poor	5.5	5.8	0.4	7.8	3.8	7.3	5.0	5.0

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank under-cutting	Bank collapse
BROADWATER SWAMP	5.8	natural	poor	6.6	9.1	6.0	3.5	6.3	6.2	10.0	10.0
YARRAMUNDI PADDOCKS EAST	5.5	natural modified	poor	5.3	6.2	3.0	7.5	2.5	3.3	5.0	5.0
UWORRA LAGOON	5.2	natural	poor	6.2	7.1	0.4	5.2	6.3	6.0	5.0	5.0
McGRATHS HILL WASTEWATER TREATMENT PONDS	5.1	WSUD	no testing	3.3	3.5	8.0	5.3	3.8	6.2	5.0	5.0
KALLAWATTA	5.0	natural	fair	5.9	7.5	0.4	3.7	8.8	5.0	5.0	10.0
PITT TOWN FERRY RD B	4.9	natural modified	fair	6.6	8.1	3.0	3.3	6.3	7.3	5.0	5.0
RICKABYS CREEK LAGOON	4.7	natural modified	poor	3.7	5.3	1.0	4.7	6.3	7.3	5.0	5.0
PITT TOWN LAGOON	4.5	natural modified	very poor	2.1	5.6	0.0	5.3	3.8	7.0	5.0	5.0
McKENZIES WEST/KILLARNEY CHAIN OF PONDS	4.4	natural modified	poor	4.2	7.3	1.0	4.1	5.0	5.0	5.0	5.0
PUGHES LAGOON	4.3	natural modified	fair	3.8	2.8	3.0	4.3	6.3	7.7	0.0	5.0
IRRIGATION DAM/FISHING CLUB DAM	4.3	artificial retro	poor	5.8	6.1	5.0	4.3	2.5	1.7	5.0	5.0
YARRAMUNDI LAGOON	4.2	natural modified	fair	3.3	7.0	6.0	3.0	6.3	7.4	0.0	0.0

Wetland name	Overall Score (0-10)	Wetland category	Water quality	Site features Landuse	Site features offsite issues	Site features onsite issues	Vegetation	Habitat features - surrounds	Habitat features - wetland	Bank under-cutting	Bank collapse
BAKERS LAGOON	4.2	natural modified	fair	5.0	4.7	2.0	4.0	2.5	6.5	5.0	5.0
BROWNS LAGOON	4.1	natural	fair	5.3	8.5	2.4	3.0	8.8	4.2	0.0	0.0
YARRAMUNDI PADDOCKS WEST	3.9	natural modified	very poor	5.0	7.5	2.4	2.5	2.5	1.7	10.0	10.0
BUSHELLS LAGOON	3.9	natural	good	2.3	6.5	0.4	3.8	8.8	5.8	0.0	0.0

Overall scores range from 3.9 for Bushells Lagoon and Yarramundi Paddocks West to 8.8 for Blundells Swamp. Wetlands with overall scores greater than 7.5 could be considered in good condition. Wetlands with overall scores less than 5.0 should be considered to be in poor condition, while wetlands scoring between 5.0 and 7.5 are in fair condition.

Care should be taken not to overinterpret these scores. For example, Long Arm Swamp, upstream from Broadwater Swamp, has an overall score of 8.6 but has water quality that scores as poor. Bushells Lagoon had the best water quality at time of survey, but scored poorly overall, despite having good fauna diversity (based on long term species records).

DISCUSSION AND RECOMMENDATIONS FOR WORKS

DISCUSSION

Previous surveys of wetlands on the Hawkesbury floodplain are in agreement on their condition being generally poor, and usually as a result of a long history of clearing and degradation associated with grazing and cropping. Most wetlands are cleared or mostly cleared, with around one third partly cleared or uncleared. Correspondingly, most wetlands are grazed around their perimeter, or at least part of the bordering lands are grazed. Different management regimes usually occur as the result of multiple ownerships and multiple/cross tenure of land surrounding a single wetland.

More recently the process of clearing and degradation has intensified to include market gardening, turf farming, vineyards, and modification and extraction of water and soils or rocks. Management is generally conducted by landholders with little or no support from government agencies. The lack of support or incentives to manage for conservation means that the cost of this process is borne by the landholder, either through loss of potential earnings because their land is 'locked up' for conservation or through direct costs associated with conservation maintenance, such as weed control.

Wetlands that have some or all of their original vegetation retained have also got some level of impact, for example, there are ongoing impacts through weed invasion. Remnant vegetation can be one or more of a number of forested Plant Community Types, or with some or all of one or more layers removed. Wetlands that are mostly cleared or cleared of surrounding vegetation generally have completely modified land use, such as market gardens, turf farms, vineyards, etc. In a very few instances there have been small areas of 'native' vegetation planting (for example, at Bushells Lagoon, Pitt Town Ferry Rd A), but this tends to be commonly planted species known to attract birds rather than a genuine attempt to replace or recreate the original vegetation.

Vegetation within the wetland can be present or absent, can form a fringing strip around the edges, or completely cover the whole of the wetland. Vegetated wetlands can comprise predominantly herbaceous plants (such as The Driftway West and East) or be dominated by sedges and rushes (such as Reedy Swamp and Wheeny Lagoon). Other vegetated wetlands have a mix of sedges, rushes, and herbs, and some of these are dominated by weeds, and even by priority control weeds (including Teales Swamp and Upper Howes Creek Wetland).



Figure 11 Driftway West is located in Western Sydney University



Figure 12 Wheeny Lagoon north of Little Cattai Creek

The type and quality of the vegetation in the wetland is often defined or at least influenced by the quality and quantity of water available. Higher nutrient loaded wetlands that are common in agricultural and horticultural situations will favour predominantly vegetated wetlands, and this vegetation is more likely to be introduced. The higher the nutrient load, typically the greater the weed burden. Water quality is frequently outside ANZECC guidelines for freshwater wetlands for multiple parameters. For the four key parameters (pH, Conductivity, Dissolved Oxygen%, Turbidity) all but one wetland exceeds guideline triggers for at least two parameters. The only wetland that only fails for one water quality parameter is Bushells' Lagoon, the lowest overall scored wetland.

Water depth is another factor that strongly influences the presence of macrophytes. Once the water depth is greater than 2m the species that can establish are very few. Fluctuating water depth will also affect the survival of macrophytes, especially if the fluctuations are frequent and/or significant (ie. 1m or more). Causes of fluctuation can be natural, such as drought or flood, or artificial, such as water extraction, or changes in surface and groundwater flow paths. Regardless of the cause, marked changes in water levels affects the extant vegetation and has consequent impacts for the local fauna species. Flooding in particular has very strong impacts on the wetland ecosystem, including flushing of a wetland, temporary connection to the river and the wider floodplain. This process is important for wetland health under normal conditions, however, in the Hawkesbury floodplain there can be drastic results as well. Pest animals such as carp and gambusia have access to the wetlands, coming in on the floodwaters but failing to leave when the water recedes. Similarly, water weeds can be rapidly spread through the catchment under flood conditions. All of this affects the management required, while the capacity to rise to these challenges may not change accordingly.



Figure 13 Drifts of Alligator Weed move in and out of Yarramundi Lagoon

SUMMARY OF RECOMMENDATIONS FOR WORKS

When developing a program of work to manage/improve/remediate a natural area there are a couple of things to consider – what needs to be done, and what capacity there is to actually achieve any, some or all of these outcomes/goals. Capacity to deliver is largely dependent on having the time, money, incentive, knowledge and motivation to undertake works. Shortfalls in any of these areas are likely to reduce the capacity to varying degrees. Funding for works on private land is always inadequate and can be difficult to source. Barring the availability of external funding, there needs to be an incentive for the landholder(s) to allocate their own resources to natural area works.

In some cases, the benefits can be mutual, for example, establishing offline watering points. This reduces the damage to the banks of wetlands and streams and reduces degrading impacts on water quality. At the same time, it provides water consistently to locations that are within reach of grazing animals, reducing the amount of time and energy that is expended by travelling between sources of food, drinking water and shelter. Water quality is improved, reducing disease and maintaining condition. Monitoring and treating for water-borne diseases and conditions is much simpler, and spread of diseases can be greatly reduced, with further cost savings for farmers. Fencing to support the use of new watering points can be harder to justify but while this may be expensive it tends to be a cost that can be spread across many years. Temporary fencing such as electric fencing may also be suitable, and in many cases is enough to discourage stock while they become accustomed to the new watering points.

The following tables provide lists of works that are recommended for each wetland. This takes into account the current ownership – public or private, one owner or multiple owners. Getting started on works within the wetland just requires the involvement of one owner, but it is certainly easier if more than one, or all of the relevant landholders can become involved. Realistically, not every recommended works activity can be undertaken at each wetland. In some cases, site specific actions will need to be developed or designed – outside the scope of this project. This includes naturalisation of channels and banks to improve water quality, or control of carp to reduce bank undercutting etc. Control of carp is always going to be an ongoing challenge as each new flood brings more fish into the wetland, and they remain behind when the waters recede.

One of the key areas where the HLN can make a contribution is with access to information. Often landholders will refrain from making changes or taking on challenges in natural area management because it simply seems too hard. Providing information about simple and cost effective solutions and showcasing case studies gives landholders a better understanding of what can be achieved and how, and the potential costs in terms of time and money. Getting landholders to work together also encourages them to tackle some of the larger problems, and increases the likelihood of better results. An example of this is weed control – all the landholders around a wetland need to be involved if a target weed is to be reduced or even eradicated, until the next flood at least.

The other factor to consider when working towards the successful completion of a natural area management project is what to identify as ‘success’. Some weeds, for example, produce numerous seeds that remain in the soil for many years, and realistically may only be reduced to a level of low impact. Others may be easier to control on site, but new propagules are washed in with every flood. Understanding this makes it easier to develop realistic expectations – ‘if I want to keep this weed off my place then I need to hunt it out after each flood’. Flood deposited weeds are often difficult to access if they become established in existing stands of reeds. Again, what support is out there for landholders and what is an achievable level of control.

The other important area for HNLN is sourcing grant funding for works, or providing landholders with access to their own grant funding. Most landholders are not aware of the grants they are eligible for, and many would struggle to put together a successful application. Additionally, there are reporting requirements that go with a grant that can be an onerous task. Providing information, education and support through each stage of this process is a valuable contribution. Furthermore, it empowers landholders to feel that the environmental gains they have made are theirs, increasing their sense of success in the role of custodian for the wetland, and encouraging them to tackle similar challenges in the future.

The following works actions are broadly grouped into reducing degrading impacts (Table 11), improving overall habitat value of the wetland (Table 12), and increasing knowledge and support for landholders (Table 13).



Figure 14 McKenzies Lagoon East



Figure 15 Bushells Lagoon



Figure 16 Pitt Town Lagoon

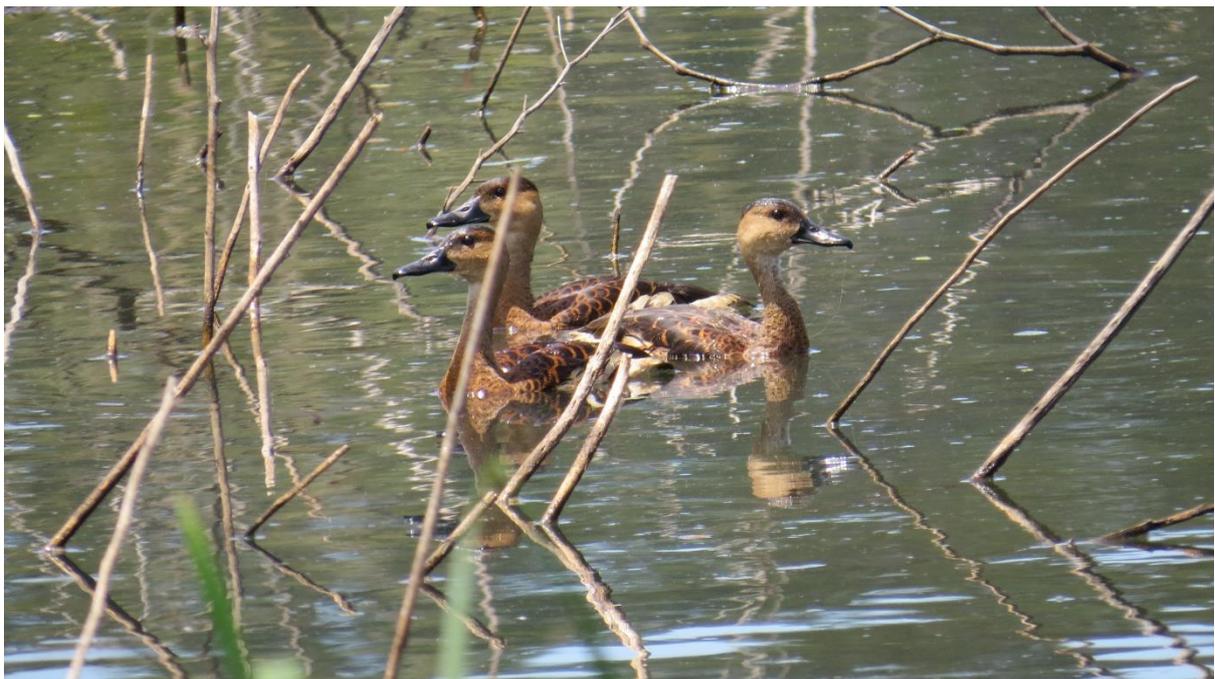


Figure 17 Longneck Lagoon

Table 11 Restoration works that may be required in Hawkesbury floodplain wetlands

WETLAND	Priority weeds	Environmental weeds	Fence off wetland	Restrict grazing	Offline waterpoint	Revegetate banks	Reduce irrigation extraction
BAKERS LAGOON		y		y	y	y	y
BATS HOLLOW GULLY		y		y			
BLUNDELLS SWAMP	y	y					upstream?
BRADLEYS CREEK SWAMP	y	y	y	y	y	y	y
BROADWATER SWAMP	y	y		y	y	y	
BROWNS LAGOON	y	y	y	y	y	y	
BUSHELLS LAGOON	y	y	y	y	y	y	
CHARLES KEMP RESERVE	y	y				y	
CURRENCY WETLAND		y		y	y	y	
DEEP LAGOON		y		y	y	y	
DRIFTWAY EAST		y		y			
DRIFTWAY WEST		y		y			
HALLS SWAMP		y	y				y
IRRIGATION DAM/FISHING CLUB DAM	y	y				y	
JUBILEE VINEYARD CREEK WETLAND	y	y		y	y	y	
KALLAWATTA	y	y	y	y	y	y	y
LONG ARM SWAMP		y		y		y	
LONGNECK LAGOON	y	y				y	
McGRATHS HILL WASTEWATER TREATMENT PONDS		y				y	
McKENZIES SWAMP EAST	y	y		y	y	y	
McKENZIES WEST/KILLARNEY CHAIN OF PONDS	y	y		y	y	y	
PITT TOWN FERRY RD A	y	y		y	y	y	
PITT TOWN FERRY RD B	y	y	y	y	y	y	y
PITT TOWN LAGOON		y		y	?	y	
PUGHES LAGOON	y	y		?	?	y	?

WETLAND	Priority weeds	Environmental weeds	Fence off wetland	Restrict grazing	Offline waterpoint	Revegetate banks	Reduce irrigation extraction
REEDY SWAMP	y	y					
RICKABYS CREEK LAGOON	y	y				y	y
TEALES SWAMP	y	y			?		
TEATREE SWAMP	y	y		y	y		
UPPER HOWES CREEK WETLAND	y	y	additional areas	y	y		
UWORRA LAGOON	y	y	y	y	y	y	
WHEENY LAGOON		y		y		y	
YARRAMUNDI LAGOON	y	y		y	y	y	
YARRAMUNDI PADDOCKS EAST	y	y		y	y	y	
YARRAMUNDI PADDOCKS WEST	y	y		y	y	y	

Table 12 Habitat enhancement works that may be required in Hawkesbury floodplain wetlands

WETLAND	Maintain good condition	Cease excavation	Improve Water Quality	Naturalise channels	Carp control	Habitat enhancement	Remediate excavation
BAKERS LAGOON				y	y	y	
BATS HOLLOW GULLY	y		y		y	y	
BLUNDELLS SWAMP	y				y		
BRADLEYS CREEK SWAMP		y	y		y	y	y
BROADWATER SWAMP			y		y	y	
BROWNS LAGOON			y	y	y	y	
BUSHELLS LAGOON		y		y	y	y	y
CHARLES KEMP RESERVE						y	
CURRENCY WETLAND						y	
DEEP LAGOON					y	y	
DRIFTWAY EAST	y						

WETLAND	Maintain good condition	Cease excavation	Improve Water Quality	Naturalise channels	Carp control	Habitat enhancement	Remediate excavation
DRIFTWAY WEST	y						
HALLS SWAMP	y						
IRRIGATION DAM/FISHING CLUB DAM			y			y	
JUBILEE VINEYARD CREEK WETLAND		y	y	y	y	y	y
KALLAWATTA				y	y	y	
LONG ARM SWAMP			y			y	
LONGNECK LAGOON			y		y	y	
McGRATHS HILL WASTEWATER TREATMENT PONDS	y					y	
McKENZIES SWAMP EAST			y		y	y	
McKENZIES WEST/KILLARNEY CHAIN OF PONDS			y	y	y	y	
PITT TOWN FERRY RD A					y	y	
PITT TOWN FERRY RD B		y		y	y	y	y
PITT TOWN LAGOON			y	y	y	y	
PUGHES LAGOON			y		y	y	
REEDY SWAMP	y						
RICKABYS CREEK LAGOON			y	y	y	y	
TEALES SWAMP			y				
TEATREE SWAMP	y						
UPPER HOWES CREEK WETLAND			y				
UWORRA LAGOON			y		y	y	
WHEENY LAGOON	y					y	
YARRAMUNDI LAGOON				y	y	y	
YARRAMUNDI PADDOCKS EAST			y			y	
YARRAMUNDI PADDOCKS WEST			y			y	

Table 13 Works to build community awareness of values for Hawkesbury floodplain wetlands

WETLAND	Educate landholders	Coordinate landholders	Opportunities for public education	Threatened species management	Locate funding sources
BAKERS LAGOON	y	y		y	y
BATS HOLLOW GULLY	y	y		y	y
BLUNDELLS SWAMP				y	y
BRADLEYS CREEK SWAMP	y	y		y	y
BROADWATER SWAMP	y	y		y	y
BROWNS LAGOON	y	y	y	y	y
BUSHELLS LAGOON	y	y	y	y	y
CHARLES KEMP RESERVE			y	y	y
CURRENCY WETLAND	y	y		y	y
DEEP LAGOON	y	y		y	y
DRIFTWAY EAST			y	y	
DRIFTWAY WEST			y	y	
HALLS SWAMP	y	y		y	y
IRRIGATION DAM/FISHING CLUB DAM	y	y		y	
JUBILEE VINEYARD CREEK WETLAND	y	y	y	y	y
KALLAWATTA	y	y		y	y
LONG ARM SWAMP	y	y		y	y
LONGNECK LAGOON	y	y	y	y	
McGRATHS HILL WASTEWATER TREATMENT PONDS	y		y	y	y
McKENZIES SWAMP EAST	y	y		y	y
McKENZIES WEST/KILLARNEY CHAIN OF PONDS	y	y	y	y	y
PITT TOWN FERRY RD A	y	y		y	y
PITT TOWN FERRY RD B	y	y			y
PITT TOWN LAGOON	y	y	y	y	y
PUGHES LAGOON	y		y	y	y
REEDY SWAMP			y	y	
RICKABYS CREEK LAGOON	y	y	y		
TEALES SWAMP	y	y		y	y
TEATREE SWAMP		y		y	y
UPPER HOWES CREEK WETLAND	y	y		y	y
UWORRA LAGOON	y	y		y	y
WHEENY LAGOON	y	y		y	y
YARRAMUNDI LAGOON	y	y		y	y
YARRAMUNDI PADDOCKS EAST	y		y	y	
YARRAMUNDI PADDOCKS WEST	y		y	y	

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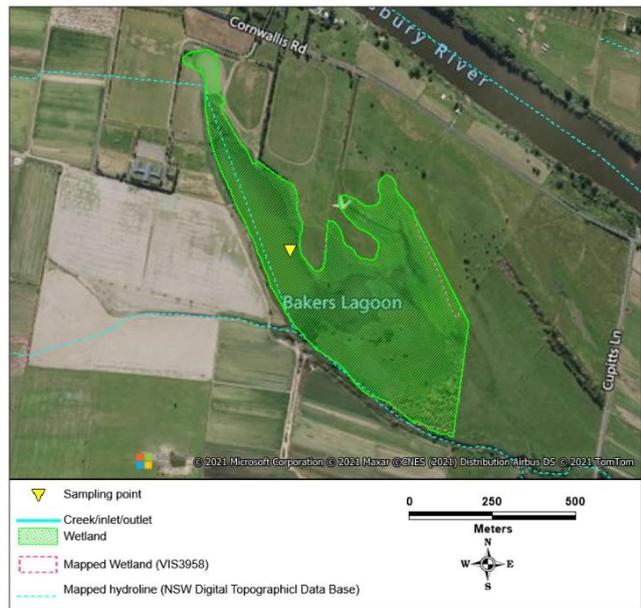
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BAKERS LAGOON

Overall Score (0-10) **4.2**

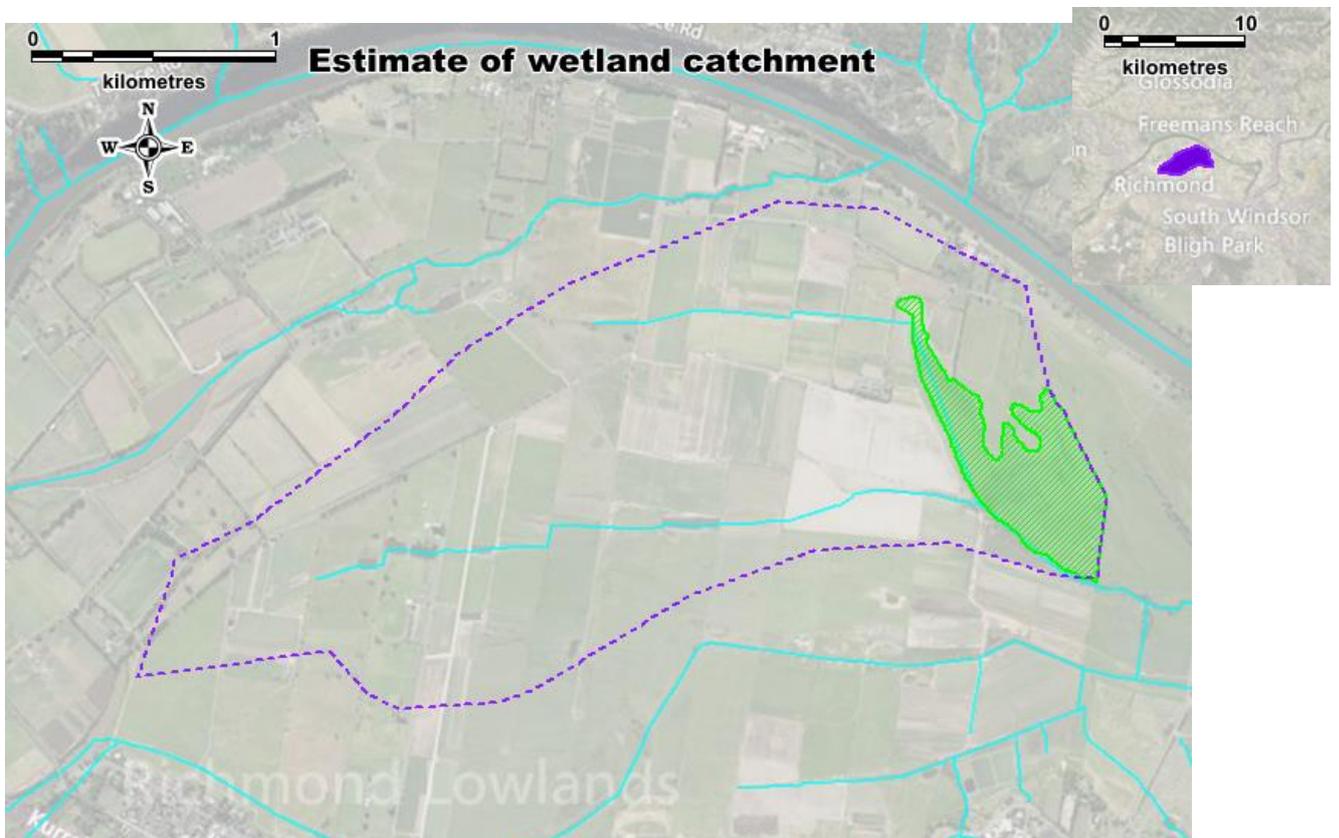
Latitude	██████████
Longitude	██████████
Address	Cornwallis Rd, Cornwallis
Catchment (ha)	454

Wetland category	natural	modified
Water quality	██████████	fair
Site features Landuse	██████████	5.0
Site features offsite issues	██████████	4.7
Site features onsite issues	██████████	2.0
Vegetation	██████████	4.0
Habitat features -surrounds	██████████	2.5
Habitat features -wetland	██████████	6.5
Bank undercutting	██████████	5.0
Bank collapse	██████████	5.0



MAP 1 Wetland and sampling location

The wetland is a shallow open water swamp surrounded by very large stands of fringing macrophytes that provide extensive habitat. Surrounding land use is completely cleared for pasture for racehorse studs and market gardens with peri urban residential development.



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 15/02/2021: (left) this is a large open water lagoon surrounded by horse studs, (top right) with extensive stands of fringing macrophytes, (bottom right) one of several inflow/outflow swales

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Gleditsia triacanthos</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Bromus catharticus</i>	10-25
<i>Tradescantia albiflora</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Bidens pilosa</i>	<10
<i>Plantago lanceolata</i>	<10

Recommended works:

- Control environmental weeds
- Reduce extraction for irrigation
- Fence off wetland, establish offline watering points where appropriate
- Revegetate degraded banks

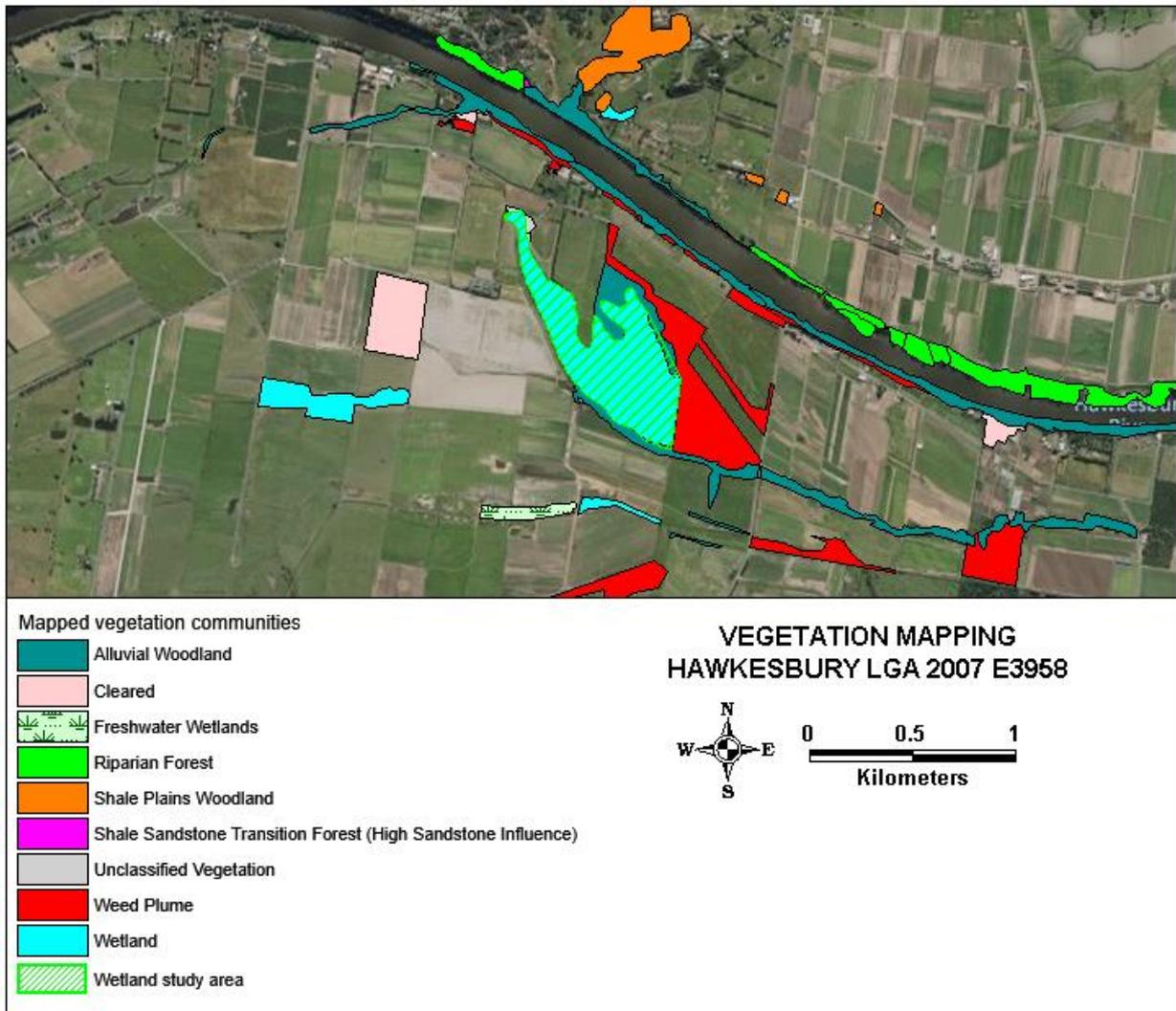
Priority weed – none noted

ASSETS 15/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	10-25	<i>Lachnagrostis filiformis</i>
<i>Phragmites australis</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Persicaria lapathifolia</i>	<i>Juncus usitatus</i>
		<i>Marsillea drummondii</i>
		<i>Alternanthera denticulata</i>

Fauna noted: Willie Wagtail, Australian Wood Duck, Pacific Black Duck, Eurasian Coot, Australasian Darter, White-faced heron

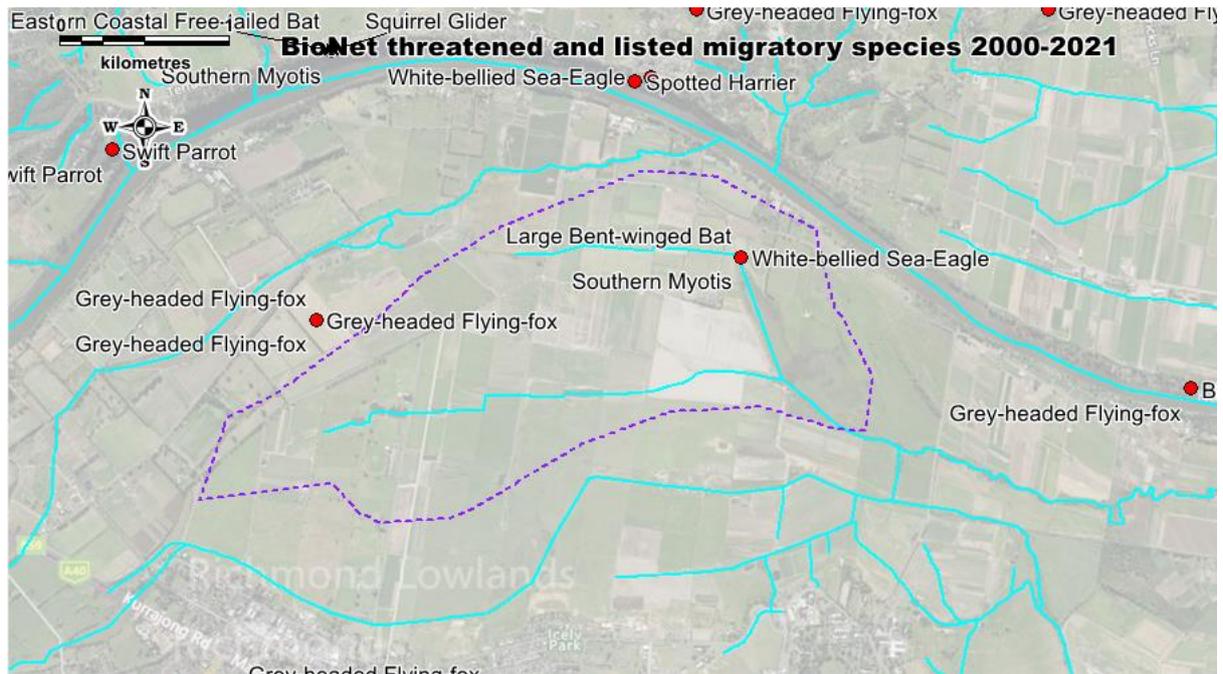
VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	>75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>	V,P		1
Mammalia	Southern myotis	<i>Myotis macropus</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		1



IMAGE 1 Horse studs are common surrounding Bakers Lagoon



IMAGES 12/05/2021: (left) high water mark from recent flooding was visible from mud deposited on trees, (right) an old road connects areas of permanent grazing around the edge of the lagoon

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Lantana camara</i>	<10
<i>Bidens pilosa</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Cyperus eragrostis</i>	<10
<i>Sonchus oleraceus</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control environmental weeds
 - Restrict grazing, consider fencing
 - Ensure new development complies with environmentally sustainable design building codes to ensure good outcomes

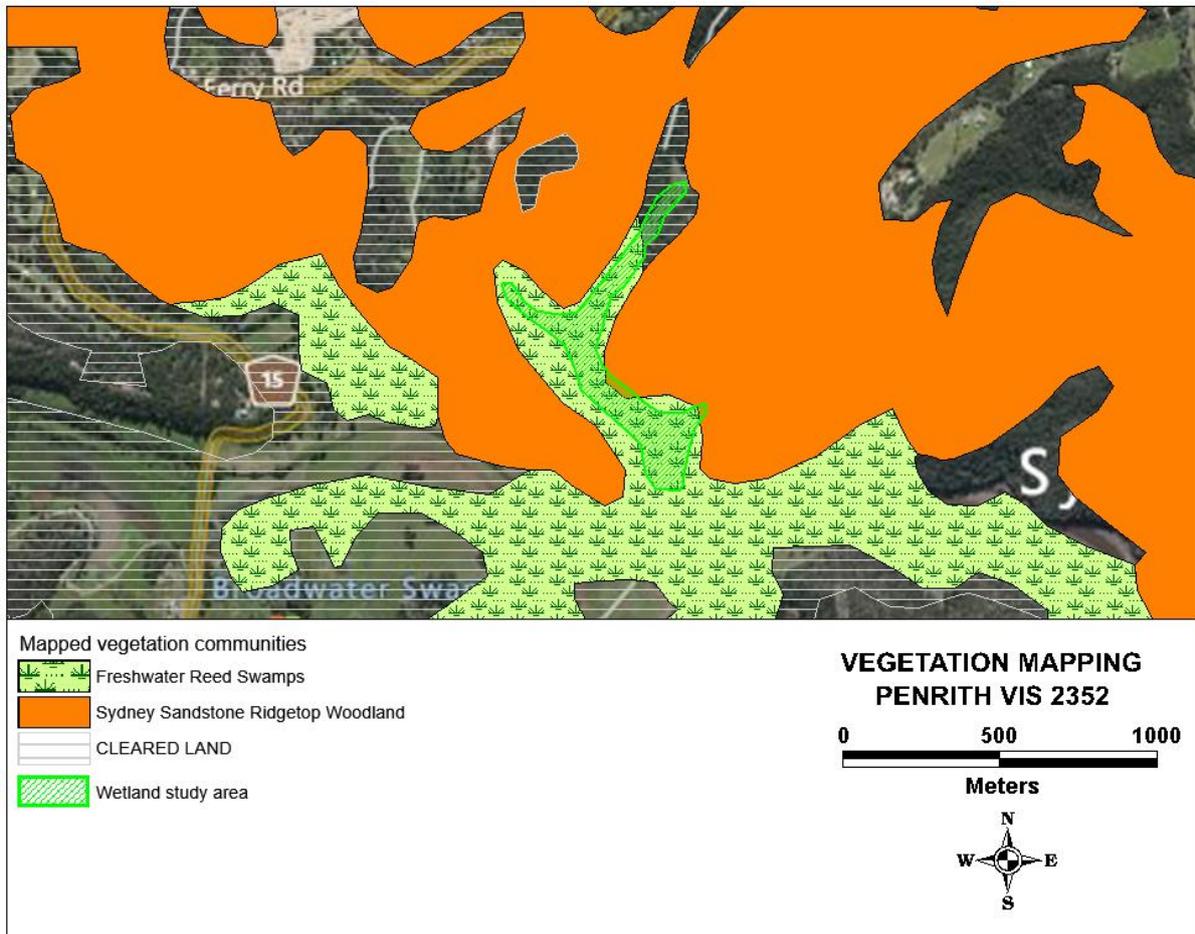
Priority weed

ASSETS 12/05/21 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
Not visible	wetland in flood	<i>Paspalum distichum</i>
		<i>Eriochloa pseudoacrotricha</i>
		<i>Digitaria parviflora</i>
		<i>Microlaena stipoides</i>
		<i>Hemarthria uncinata</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca styphelioides</i>	<i>Callistemon citrinus</i>	<i>Centella asiatica</i>
<i>Melaleuca decora</i>	<i>Bursaria spinosa</i>	<i>Commelina cyanea</i>
<i>Eucalyptus tereticornis</i>	<i>Acacia parramattensis</i>	<i>Cyperus flaccidus</i>
<i>Angophora floribunda</i>		<i>Juncus usitatus</i>
		<i>Hydrocotyle sibthorpioides</i>

Fauna noted: Pacific Black Duck, Chestnut Teal, Australian Wood Duck, White-faced heron, Australasian Swamphen, Australasian Darter, Australasian Grebe

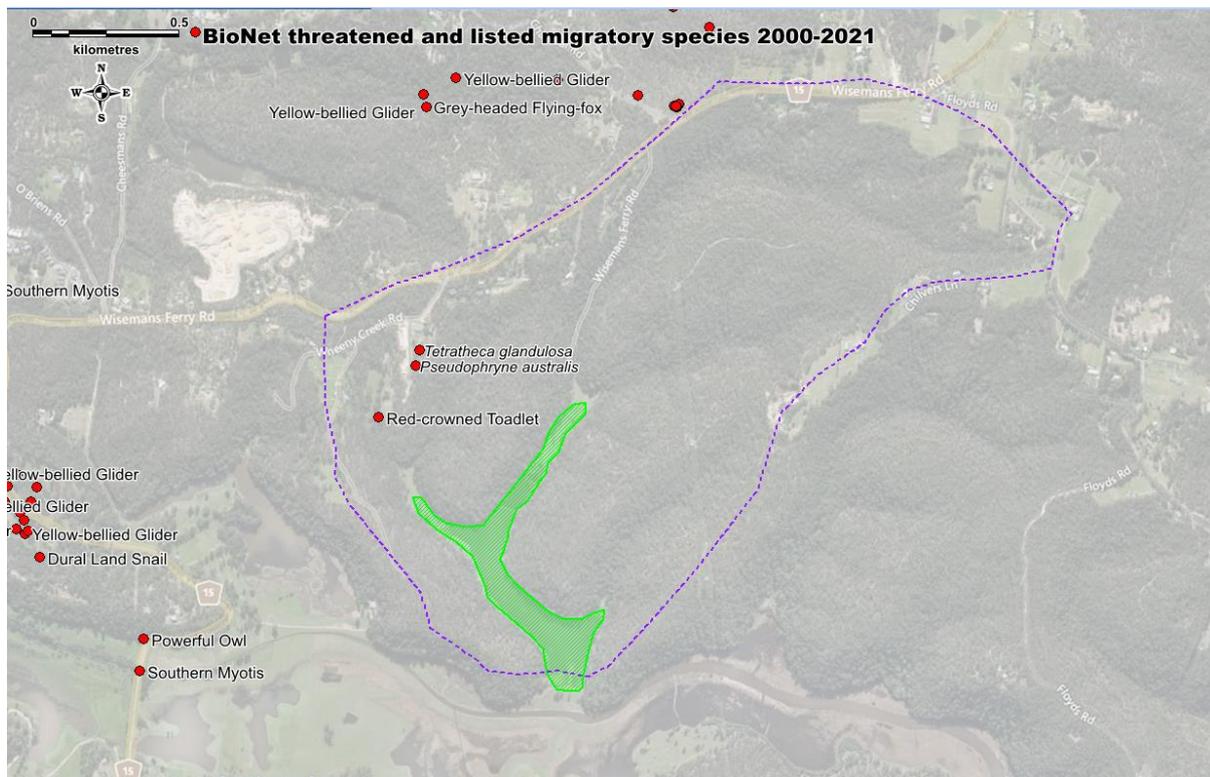
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75
peri-urban mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

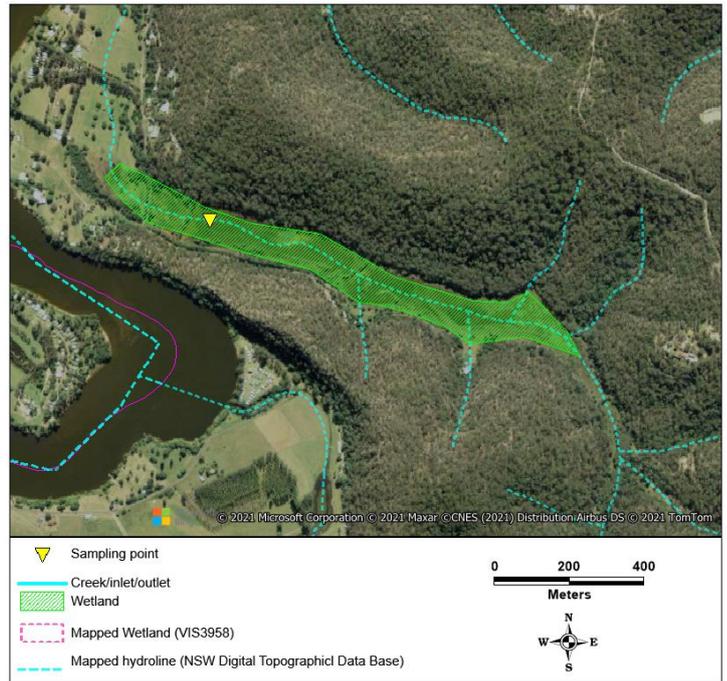
Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Amphibia	Red-crowned Toadlet	<i>Pseudophryne australis</i>	V,P		4
Flora		<i>Tetratheca glandulosa</i>	V		2

BLUNDELLS SWAMP

Overall Score (0-10) 8.8

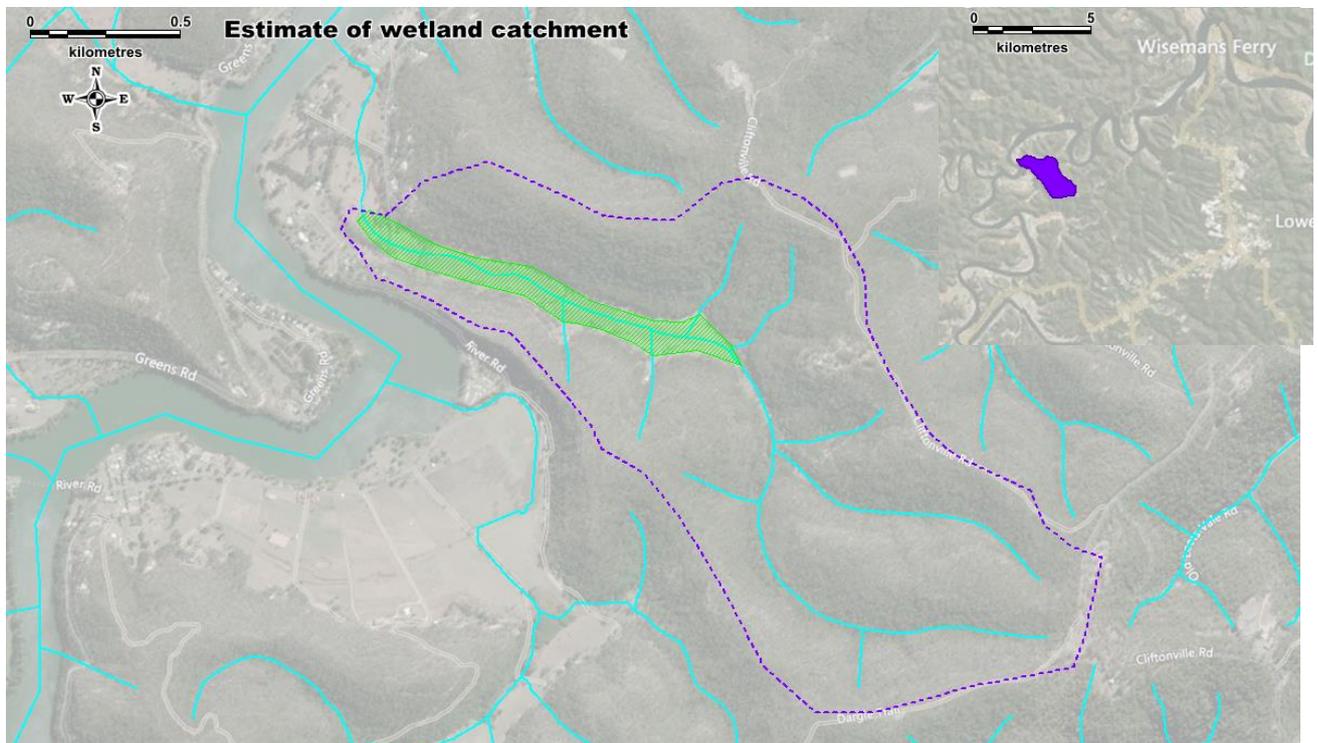
Latitude	██████████
Longitude	██████████
Address	River Rd, Lower Portland
Catchment (ha)	207

Wetland category	natural
Water quality	fair
Site features Landuse	10.0
Site features offsite issues	9.5
Site features onsite issues	4.0
Vegetation	10.0
Habitat features -surrounds	10.0
Habitat features -wetland	9.1
Bank undercutting	5.0
Bank collapse	5.0



MAP 1 Wetland and sampling location

The wetland is a high conservation value sedge swamp/forested wetland surrounded by a fully forested catchment. A dam retains water at a reasonably constant level. The dam is currently managed for conservation.



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 02/03/2021: (left) the lagoon has open water and sedgeland, (top right) with paperbark swamp patches, (bottom right) water levels are maintained by a dam wall which is also the road

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
WEED SPECIES (TOP 10)	DENSITY
<i>Lantana camara</i>	<10
<i>Bidens pilosa</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Cyperus eragrostis</i>	<10
<i>Sonchus oleraceus</i>	<10
<i>Cortaderia selloana</i>	<10
<i>Paspalum urvillei</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control environmental weeds
 - Minimise potential for impacts from upstream development through development control regulations

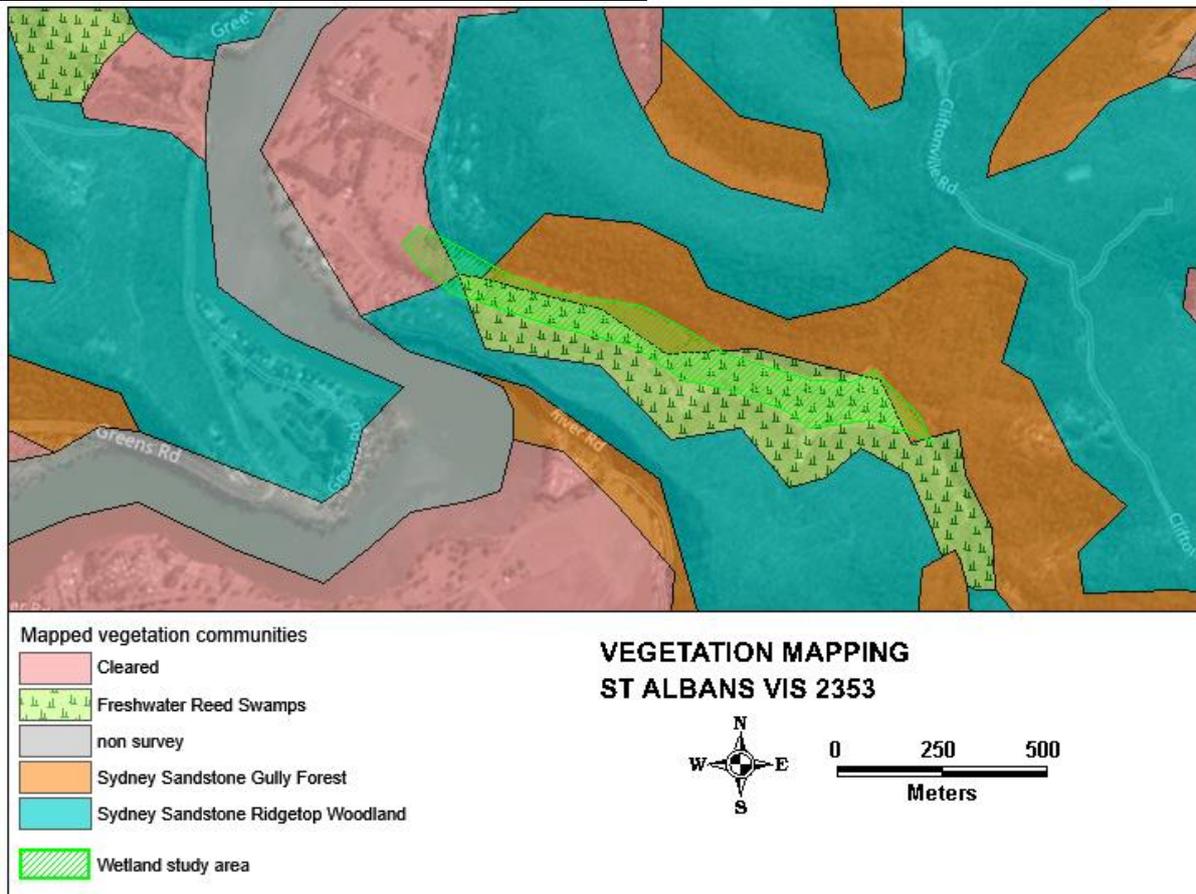
Priority weed

ASSETS 02/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>		<i>Paspalum distichum</i>
<i>Hydrocotyle tripartita</i>		<i>Eriochloa pseudoacrotricha</i>
<i>Bolboschoenus caldwellii</i>		<i>Digitaria parviflora</i>
<i>Lepironia articulata</i>		<i>Microlaena stipoides</i>
<i>Lemna spp.</i>		<i>Hemarthria uncinata</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca styphelioides</i>	<i>Leptospermum juniperinum</i>	<i>Hydrocotyle sibthorpioides</i>
<i>Melaleuca decora</i>	<i>Bursaria spinosa</i>	<i>Pteridium esculentum</i>
<i>Eucalyptus tereticornis</i>	<i>Acacia parramattensis</i>	<i>Smilax glycyphylla</i>
	<i>Glochidion ferdinandi</i>	<i>Dichondra repens</i>
	<i>Astrotricha floccosa</i>	<i>Persicaria strigosa</i>

Fauna noted: Pacific Black Duck, Chestnut Teal, Australian Wood Duck, White-faced heron, Willie Wagtail, Black Swan, Australian Pelican, Dusky Moorhen, Australasian Swamphen, Australasian Darter, Australasian Grebe, Grey Teal

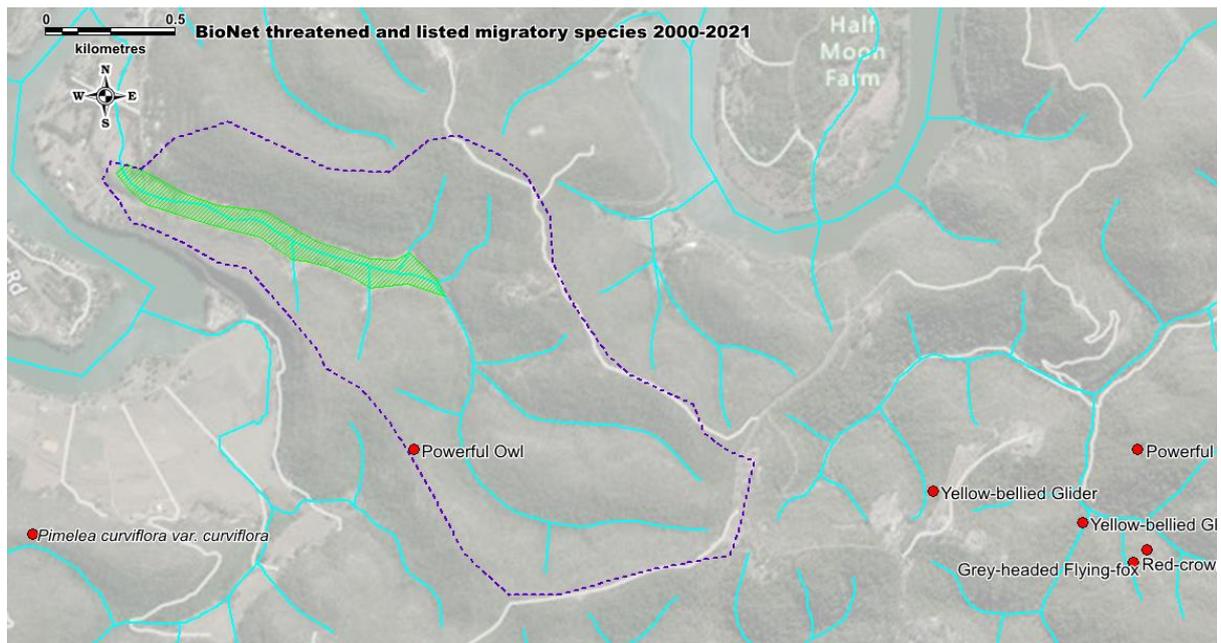
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75
peri-urban mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Powerful owl	<i>Ninox strenua</i>	V,P,3		1



IMAGE 1 Flocks of Chestnut Teals and Grey Teals are a common sight on Blundells Swamp



IMAGE 2 Australasian Grebes were present in breeding plumage



IMAGE 3 Pacific Black Ducks were also common on the wetland

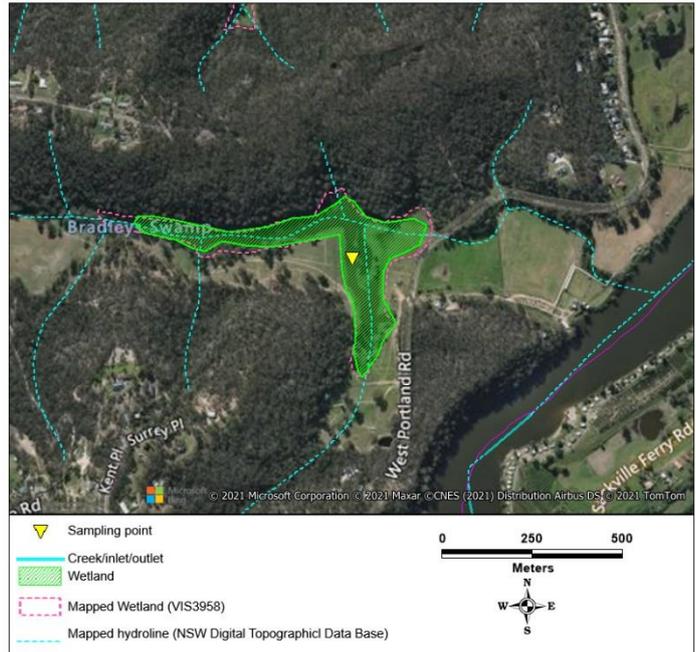
BRADLEYS CREEK SWAMP

Overall Score (0-10) 6.7

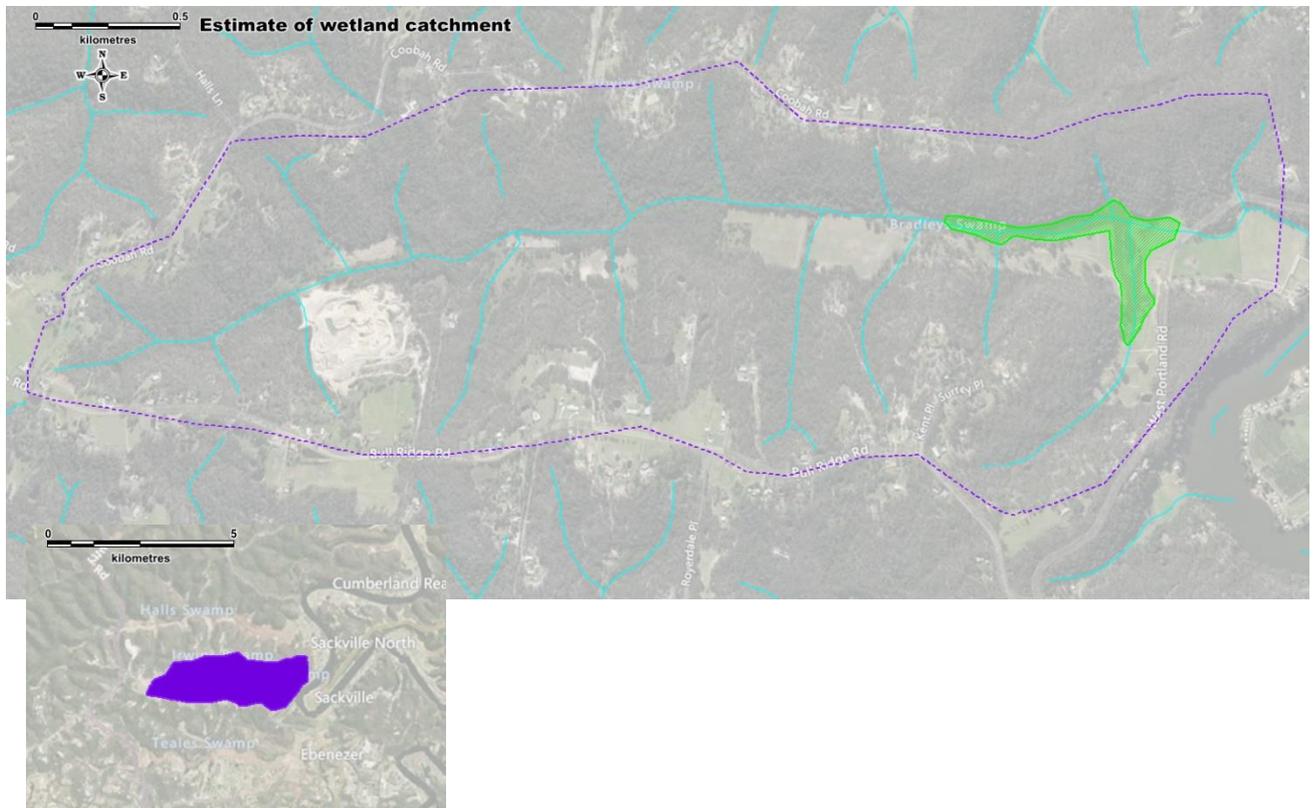
Latitude	██████████
Longitude	██████████
Address	██████████ West Portland Rd, Sackville
Catchment (ha)	455

Wetland category	natural	modified
Water quality		Very poor
Site features Landuse		8.3
Site features offsite issues		7.5
Site features onsite issues		2.4
Vegetation		6.9
Habitat features -surrounds		8.8
Habitat features -wetland		7.7
Bank undercutting		5.0
Bank collapse		5.0

The wetland has a paperbark swamp upstream of an open water lagoon surrounded by fringing macrophytes. Surrounding land use is around half forested with the remainder cleared for grazing. Ownership is a single landholder.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 01/03/2021: (left) the lower section of the wetland is cleared and periodically grazed, (top right) water is extracted for crop irrigation, (bottom right) the upper wetland is a paperbark swamp

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Senecio madagascariensis</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Phytolaca octandra</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Conyza sp.</i>	<10
<i>Solanum mauritianum</i>	<10
<i>Datura ferox</i>	<10
<i>Digitaria sanguinalis</i>	<10
<i>Sorghum halepense</i>	<10
<i>Paspalum urvillei</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Fence off wetland, restrict grazing, install offline watering points
- Restrict extraction for irrigation
- Revegetate cleared banks to improve overall health and condition

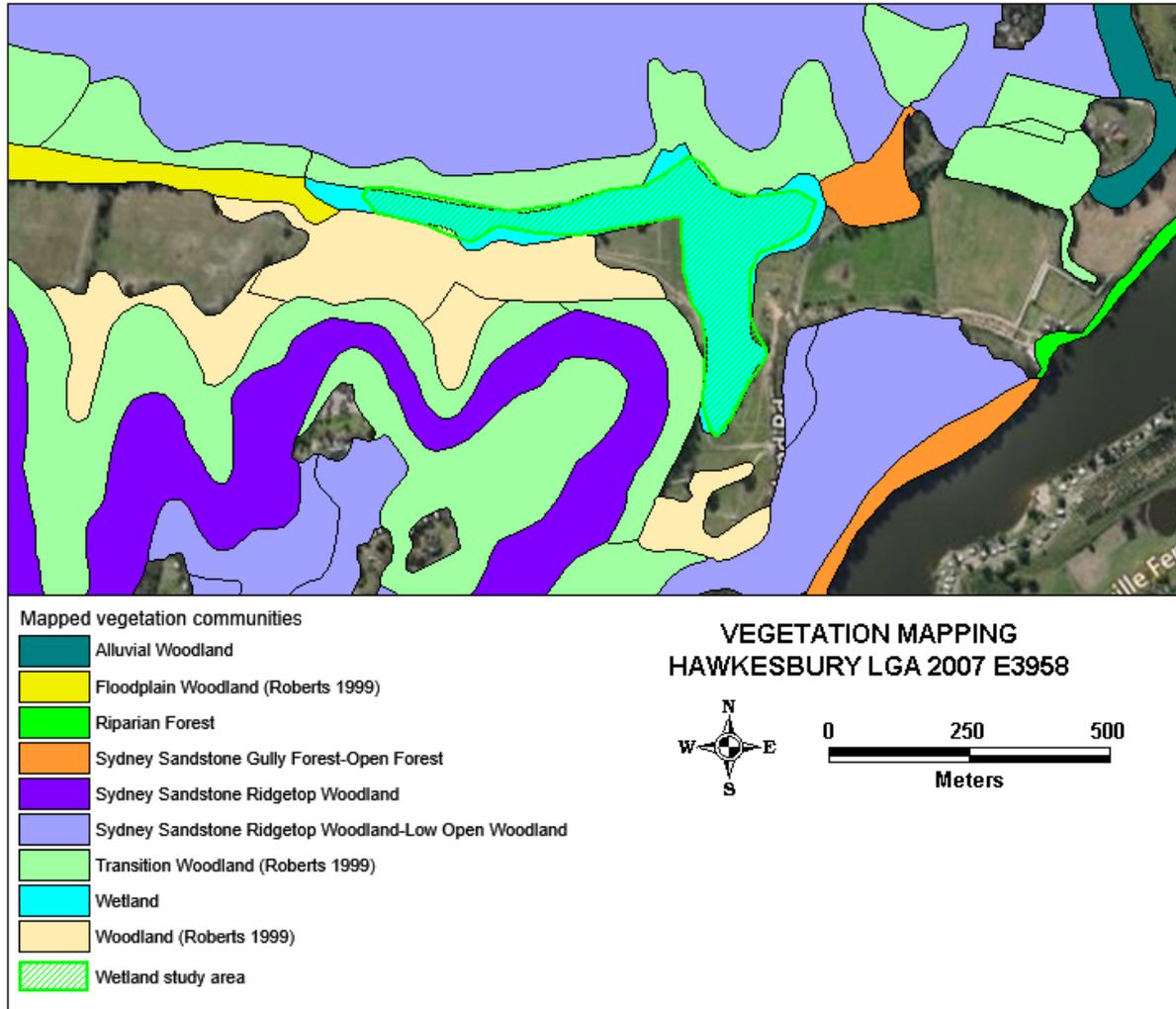
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	<10	<i>Paspalum distichum</i>
<i>Bolboschoenus caldwellii</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca decora</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
<i>Eucalyptus robusta</i>	<i>Acacia parramattensis</i>	<i>Pteridium esculentum</i>
<i>Eucalyptus punctata</i>	<i>Leptospermum polygalifolium</i>	<i>Juncus usitatus</i>
<i>Angophora floribunda</i>	<i>Persicaria hydropiper</i>	<i>Desmodium varians</i>
<i>Eucalyptus paniculata</i>		<i>Juncus prismatocarpus</i>

Fauna noted: Pacific Black Duck, Eurasian Coot

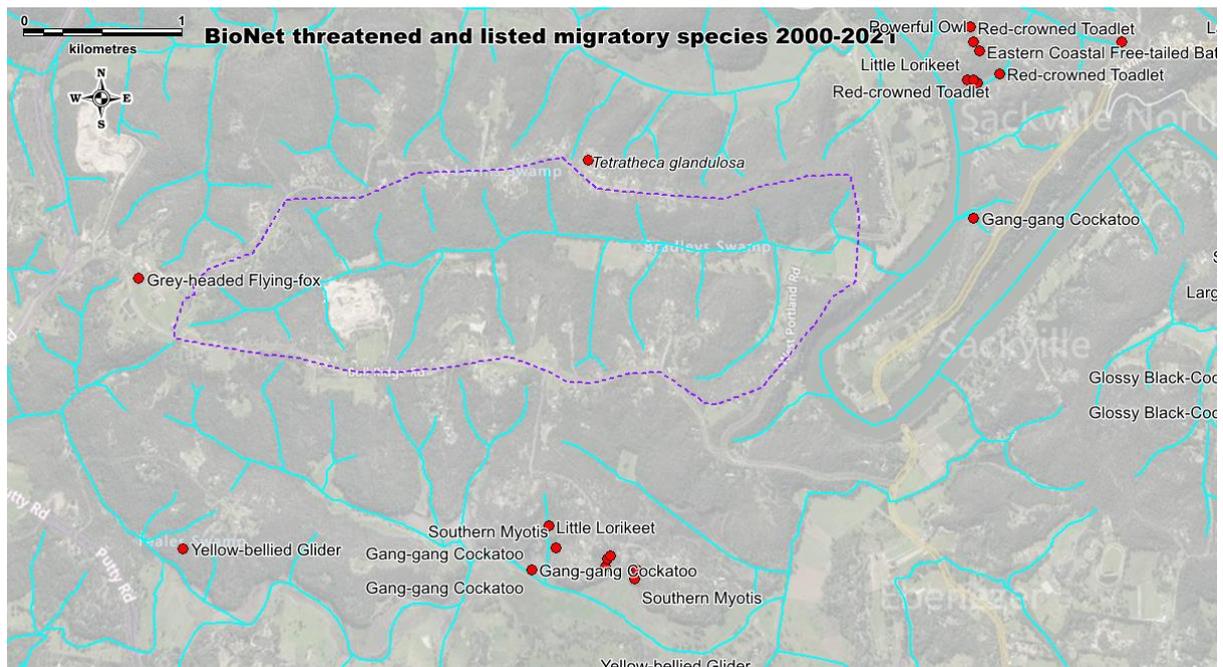
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	50-75
pasture/grazing	25-50
peri-urban mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					



IMAGE 1 Land management around the wetland includes irrigation of planted exotic trees

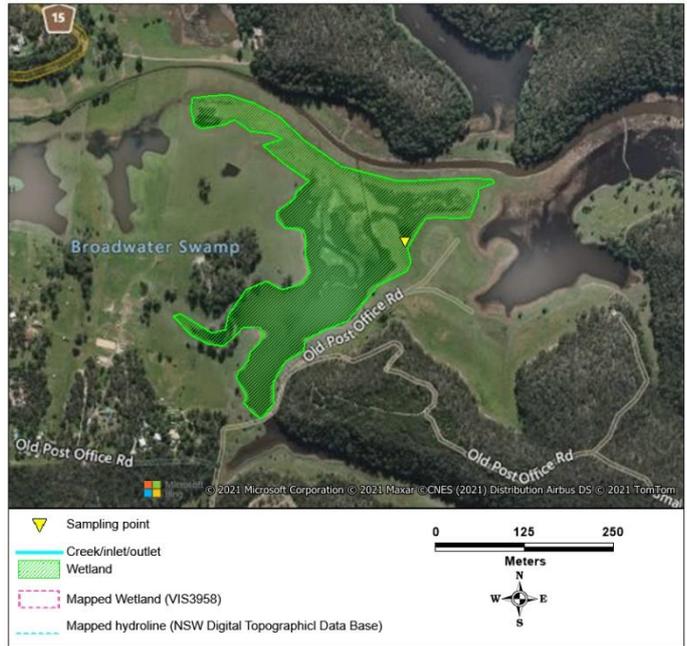
BROADWATER SWAMP

Overall Score (0-10) 5.8

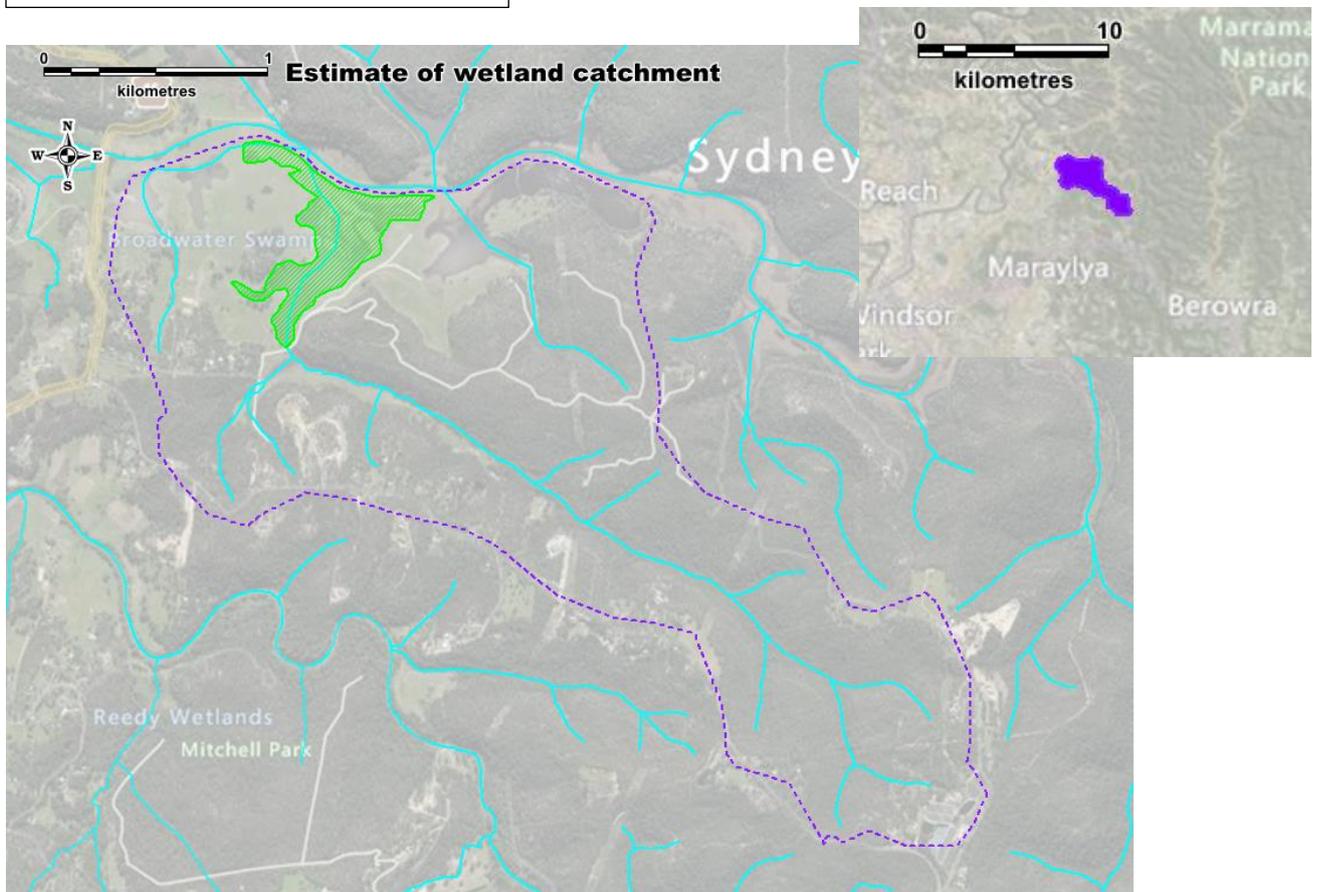
Latitude	██████████
Longitude	██████████
Address	Old Post Office Rd, Cattai
Catchment (ha)	513

Wetland category	natural
Water quality	poor
Site features Landuse	6.6
Site features offsite issues	9.1
Site features onsite issues	6.0
Vegetation	3.5
Habitat features -surrounds	6.3
Habitat features -wetland	6.2
Bank undercutting	10.0
Bank collapse	10.0

The wetland is a large shallow open water swamp that periodically floods and usually dries rapidly. Surrounding land use is mainly cleared for grazing, with a large forested area and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 1 Site 21/01/2021

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Cirsium vulgare</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Ludwigia peruviana</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Setaria viridis</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Xanthium occidentale</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Brassica fruticulosa</i>	<10
<i>Cynodon dactylon</i>	10-25

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Fence the wetland, restrict grazing, establish offline watering points

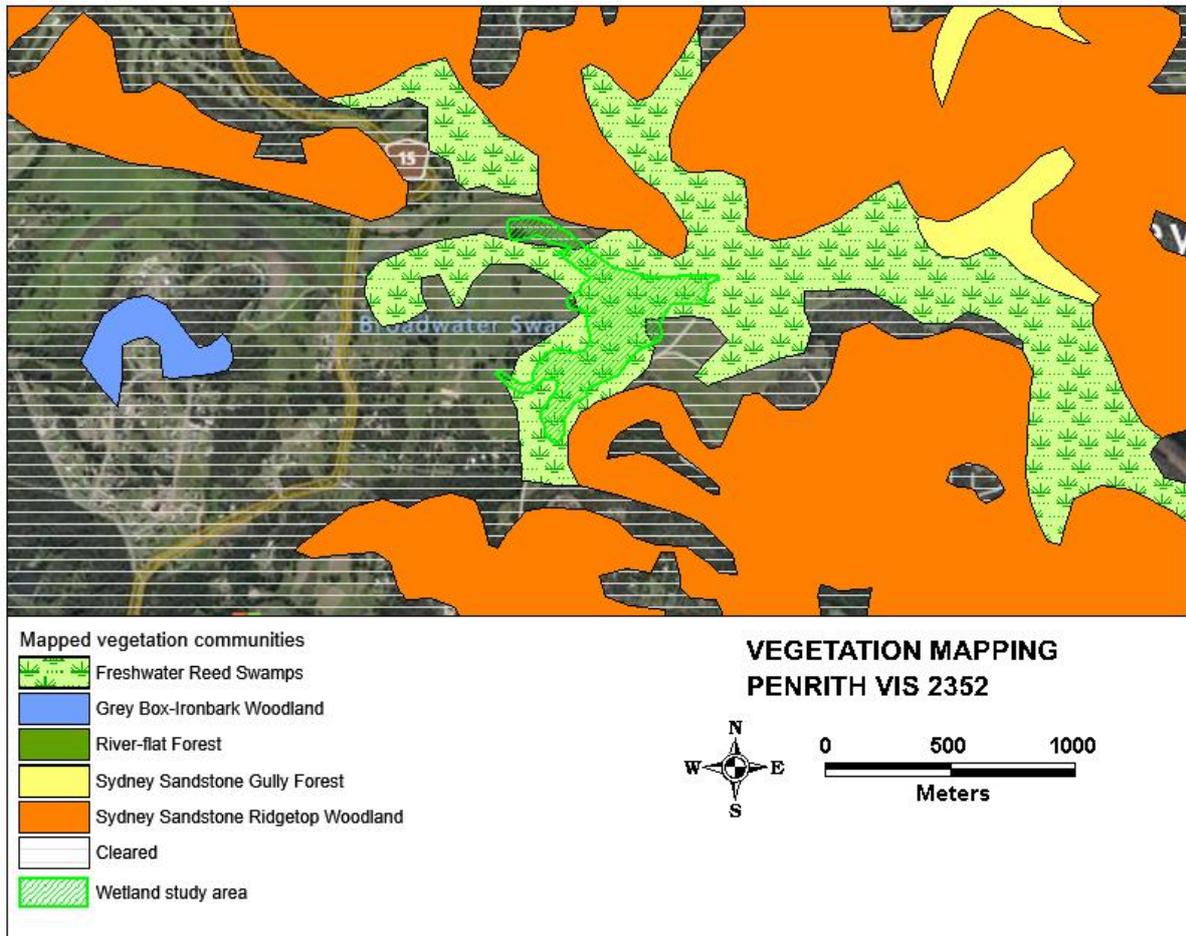
Priority weed

ASSETS 21/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
None noted		<i>Lachnagrostis filiformis</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
<i>Melaleuca linariifolia</i>		

Fauna noted: Pacific Black Duck, Eurasian Coot, Dusky Moorhen, Australian Wood Duck, Grey Teal, Little Black Cormorant, Australasian Grebe, Greylag Goose, Pekin Duck

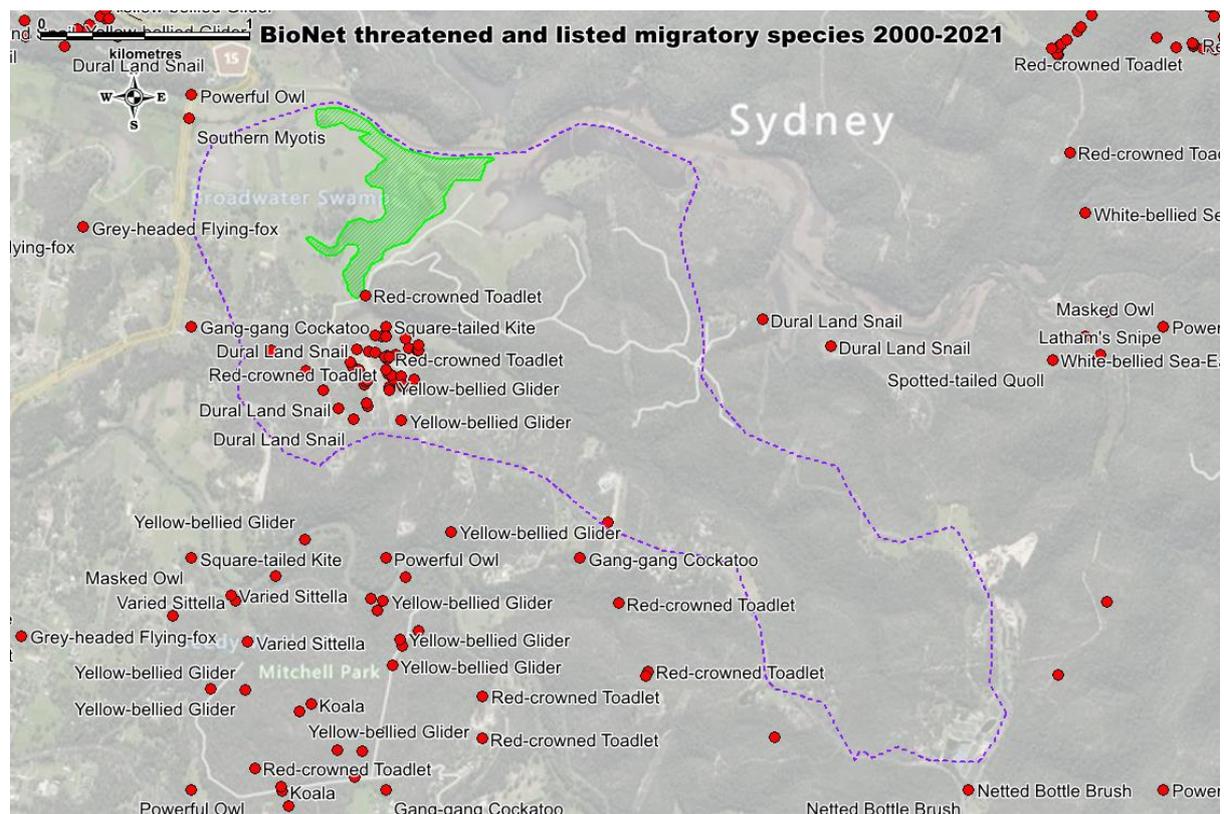
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	25-50
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Amphibia	Red-crowned Toadlet	<i>Pseudophryne australis</i>	V,P		3
Amphibia	Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V,P	V	1
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Latham's Snipe	<i>Gallinago hardwickii</i>	P	J,K	1
Aves	Barking Owl	<i>Ninox connivens</i>	V,P,3		1
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		5
Mammalia	Squirrel Glider	<i>Petaurus norfolkensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	2
Mammalia	Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	V,P		1
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		1
Mammalia	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V,P	V	2
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		2
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		2
Mammalia	Eastern Cave Bat	<i>Vespadelus troughtoni</i>	V,P		1
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		2
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		2

Gastropod a	Dural Land Snail	<i>Pommerhelix duralensis</i>	E1	E	29
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IMAGE 1 Broadwater Swamp catchment setting

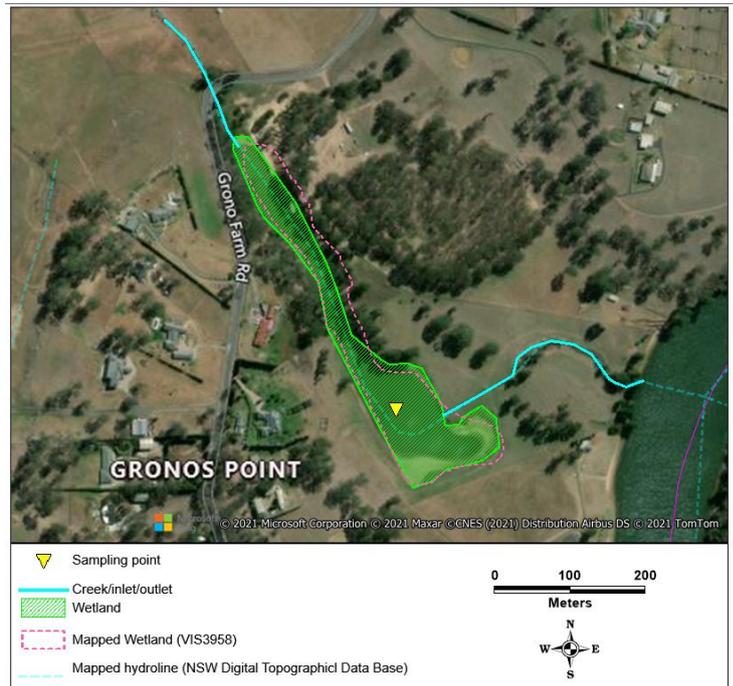
BROWNS LAGOON

Overall Score (0-10)

4.1

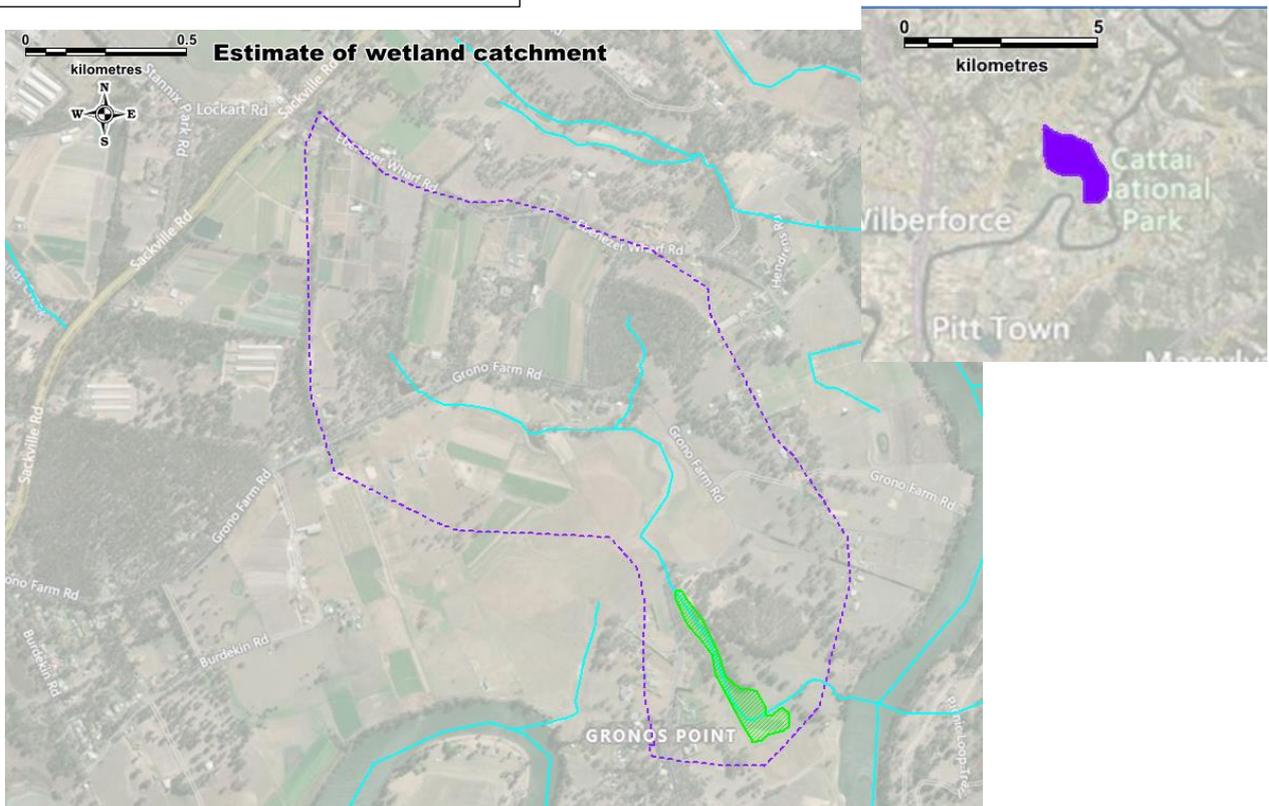
Latitude	██████
Longitude	██████
Address	Grono Farm Road, Wilberforce
Catchment (ha)	172

Wetland category	natural
Water quality	fair
Site features Landuse	5.3
Site features offsite issues	8.5
Site features onsite issues	2.4
Vegetation	3.0
Habitat features -surrounds	8.8
Habitat features -wetland	4.2
Bank undercutting	0.0
Bank collapse	0.0



Browns Lagoon has been modified through damming towards the discharge point, now breached, excavation and formalisation of banks, clearing of the lower half and grazing throughout. Small reedlands have been retained towards the creek outflow channel.

MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 21/12/2020: (left) the lower wetland has been cleared except for a small herbaceous reedland, (top right) grazing around upper wetland, (bottom right) formalised outflow channel

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Conyza sp.</i>	<10
<i>Cenchrus clandestinus</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Senecio madagascariensis</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Sida rhombifolia</i>	<10
<i>Ligustrum sinense</i>	<10
<i>Rubus fruticosus</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Fence wetland to prevent degradation and restrict grazing
- Install offline watering points and revegetate wetland banks

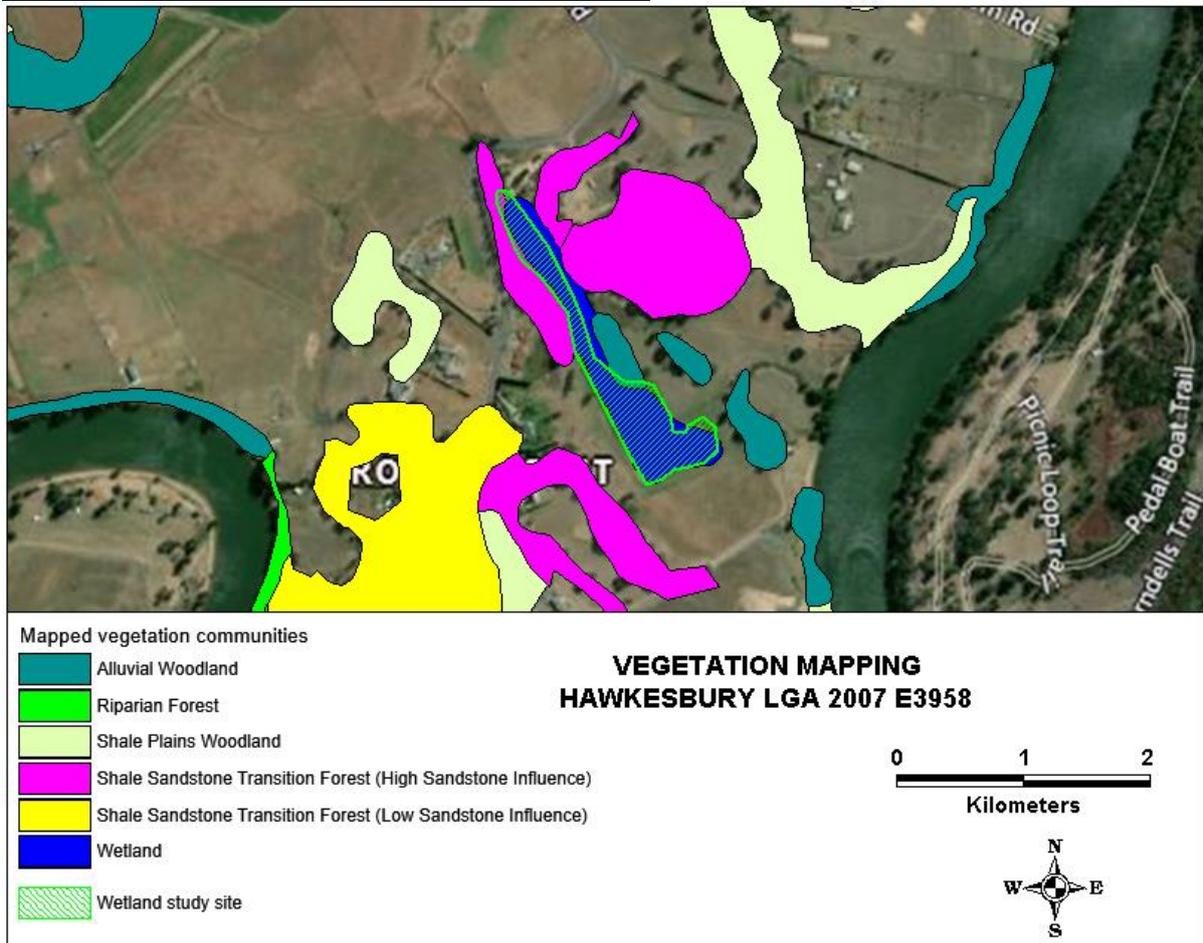
Priority weed

ASSETS 21/12/2020 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
None visible		<i>Lachnagrostis filiformis</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
<i>Melaleuca linariifolia</i>		

Fauna noted: Chestnut Teal, Welcome Swallow, Dusky Moorhen, Masked Lapwing, Superb Fairywren, Red-browed Finch, Eastern Water Dragon, Dusky Woodswallow, Eastern Water Dragon, Rainbow Bee-eater

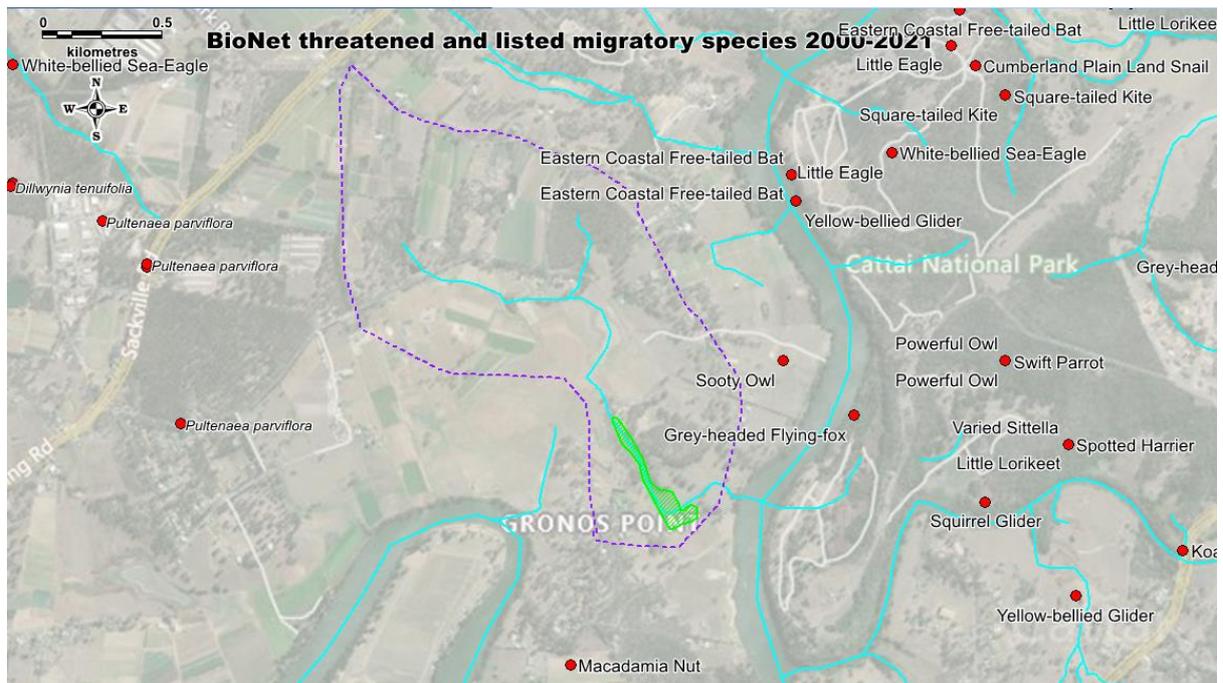
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	<10
pasture/grazing	>75
market gardens	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					

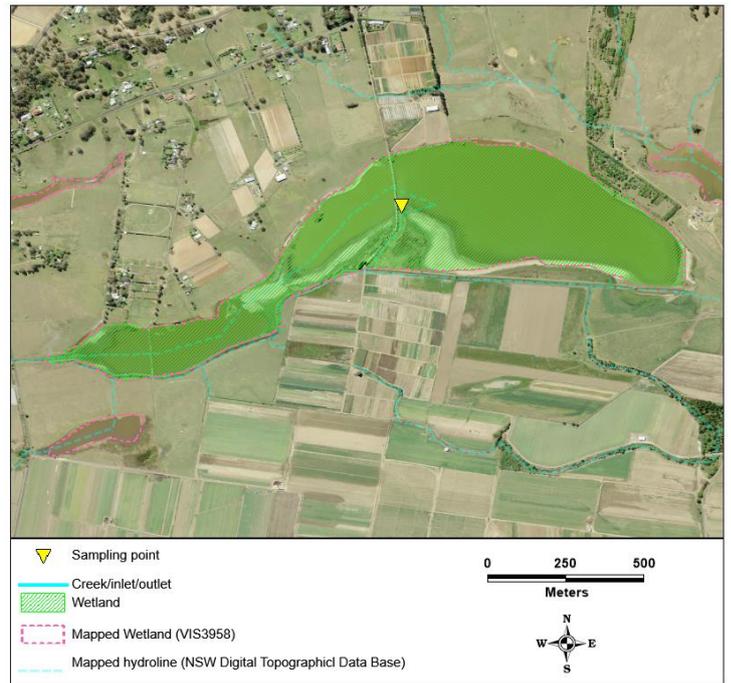
BUSHELLS LAGOON

Overall Score (0-10) 3.9

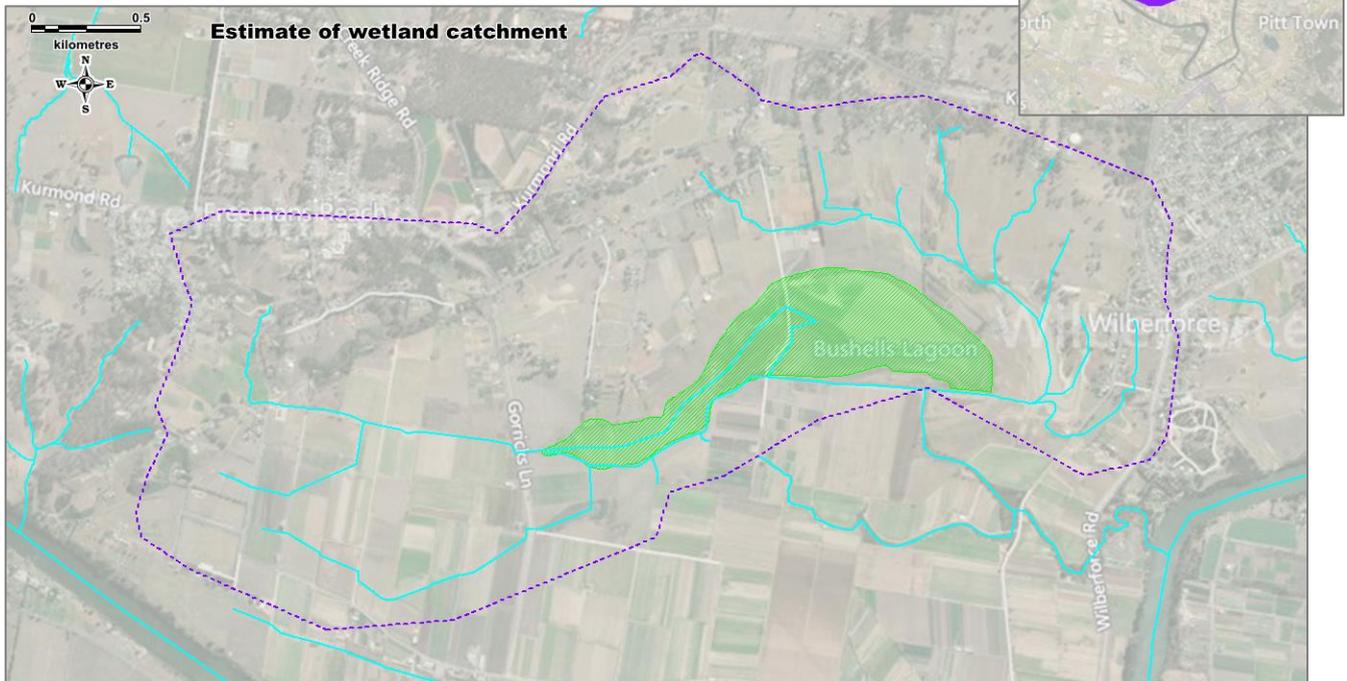
Latitude	██████
Longitude	██████
Address	Brewers Lane, Freemans Reach
Catchment (ha)	764

Wetland category	natural
Water quality	OK
Site features Landuse	2.3
Site features offsite issues	6.5
Site features onsite issues	0.4
Vegetation	3.8
Habitat features -surrounds	8.8
Habitat features -wetland	5.8
Bank undercutting	0.0
Bank collapse	0.0

This is a very large open water wetland with areas of fringing macrophyte vegetation, especially along the southern banks where it provides important habitat. The surrounding area has a complex mosaic of land uses, including market gardens, turf growing, grazing and peri-urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location

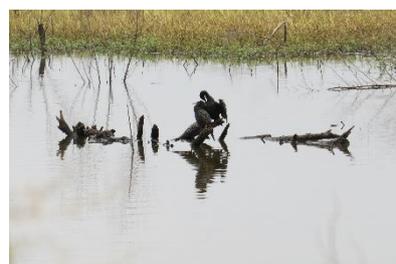


IMAGE 1 Site 04/02/2021

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	Nil
WEED SPECIES (TOP 10)	DENSITY
<i>Alternanthera philoxeroides</i>	10-25
<i>Cenchrus clandestinus</i>	10-25
<i>Ricinus communis</i>	<10
<i>Ulmus parviflora</i>	<10
<i>Araujia sericifera</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Lactuca serriola</i>	<10
<i>Solanum nigrum</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Conyza sp.</i>	<10

Recommended works:

- Encourage the establishment of offline watering points and fence the wetland
- Educate market gardeners and turf farmers in the values of low fertiliser farming
- Weed control required for priority control weeds
- Fence and revegetate perimeter areas with appropriate local provenance species for this vegetation community

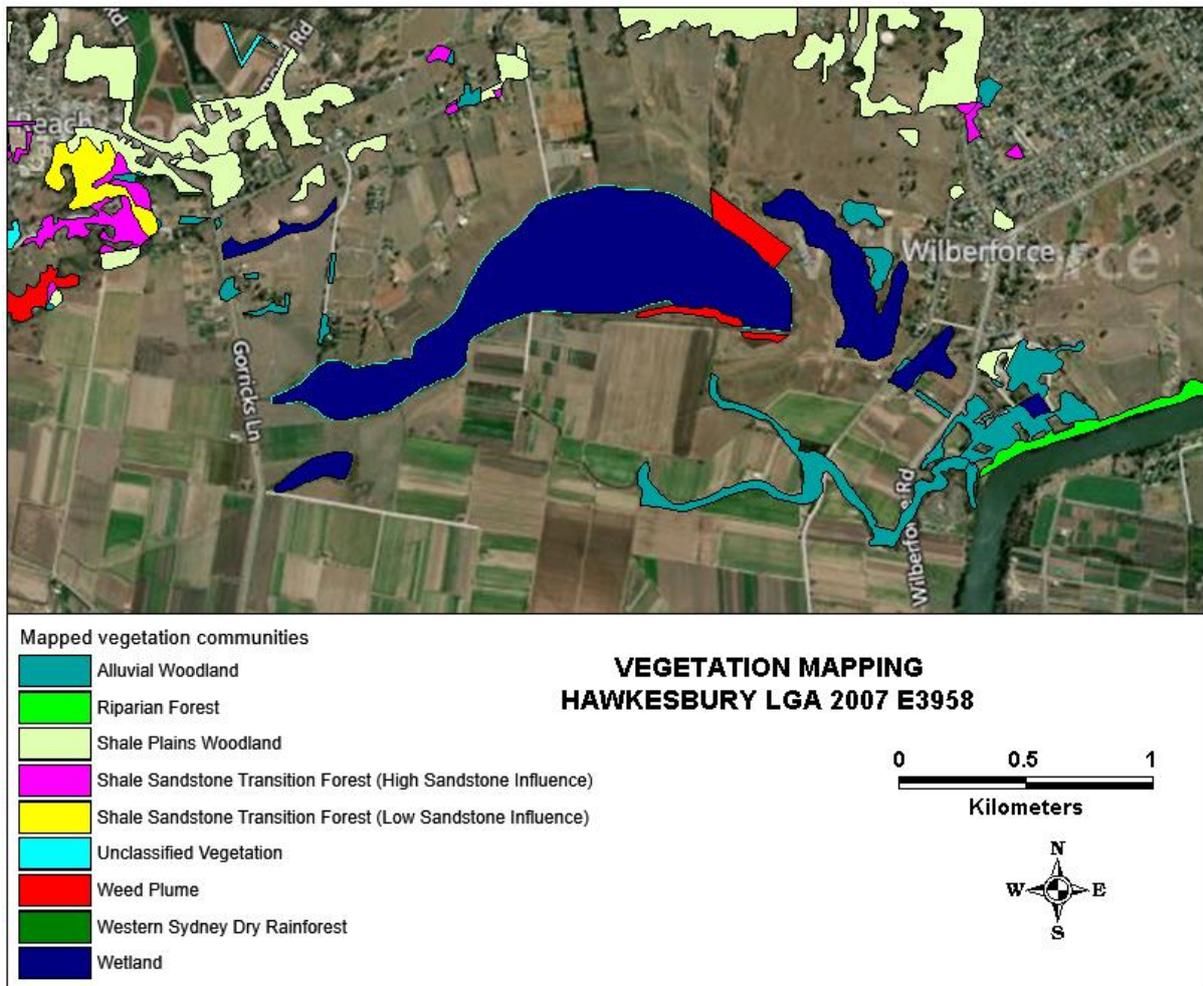
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Typha orientalis</i>	<10	
<i>Phragmites australis</i>	<10	
<i>Myriophyllum aquaticum</i>	<10	
<i>Persicaria decipiens</i>	<10	
Other native vegetation		Ground covers
Trees	Shrubs	<i>Centella asiatica</i>
<i>Casuarina glauca</i>	<i>Callistemon citrinus</i>	<i>Juncus usitatus</i>
<i>Eucalyptus amplifolia</i>	<i>Persicaria decipiens</i>	<i>Velleia lyrata</i>
<i>Eucalyptus tereticornis</i>	<i>Persicaria sp.</i>	<i>Hydrocotyle tripartita</i>
<i>Melia azedarach</i>		

Fauna noted: Sydney Basin Short-necked Turtle, Cattle Egret, Australian Pelican, Australian Reed Warbler, Black Swan, Chestnut Teal, Eurasian Coot, Eastern Great Egret, Great Crested Grebe, Intermediate Egret, Little Black Cormorant, Little Pied Cormorant, Magpie-lark, Masked Lapwing, Pacific Black Duck, Pied Stilt, White-faced Heron

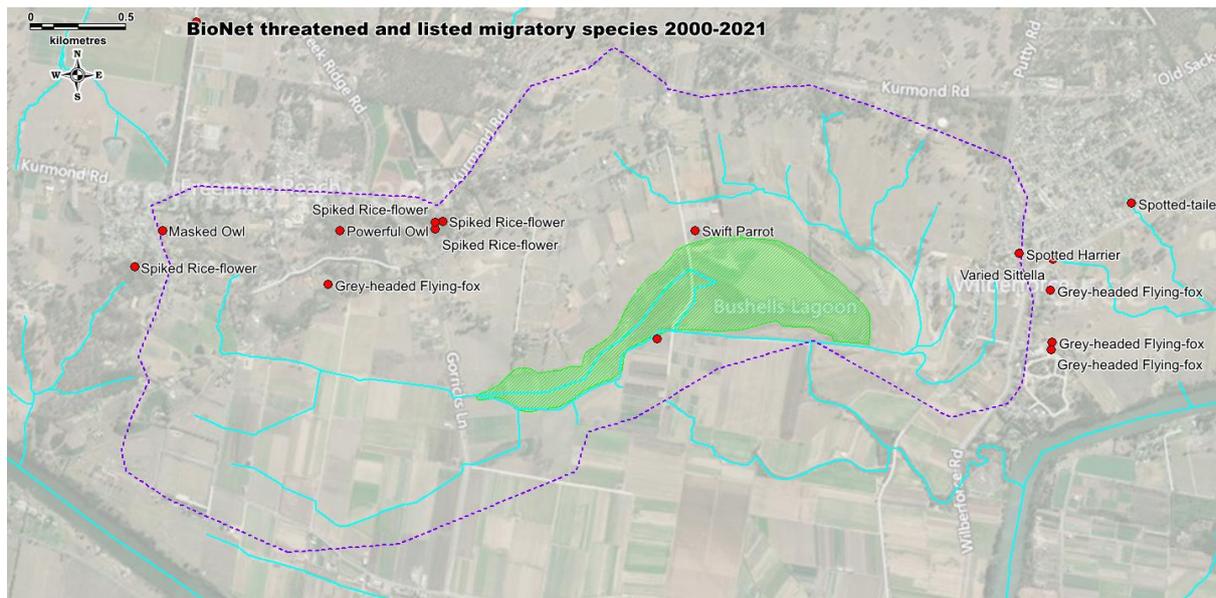
VEGETATION MAPPING AND LAND USE

Observed land use	%
Pasture/Grazing	25-50
Market Gardens	50-75
Peri-Urban Mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Spotted Harrier	<i>Circus assimilis</i>	V,P		1
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	1
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		1
Aves	Masked Owl	<i>Tyto novaehollandiae</i>	V,P,3		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	1
Flora		<i>Tetradlea glandulosa</i>	V		1
Flora	Spiked Rice-flower	<i>Pimelea spicata</i>	E1	E	3

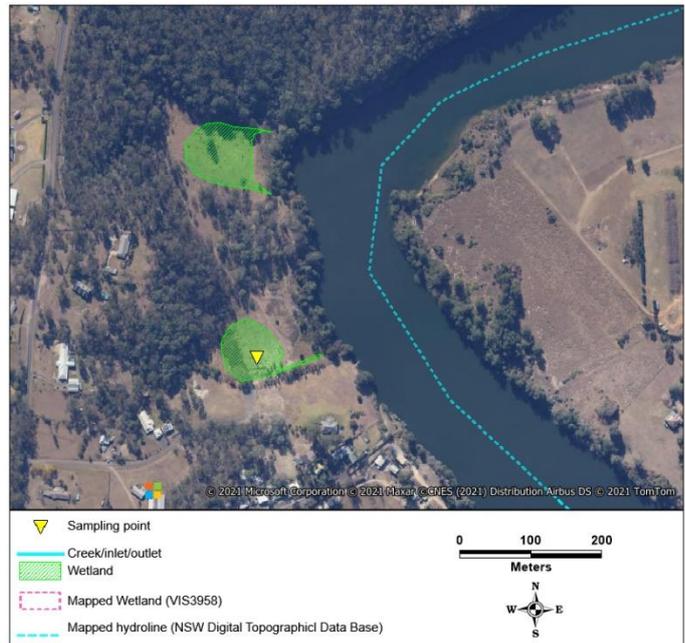
CHARLES KEMP RESERVE

Overall Score (0-10)

7.3

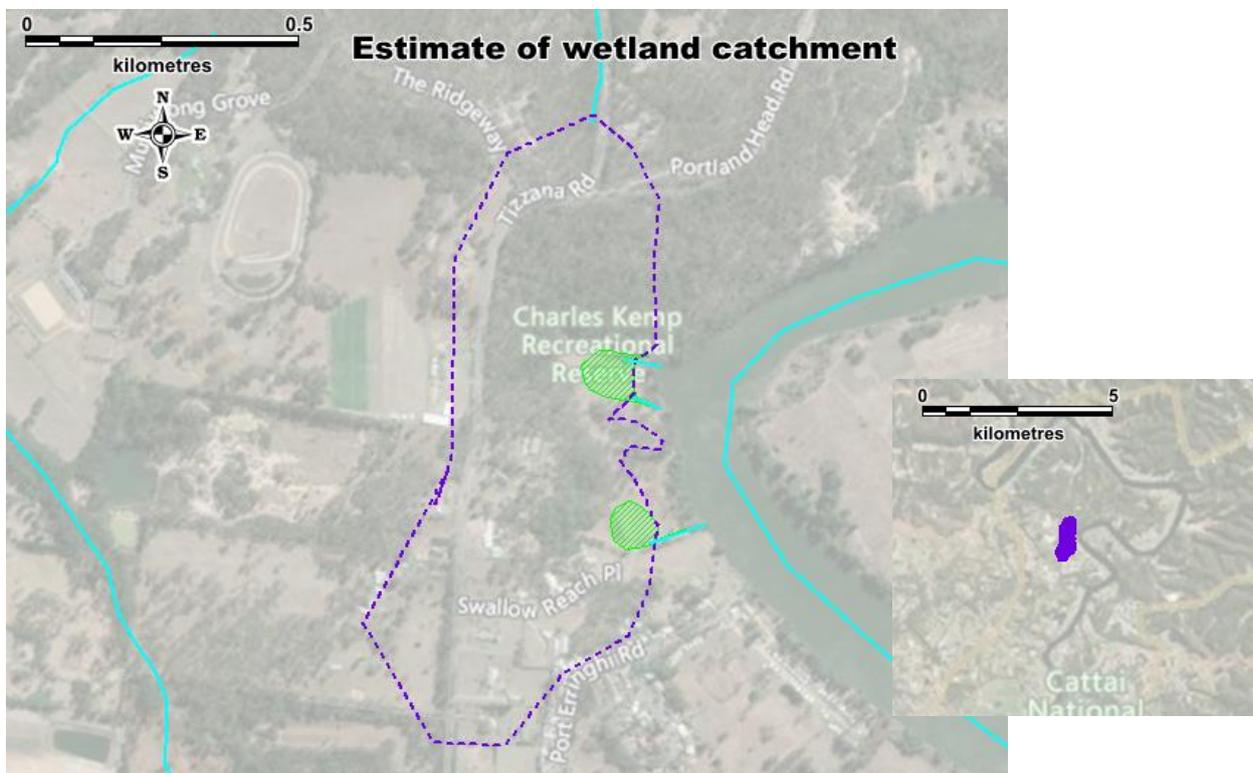
Latitude	-33.514806
Longitude	150.896652
Address	Swallow Reach Place, Ebenezer
Catchment (ha)	39

Wetland category	natural modified
Water quality	No testing
Site features Landuse	10.0
Site features offsite issues	7.1
Site features onsite issues	10.0
Vegetation	5.8
Habitat features -surrounds	7.5
Habitat features -wetland	5.3
Bank undercutting	10.0
Bank collapse	10.0



Charles Kemp Reserve has two detention basins. The northern basin is usually dry, while the southern basin has a damp sedge swamp that connects to the river via a drainage swale. Both basins are surrounded by regenerating bushland, and weeds.

MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 15/02/2021: (left) sedge swamp in southern basin, (top right) dry northern basin, (bottom right) ephemeral outflow from southern basin, (below) Lewins Honeyeater in reveg

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Antisocial activities including motorbikes, 4WDs, littering and dumping	
WEED SPECIES (TOP 10)	DENSITY
<i>Sida rhombifolia</i>	<10
<i>Cenchrus clandestinus</i>	<10
<i>Conyza sp.</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Araujia sericifera</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Bidens pilosa</i>	<10
<i>Bromus catharticus</i>	<10
<i>Lantana camara</i>	<10
<i>Eragrostis curvula</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Revegetate banks to improve habitat resources

Priority weed



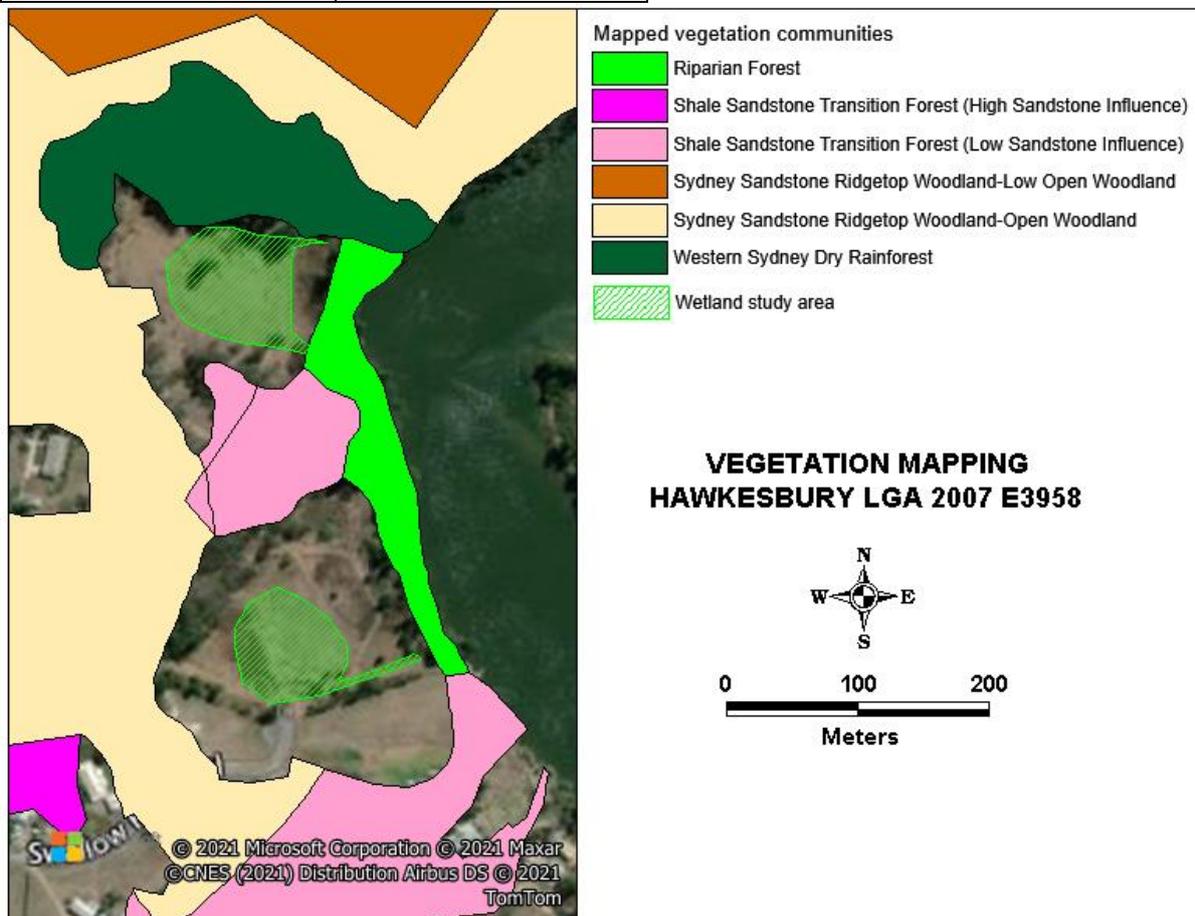
ASSETS 15/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Nil</i>		<i>Microlaena stipoides</i>
		<i>Lachnagrostis filiformis</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Angophora floribunda</i>	<i>Acacia decurrens</i>	<i>Centella asiatica</i>
<i>Eucalyptus amplifolia</i>	<i>Acacia longifolia</i>	<i>Juncus usitatus</i>
<i>Melaleuca decora</i>	<i>Callistemon citrinus</i>	<i>Carex appressa</i>

Fauna noted:

Laughing Kookaburra, Bell Miner, Lewin's Honeyeater

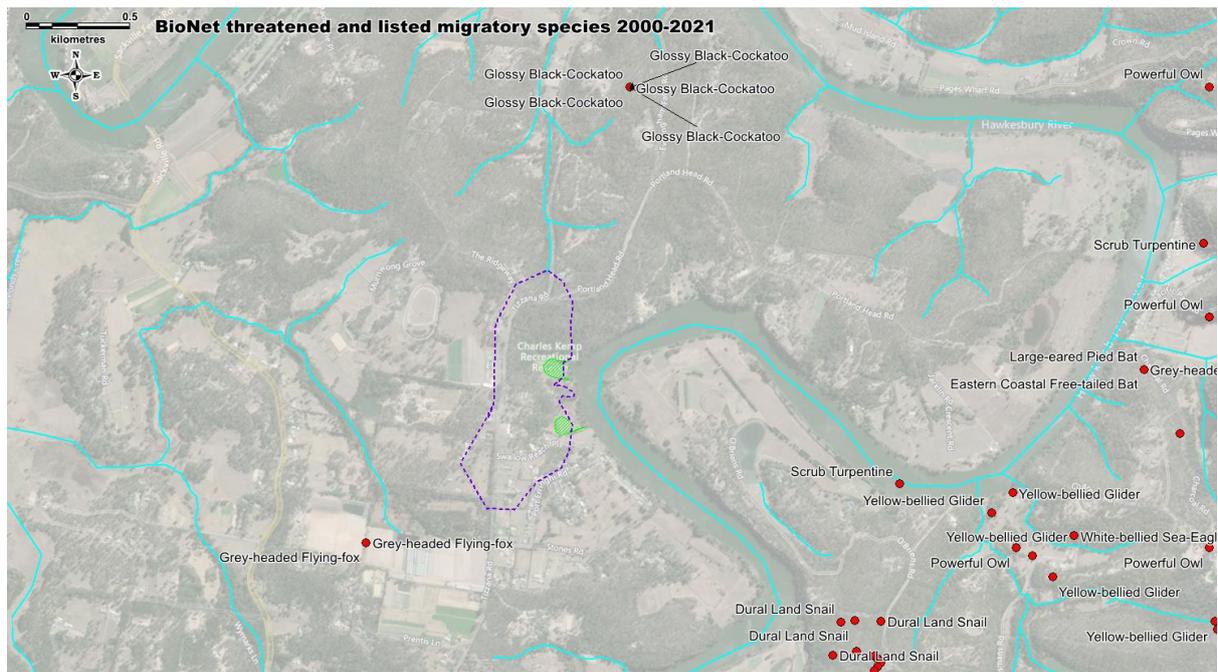
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75
residential	10-25



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					

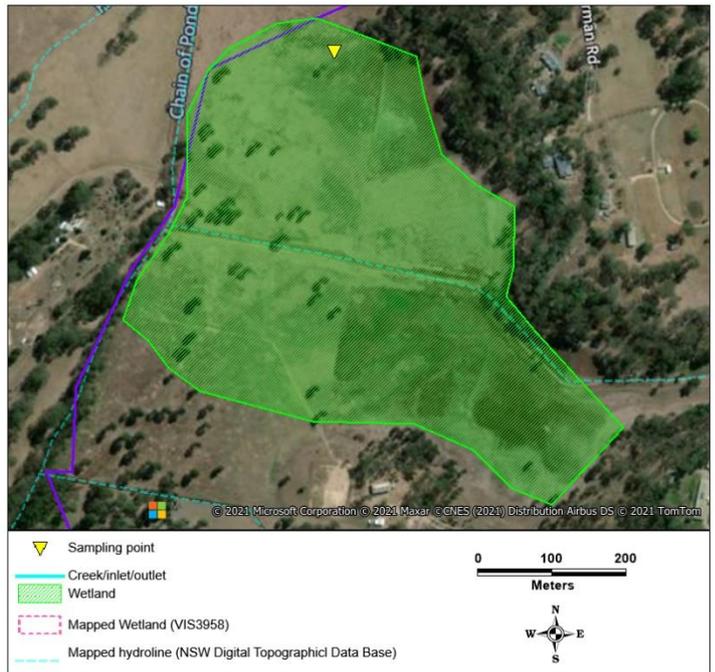
CURRENCY WETLAND

Overall Score (0-10) 6.6

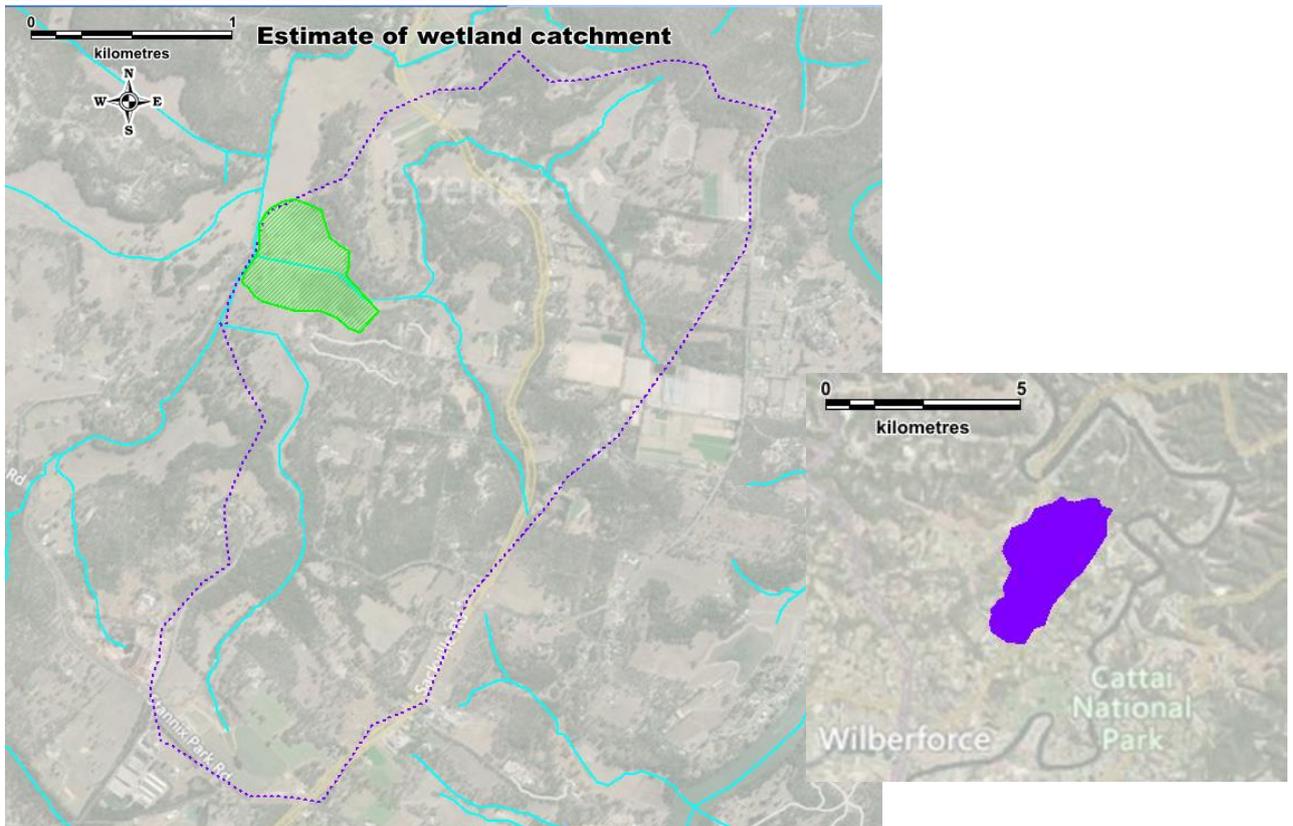
Latitude	██████
Longitude	██████
Address	Tuckerman Road Ebenezer
Catchment (ha)	610

Wetland category	natural
Water quality	No testing
Site features Landuse	5.3
Site features offsite issues	9.0
Site features onsite issues	8.0
Vegetation	4.3
Habitat features -surrounds	10.0
Habitat features -wetland	6.2
Bank undercutting	10.0
Bank collapse	10.0

Currency Wetland is located on a minor tributary of Chain of Ponds Creek and consists of a floodplain which is infrequently inundated during moderate to major flooding events. Large areas have been cleared for grazing etc, but some ephemeral wetland vegetation persists in patches.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 07/02/2021: (left) Pink flowering *Persicaria* species are typical of ephemeral wetlands, (top right) view west towards Chain of Ponds Creek, (bottom right) formalised outflow channel looking west

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum dilatatum</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Persicaria maculosa</i>	<10
<i>Echinochloa crus-galli</i>	<10
<i>Conyza sp.</i>	<10
<i>Brassica fruticulosa</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Chloris gayana</i>	<10
<i>Hypochaeris radicata</i>	<10
<i>Cynodon dactylon</i>	<10

Recommended works:

- Control of environmental weeds to prevent spread to downstream areas
- Restrict grazing, establish offline watering points where appropriate, revegetate banks and channel surrounds

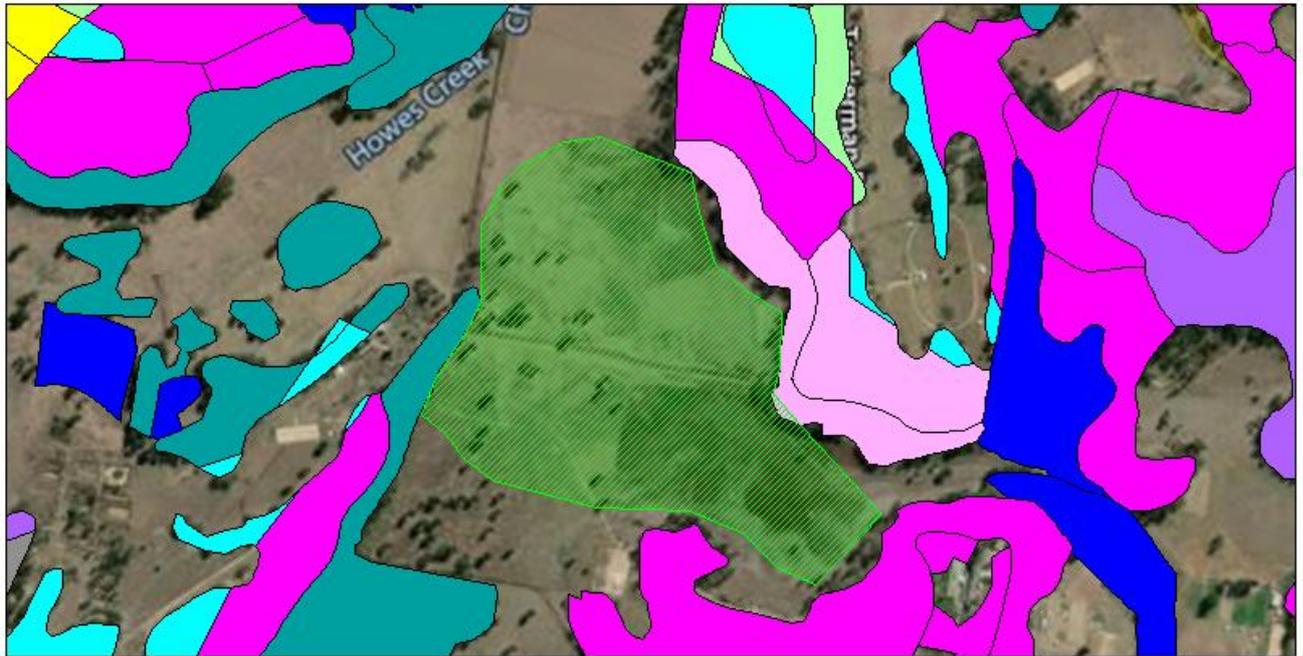
Priority weed – none noted

ASSETS 07/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Persicaria decipiens</i>	25-50	<i>Lachnagrostis filiformis</i>
		<i>Digitaria parviflora</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
		<i>Juncus usitatus</i>
		<i>Hydrocotyle tripartita</i>
		<i>Alternanthera denticulata</i>

Fauna noted: Golden-headed Cisticola, Brown Quail, Sacred Kingfisher, White-faced heron, Green Tree Frog, Striped Marsh Frog

VEGETATION MAPPING AND LAND USE

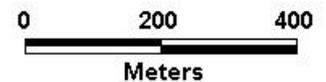
Observed land use	%
bushland	25-50
pasture/grazing	25-50



Mapped vegetation communities

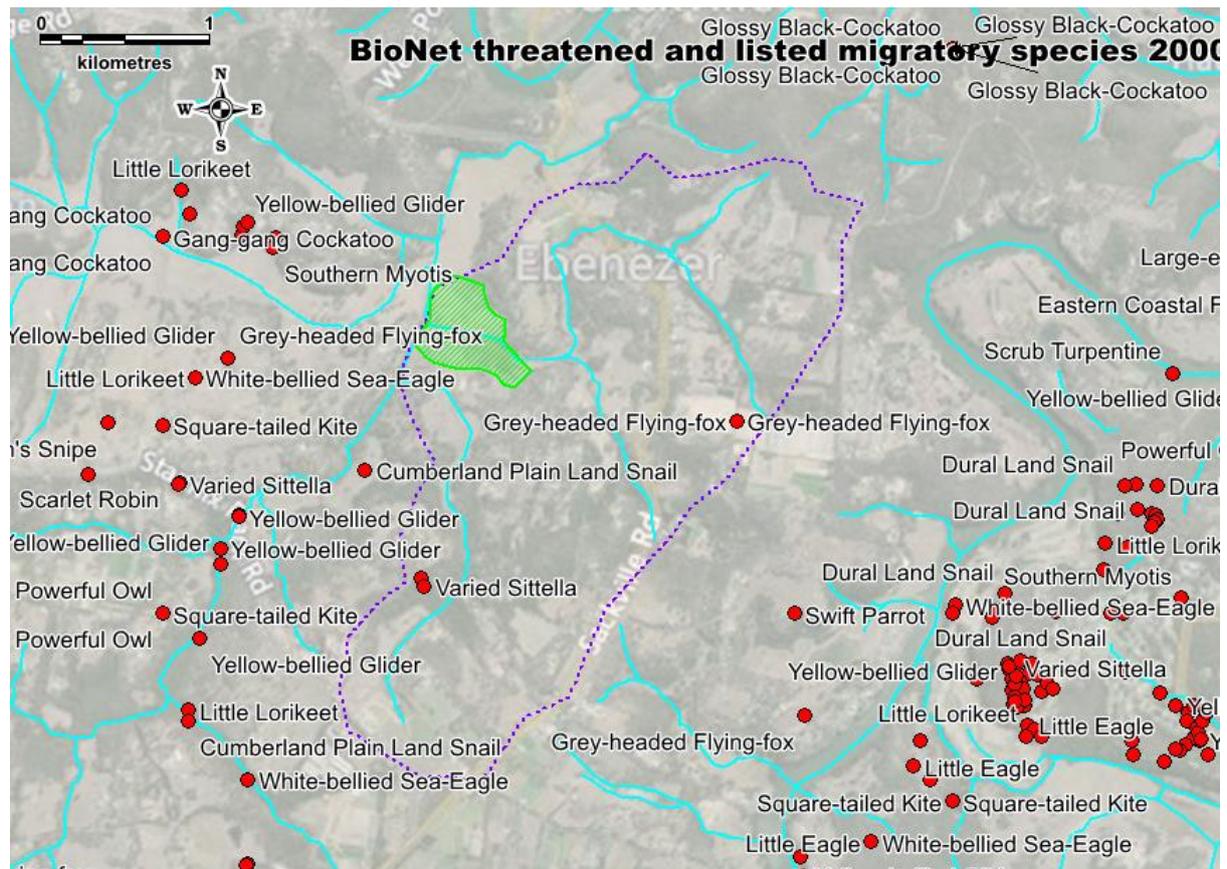
-  Alluvial Woodland
-  Floodplain Woodland (Roberts 1999)
-  Shale Sandstone Transition Forest (High Sandstone Influence)
-  Shale Sandstone Transition Forest (Low Sandstone Influence)
-  Sydney Sandstone Ridgetop Woodland
-  Sydney Sandstone Ridgetop Woodland-Low Open Woodland
-  Transition Woodland (Roberts 1999)
-  Unclassified Vegetation
-  Upper Georges River Sandstone Woodland
-  Wetland
-  Woodland (Roberts 1999)
-  Wetland study area

**VEGETATION MAPPING
HAWKESBURY LGA 2007 E3958**



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	2
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		1

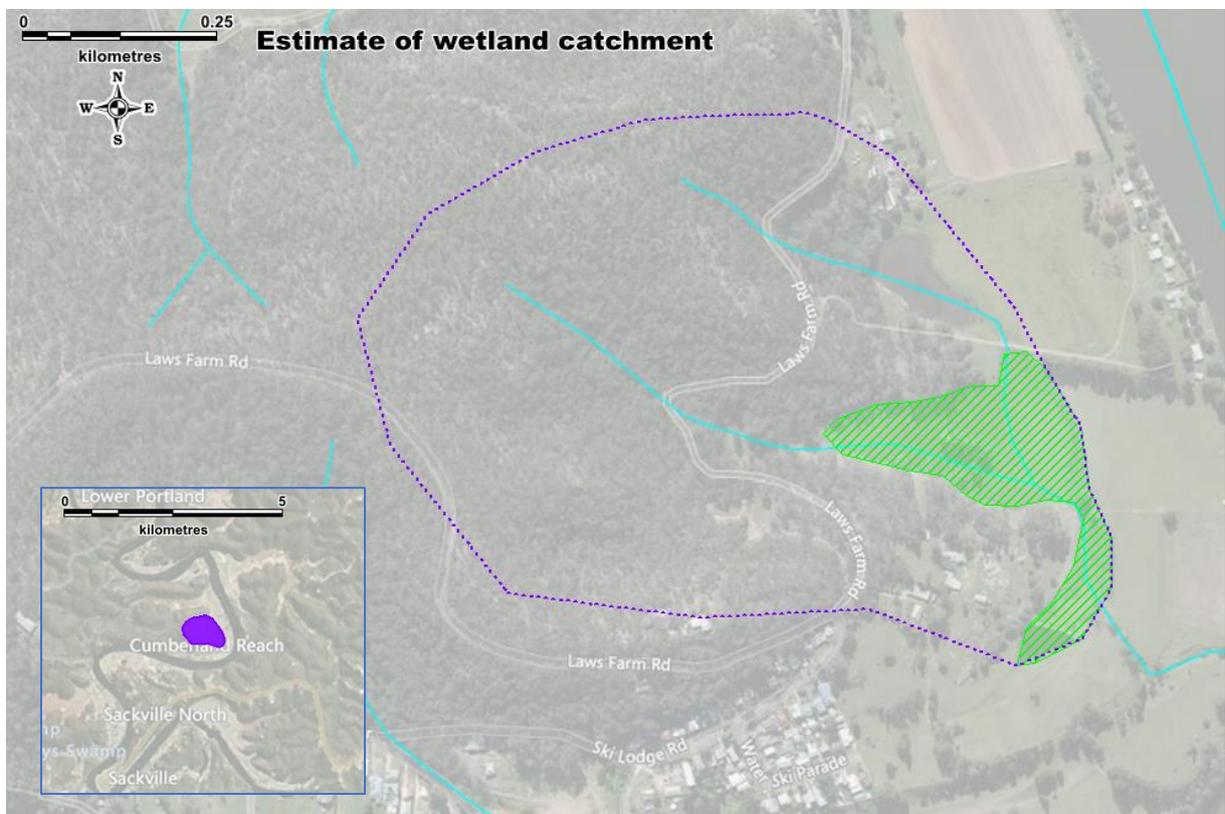
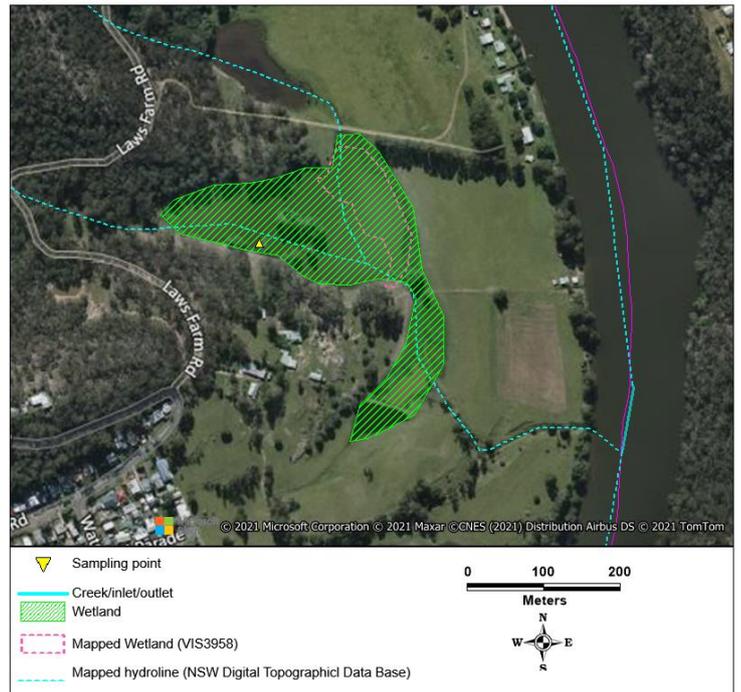
DEEP LAGOON

Overall Score (0-10) 6.6

Latitude	██████████
Longitude	██████████
Address	Laws Farm Road, Lower Portland
Catchment (ha)	49

Wetland category	natural	modified
Water quality		fair
Site features Landuse		6.3
Site features offsite issues		9.5
Site features onsite issues		3.0
Vegetation		7.9
Habitat features -surrounds		5.0
Habitat features -wetland		6.2
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a mostly shallow open water lagoon with several small islands constructed for habitat. Surrounding land use is partly forested and predominantly cleared for pasture and peri urban residential development. The wetland periodically dries out almost completely.



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 29/01/2021: (left) the lagoon has several small islands for bird habitat, (top right) the upper edge has forest remnants, (bottom right) the lower end is open water surrounded by sedges and is largely cleared

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Eragrostis curvula</i>	25-50
<i>Bryophyllum delagoense</i>	<10
<i>Cynodon dactylon</i>	25-50
<i>Conyza sp.</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Ludwigia peruviana</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control of environmental weeds to prevent spread to downstream areas
 - Fence off the wetland, restrict access by stock, establish offline watering points

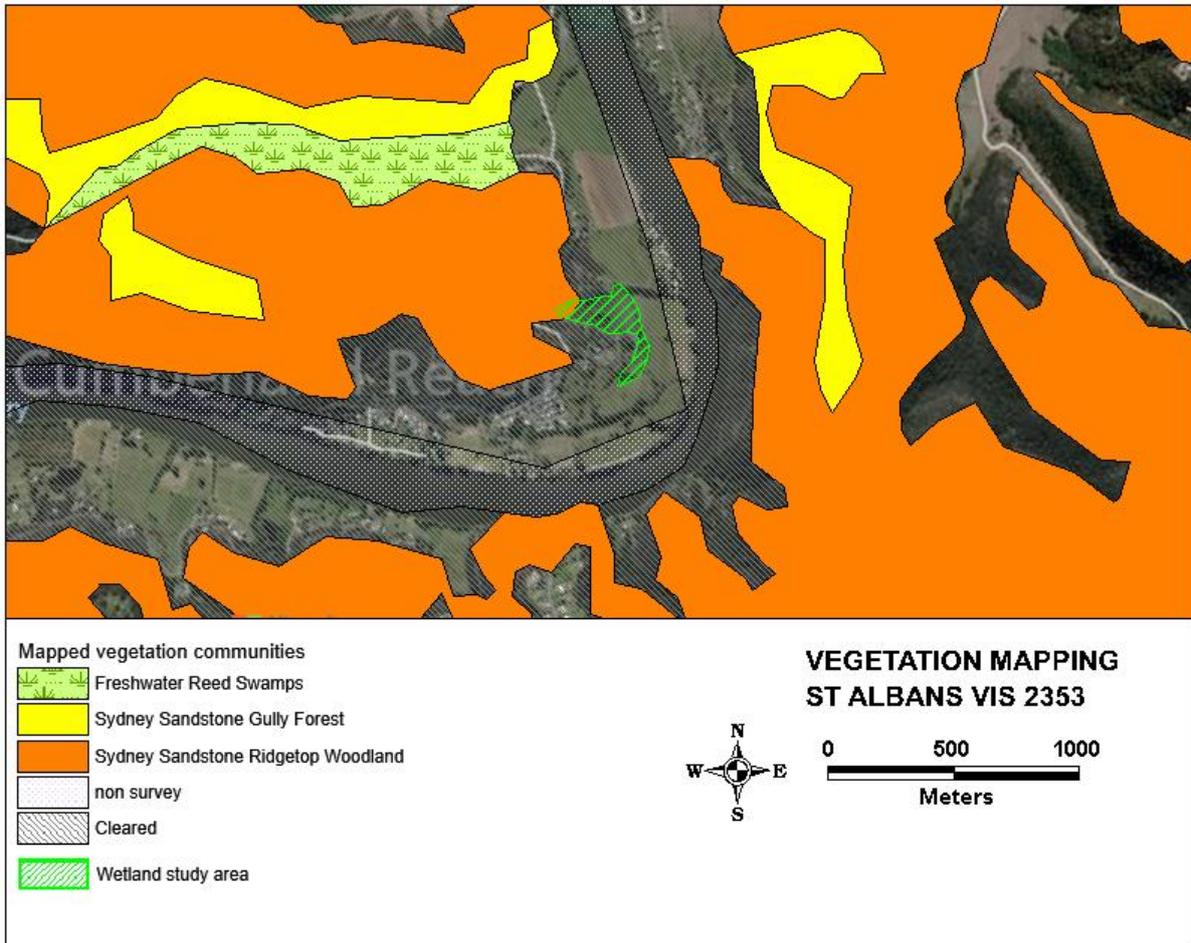
Priority weed

ASSETS 29/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Azolla spp.</i>	25-50	<i>Microlaena stipoides</i>
<i>Eleocharis sp</i>	<10	<i>Lachnagrostis filiformis</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Persicaria lapathifolia</i>	<i>Juncus usitatus</i>
<i>Eucalyptus amplifolia</i>		<i>Carex appressa</i>

Fauna noted: Australasian Darter, Australian Wood Duck, Pacific Black Duck, Black Swan, Little Pied Cormorant, Dusky Moorhen, Pelican, European Carp, cattle and horses

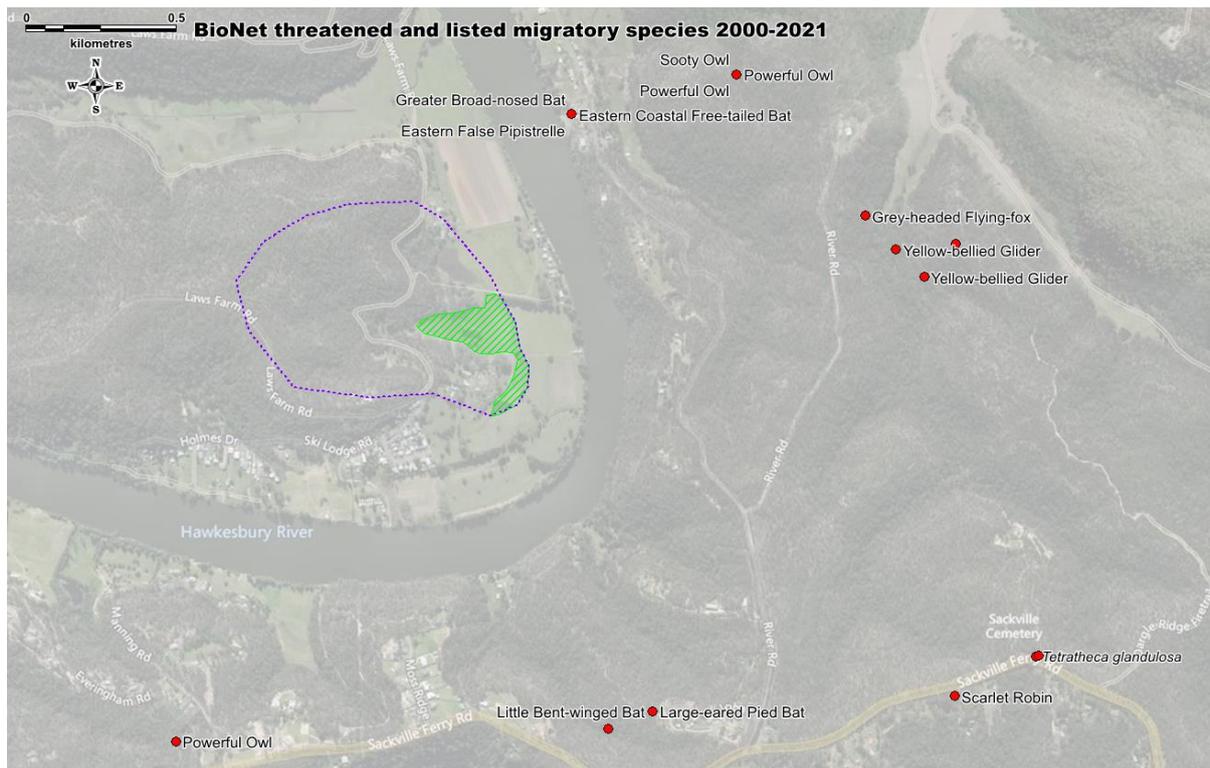
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	10-25
pasture/grazing	>75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					



IMAGE 1 A fallen tree provides great roosting habitat for Australian Wood Ducks and Little Pied Cormorants



IMAGE 2 Pacific Black Ducks perch in the shallows watching a Dusky Moorhen foraging



IMAGE 3 Black Swan and Pacific Black Duck foraging

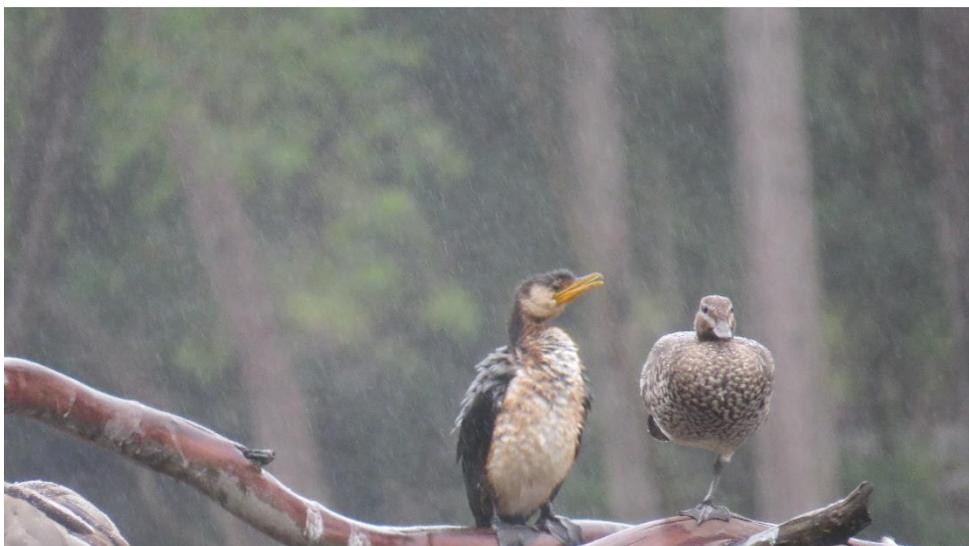


IMAGE 4 Little Pied Cormorant and juvenile Australian Wood Duck perching together

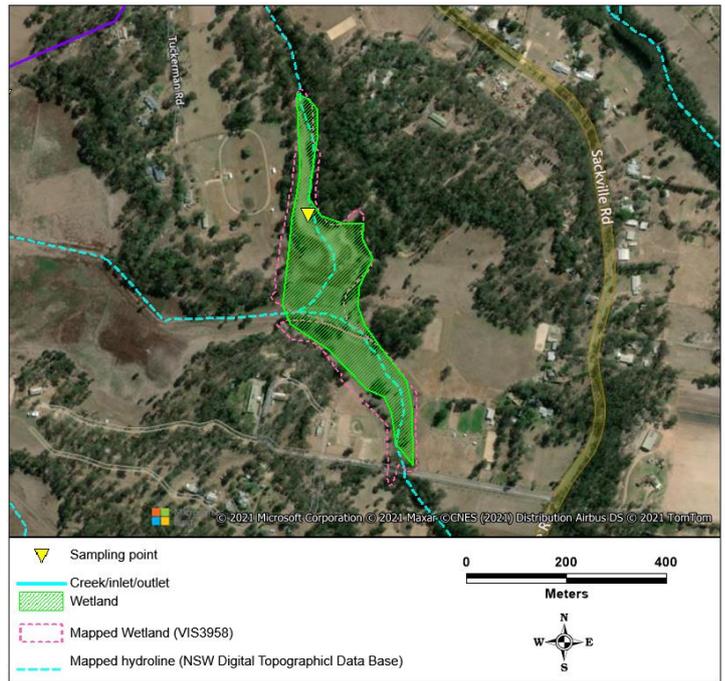
HALLS SWAMP

Overall Score (0-10) 6.9

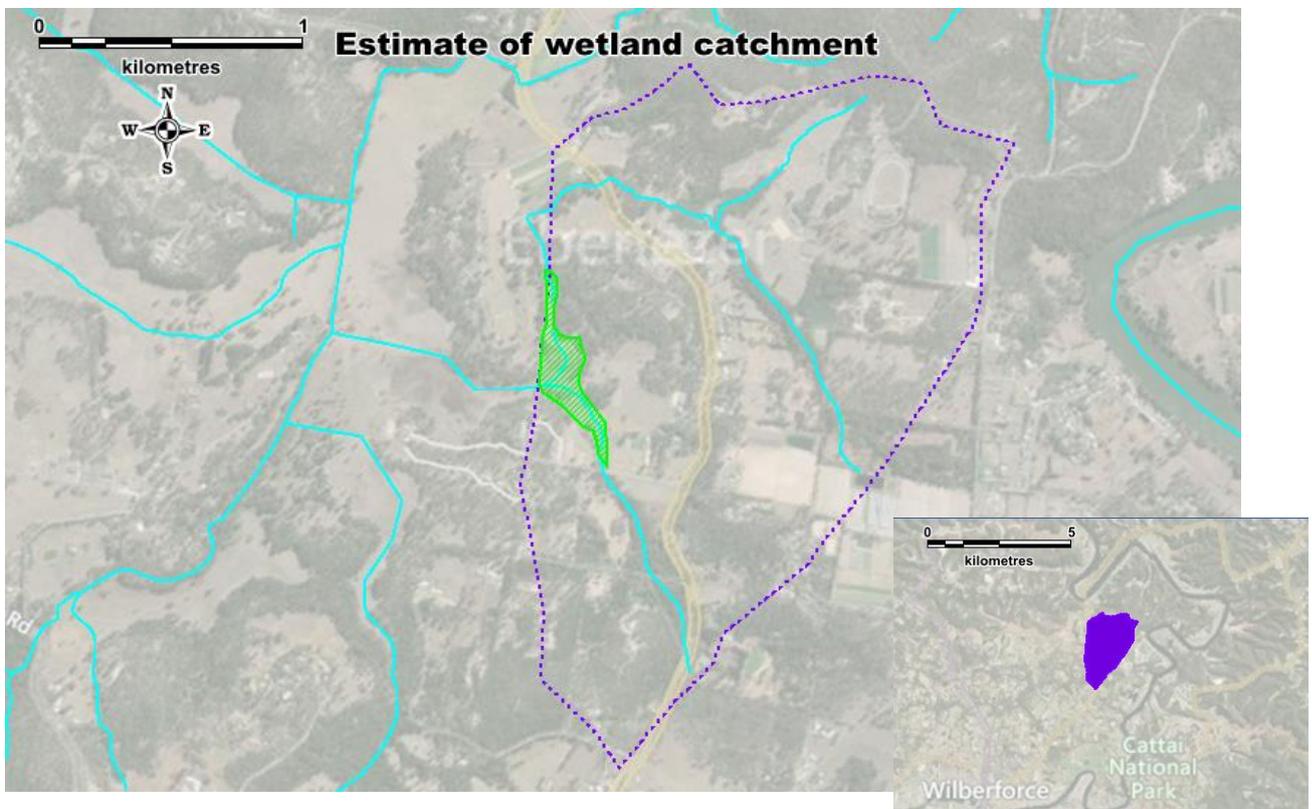
Latitude	██████
Longitude	██████
Address	Tuckerman Road Ebenezer
Catchment (ha)	305

Overall Score (0-10)	6.9
Wetland category	natural modified
Water quality	fair
Site features Landuse	5.3
Site features offsite issues	8.0
Site features onsite issues	8.0
Vegetation	6.0
Habitat features -surrounds	10.0
Habitat features -wetland	6.2
Bank undercutting	5.0
Bank collapse	10.0

This wetland is a well vegetated sedge swamp surrounded by forested wetland that floods rapidly and dries down to a low flow channel of connected ponds. Surrounding land use is mainly forested with small areas of pasture and peri urban development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 21/12/2020 & 29/1/21: (left) ponded channel mid swamp, (top right) upper ponds are impacted by turf farming upstream, (bottom right) lower swamp is permanently wet

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Alternanthera philoxeroides</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Cenchrus clandestinus</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Ulmus parviflora</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Ricinus communis</i>	<10
<i>Conyza sp.</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Araujia sericifera</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Maintain existing overall good condition
- Mitigate impacts from turf farming and other upstream activities

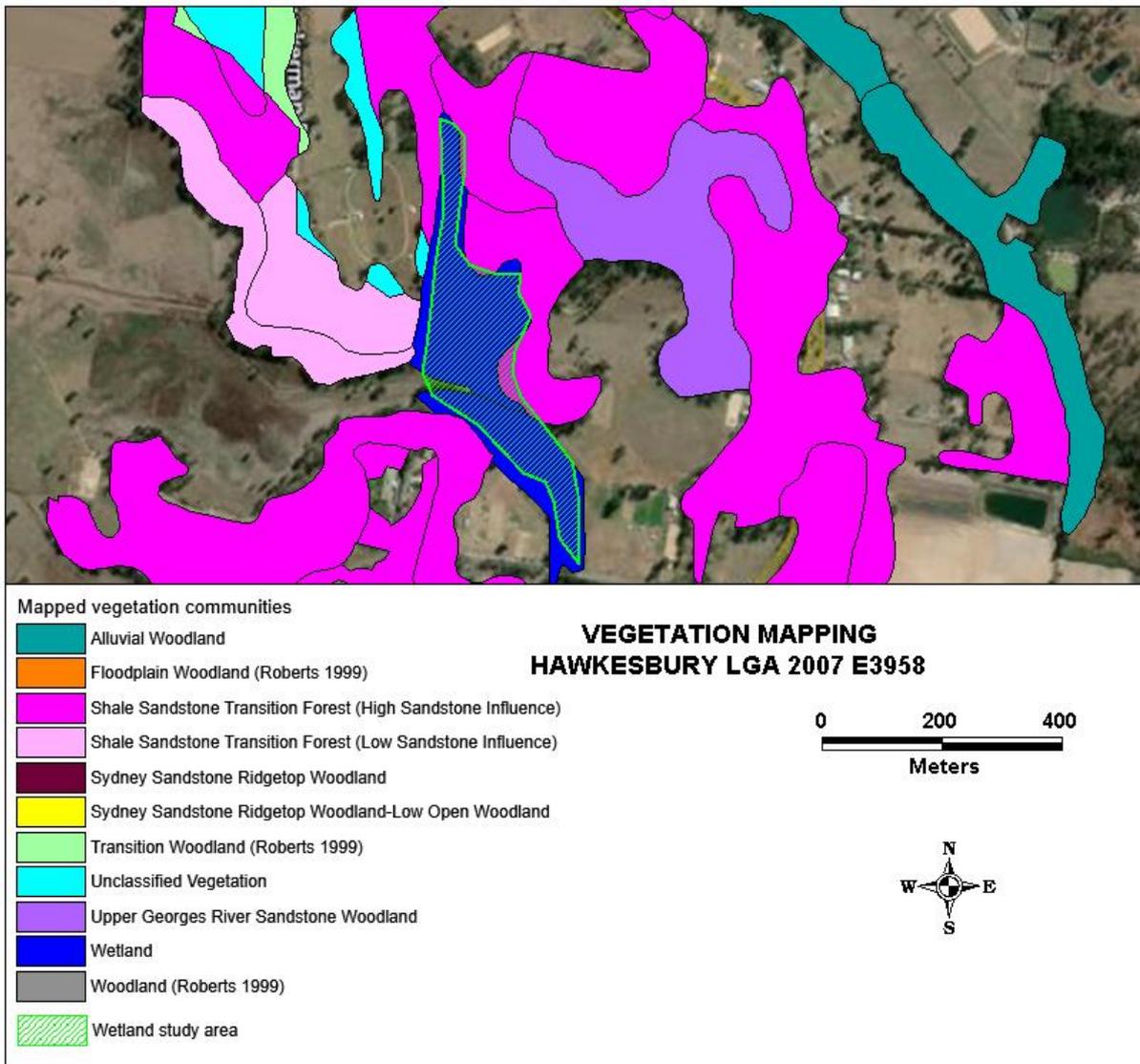
Priority weed

ASSETS 21/12/2020 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Typha orientalis</i>	10-25	<i>Paspalum distichum</i>
<i>Azolla spp.</i>	<10	<i>Eriochloa pseudoacrotricha</i>
<i>Lemna spp.</i>	10-25	<i>Microlaena stipoides</i>
		<i>Echinochloa telmatophila</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Bursaria spinosa</i>	<i>Juncus usitatus</i>
<i>Eucalyptus amplifolia</i>	<i>Persicaria lapathifolia</i>	<i>Commelina cyanea</i>
<i>Eucalyptus robusta</i>		<i>Centella asiatica</i>
<i>Melia azedarach</i>		<i>Marsdenia suaveolens</i>
		<i>Einadia nutans</i>

Fauna noted: Chestnut Teal, Australian Wood Duck, White-faced heron, Dusky Moorhen, Sacred Kingfisher, Pacific Black Duck

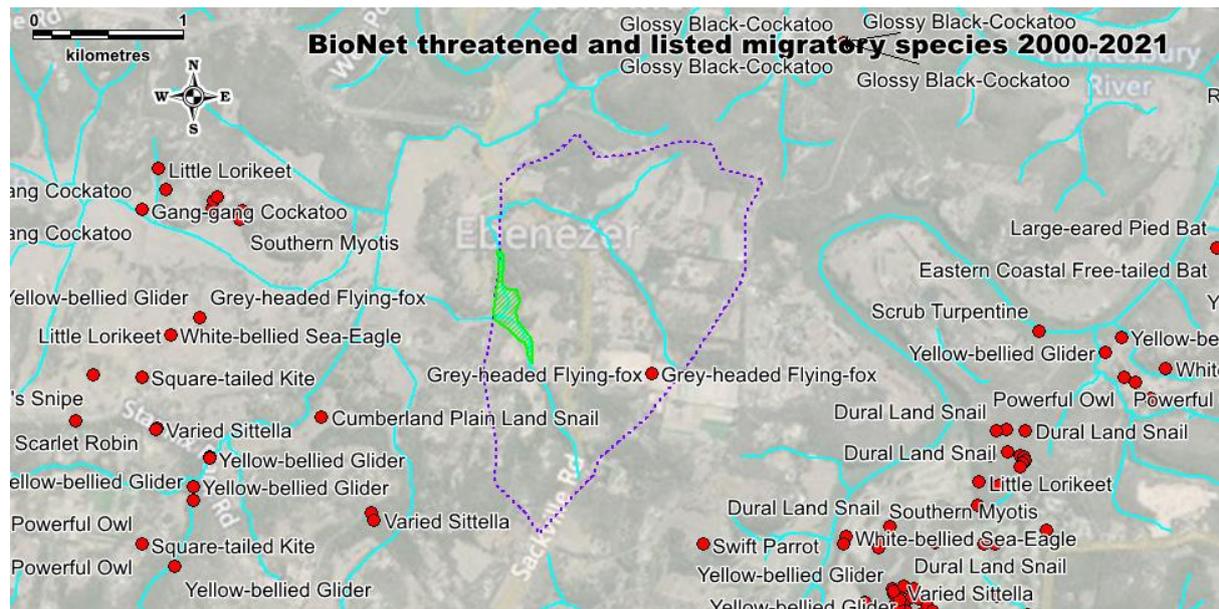
Observed land use	%
bushland	25-50
pasture/grazing	25-50

VEGETATION MAPPING AND LAND USE



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	2

SITE IMAGES - FAUNA



IMAGE 2 Dusky Moorhens and Australian Wood Ducks had ample cover around the southern edges of the wetland



IMAGE 3 Sacred Kingfishers were observed hunting at the wetland and breeding at the edge in an arboreal termite nest



IMAGE 4 Purple Swamphen enjoying the pickings after rain



IMAGE 5 Pacific Black Ducks were a common sight



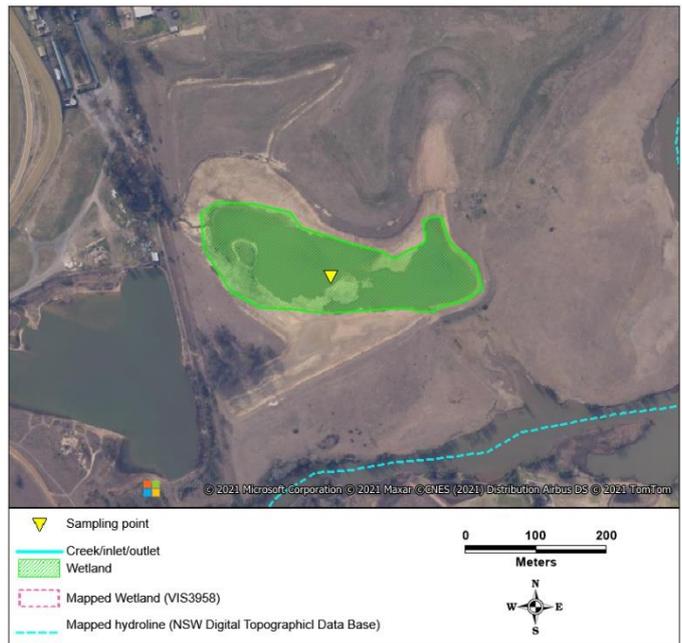
IMAGE 6 Woody debris on waterways provides important habitat for a range of birds and animals

HAWKESBURY RACECOURSE/IRRIGATION DAM/FISHING CLUB DAM

Overall Score (0-10) **4.3**

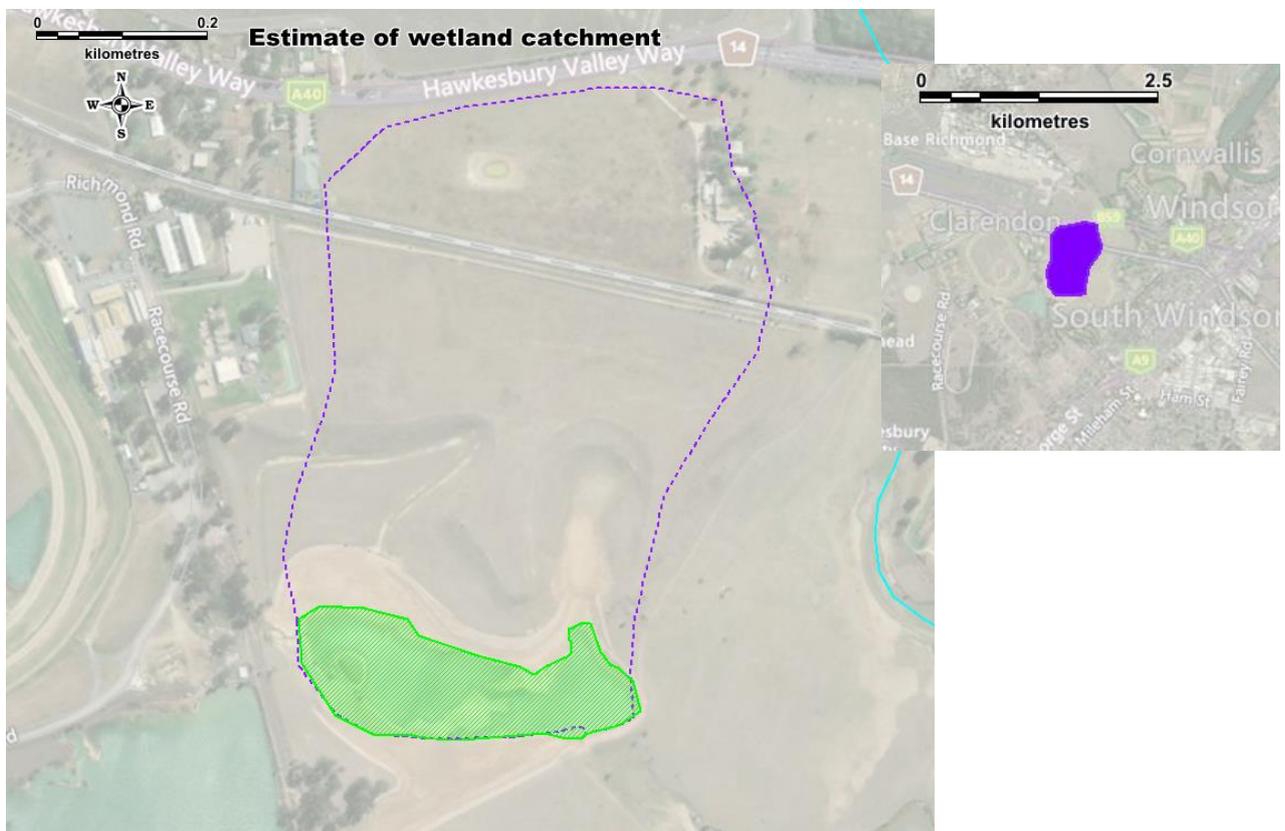
Latitude	-33.615556
Longitude	150.795157
Address	Racecourse Rd, Clarendon NSW 2756
Catchment (ha)	32

Wetland category	artificial retro
Water quality	poor
Site features Landuse	5.8
Site features offsite issues	6.1
Site features onsite issues	5.0
Vegetation	4.3
Habitat features -surrounds	2.5
Habitat features -wetland	1.7
Bank undercutting	5.0
Bank collapse	5.0



MAP 1 Wetland and sampling location

The wetland is a modified natural wetland that has been dammed to provide permanent water. It has some fringing macrophyte beds but has been largely cleared of any native vegetation. The open water areas are very popular with waterbirds, as well as the local fishing club that catch carp on a regular basis.



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 29/01/2021: (left) open water areas have some fringing vegetation, (right) most of the wetland surrounds have been cleared of native vegetation, with only small stands of macrophytes remaining

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Carp, introduction of weeds from back flooding events	
WEED SPECIES (TOP 10)	DENSITY
<i>Eragrostis curvula</i>	25-50
<i>Conyza sp.</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Cynodon dactylon</i>	50-75
<i>Paspalum dilatatum</i>	<10
<i>Cenchrus clandestinus</i>	10-25
<i>Salix fragilis</i>	<10
<i>Sida rhombifolia</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Cirsium vulgare</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Revegetate banks to improve overall condition and habitat value

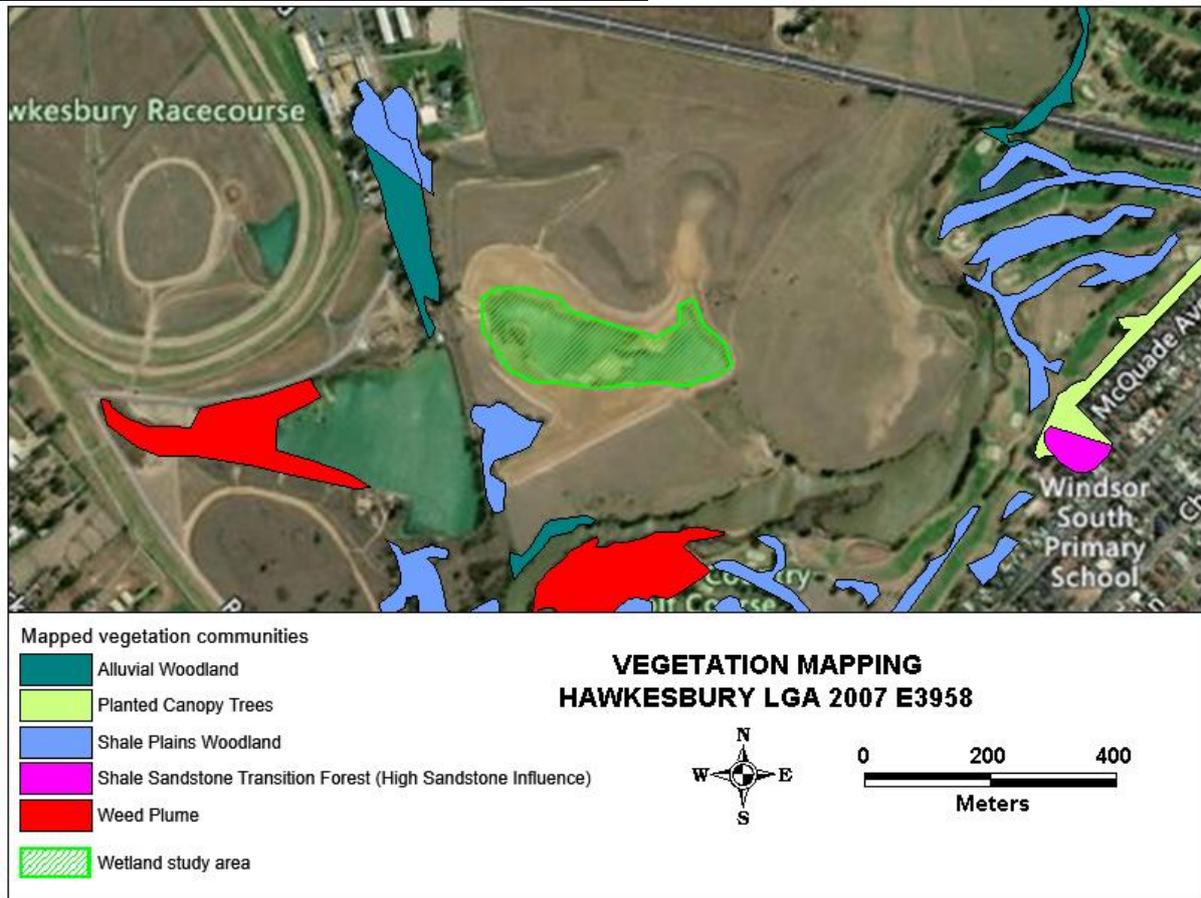
Priority weed

ASSETS 29/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Phragmites australis</i>	10-25	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Persicaria lapathifolia</i>	None noted

Fauna noted: Black Swan, Australian Pelican, White-headed Stilt, Australasian Darter, Australasian Grebe, Australian Wood Duck, Pacific Black Duck, Masked Lapwing, Chestnut Teal, Little Black Cormorant, Eurasian Coot, European Carp

VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	>75
peri-urban mixed	<10
bushland	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Koala	<i>Phascolarctos cinereus</i>	V,P	V	1



IMAGE 1&2: (left) Chestnut Teals, (right) White-headed Stilt



IMAGE 3 & 4: (left) Australasian Darter, (right) Little Black Cormorants



IMAGE 5 & 6: (left) Australian Pelican, (right) Pacific Black Ducks with Eurasian Coot



IMAGE 7: Masked Lapwing

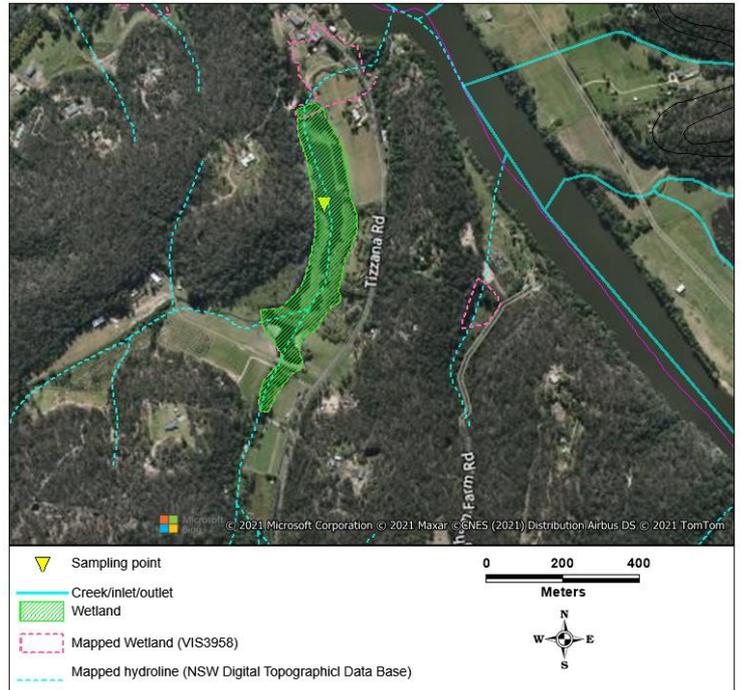
DEEP JUBILEE VINEYARD CREEK WETLAND

Overall Score (0-10) **7.3**

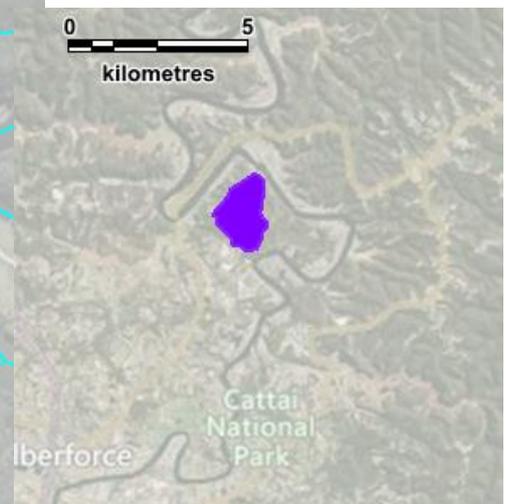
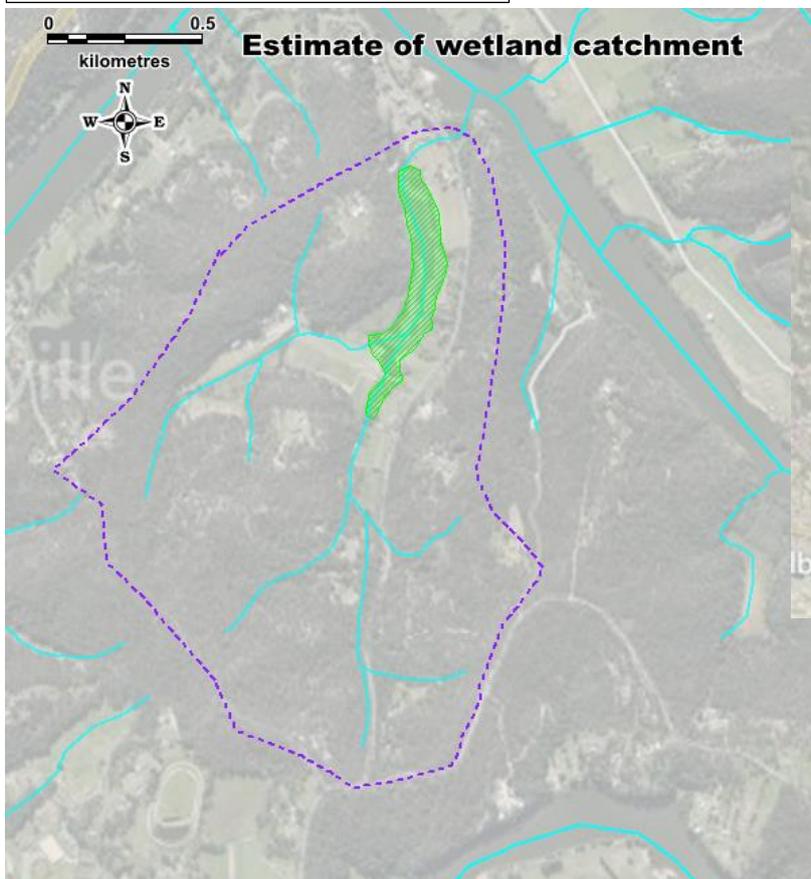
Latitude	██████
Longitude	██████
Address	Tizzana Rd Ebenezer
Catchment (ha)	198

Wetland category	impoundment
Water quality	poor
Site features Landuse	5.3
Site features offsite issues	6.0
Site features onsite issues	6.0
Vegetation	8.2
Habitat features -surrounds	10.0
Habitat features -wetland	7.8
Bank undercutting	0.0
Bank collapse	10.0

The wetland is a narrow open water swamp downstream, and sedge swamp upstream, with extensive rafts of floating macrophytes. Surrounding land use is forested, or cleared for vineyards, with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 21/01/2021: (top left) upstream has established market gardens and orchards, (bottom left) mid wetland with priority control weeds and floating macrophytes, (right) one of the vineyards

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Damming and extraction upstream, excavation downstream	
WEED SPECIES (TOP 10)	DENSITY
<i>Lantana camara</i>	<10
<i>Bidens pilosa</i>	<10
<i>Sida rhombifolia</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Rubus fruticosus</i> aggregate species	<10
<i>Ligustrum sinense</i>	<10
<i>Paspalum urvillei</i>	<10
<i>Alternanthera pungens</i>	<10
<i>Nymphaea spp.</i>	25-50
<i>Ludwigia longifolia</i>	10-25

- Recommended works:
- Weed control required for priority control weeds
 - Control of environmental weeds to prevent spread to downstream areas
 - Prohibit unauthorised excavation and damming
 - Restrict extraction to sustainable levels

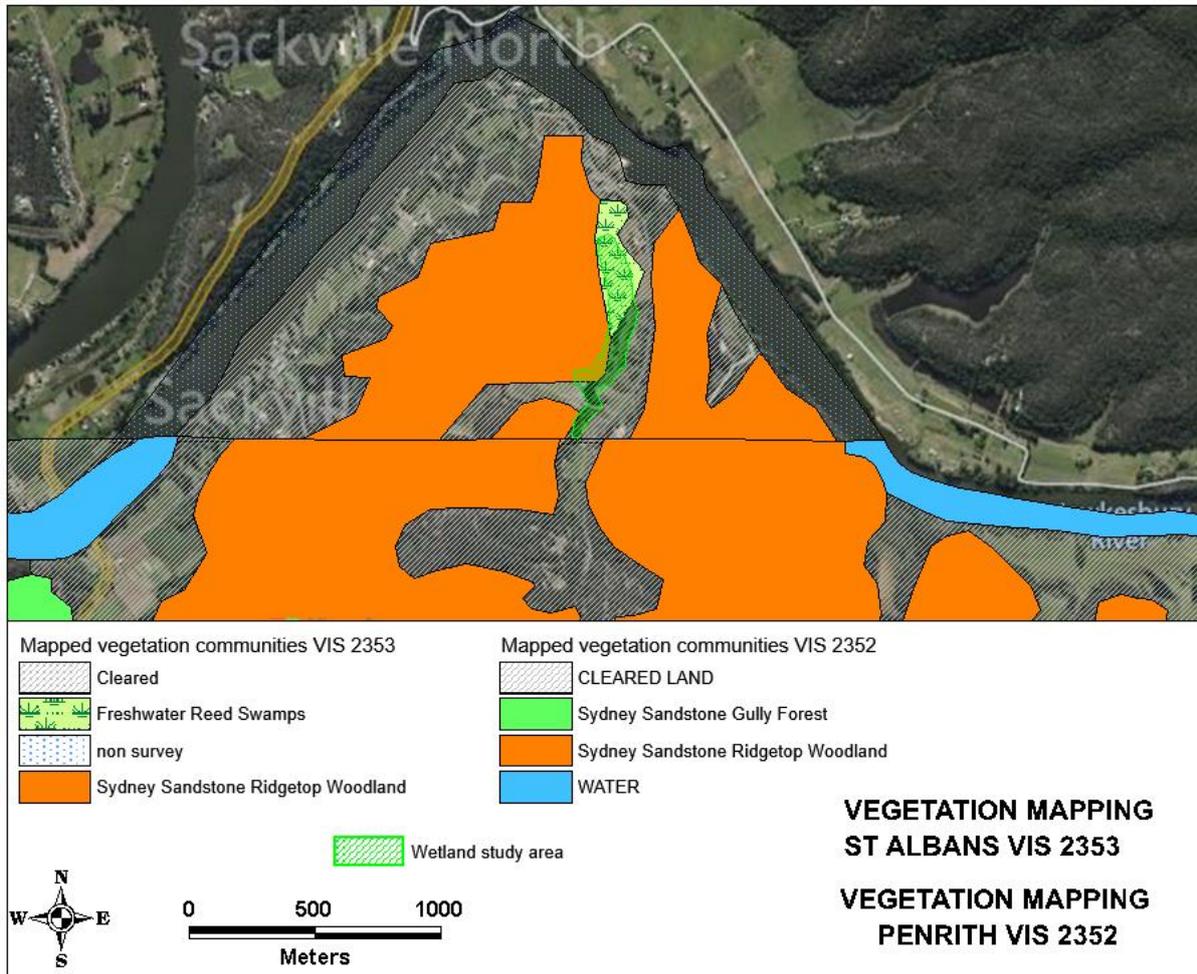
Priority weed

ASSETS 21/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Nymphaea spp.</i>	25-50	<i>Hemarthria uncinata</i>
<i>Ludwigia longifolia</i>	10-25	<i>Entolasia marginata</i>
<i>Nymphaea gigantea</i>	10-25	<i>Imperata cylindrica</i>
<i>Typha orientalis</i>	<10	<i>Gahnia sieberiana</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca linariifolia</i>	<i>Acacia parramattensis</i>	<i>Pteridium esculentum</i>
<i>Eucalyptus robusta</i>	<i>Trema tomentosa</i>	<i>Blechnum cartilagineum</i>
<i>Melaleuca quinquenervia</i>	<i>Leptospermum juniperinum</i>	<i>Gleichenia dicarpa</i>
<i>Casuarina glauca</i>	<i>Rubus parviflora</i>	<i>Lobelia purpurascens</i>
<i>Cyathea australis</i>	<i>Pittosporum revolutum</i>	<i>Pandorea pandorana</i>

Fauna noted: Eastern Whipbird, Lewins Honeyeater, Restless Flycatcher, Australian Magpie, Pied Currawong, Australasian Swamphen, Pacific Black Duck, Swamp Harrier, Red-whiskered Bul-bul

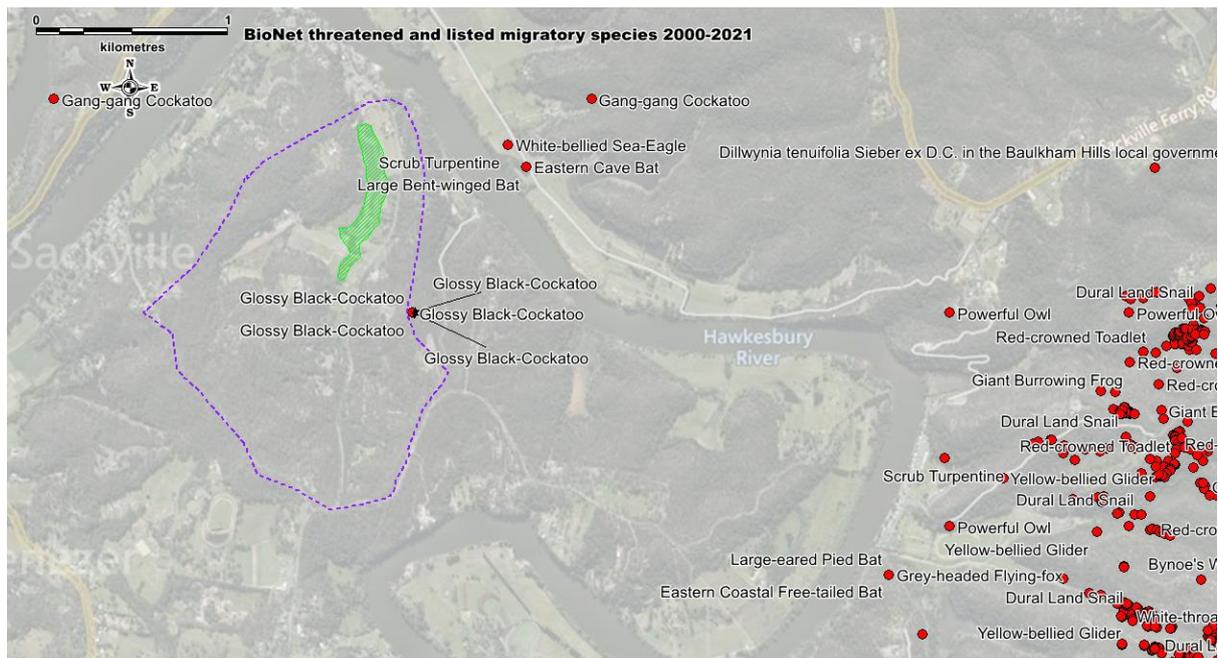
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	25-50
vineyards/farming	10-25
pasture/grazing	25-50



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					



IMAGE 1 Southern (upstream) extent is a forested wetland

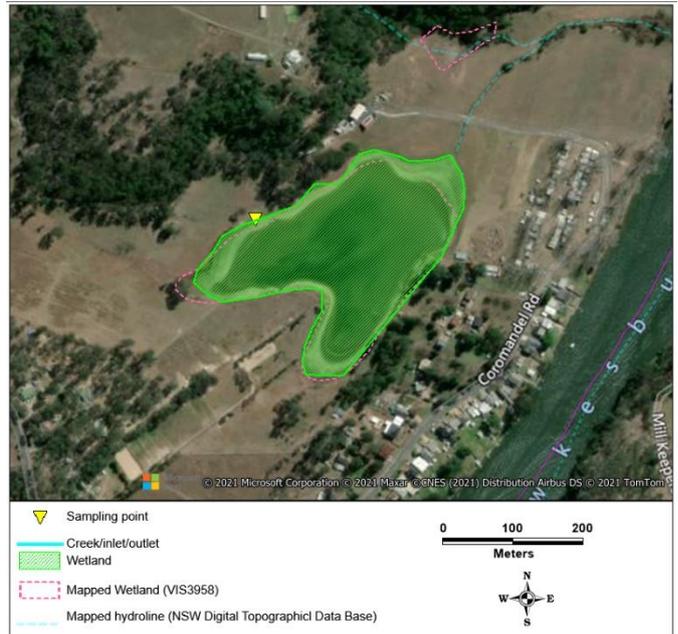
KALLAWATTA WETLAND

Overall Score (0-10) **5.0**

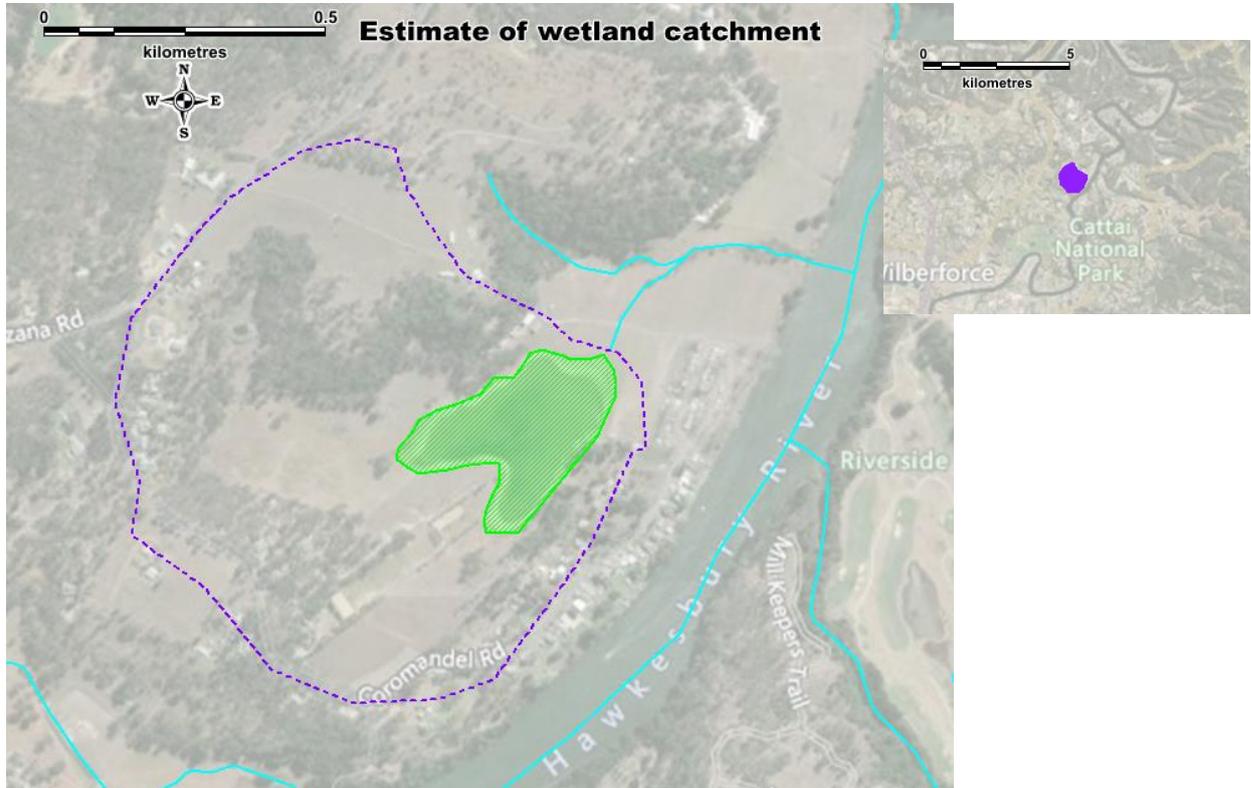
Latitude	██████████
Longitude	██████████
Address	Tizzana Road, Ebenezer
Catchment (ha)	62

Wetland category	natural
Water quality	fair
Site features Landuse	5.9
Site features offsite issues	7.5
Site features onsite issues	0.4
Vegetation	3.7
Habitat features -surrounds	8.8
Habitat features -wetland	5.0
Bank undercutting	5.0
Bank collapse	10.0

The wetland is predominantly open water with small areas of macrophytes towards the upper end. The outflow is formalised into a channel. The wetland is owned by several landholders, each of whom use their section differently.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 1 Site 04/12/2020

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Concerns about over extraction of water by residents in lifestyle blocks to the east – particularly during drought.	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum dilatatum</i>	10-25
<i>Cynodon dactylon</i>	10-25
<i>Senecio madagascariensis</i>	<10
<i>Polygonum aviculare</i>	<10
<i>Centaurium sp</i>	<10
<i>Conyza sp.</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Cyperus eragrostis</i>	<10
<i>Sonchus oleraceus</i>	<10
<i>Plantago lanceolata</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Fence off the wetland, restrict access by grazing animals, install offline watering points
- Revegetate banks to improve overall health and condition
- Reduce extraction for peri-urban irrigation purposes

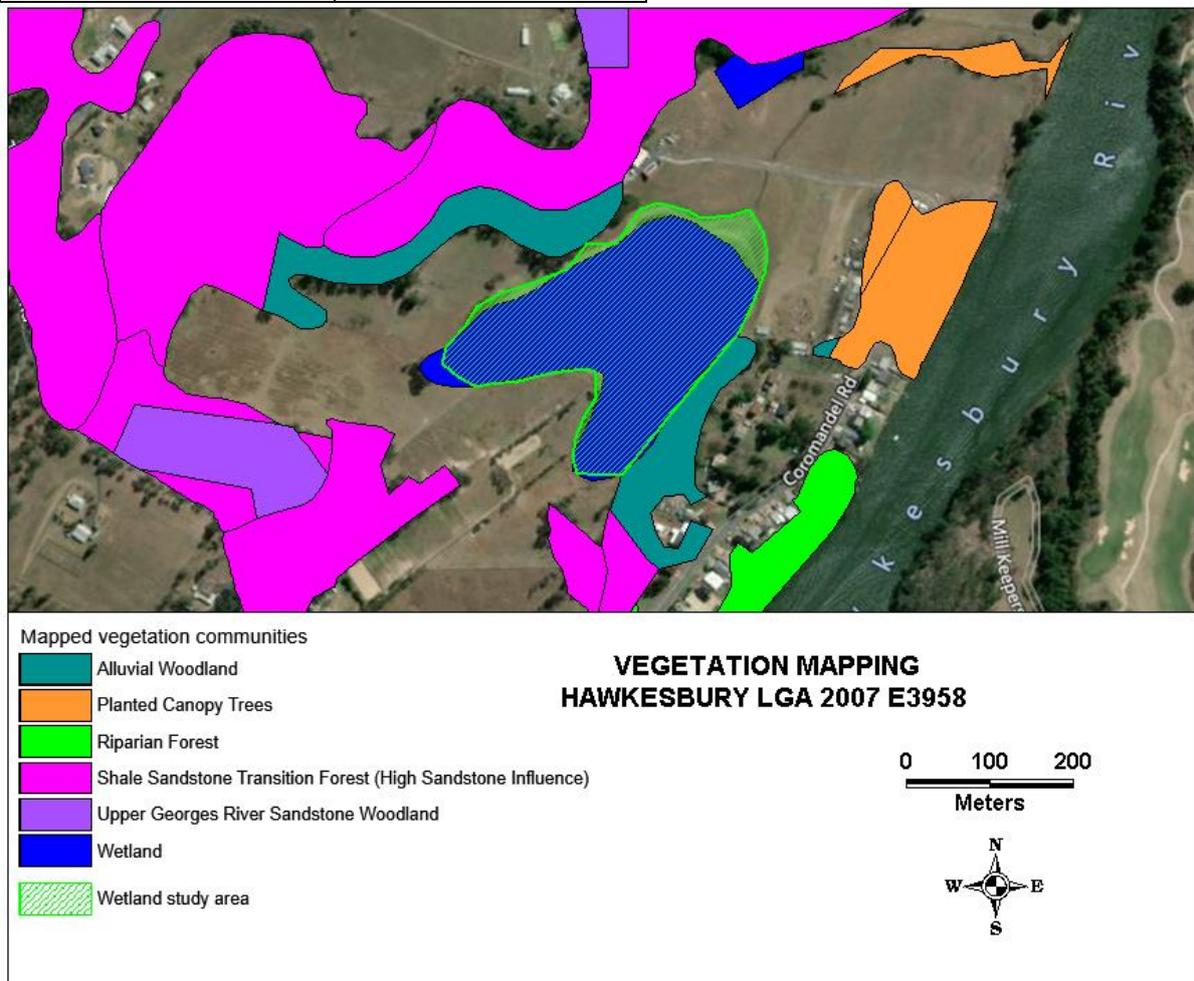
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Schoenoplectus validus</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Juncus usitatus</i>	<10	
<i>Ludwigia peploides</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus amplifolia</i>		<i>Alternanthera denticulata</i>
		<i>Cyperus sanguinolentis</i>

Fauna noted: Australasian Grebe, Australian Pelican, Black-fronted Dotteral, Eurasian Coot, Great Cormorant, Little Pied Cormorant, Masked Lapwing, Pacific Black Duck, Welcome Swallow

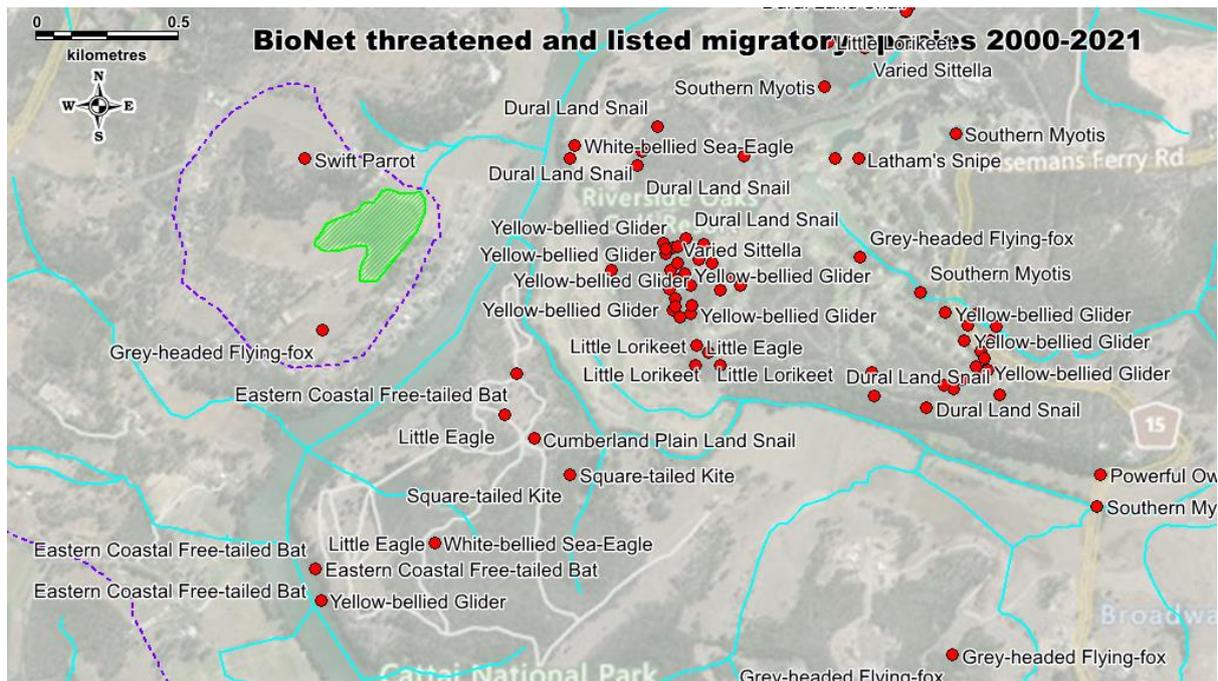
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	25-50
pasture/grazing	25-50
peri-urban mixed	10-25



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Common Status	Count
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	1 record (5 individuals 2019)
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	1



IMAGE 2 Emergent vegetation provides habitat



IMAGE 3 Boundary fencing in the wetland provides roosting habitat for water birds



IMAGE 4 (LEFT) Looking north along western edge. Area is cleared and grazed with earthworks, sheds and numerous watercraft stored on adjoining property.



IMAGE 5 (RIGHT) Looking south along western edge. Area is cleared and grazed.

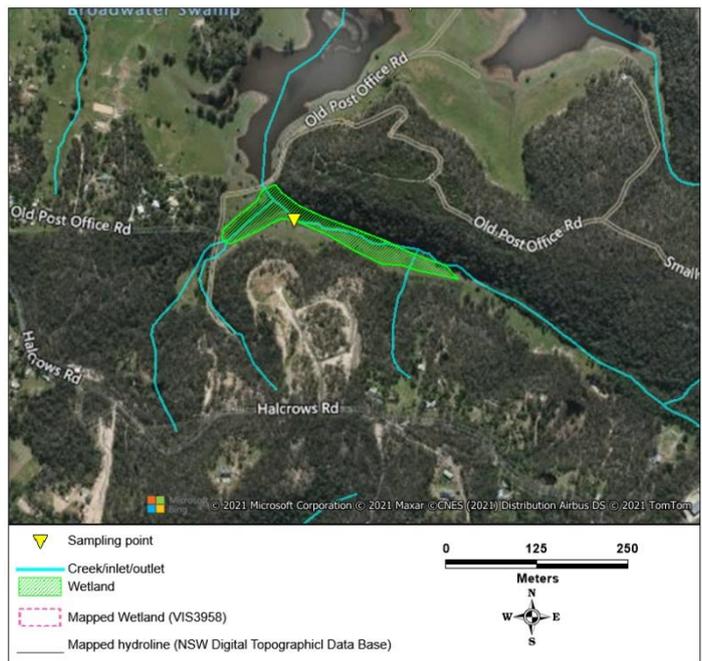
LONG ARM SWAMP

Overall Score (0-10) 8.6

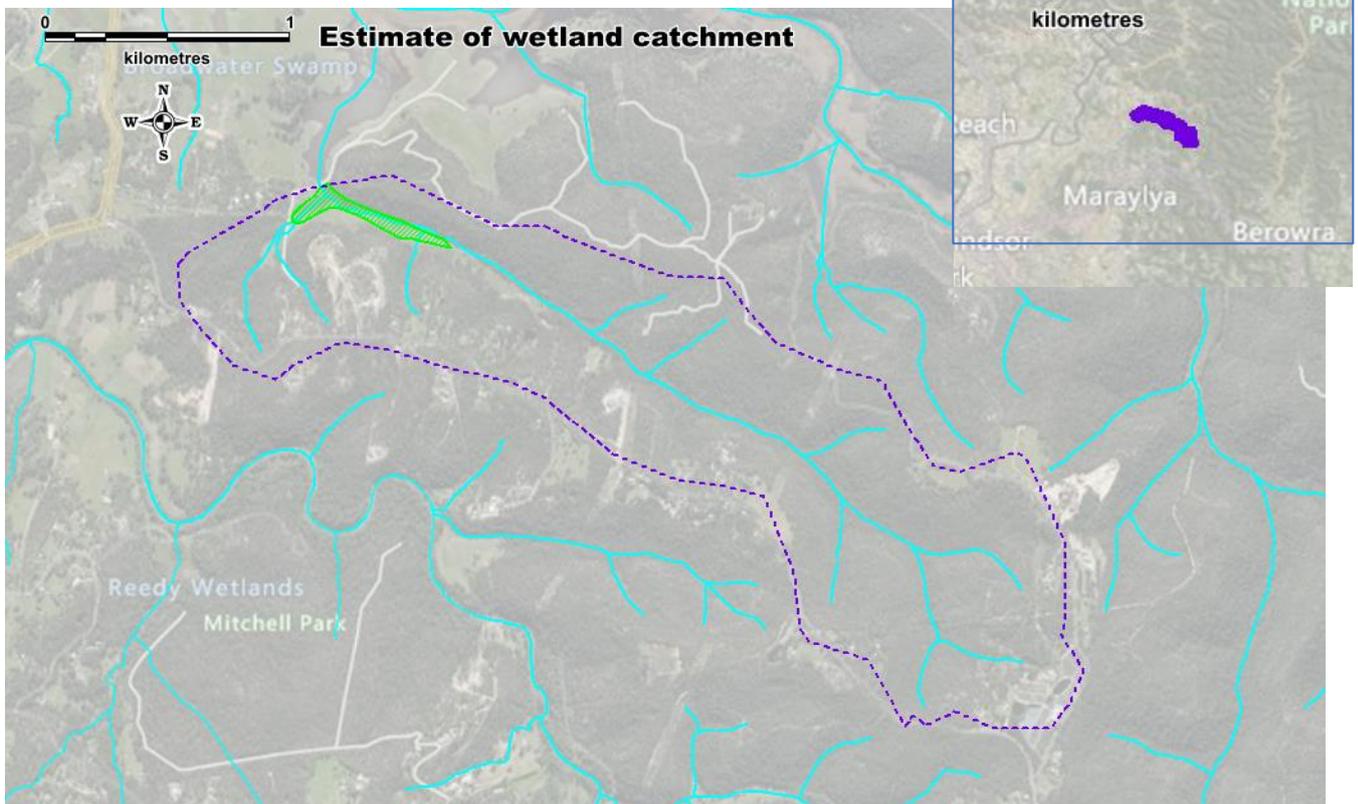
Latitude	██████████
Longitude	██████████
Address	Halcrows Road Cattai / Old Postoffice Road Cattai
Catchment (ha)	294

Wetland category	natural
Water quality	poor
Site features Landuse	9.4
Site features offsite issues	9.5
Site features onsite issues	3.0
Vegetation	9.1
Habitat features -surrounds	10.0
Habitat features -wetland	7.5
Bank undercutting	10.0
Bank collapse	10.0

The wetland is a small sedge swamp separated from Broadwater Swamp by a raised embankment with a vehicle track. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 21/01/2021: (left) view up the long arm of the swamp, (top right) catchment setting, (bottom right) the wetland is predominantly a sedge swamp

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Cirsium vulgare</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Ludwigia peruviana</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Setaria viridis</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Xanthium occidentale</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Brassica fruticulosa</i>	<10
<i>Cynodon dactylon</i>	10-25

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Restrict access for grazing
- Revegetate banks to improve overall health and condition

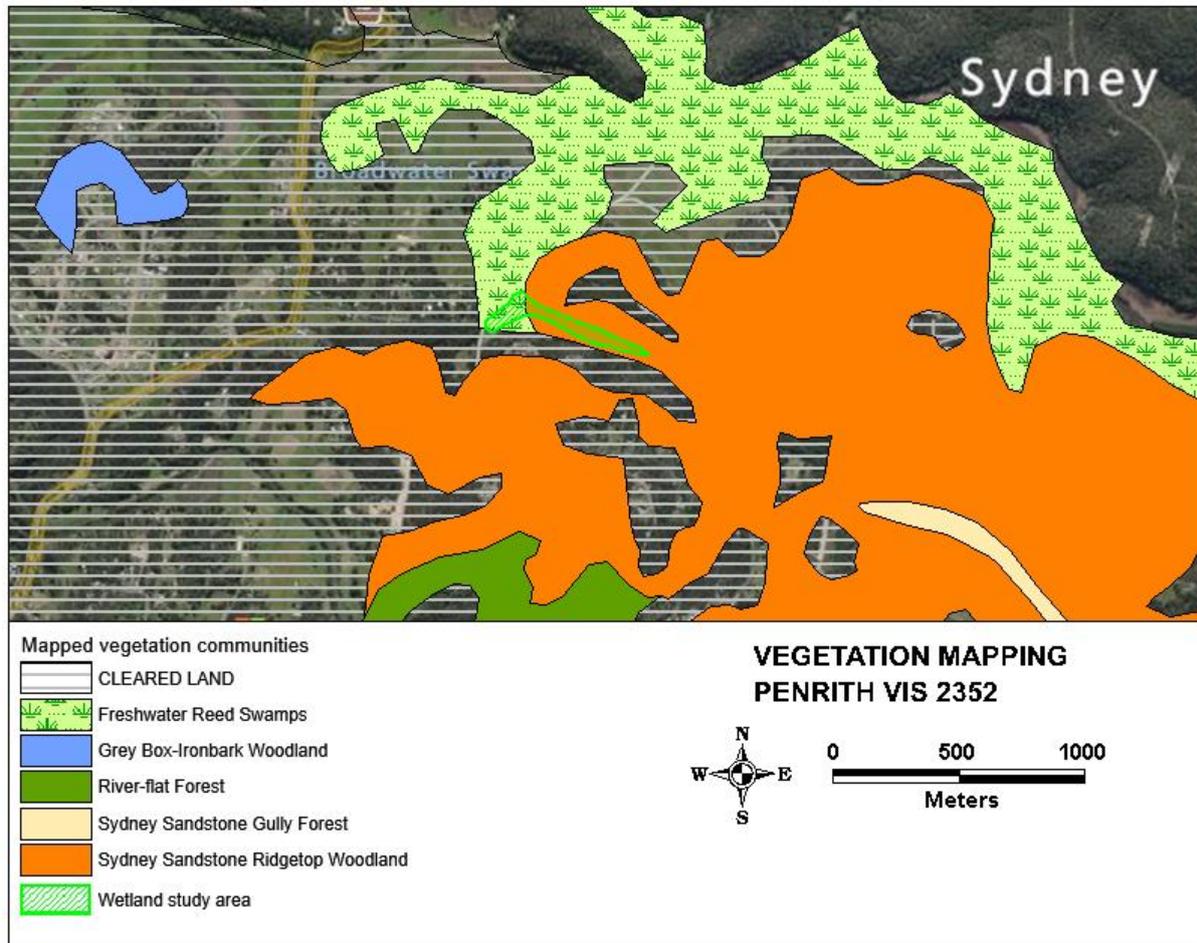
Priority weed

ASSETS 21/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Eleocharis sphacelata</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Cynogeton procerum</i>	10-25	<i>Paspalum distichum</i>
<i>Juncus usitatus</i>	<10	
<i>Juncus prismatocarpus</i>	<10	
<i>Paspalum distichum</i>	10-25	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
<i>Melaleuca linariifolia</i>		<i>Hydrocotyle tripartita</i>

Fauna noted: Pacific Black Duck, White-faced heron, Willie Wagtail

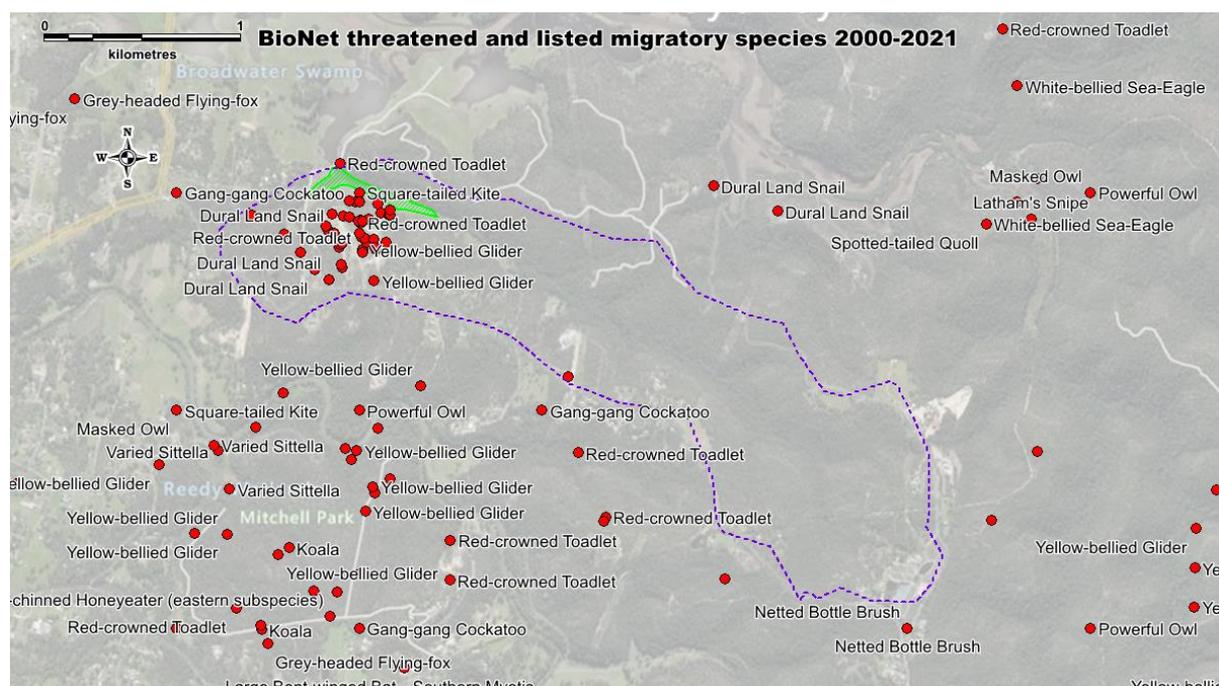
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	50-75
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Amphibia	Red-crowned Toadlet	<i>Pseudophryne australis</i>	V,P		3
Amphibia	Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V,P	V	1
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Latham's Snipe	<i>Gallinago hardwickii</i>	P	J,K	1
Aves	Barking Owl	<i>Ninox connivens</i>	V,P,3		1
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		5
Mammalia	Squirrel Glider	<i>Petaurus norfolkensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	2
Mammalia	Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	V,P		1
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		1
Mammalia	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V,P	V	2
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		2
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		2
Mammalia	Eastern Cave Bat	<i>Vespadelus troungtoni</i>	V,P		1
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		2
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		2
Gastropoda	Dural Land Snail	<i>Pommerhelix duralensis</i>	E1	E	29



IMAGE 1 Long arm swamp is well vegetated with no grazing or extraction pressures



IMAGE 2 Large woody debris around banks provides useful habitat

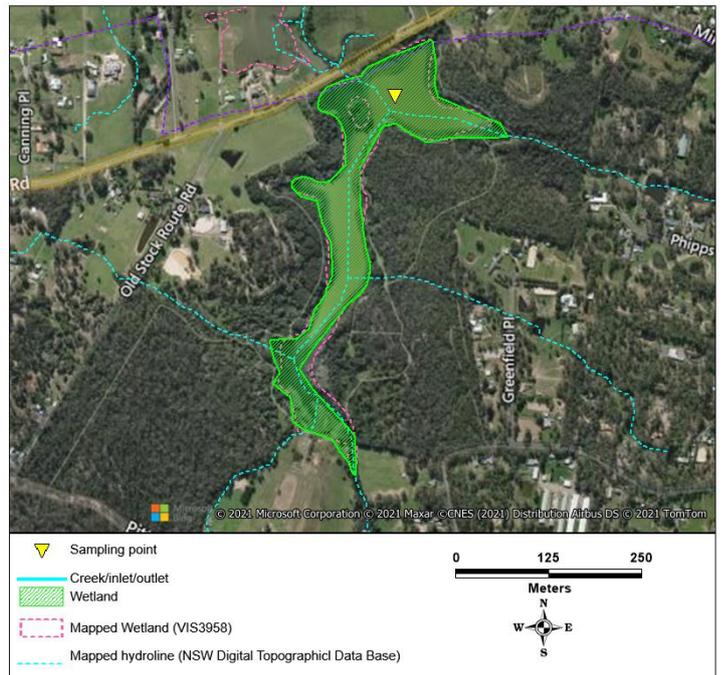
LONGNECK LAGOON

Overall Score (0-10) 7.2

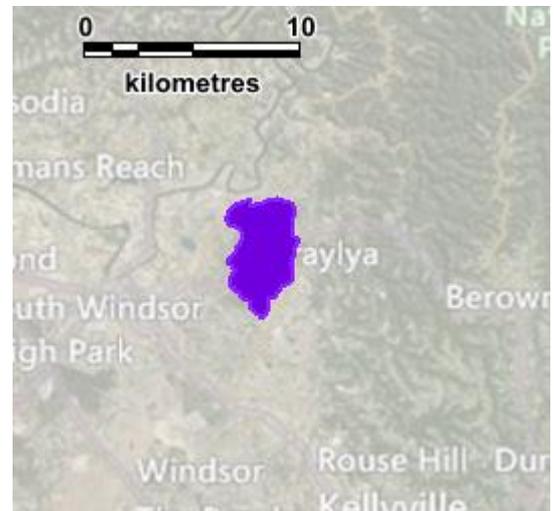
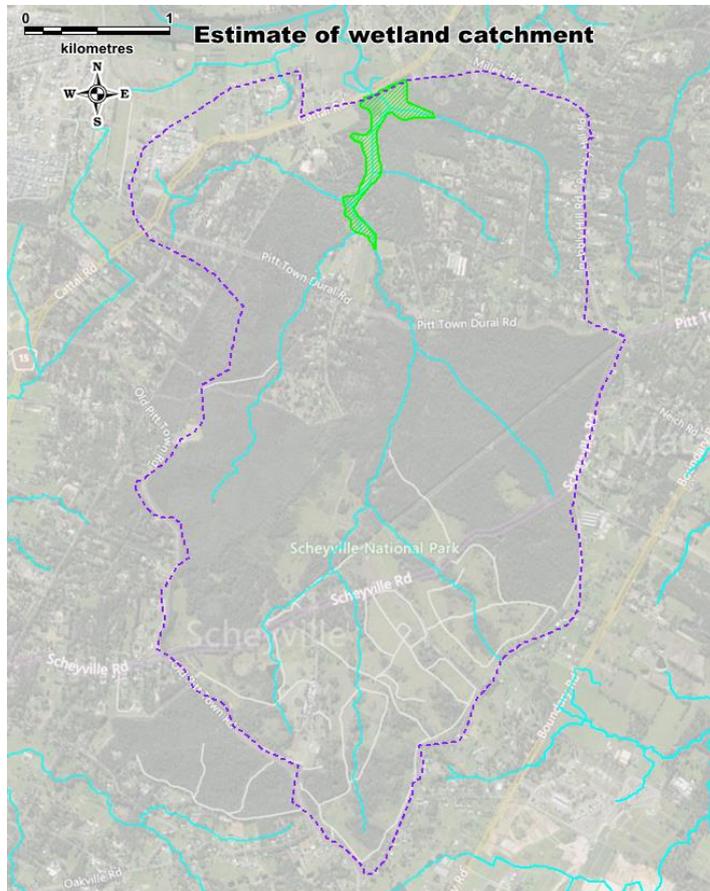
Latitude	-33.572721
Longitude	150.892687
Address	Maraylya NSW 2765
Catchment (ha)	1269

Wetland category	natural	modified
Water quality		fair
Site features Landuse		10.0
Site features offsite issues		7.3
Site features onsite issues		10.0
Vegetation		5.4
Habitat features -surrounds		8.8
Habitat features -wetland		9.0
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a very large open water lagoon surrounded by forests and with areas of dense macrophytes towards the upstream end. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development. The site is owned by NPWS.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 05/02/2021: (left) the open water lagoon is surrounded by She-oaks and has large beds of fringing macrophytes, (top right) formalised outflow under Cattai Rd, (bottom right) the famous boardwalk was overgrown by macrophytes, affected by bushfire, and destroyed by flooding in 2021

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Conyza sp.</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Cenchrus clandestinus</i>	<10
<i>Ligustrum sinense</i>	10-25
<i>Cynodon dactylon</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Lactuca serriola</i>	<10
<i>Ligustrum lucidum</i>	<10
<i>Senecio madagascariensis</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control environmental weeds
 - Maintain existing overall good condition
 - Monitor for degrading impacts entering the wetland from upstream

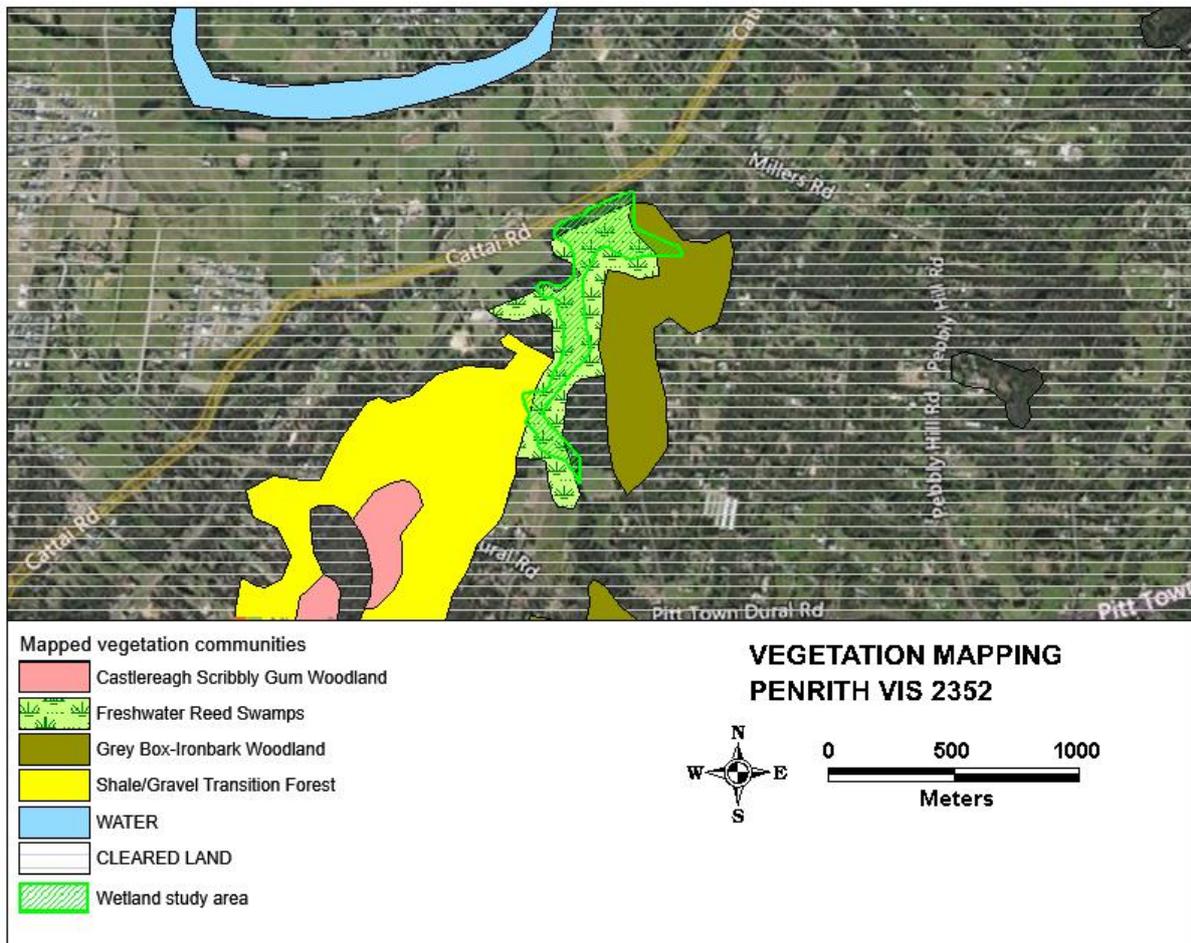
Priority weed

ASSETS 05/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	<10	
<i>Typha orientalis</i>	<10	
<i>Azolla spp.</i>	<10	
<i>Lemna spp.</i>	<10	
<i>Phragmites australis</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Persicaria decipiens</i>	<i>Centella asiatica</i>
<i>Eucalyptus amplifolia</i>		<i>Juncus usitatus</i>

Fauna noted: Plumed Whistling-Duck, Blue-billed Duck, Australian Pelican, Australasian Darter, Pacific Black Duck, Black Swan, Eurasian Coot

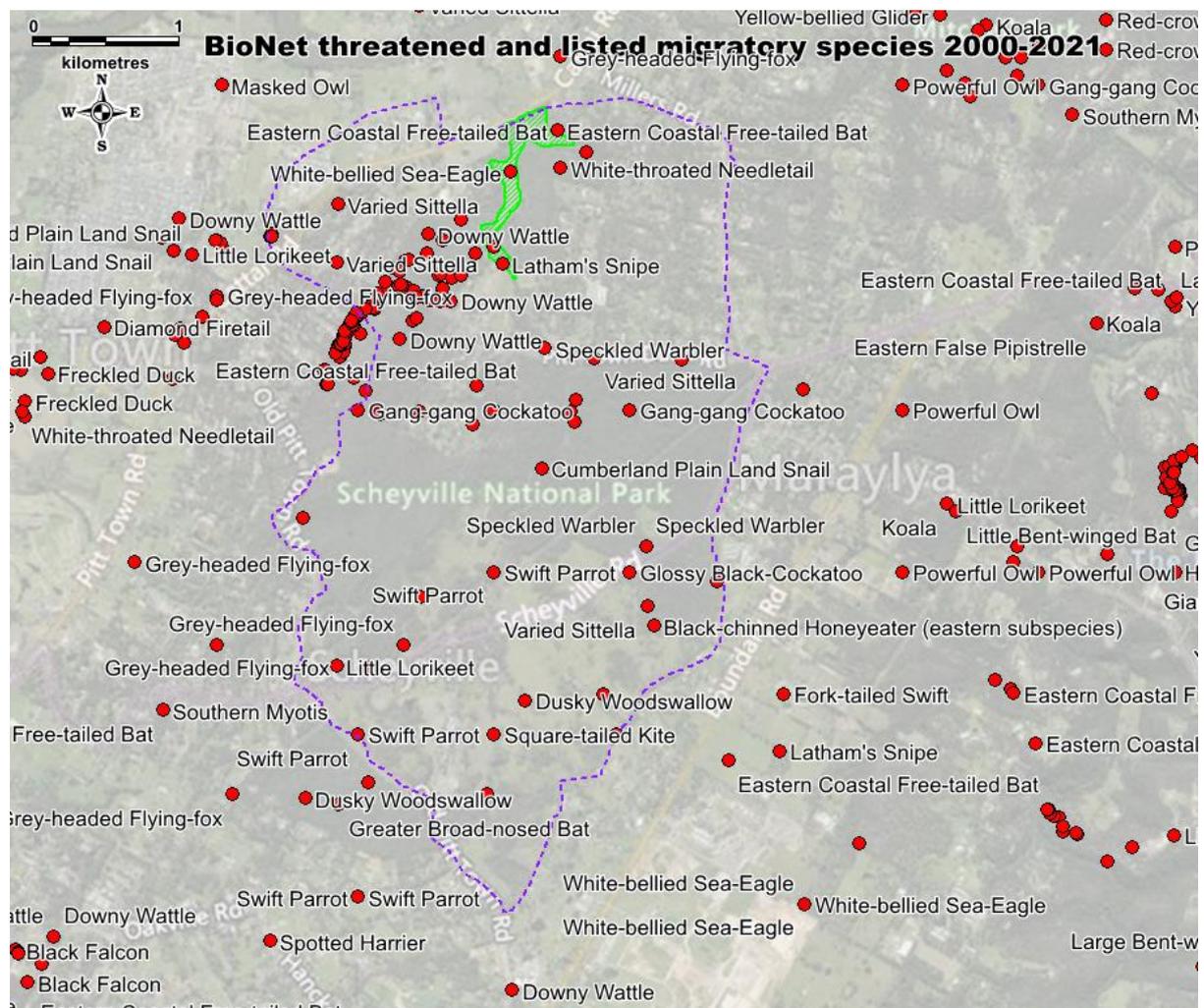
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75
market gardens	<10
peri-urban mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	White-throated Needletail	<i>Hirundapus caudacutus</i>	P	V,C,J,K	1
Aves	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V,P		1
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Latham's Snipe	<i>Gallinago hardwickii</i>	P	J,K	1
Aves	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V,P,3		2
Aves	Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	V,P,2		14
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		6
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	6
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		4
Aves	Speckled Warbler	<i>Chthonicola sagittata</i>	V,P		15
Aves	Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V,P		1
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		8
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		12
Aves	Scarlet Robin	<i>Petroica boodang</i>	V,P		1

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	3
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		13
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		14
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		4
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		5
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		5
Flora		<i>Dillwynia tenuifolia</i>	V		32
Flora		<i>Pultenaea parviflora</i>	E1	V	5
Flora	Downy Wattle	<i>Acacia pubescens</i>	V	V	24
Flora	Sydney Plains Greenhood	<i>Pterostylis saxicola</i>	E1,P,2	E	1



IMAGE 1 Plumed Whistling Duck with Blue-billed Duck top right corner



IMAGE 2 Small family of Plumed Whistling Ducks



IMAGE 3 Australian Pelican



Image 4 Black Swan



IMAGE 5 Pacific Black Ducks

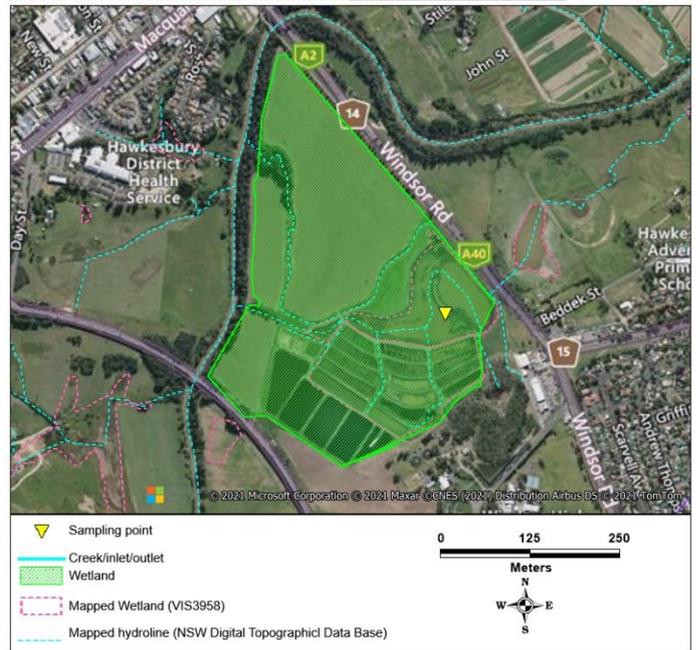
McGRATHS HILL WASTEWATER TREATMENT PONDS

Latitude	-33.614161
Longitude	150.830497
Address	Mulgrave Rd, McGraths Hill
Catchment (ha)	NA

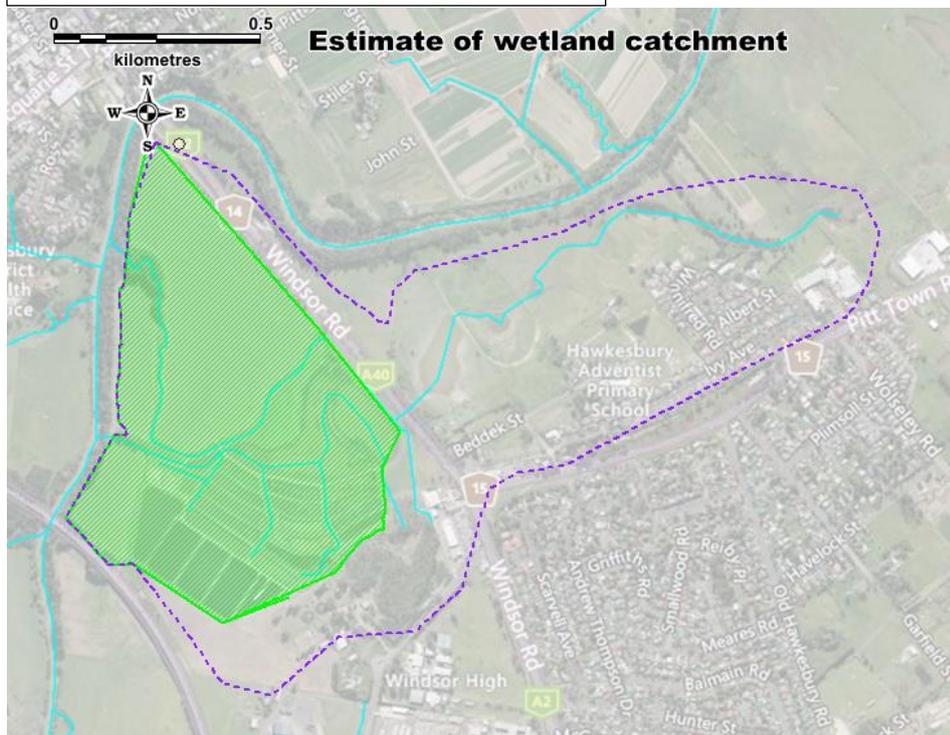
Wetland category	WSUD
Water quality	No testing
Site features Landuse	3.3
Site features offsite issues	3.5
Site features onsite issues	8.0
Vegetation	5.3
Habitat features -surrounds	3.8
Habitat features -wetland	6.2
Bank undercutting	5.0
Bank collapse	5.0

The wetland is a series of connected constructed wetlands that are designed to treat wastewater from the local area. It includes open water wetlands for UV treatment and macrophyte wetlands to strip nutrients from the water, ending in a large 'natural' wetland before being discharged to the river.

Overall Score (0-10) **5.1**



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) although it must be noted that the catchment is much larger via the reticulated sewage system



IMAGE 1 Courtesy of Denise Hayes 2021

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Myriophyllum sp</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Conyza sp.</i>	<10
<i>Cenchrus clandestinus</i>	<10
<i>Ehrharta erecta</i>	<10
<i>Plantago lanceolata</i>	<10
<i>Alternanthera phylloxeroides</i>	<10
<i>Ludwigia peruviana</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Maintain existing overall good condition

Priority weed

ASSETS 05/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	10-25	<i>Paspalum distichum</i>
<i>Bolboschoenus caldwellii</i>	10-25	
<i>Phragmites australis</i>	10-25	
<i>Azolla spp.</i>	<10	
<i>Schoenoplectus validus</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
None noted	<i>Persicaria lapathifolia</i>	<i>Juncus usitatus</i>
		<i>Ludwigia peploides</i>
		<i>Damasonium minus</i>

Fauna noted: White-faced heron, Black Swan, Golden-headed Cisticola, Welcome Swallow, Hardhead, Grey Teal, Chestnut Teal, Australasian Grebe, Australasian Shoveler, Masked lapwing, Australasian Swampphen, Eurasian Coot, Pacific Black Duck, Great Cormorant, Fairy Martin, Australasian Reed Warbler, Australasian Darter, Little Grassbird, Spotless Crake, Great Egret, Little Pied Cormorant



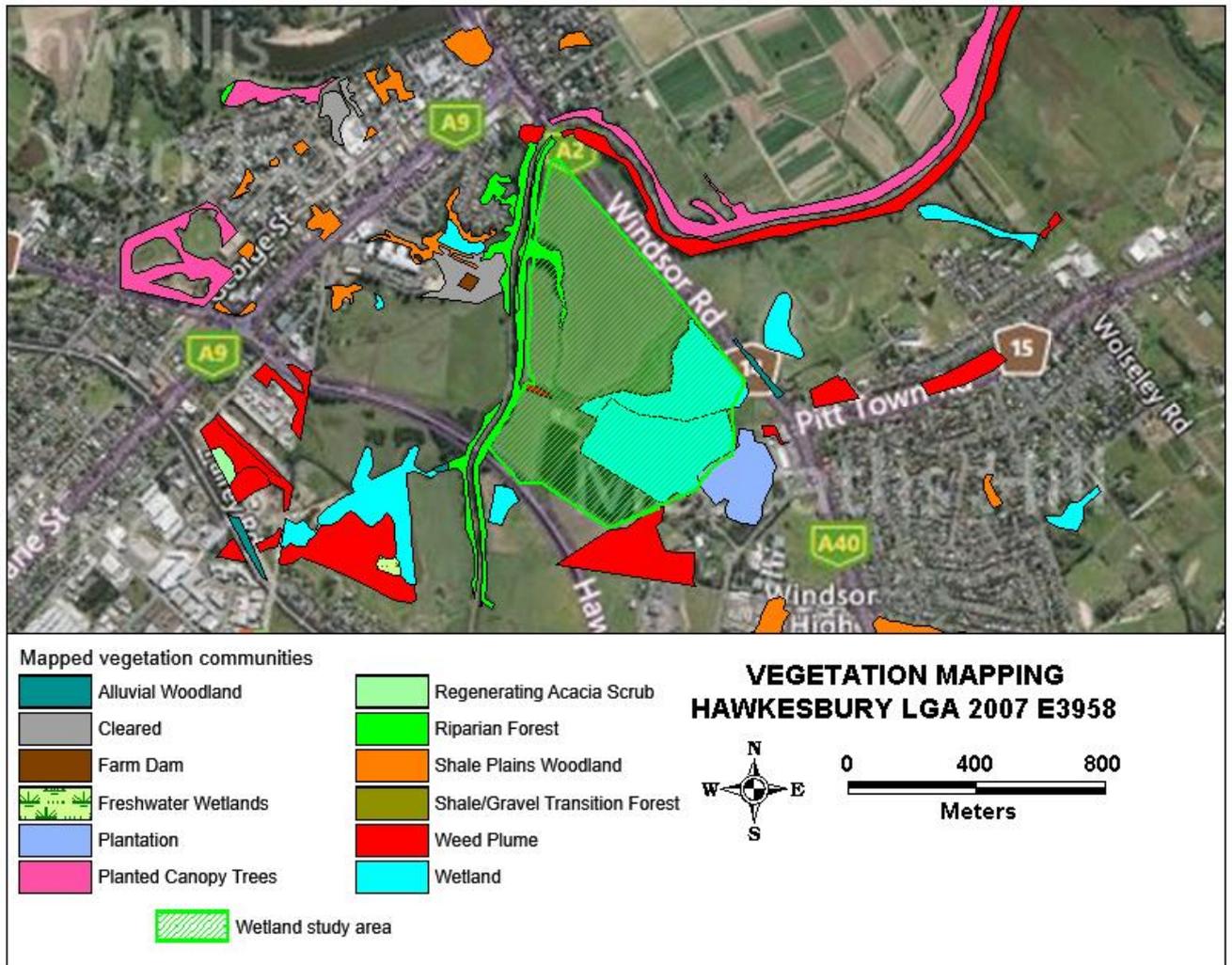
Image 1 vegetated treatment ponds



Image 2 Masked Lapwings and a White-faced heron

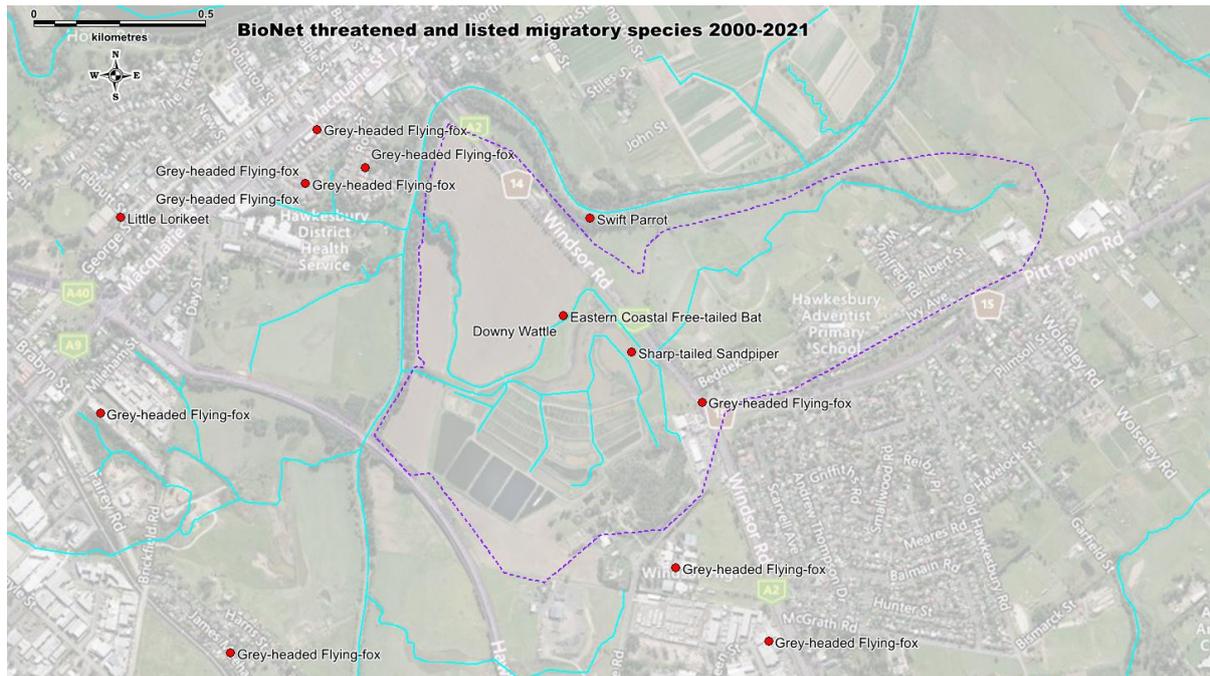
VEGETATION MAPPING AND LAND USE

Observed land use	%
market gardens	25-50
peri-urban mixed	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	P	C,J,K	2
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	1
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		3
Flora	Downy Wattle	<i>Acacia pubescens</i>	V	V	3



Images 3-5 Little Grassbird (left), Black Swan (centre), and Great Egret (right)

McKENZIES SWAMP EAST

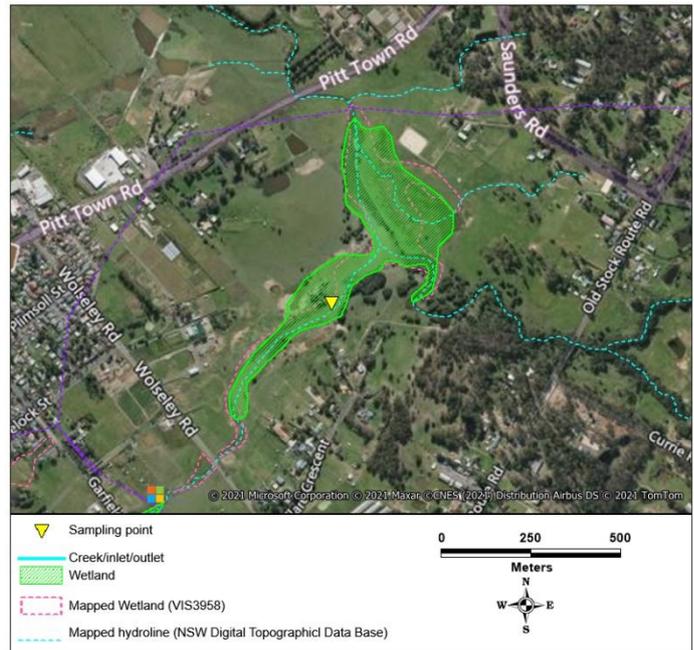
Overall Score (0-10)

5.9

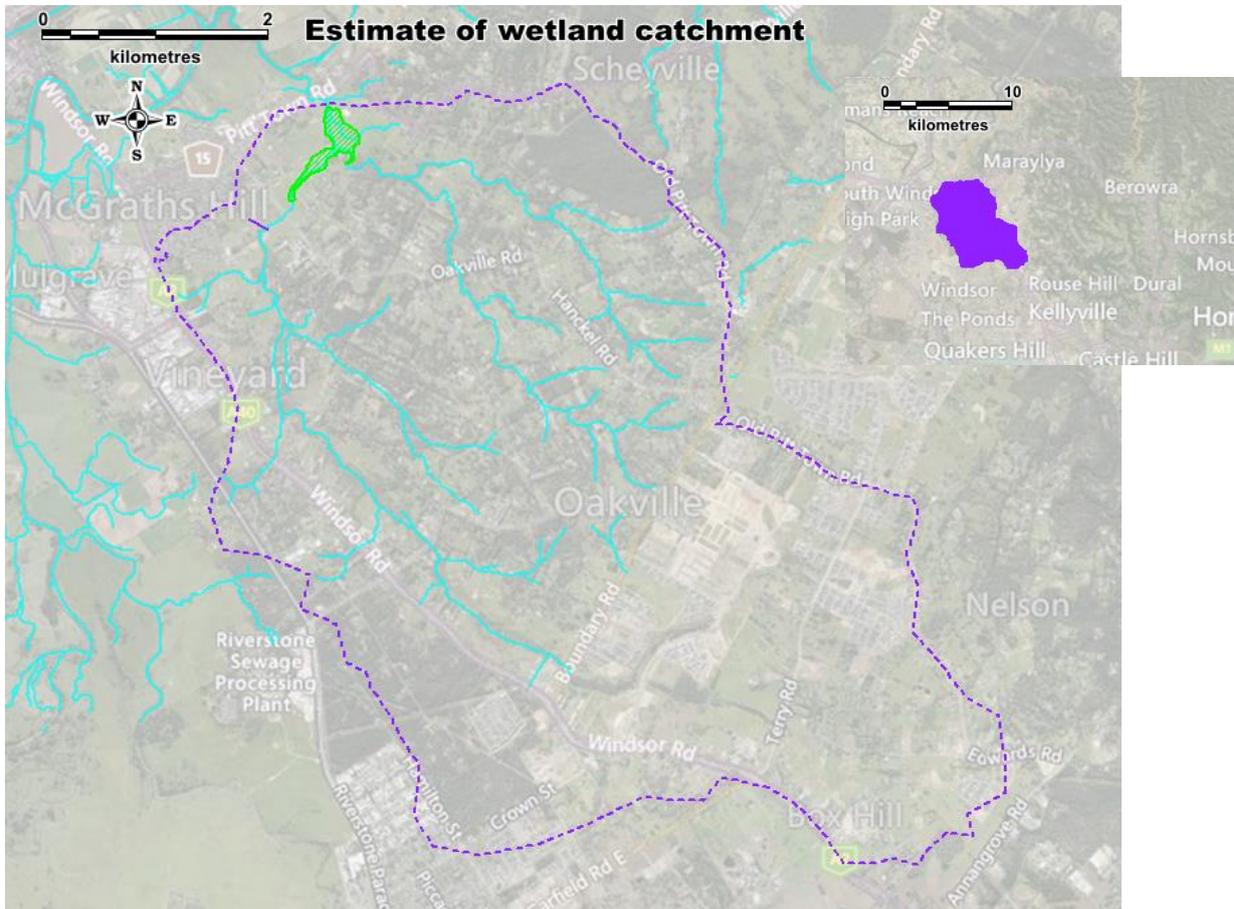
Latitude	
Longitude	
Address	Pitt Town Rd, McGraths Hill
Catchment (ha)	3139

Wetland category	natural	modified
Water quality		poor
Site features Landuse		5.5
Site features offsite issues		5.8
Site features onsite issues		0.4
Vegetation		7.8
Habitat features -surrounds		3.8
Habitat features -wetland		7.3
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a shallow degraded swamp surrounded by small areas of forested wetland. Surrounding land use is mixed urban residential development with areas of small acreage holdings and grazed pastures.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 01/03/2021: (left) the forested wetland has been degraded through grazing, (top right) large parts of the wetland are cleared, (bottom right) urban development reaches to the edge of the swamp

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Salvinia molesta</i>	<10
<i>Alternanthera phyloxeroides</i>	<10
<i>Nymphaea mexicana</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Ligustrum sinense</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Conyza sp.</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control environmental weeds
 - Fence the wetland, restrict grazing and establish offline watering points
 - Revegetate banks to improve overall health and condition

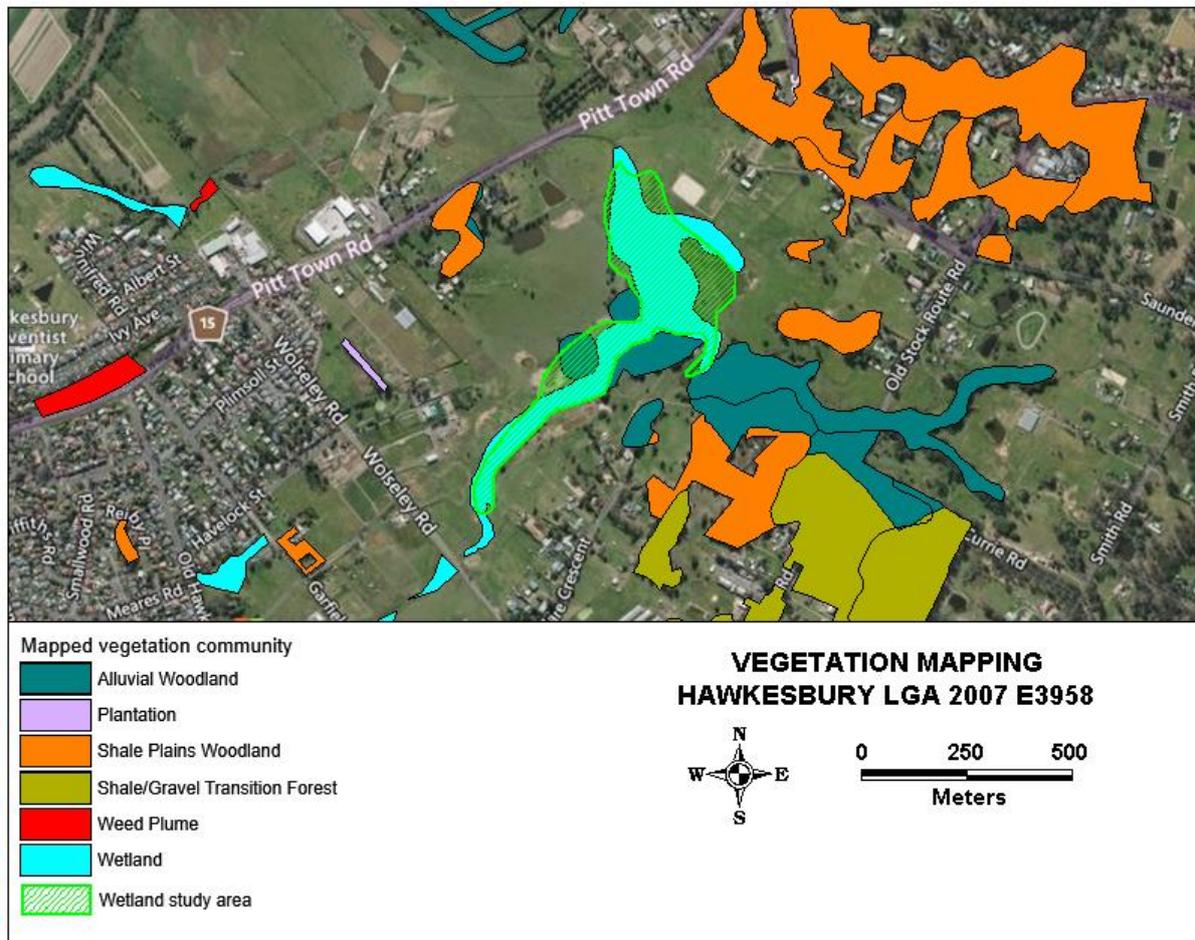
Priority weed

ASSETS 01/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	<10	<i>Digitaria parviflora</i>
<i>Bolboschoenus caldwellii</i>	<10	
<i>Azolla spp.</i>	10-25	
<i>Schoenoplectus validus</i>	10-25	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca styphelioides</i>	<i>None noted</i>	<i>None noted</i>
<i>Casuarina glauca</i>		

Fauna noted: Black Swan, Australian Pelican, Pacific Black Duck, Australian Wood Duck, Eurasian Coot, Eastern Great Egret, Australasian Swamphen, Dusky Moorhen, Masked Lapwing, cattle, horses

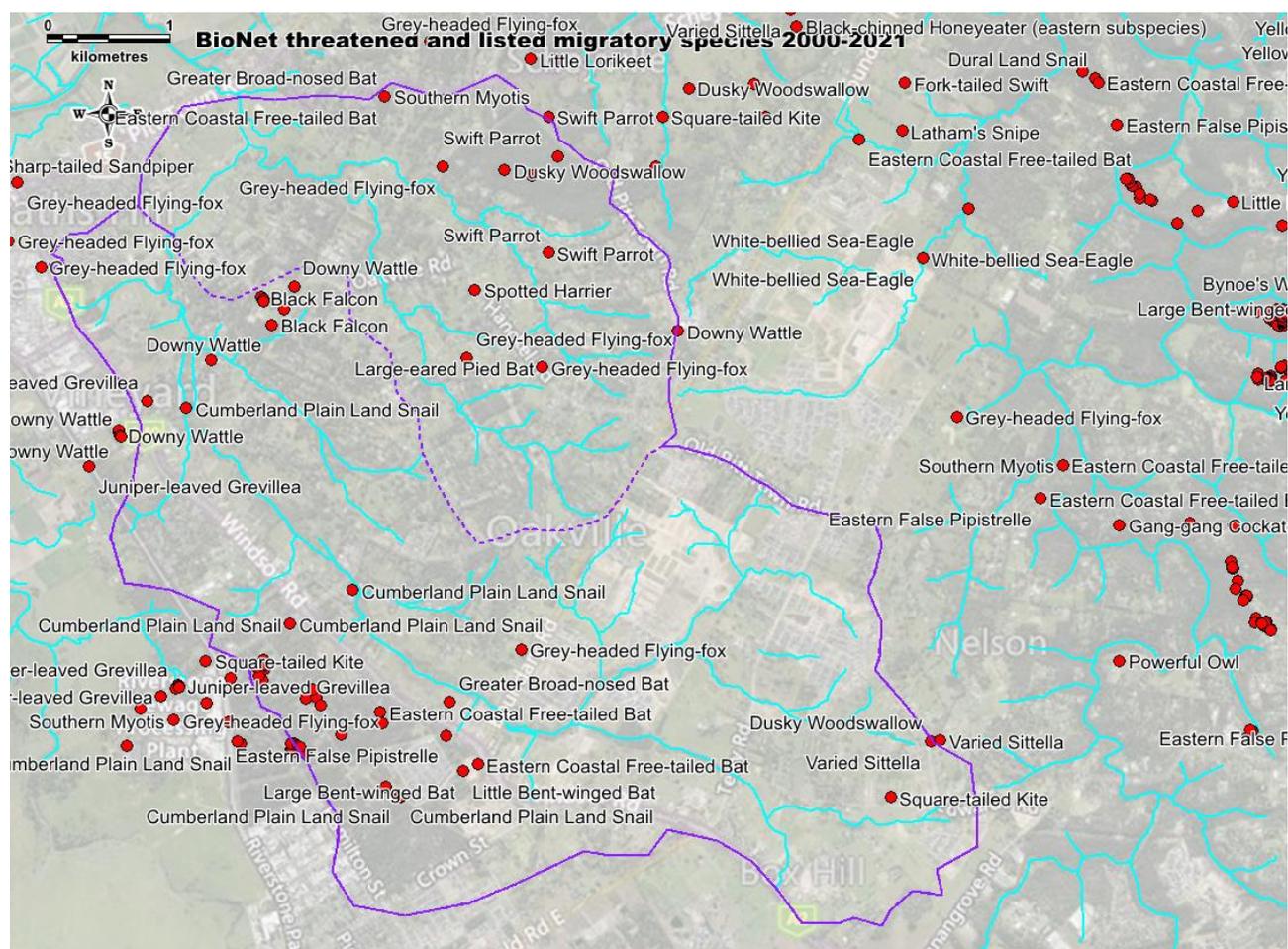
VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	>75
bushland	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Spotted Harrier	<i>Circus assimilis</i>	V,P		1
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	5
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		2
Aves	Black Falcon	<i>Falco subniger</i>	V,P		2
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		1
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		2
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	4
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		6
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		1
Mammalia	Large-eared Pied Bat	<i>Chalinolobus dwyeri</i>	V,P	V	2
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		2
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		4
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		4
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		5
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		12
Flora		<i>Dillwynia tenuifolia</i>	V		11

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Flora		<i>Pultenaea parviflora</i>	E1	V	12
Flora	Downy Wattle	<i>Acacia pubescens</i>	V	V	3
Flora	Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	V		10



IMAGE 1 Australian Pelicans share the wetland with grazing cattle



IMAGE 2 & 3 Pacific Black Ducks and Eurasian Coots are common on the wetland



IMAGE 4 & 5 Eastern Great Egrets and Dusky Moorhens forage through the Alligator Weed



IMAGE 6 A nesting Black Swan is watched from a distance by the landholders



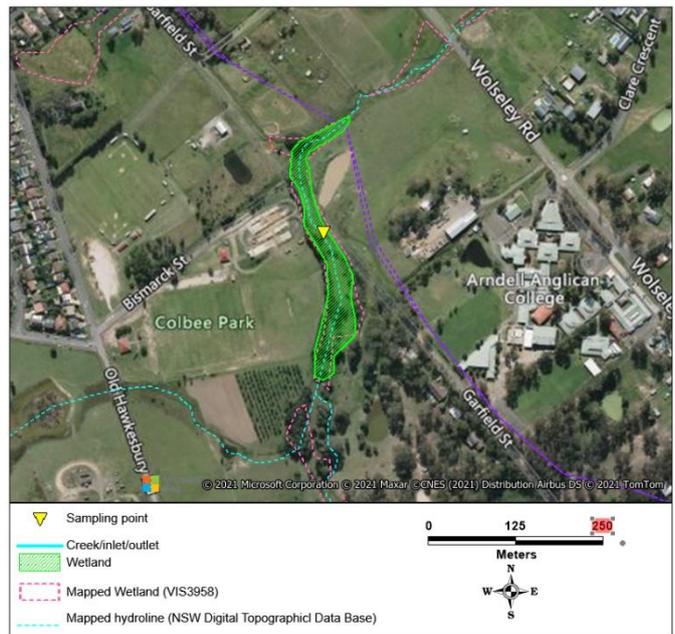
IMAGE 7 Australian Wood Ducks and Masked Lapwings graze on the mown grass

McKENZIES WEST/KILLARNEY CHAIN OF PONDS

Overall Score (0-10) **4.4**

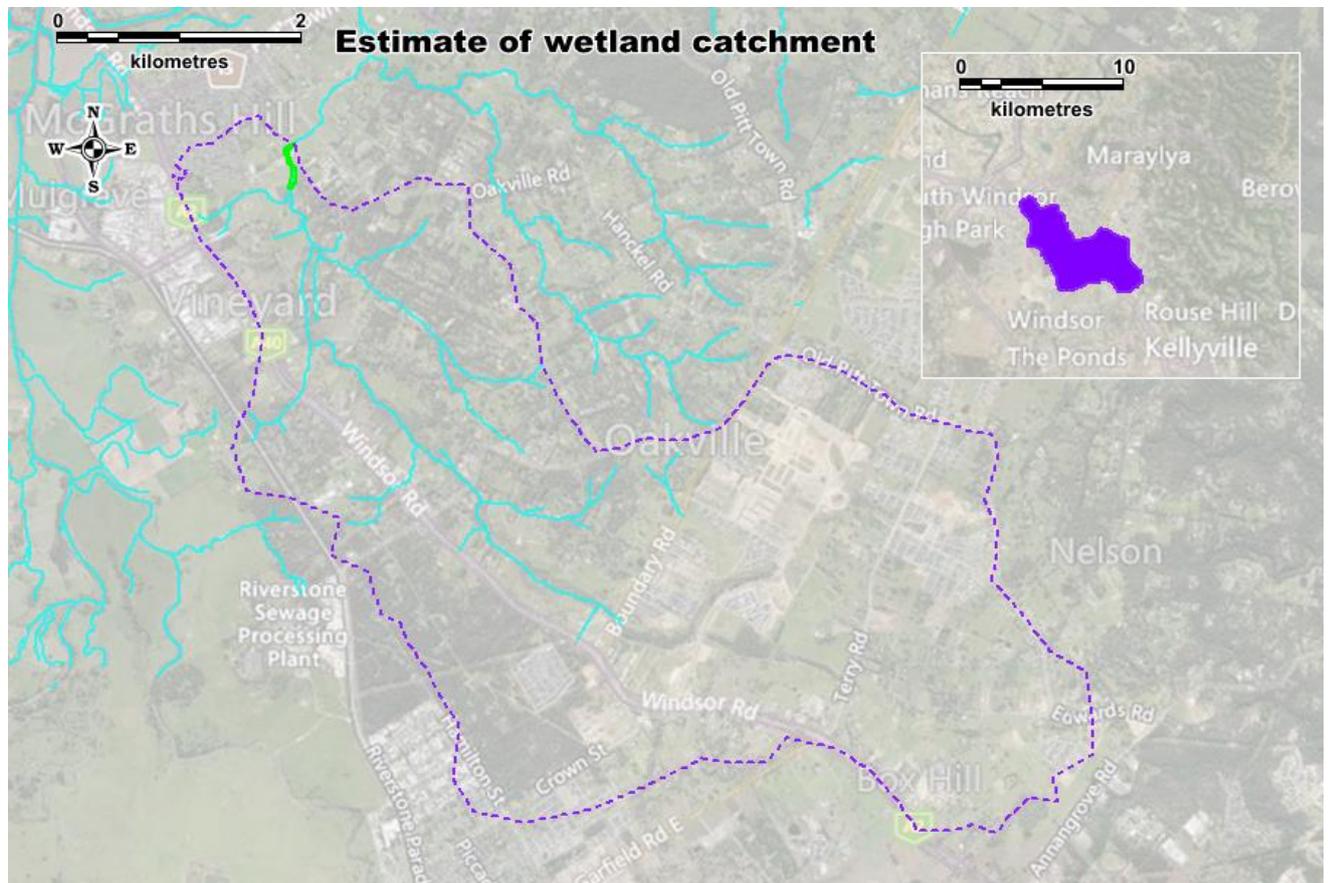
Latitude	██████
Longitude	██████
Address	Colbee Park, Old Hawkesbury Rd, McGraths Hill
Catchment (ha)	2171

Wetland category	natural	modified
Water quality		poor
Site features Landuse		4.2
Site features offsite issues		7.3
Site features onsite issues		1.0
Vegetation		4.1
Habitat features -surrounds		5.0
Habitat features -wetland		5.0
Bank undercutting		5.0
Bank collapse		5.0



MAP 1 Wetland and sampling location

The wetland is a shallow degraded swamp surrounded by small areas of forested wetland and large stands of fringing macrophytes. Surrounding land use is mainly urban residential development with areas of small acreage holdings and grazed pastures.



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 15/03/2021: (left) reveg planting lines the bank behind Colbee Park, (top right) the outflow channel flows through grazed paddocks, (bottom right) dense beds of macrophytes are common

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Cenchrus clandestinus</i>	10-25
<i>Cynodon dactylon</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Lactuca serriola</i>	<10
<i>Bidens pilosa</i>	<10
<i>Araujia sericifera</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Salvinia molesta</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control environmental weeds
 - Fence the wetland, restrict grazing and establish offline watering points
 - Revegetate banks to improve overall health and condition

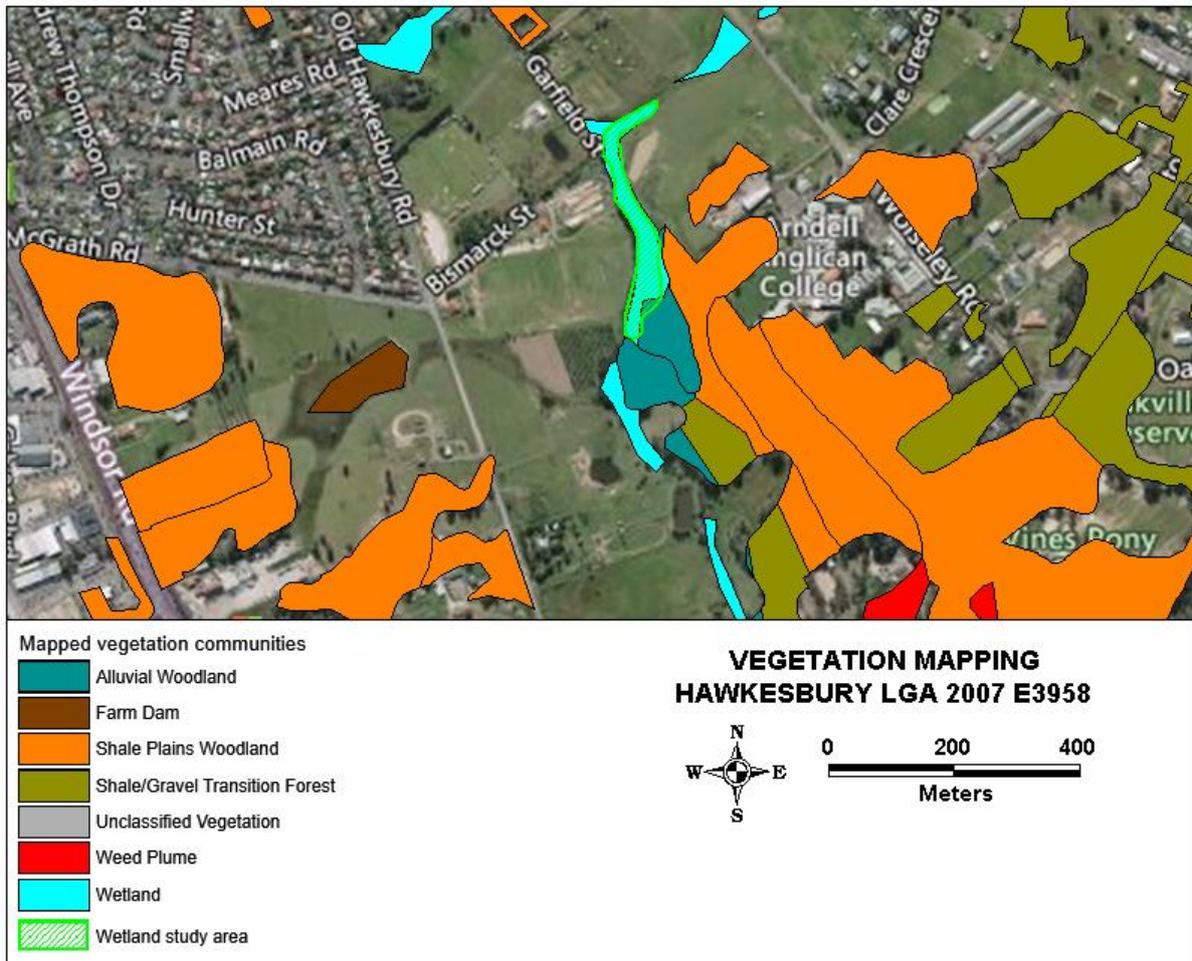
Priority weed – none noted

ASSETS 15/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	<10	<i>Paspalum distichum</i>
<i>Phragmites australis</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Acacia parramattensis</i>	<i>Juncus usitatus</i>

Fauna noted: Pacific Black Duck, Australasian Grebe

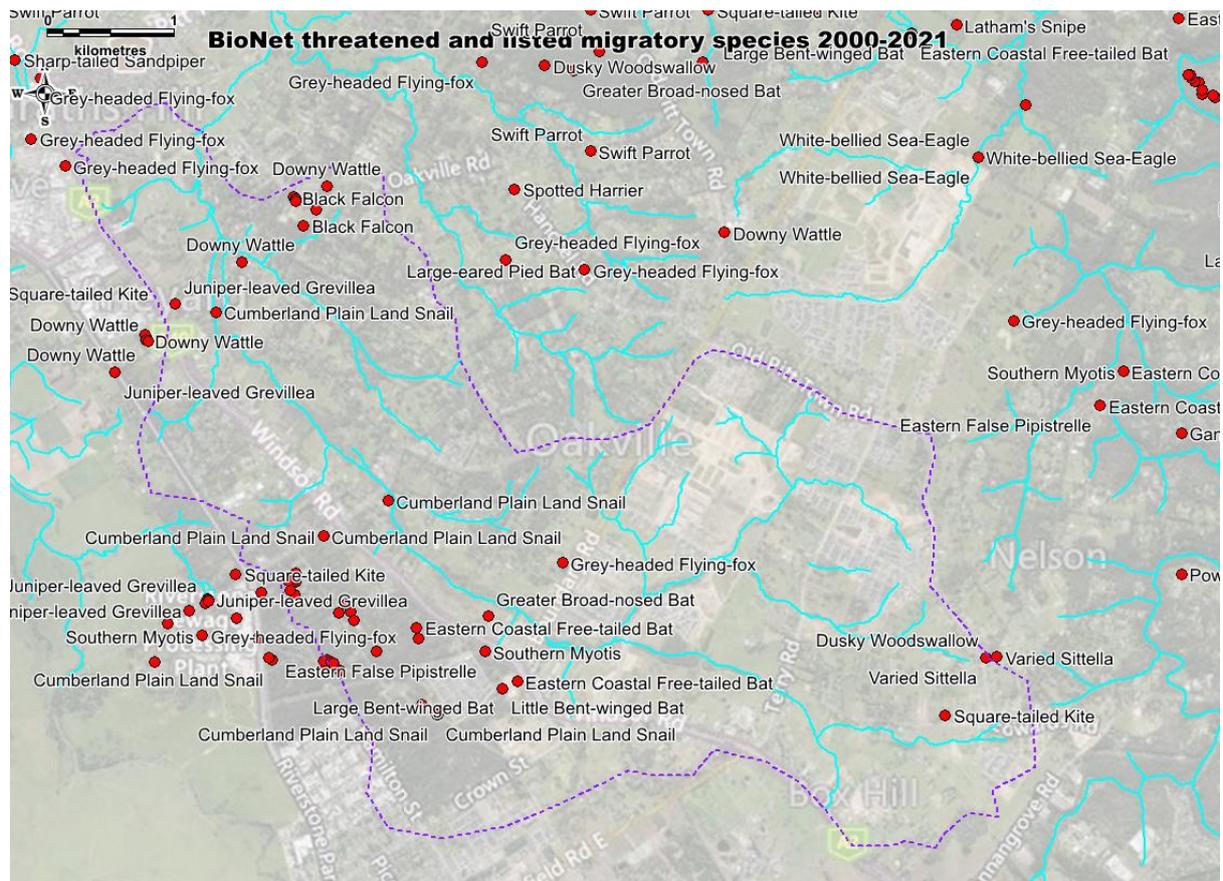
VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	50-75
sportfield/park	10-25
peri-urban mixed	10-25



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Black Falcon	<i>Falco subniger</i>	V,P		2
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		1
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	1
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		3
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		1
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		4
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		10
Flora		<i>Dillwynia tenuifolia</i>	V		11
Flora		<i>Pultanea parviflora</i>	E1	V	12
Flora	Downy Wattle	<i>Acacia pubescens</i>	V	V	3
Flora	Juniper-leaved Grevillea	<i>Grevillea juniperina subsp. juniperina</i>	V		10

PITT TOWN FERRY ROAD A

Overall Score (0-10) **6.4**

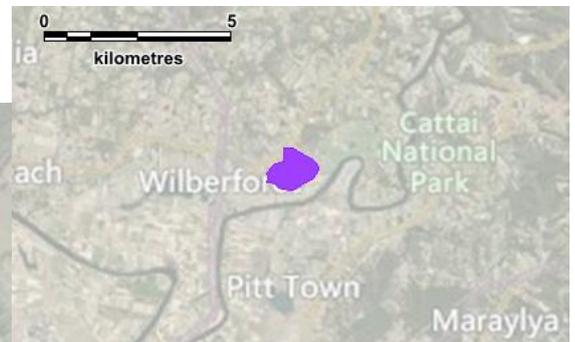
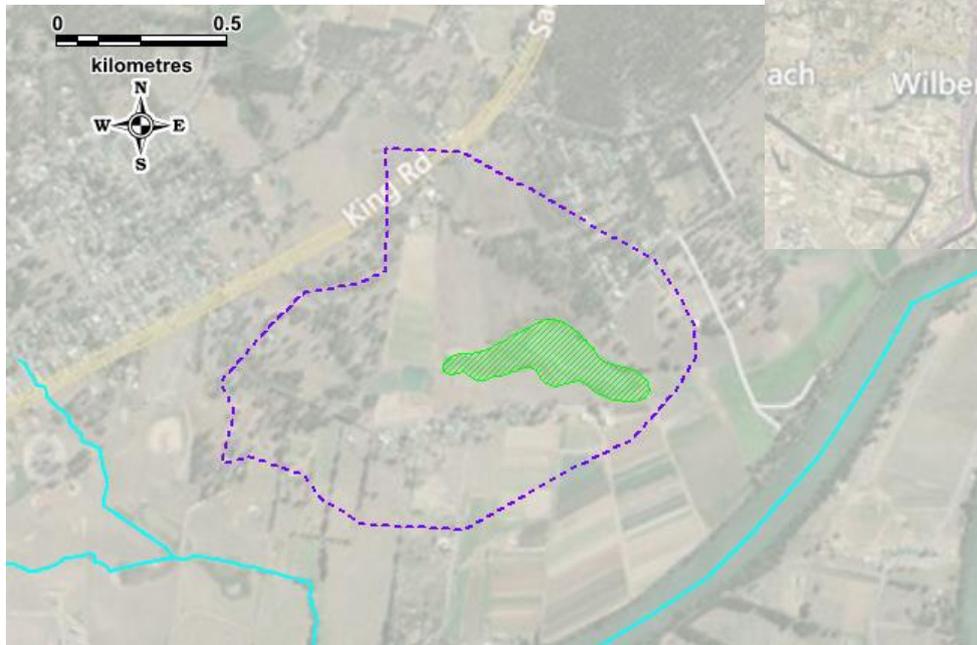
Latitude	██████████
Longitude	██████████
Address	Ferry Road, Wilberforce
Catchment (ha)	97

Wetland category	natural
Water quality	fair
Site features Landuse	5.5
Site features offsite issues	9.1
Site features onsite issues	3.0
Vegetation	7.5
Habitat features -surrounds	5.0
Habitat features -wetland	6.5
Bank undercutting	5.0
Bank collapse	5.0



The wetland is a shallow sedge swamp with open water areas, and some revegetation planting on the southern edge. Surrounding land use is mainly small acreage properties and urban residential development. This wetland has no obvious surface outflow.

MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 07/02/2021: (left) upstream end of wetland is grazed, (right) downstream end of wetland is more urbanised but also grazed

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Rubus fruticosus aggregate species</i>	<10
<i>Paspalum dilatatum</i>	25-50
<i>Senecio madagascariensis</i>	<10
<i>Conyza sp.</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Plantago lanceolata</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Ligustrum sinense</i>	<10
<i>Paspalum urvillei</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds
- Restrict grazing around wetland, establish offline watering points
- Revegetate banks to improve overall health and condition

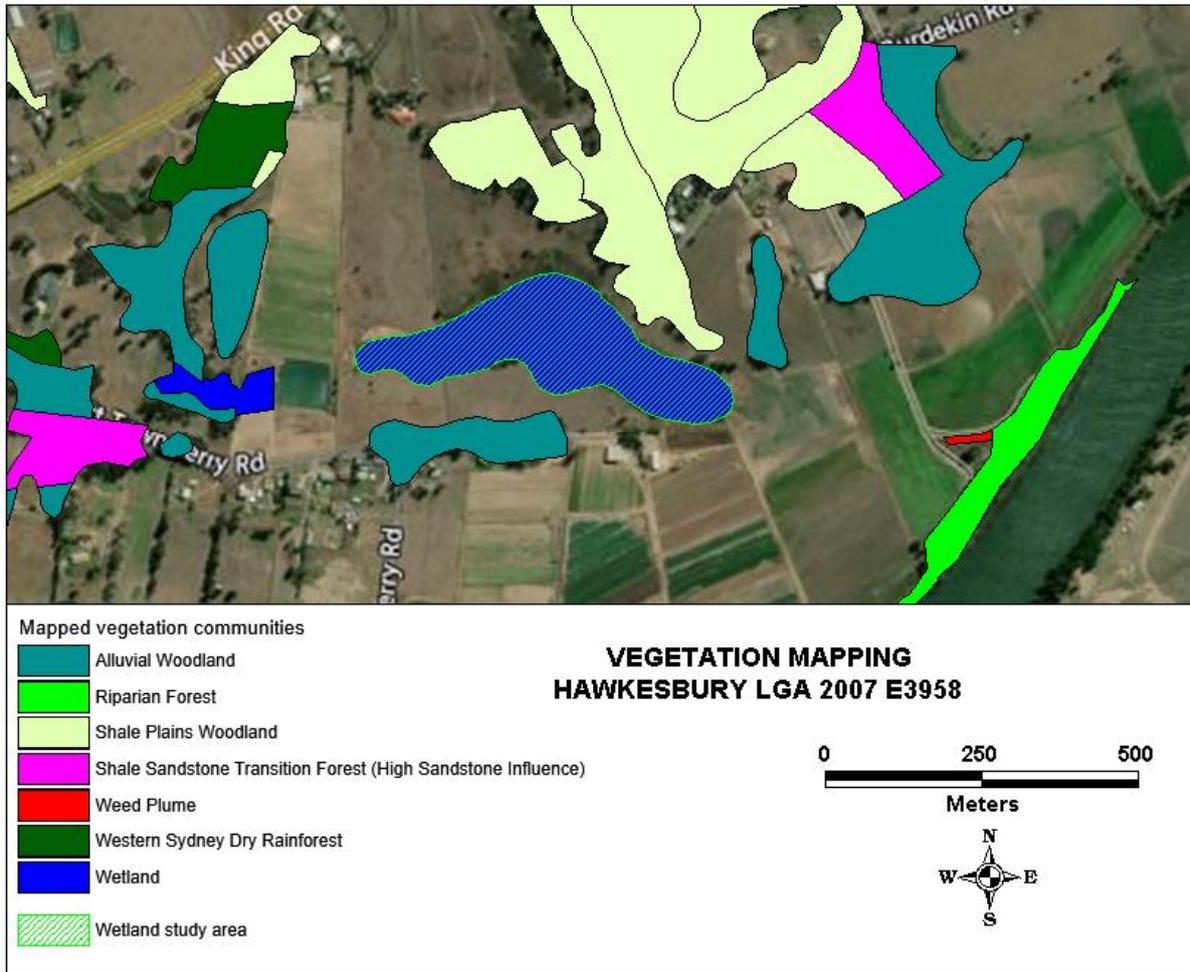
Priority weed

ASSETS 07/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Myriophyllum aquaticum</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Ludwigia peploides</i>	<10	<i>Hemarthria uncinata</i>
<i>Typha orientalis</i>	<10	
<i>Bolboschoenus caldwellii</i>	<10	
<i>Nymphaea spp.</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Callistemon citrinus</i>	<i>Centella asiatica</i>
<i>Casuarina glauca</i>	<i>Callistemon linearis</i>	
<i>Eucalyptus moluccana</i>	<i>Leptospermum juniperinum</i>	
	<i>Melaleuca ericifolia</i>	

Fauna noted: Australian Pelican, Black Swan, Chestnut Teal, Noisy Friarbird, Pacific Black Duck, Masked Lapwing

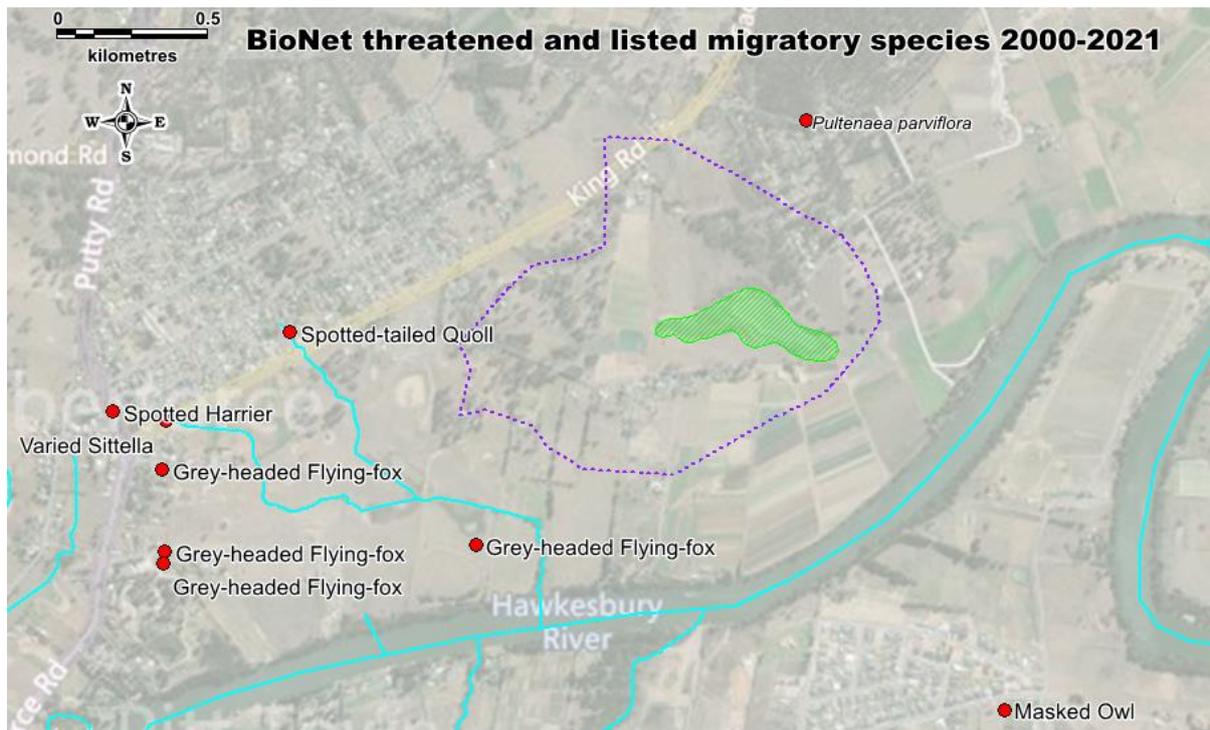
VEGETATION MAPPING AND LAND USE

Observed land use	%
peri-urban mixed	>75
bushland	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					



IMAGE 1 Pacific Black Ducks with fringing macrophytes in the background



IMAGE 2 & 3 (left) Chestnut Teal, (right) Black Swan



IMAGE 4 & 5 (left) Masked Lapwings, (right) Australian Pelican pair



IMAGE 6 Fringing vegetation creates habitat for a range of birds and animals around the wetland

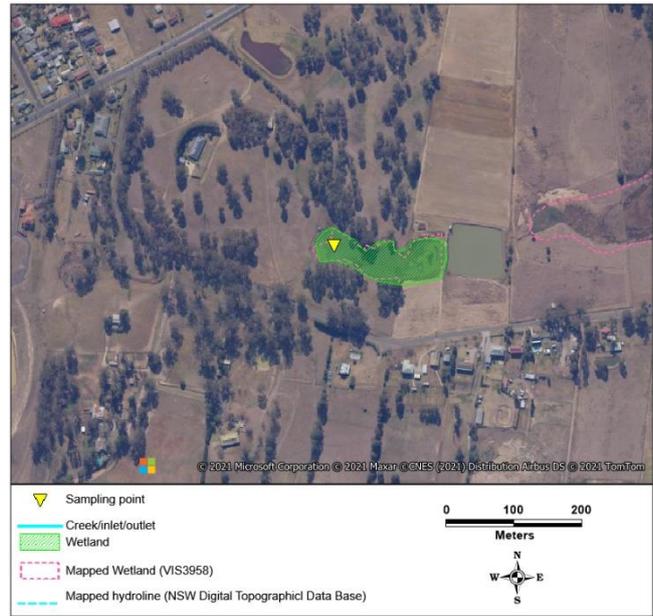
PITT TOWN FERRY ROAD B

Overall Score (0-10)	4.9
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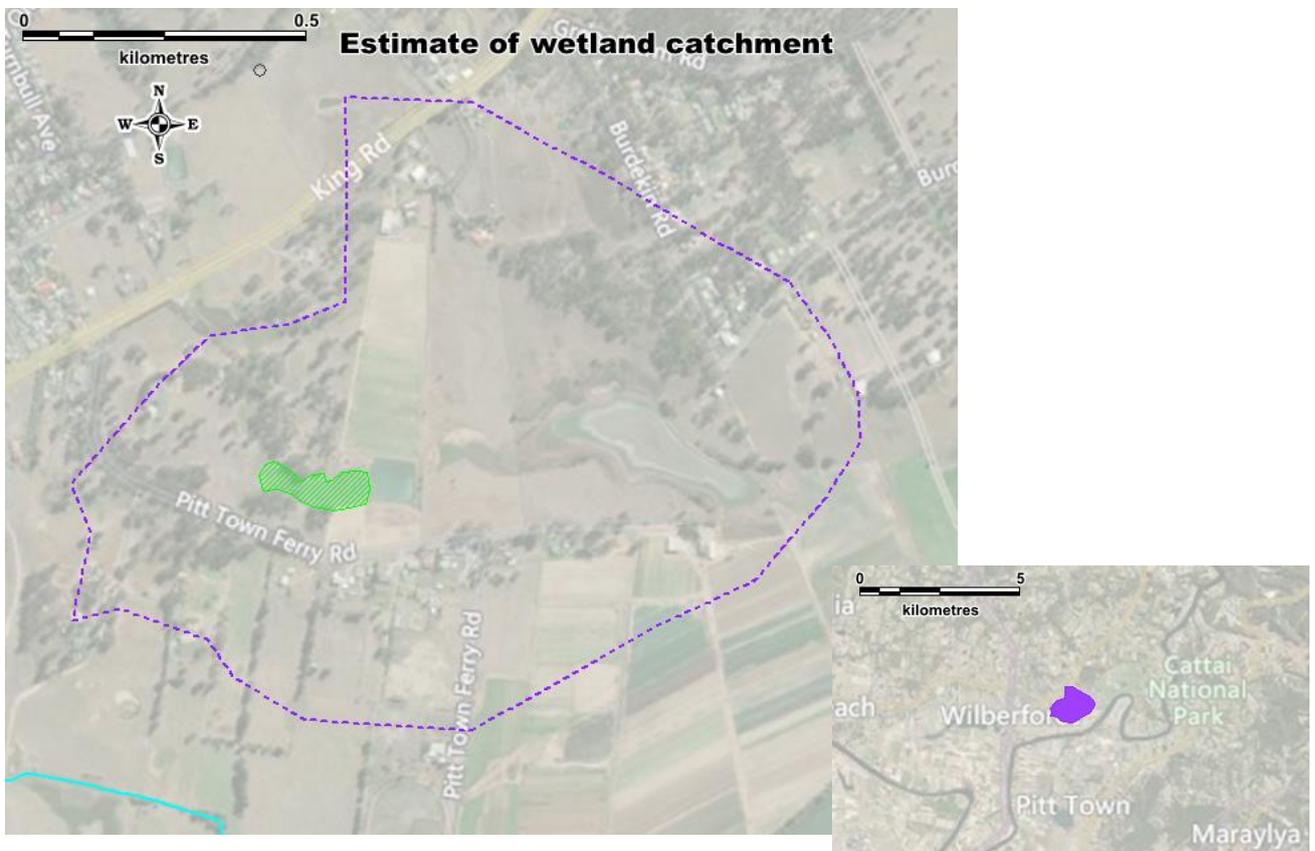
Latitude	██████████
Longitude	██████████
Address	Ferry Road, Wilberforce
Catchment (ha)	97 (combined with Pitt town A)

Wetland category	natural	modified
Water quality		fair
Site features Landuse		6.6
Site features offsite issues		8.1
Site features onsite issues		3.0
Vegetation		3.3
Habitat features -surrounds		6.3
Habitat features -wetland		7.3
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a small open water swamp with dense swathes of floating macrophytes. Surrounding land use is mainly cleared and grazed pasture with small areas of forest vegetation and small acreage holdings.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 07/02/2021: (left) the wetland is surrounded by grazed pasture with areas of forest, (right) the dense swaths of floating macrophytes are moved from bank to bank by the wind and currents

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Rubus fruticosus aggregate species</i>	<10
<i>Paspalum dilatatum</i>	25-50
<i>Senecio madagascariensis</i>	<10
<i>Conyza sp.</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Plantago lanceolata</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Ligustrum sinense</i>	<10
<i>Paspalum urvillei</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Fence off wetland to restrict grazing, establish offline watering points
- Revegetate banks to improve overall health and condition

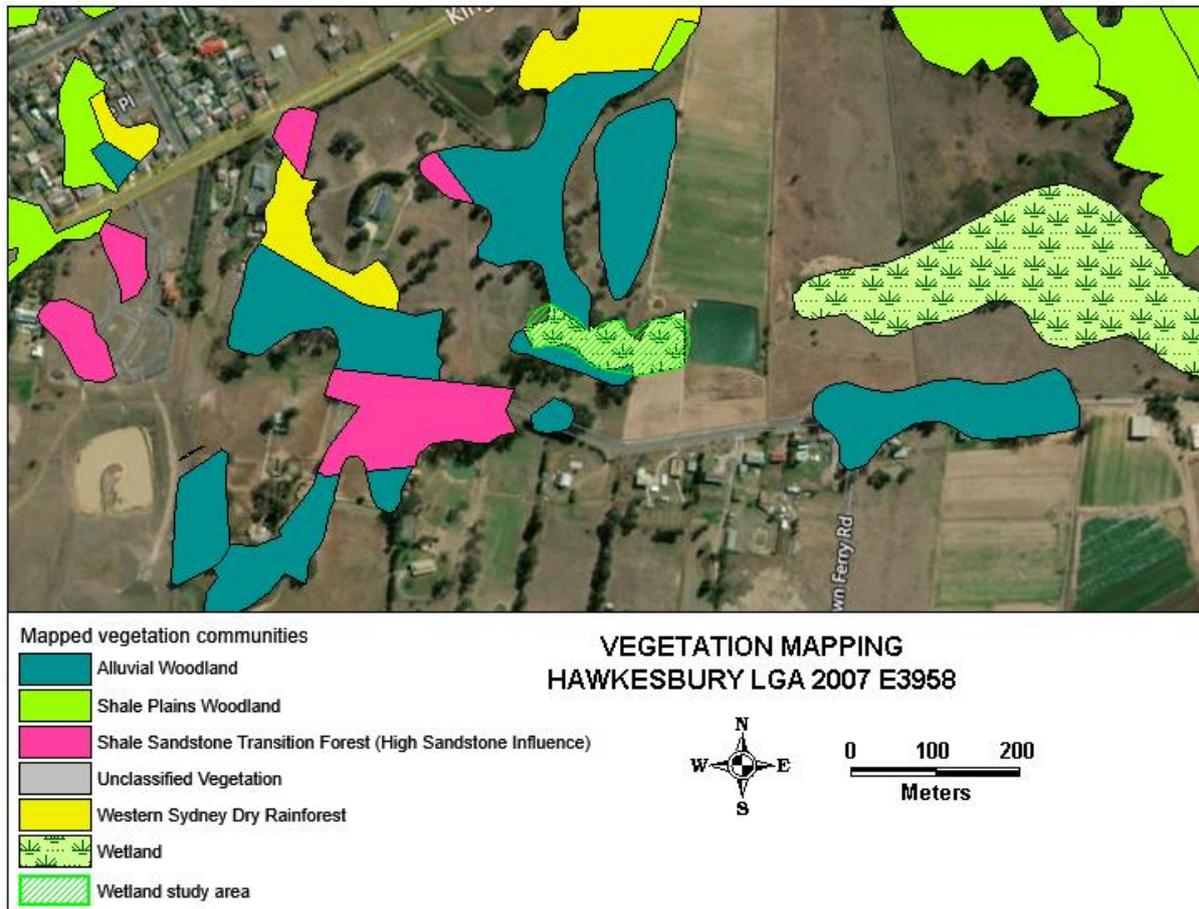
Priority weed

ASSETS 07/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Myriophyllum aquaticum</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Ludwigia peploides</i>	<10	<i>Hemarthria uncinata</i>
<i>Typha orientalis</i>	<10	
<i>Bolboschoenus caldwellii</i>	<10	
<i>Nymphaea spp.</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus tereticornis</i>	<i>Callistemon citrinus</i>	<i>Centella asiatica</i>
<i>Casuarina glauca</i>	<i>Callistemon linearis</i>	
<i>Eucalyptus moluccana</i>	<i>Leptospermum juniperinum</i>	
	<i>Melaleuca ericifolia</i>	

Fauna noted: Australian Pelican, Black Swan, Chestnut Teal, Noisy Friarbird, Pacific Black Duck, Masked Lapwing

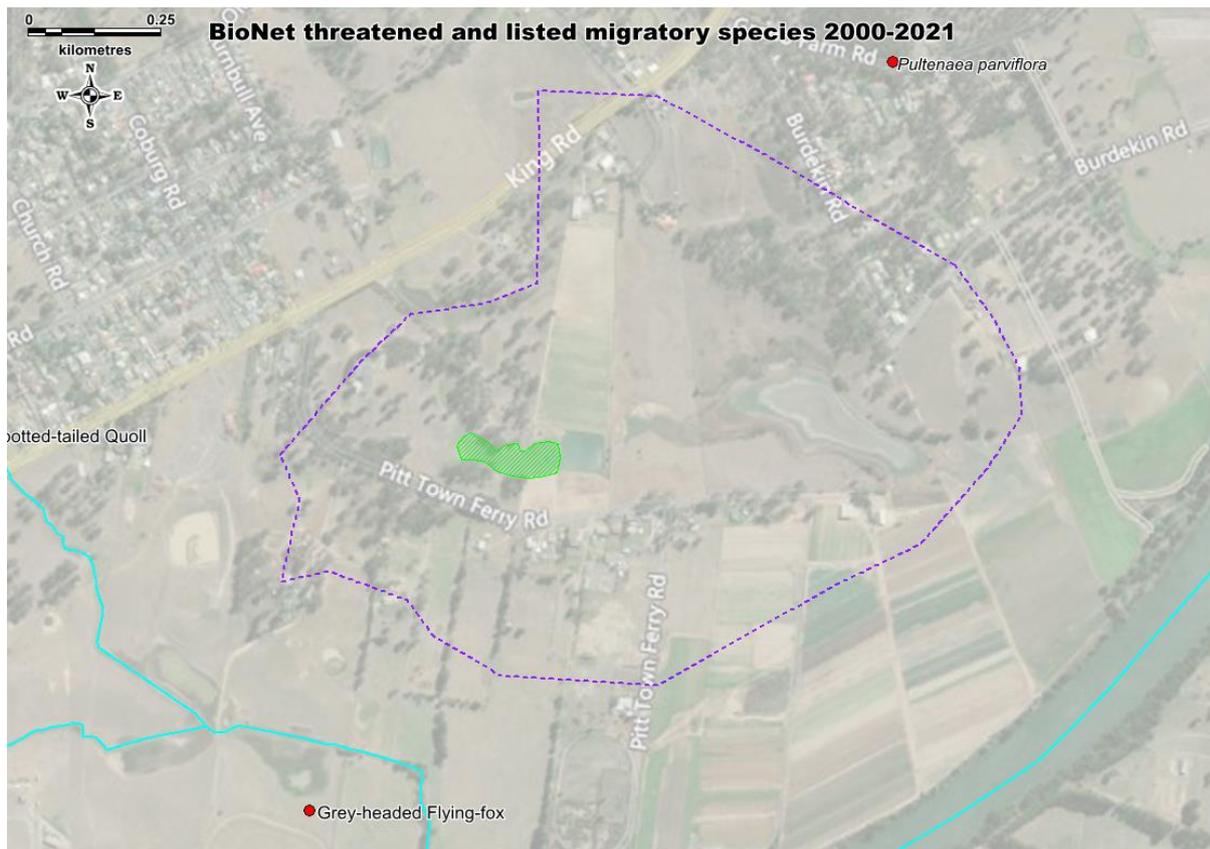
VEGETATION MAPPING AND LAND USE

Observed land use	%
peri-urban mixed	>75
bushland	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					

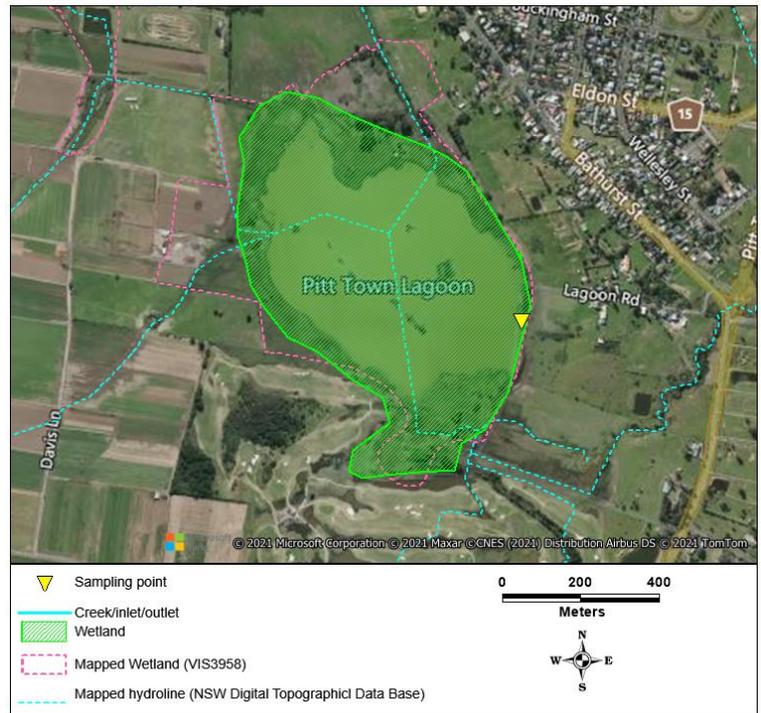
PITT TOWN LAGOON

Overall Score (0-10) **4.5**

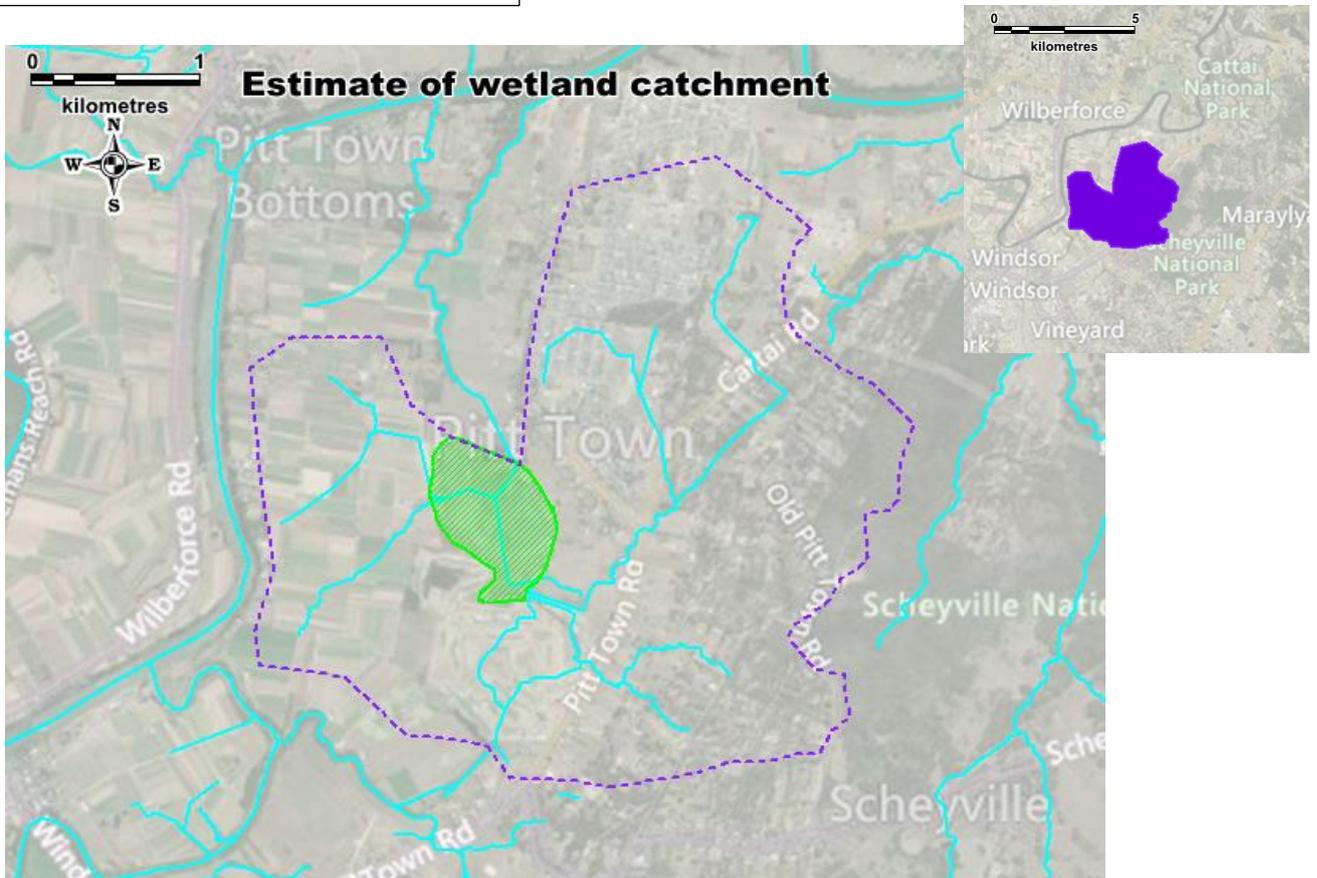
Latitude	-33.591423
Longitude	150.858684
Address	Pitt Town Bottoms
Catchment (ha)	940

Wetland category	natural modified
Water quality	Very poor
Site features Landuse	2.1
Site features offsite issues	5.6
Site features onsite issues	0.0
Vegetation	5.3
Habitat features -surrounds	3.8
Habitat features -wetland	7.0
Bank undercutting	5.0
Bank collapse	5.0

The wetland is very large open water lagoon with fringing macrophytes around most of its perimeter. Surrounding land use is cleared with small acreage holdings and urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 05/02/2021: (left) the lagoon has very large areas of open water (top right) islands provide bird habitat, (bottom right) urban development goes right to the water's edge in some places

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
WEED SPECIES (TOP 10)	DENSITY
<i>Cynodon dactylon</i>	<10
<i>Lactuca serriola</i>	<10
<i>Conyza sp.</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Plantago lanceolata</i>	<10
<i>Cotula coronopifolia</i>	<10
<i>Polygonum aviculare</i>	<10

Recommended works:

- Control of environmental weeds to prevent spread to downstream areas
- Restrict grazing, consider offline watering points as appropriate
- Revegetate surrounding banks to improve overall health and condition

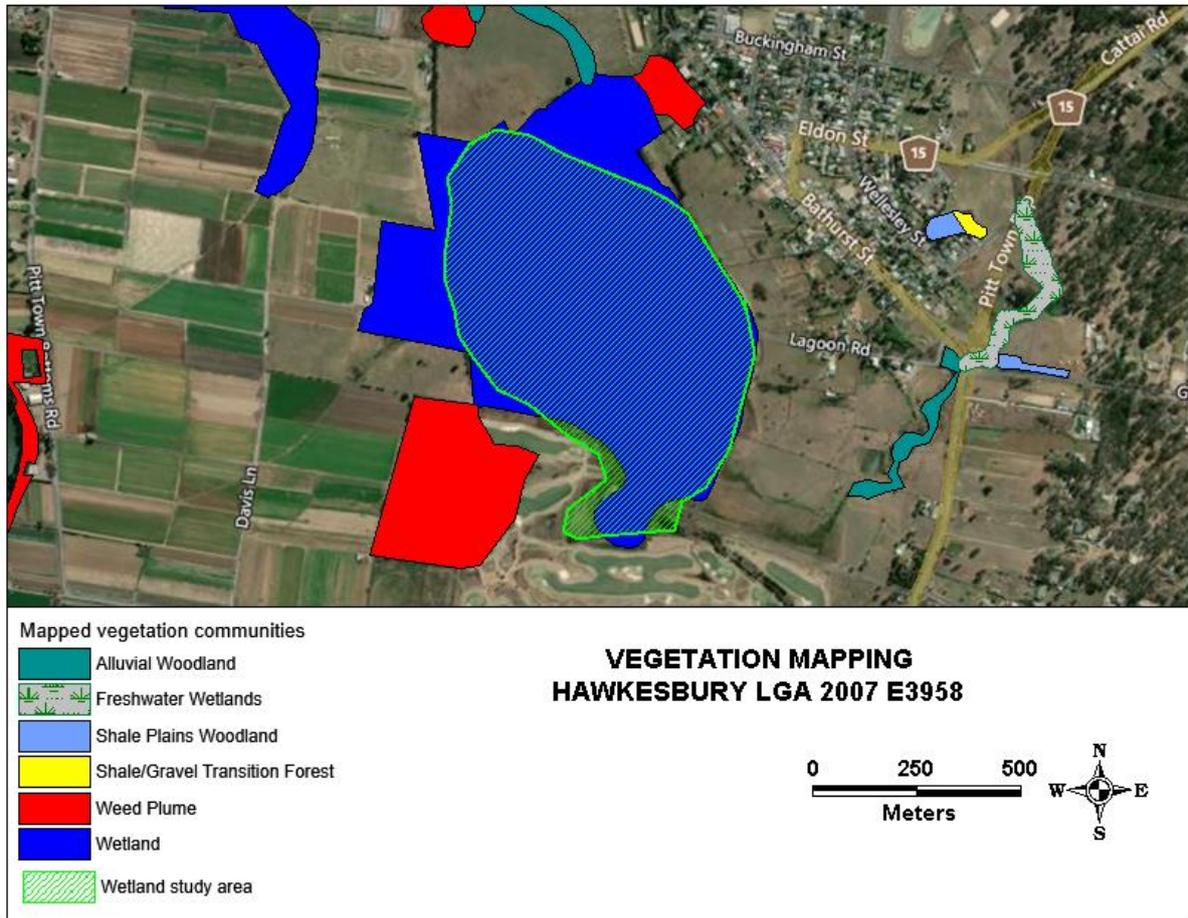
Priority weed – none noted

ASSETS 05/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	<10%	<i>Paspalum distichum</i>
<i>Myriophyllum aquaticum</i>	<10%	
<i>Phragmites australis</i>	<10%	
<i>Bolboschoenus caldwellii</i>	<10%	
<i>Lemna spp.</i>	<10%	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Persicaria lapathifolia</i>	<i>Atriplex semibaccata</i>
		<i>Centella asiatica</i>
		<i>Juncus usitatus</i>
		<i>Alternanthera denticulata</i>

Fauna noted: Willie Wagtail, Black-fronted Dotterel, Australian Pelican, Australian Wood Duck, Pacific Black Duck, Little Pied Cormorant, Australasian Darter, Purple Swamphen, Masked Lapwing, Little Black Cormorant, Cattle Egret, Intermediate Egret

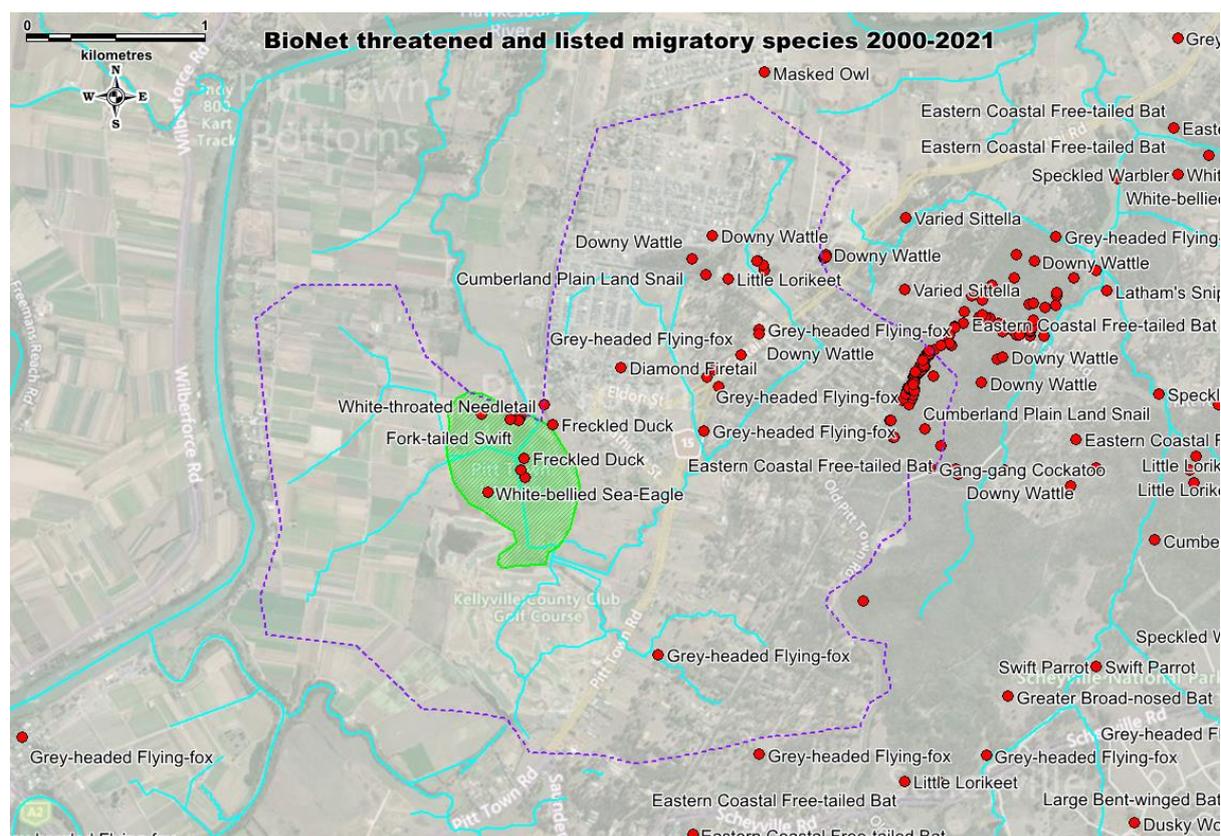
VEGETATION MAPPING AND LAND USE

Observed land use	%
market gardens	50-75
peri-urban mixed	25-50



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Freckled Duck	<i>Stictonetta naevosa</i>	V,P		2
Aves	Fork-tailed Swift	<i>Apus pacificus</i>	P	C,J,K	1
Aves	White-throated Needletail	<i>Hirundapus caudacutus</i>	P	V,C,J,K	2
Aves	Australasian Bittern	<i>Botaurus poiciloptilus</i>	E1,P	E	1
Aves	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V,P		5
Aves	Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	P	C,J,K	2
Aves	Red-necked Stint	<i>Calidris ruficollis</i>	P	C,J,K	1
Aves	Ruff	<i>Philomachus pugnax</i>	P	C,J,K	1
Aves	Marsh Sandpiper	<i>Tringa stagnatilis</i>	P	C,J,K	2
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		1
Aves	Masked Owl	<i>Tyto novaehollandiae</i>	V,P,3		1
Aves	Diamond Firetail	<i>Stagonopleura guttata</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	5
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		3
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		2
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		2
Flora		<i>Dillwynia tenuifolia</i>	V		11
Flora		<i>Pultenaea parviflora</i>	E1	V	59
Flora	Downy Wattle	<i>Acacia pubescens</i>	V	V	9



IMAGE 1 Australian Pelicans were common on the lagoon



IMAGE 2 Purple Swamphens foraging in fringing vegetation



IMAGE 3 Cattle Egrets perched on old fence posts



IMAGE 4 Intermediate Egrets foraged along the foreshore while Little Black Cormorants perched on fence posts

PUGHES LAGOON

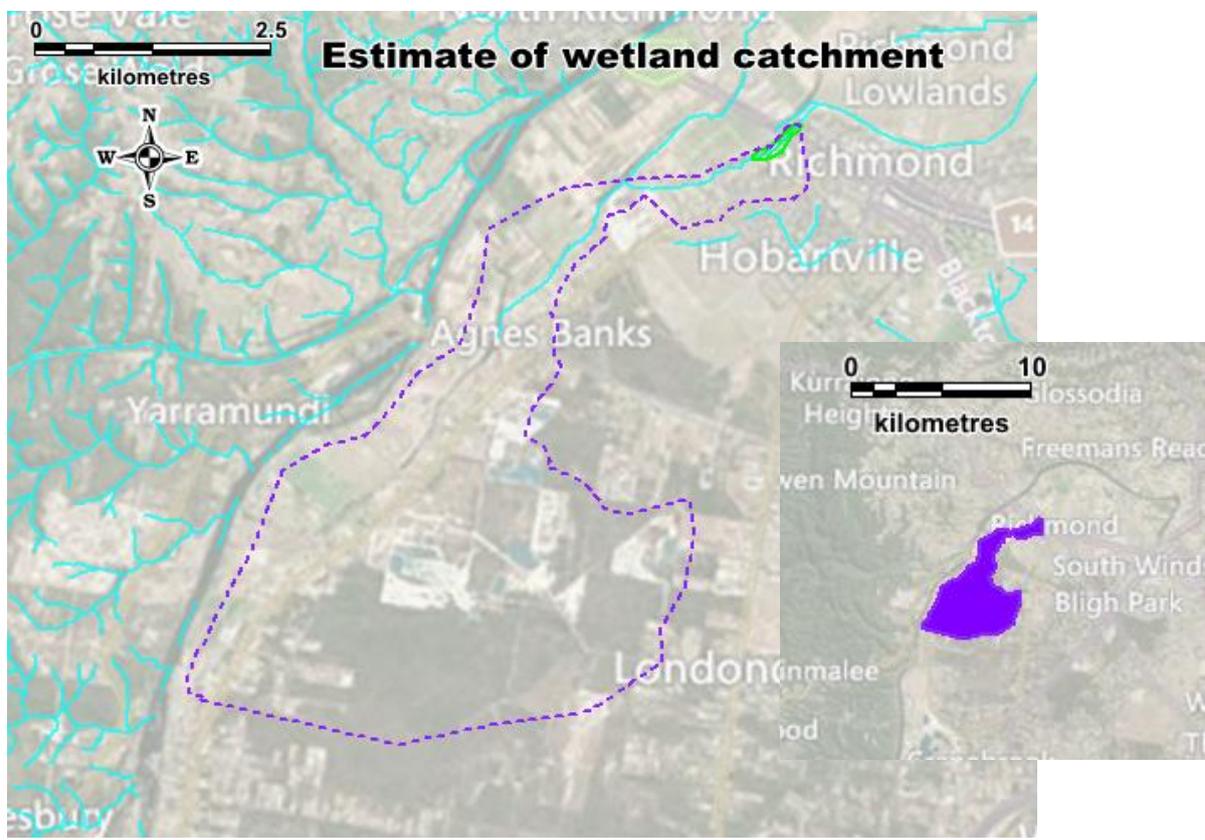
Overall Score (0-10) **4.3**

Latitude	-33.593259
Longitude	150.742135
Address	Old Kurrajong Rd, Windsor
Catchment (ha)	1697

Wetland category	natural	modified
Water quality		fair
Site features Landuse		3.8
Site features offsite issues		2.8
Site features onsite issues		3.0
Vegetation		4.3
Habitat features -surrounds		6.3
Habitat features -wetland		7.7
Bank undercutting		0.0
Bank collapse		5.0



The wetland is a series of connected shallow open water ponds surrounded by cleared paddocks and peri urban or urban residential development. The main lagoon is within a public reserve and regularly visited for fishing and bird watching.





IMAGES 05/03/2021: (left) one of the larger lagoons surrounded by macrophytes, (top right) recreational use includes fishing, (bottom right) revegetation planting

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum dilatatum</i>	10-25
<i>Cenchrus clandestinus</i>	10-25
<i>Cynodon dactylon</i>	10-25
<i>Sida rhombifolia</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Solanum nigrum</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Salix babylonica</i>	<10
<i>Ulmus parviflora</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Restrict grazing, establish offline watering points
- Revegetate surrounding banks and restrict extraction for irrigation

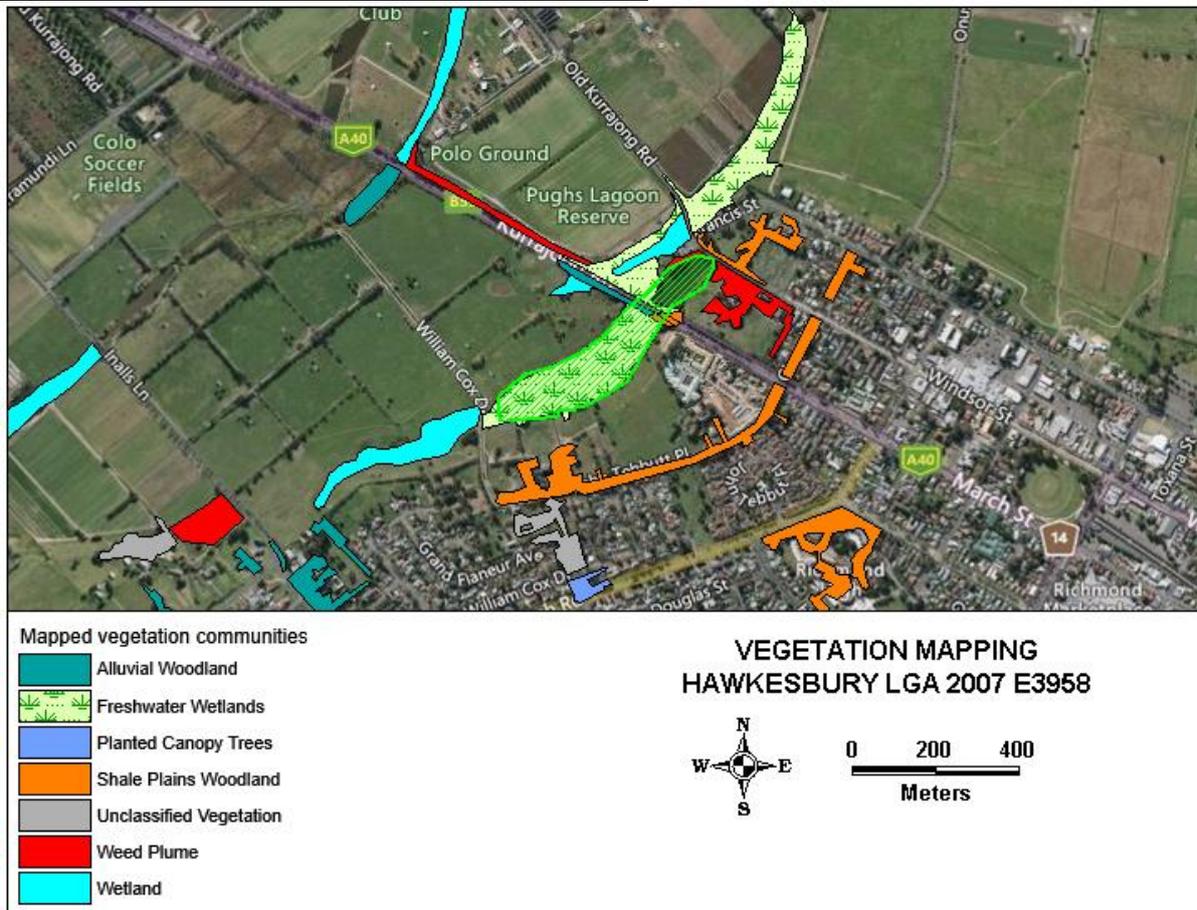
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	<10	<i>Oplismenus aemulus</i>
<i>Phragmites australis</i>	<10	<i>Microlaena stipoides</i>
<i>Bolboschoenus caldwellii</i>	<10	<i>Digitaria parviflora</i>
<i>Lemna spp.</i>	<10	<i>Entolasia marginata</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Leptospermum juniperinum</i>	<i>Centella asiatica</i>
<i>Angophora floribunda</i>	<i>Callistemon citrinus</i>	<i>Dichondra repens</i>
<i>Syncarpia glomulifera</i>	<i>Acacia parramattensis</i>	<i>Desmodium varians</i>
<i>Eucalyptus amplifolia</i>	<i>Persicaria lapathifolia</i>	<i>Juncus usitatus</i>

Fauna noted: Pacific Black Duck, Eurasian Coot, Dusky Moorhen, Australian Wood Duck, Grey Teal, Little Black Cormorant, Australasian Grebe, Greylag Goose, Pekin Duck

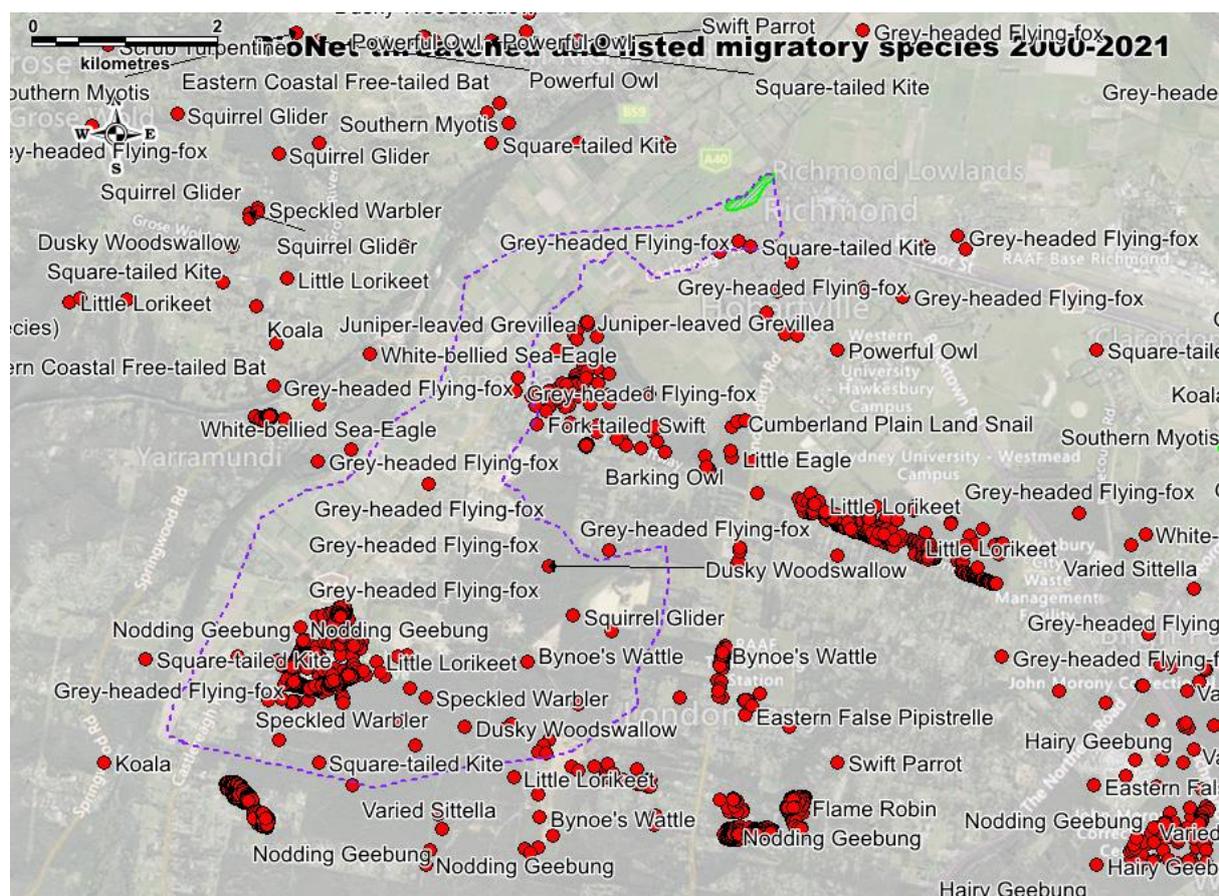
VEGETATION MAPPING AND LAND USE

Observed land use	%
market gardens	10-25
pasture/grazing	50-75
peri-urban mixed	10-25
sportfield/park	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Com m Status	Coun t
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		2
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		1
Aves	Masked Owl	<i>Tyto novaehollandiae</i>	V,P,3		1
Aves	Speckled Warbler	<i>Chthonicola sagittata</i>	V,P		2
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		6
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		3
Mammalia	Squirrel Glider	<i>Petaurus norfolcensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	24
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		6
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		5
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		7
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		1
Flora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool	<i>Marsdenia viridiflora subsp. viridiflora</i>	E2		1

	and Penrith local government areas				
Flora		<i>Allocasuarina glareicola</i>	E1	E	2
Flora		<i>Dillwynia tenuifolia</i>	V		16
Flora	Bynoe's Wattle	<i>Acacia bynoeana</i>	E1	V	3
Flora		<i>Micromyrtus minutiflora</i>	E1	V	8
Flora	Juniper-leaved Grevillea	<i>Grevillea juniperina subsp. juniperina</i>	V		1
Flora	Hairy Geebung	<i>Persoonia hirsuta</i>	E1,P,3	E	1
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	630



Image 1 East side with a mix of native and domestic species of water fowl



Image 2-3 Chestnut Teal (left), Little Black Cormorant (right)

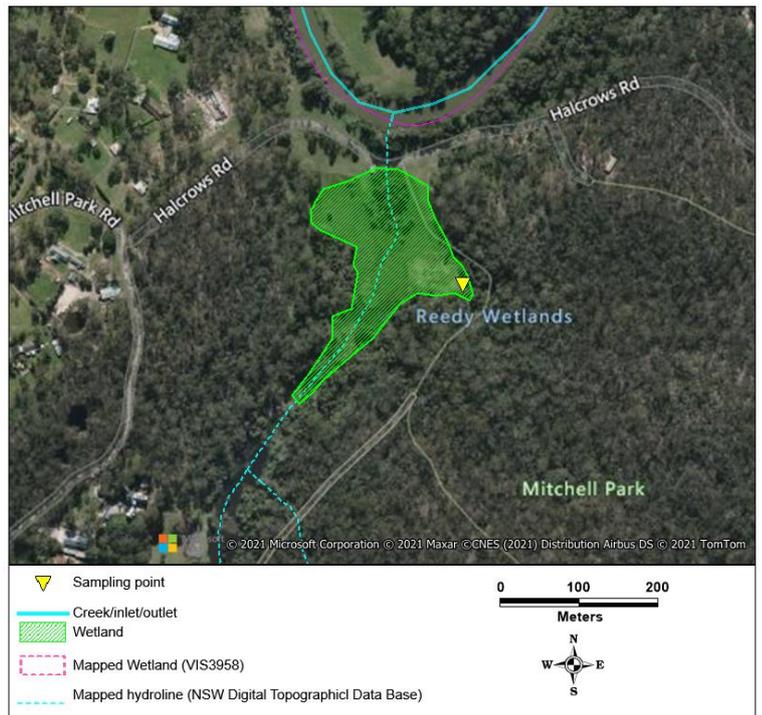
REEDY SWAMP

Overall Score (0-10) 8.5

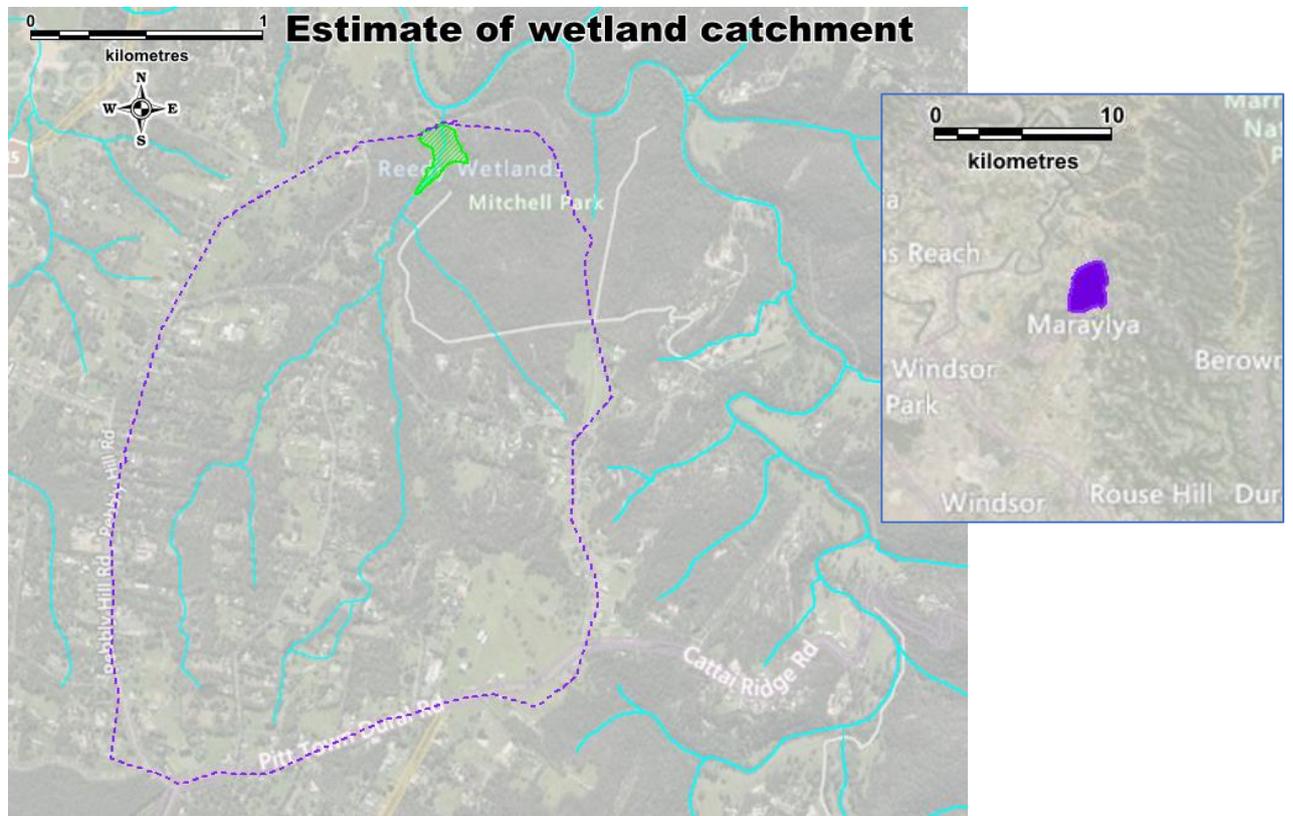
Latitude	-33.563248
Longitude	150.923338
Address	Mitchell Park Cattai
Catchment (ha)	469

Wetland category	natural
Water quality	fair
Site features Landuse	10.0
Site features offsite issues	8.1
Site features onsite issues	10.0
Vegetation	7.5
Habitat features -surrounds	10.0
Habitat features -wetland	7.0
Bank undercutting	10.0
Bank collapse	10.0

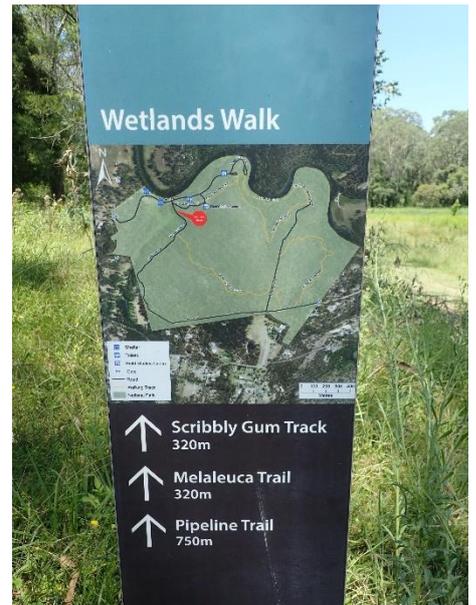
The wetland is a shallow sedge swamp surrounded by forested wetland that is constantly fed by drainage from a large catchment. Surrounding land use is mainly forested with areas of pasture and peri urban or urban residential development. It is currently managed by NPWS.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 05/02/2021: (left) the wetland is a mosaic of dense sedges and reeds, with paperbark swamp surrounding the lower edges, (right) the site is managed by NPWS and has walking trails and signage

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Conyza sp.</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Solanum pseudocapsicum</i>	<10
<i>Solanum mauritianum</i>	<10
<i>Paspalum dilatatum</i>	<10
<i>Rumex obtusifolius</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control of environmental weeds to prevent spread to downstream areas
 - Maintain existing overall good condition
 - Monitor for degrading impacts from upstream

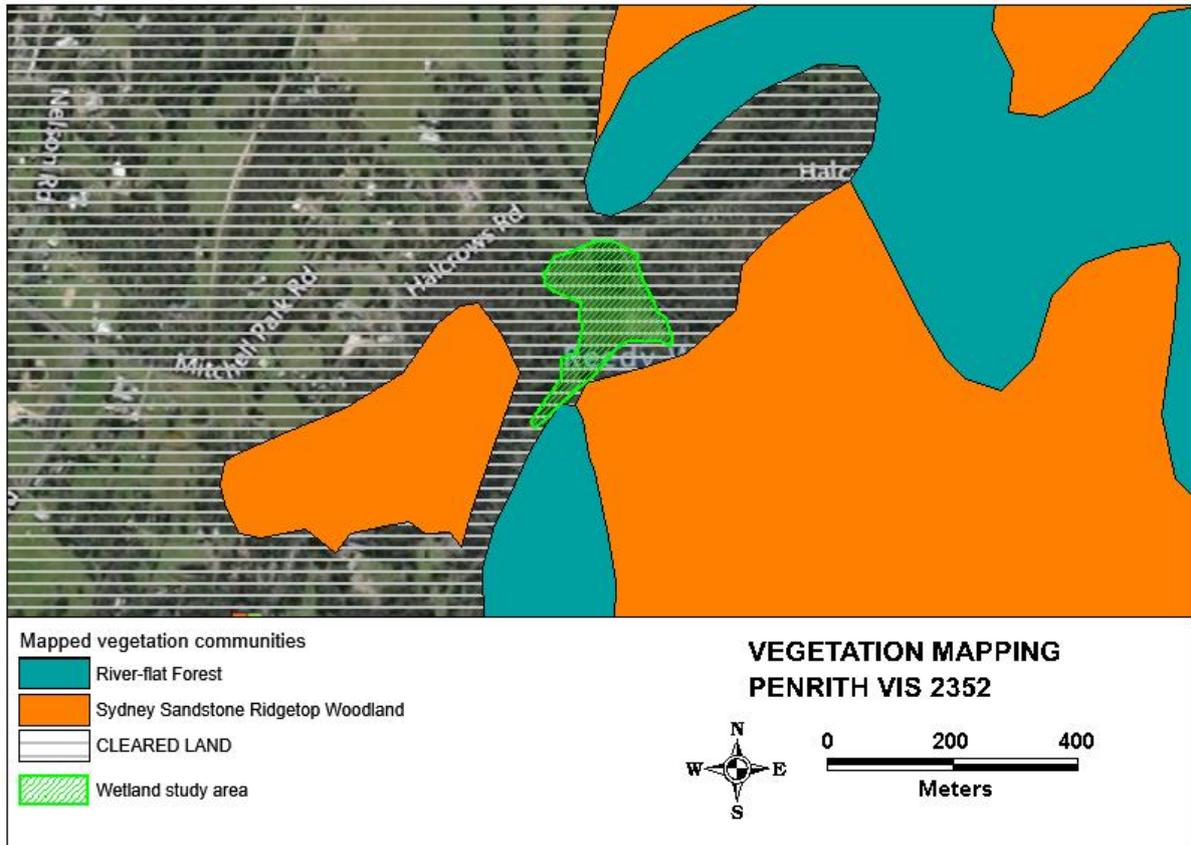
Priority weed

ASSETS 05/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Typha orientalis</i>	10-25	<i>Lachnagrostis filiformis</i>
<i>Phragmites australis</i>	10-25	<i>Hemarthria uncinata</i>
<i>Carex appressa</i>	10-25	<i>Oplismenus aemulus</i>
<i>Bolboschoenus caldwellii</i>	10-25	
<i>Juncus usitatus</i>	10-25	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus amplifolia</i>	<i>Acacia fimbriata</i>	<i>Alternanthera denticulata</i>
<i>Melaleuca quinquenervia</i>	<i>Persicaria lapathifolia</i>	<i>Carex appressa</i>
<i>Melaleuca decora</i>	<i>Persoonia strigosa</i>	<i>Centella asiatica</i>
		<i>Viola hederacea</i>

Fauna noted: Crested Pigeon, Laughing Kookaburra

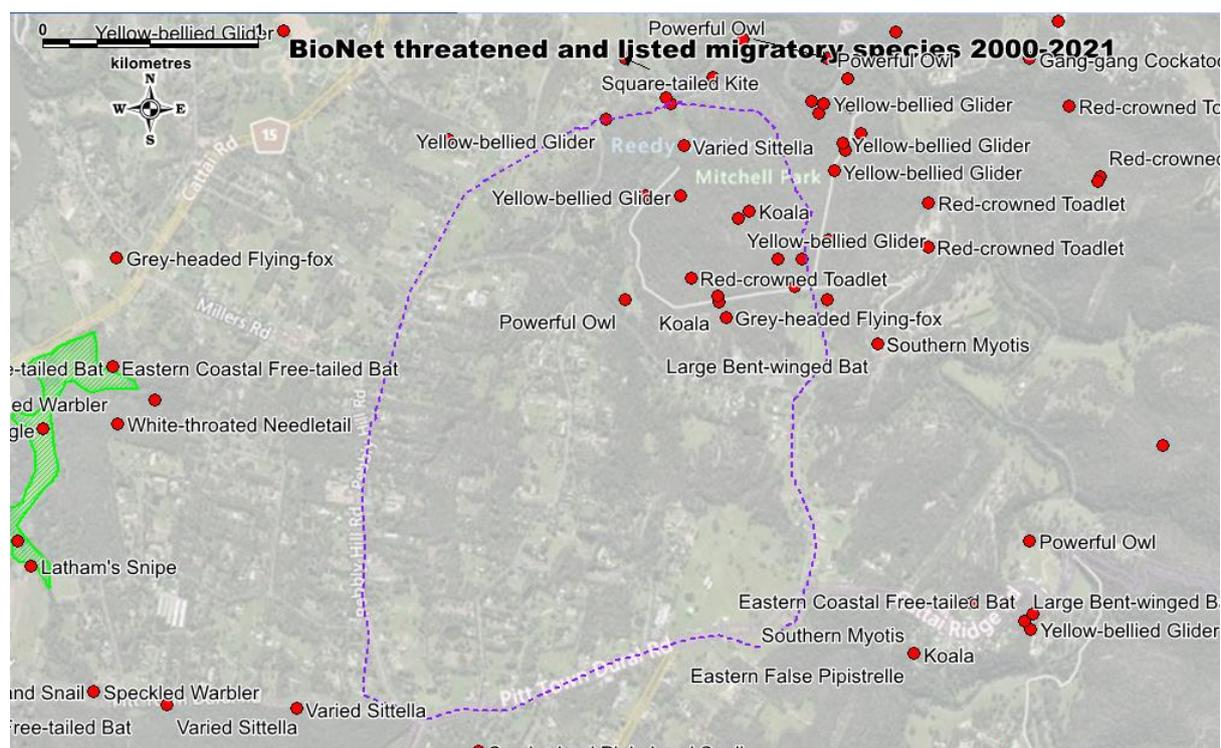
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75
sportfield/park	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Amphibia	Red-crowned Toadlet	<i>Pseudophryne australis</i>	V,P		1
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		1
Aves	Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V,P		1
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		2
Mammalia	Koala	<i>Phascolarctos cinereus</i>	V,P	V	3
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		6
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	3
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		3
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		1
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		3

RICKABYS CREEK LAGOON

Latitude	-33.619065
Longitude	150.794081
Address	Rickabys Creek
Catchment (ha)	61

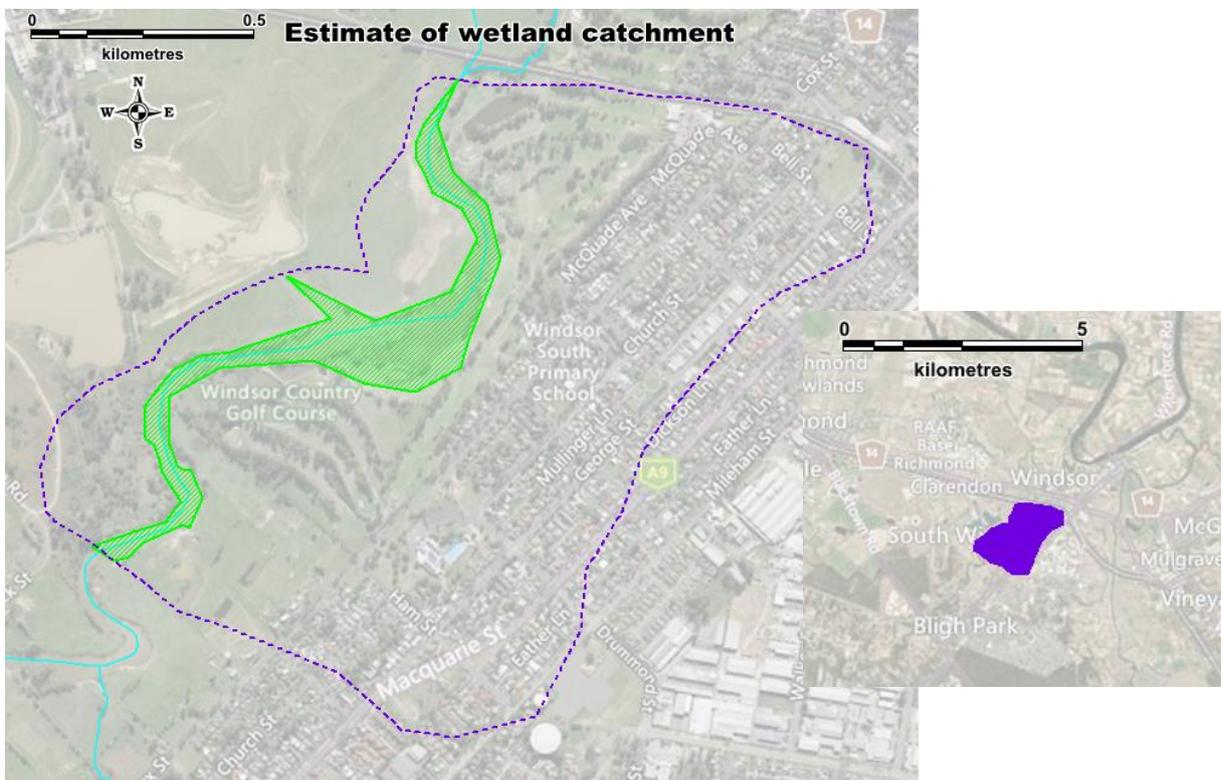
Wetland category	natural	modified
Water quality		poor
Site features Landuse		3.7
Site features offsite issues		5.3
Site features onsite issues		1.0
Vegetation		4.7
Habitat features -surrounds		6.3
Habitat features -wetland		7.3
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a shallow open water swamp surrounded by Swamp Oaks and fringing macrophytes. Surrounding land use is mainly cleared a golf course on one side and the racecourse on the other, with areas of pasture and urban residential development.

Overall Score (0-10) **4.7**



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 29/01/2021: (left) Rickabys Creek has large open water lagoons, (top right) surrounded by stands of Swamp Oaks, (bottom right) and with dense beds of macrophytes

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Rubus fruticosus</i> aggregate species	<10
<i>Cynodon dactylon</i>	10-25
<i>Gleditsia triacanthos</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Bidens pilosa</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Conyza</i> sp.	<10
<i>Rumex obtusifolius</i>	<10
<i>Lactuca serriola</i>	<10
<i>Araujia sericifera</i>	<10

- Recommended works:
- Weed control required for priority control weeds
 - Control of environmental weeds to prevent spread to downstream areas
 - Monitor for impacts from the surrounding catchment, including the golf course and racecourse

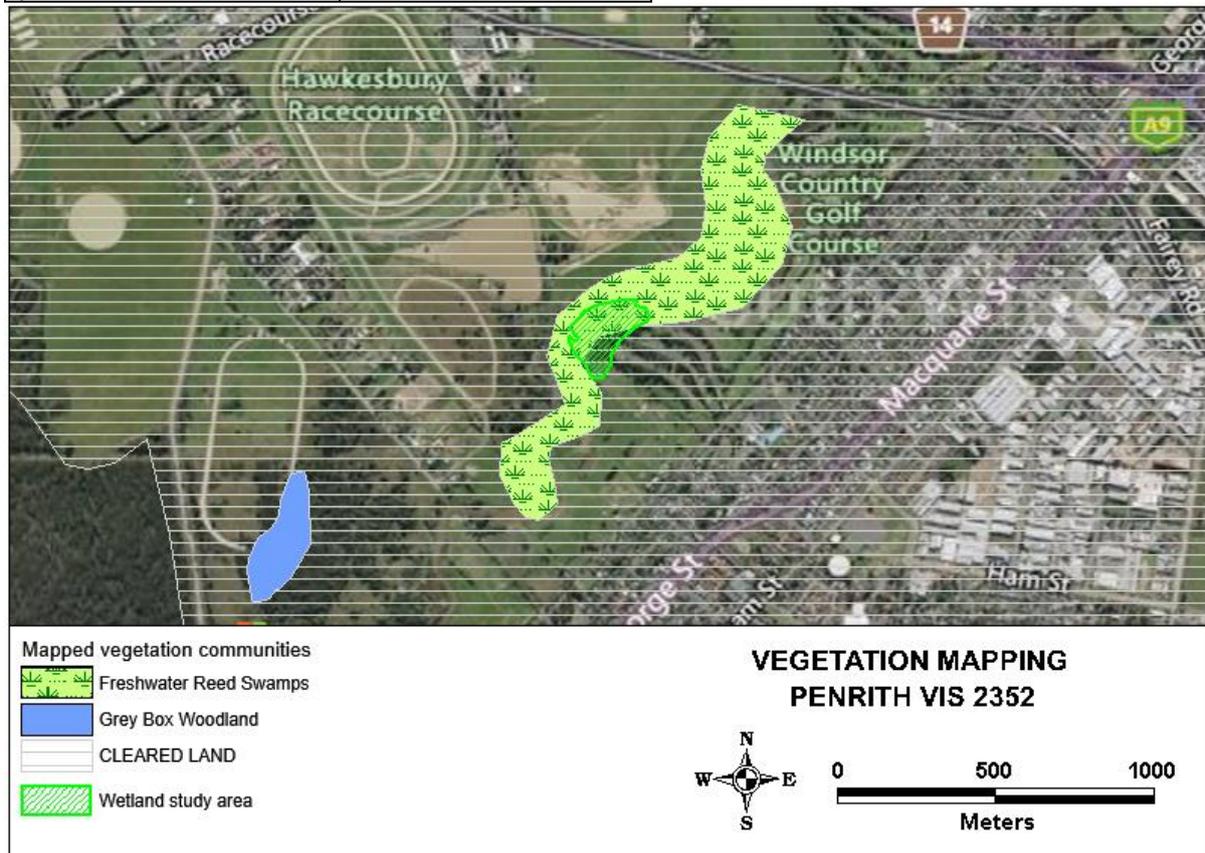
Priority weed

ASSETS 29/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Phragmites australis</i>	10-25	<i>Paspalum distichum</i>
<i>Juncus articulatus</i>	<10	<i>Hemarthria uncinata</i>
<i>Lemna</i> spp.	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Casuarina glauca</i>	<i>Bursaria spinosa</i>	<i>Commelina cyanea</i>
		<i>Marsilea hirsuta</i>
		<i>Hydrocotyle tripartita</i>

Fauna noted: Australasian Grebe, Australian Wood Duck, Pacific Black Duck, European Carp, Magpie-lark, Noisy Miner

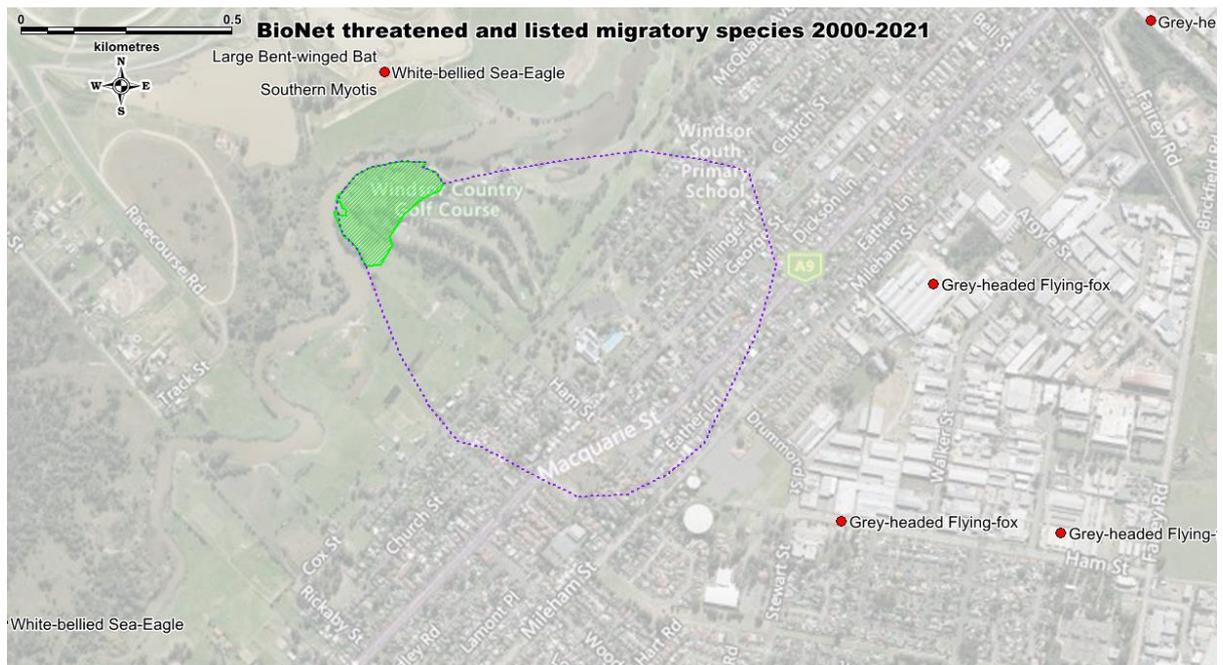
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	<10
pasture/grazing	50-75
market gardens	<10
sportfield/park	25-50
peri-urban mixed	<10



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					

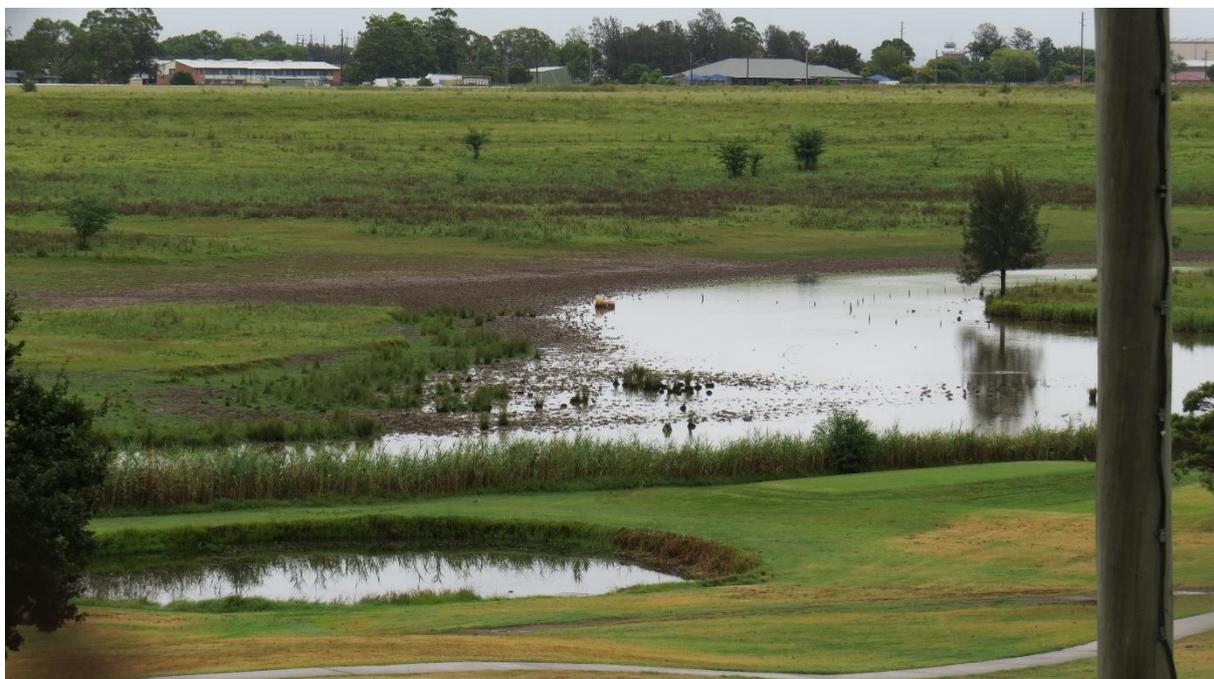


IMAGE 1 Extraction for irrigation can lower the level of water in the wetland

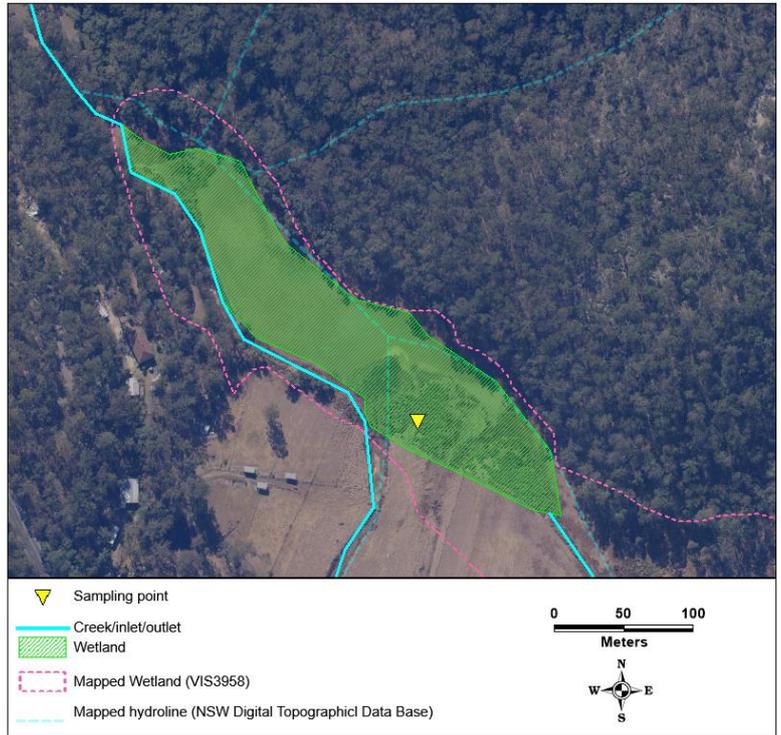
TEALES SWAMP

Overall Score (0-10) 6.5

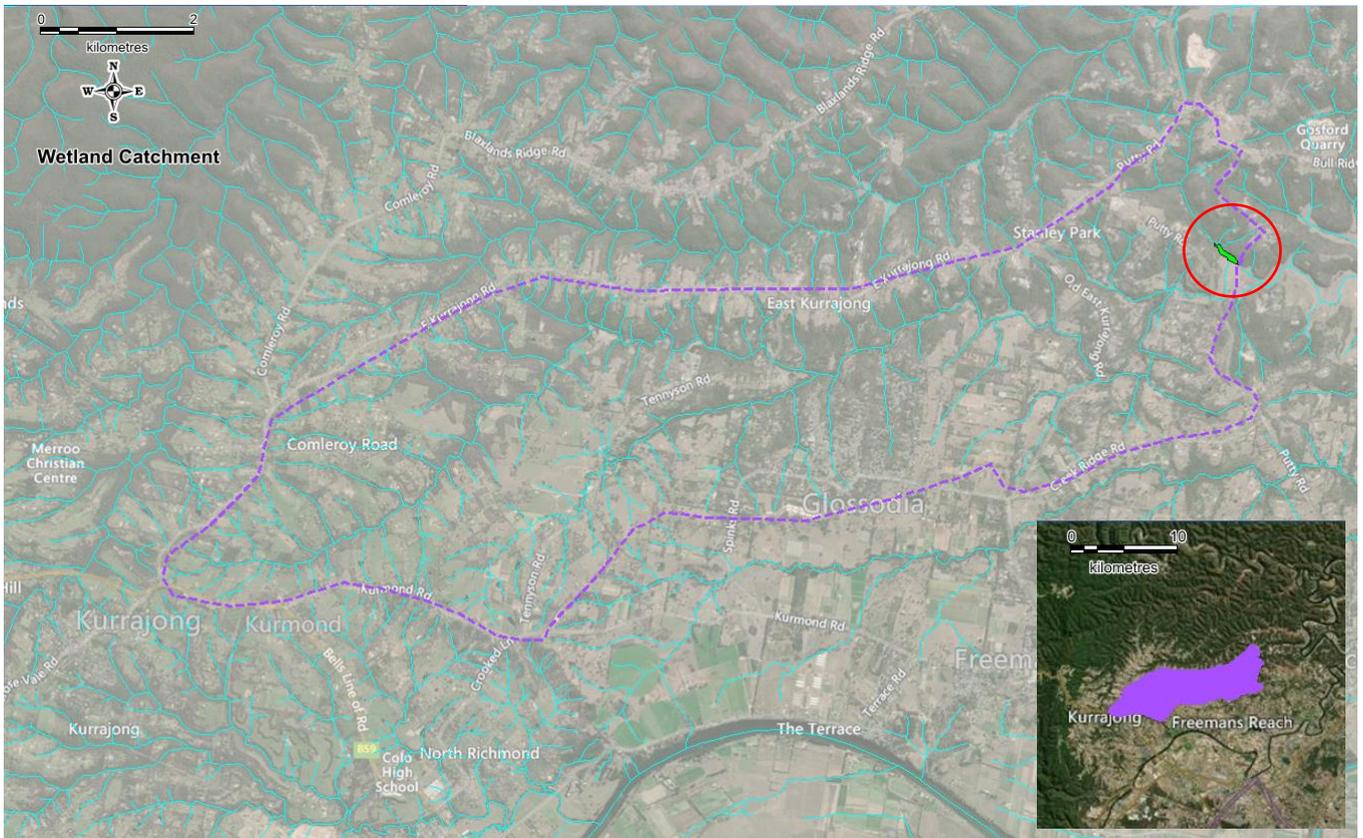
Latitude	██████████
Longitude	██████████
Address	Uworra Rd, Wilberforce
Catchment (ha)	4347

Overall Score (0-10)	6.5
Wetland category	natural
Water quality	poor
Site features Landuse	5.9
Site features offsite issues	9.5
Site features onsite issues	3.0
Vegetation	6.9
Habitat features -surrounds	6.3
Habitat features -wetland	7.7
Bank undercutting	5.0
Bank collapse	5.0

The wetland has a dense mixture of sedges, reeds, and herbaceous plants. Many of these are introduced, with some priority control weeds. The surrounding land is heavily forested or cleared and grazed, with some urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 1 Site 15/03/2021

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
No accessible surface water	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum urvillei</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Lactuca serriola</i>	<10
<i>Gymnocoronis spilanthoides</i>	10-25
<i>Senecio madagascariensis</i>	<10
<i>Bidens pilosa</i>	<10
<i>Cyperus congestus</i>	<10
<i>Paspalum dilatatum</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Fencing of wetland areas that are currently grazed
- Control of environmental weeds to prevent spread to downstream areas
- Provide offline watering points

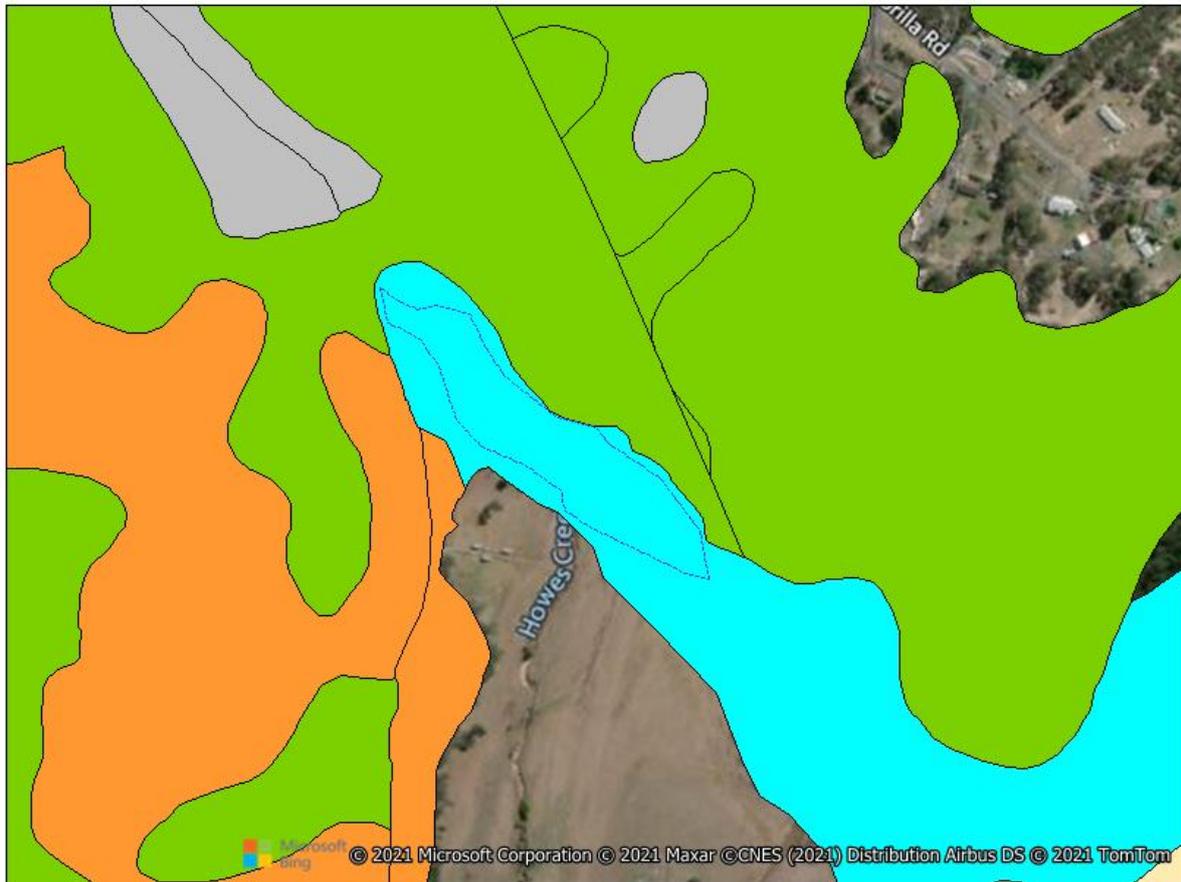
Priority weed

ASSETS 16/03/2021 SNAPSHOT SURVEY	
Macrophytes present	Density
<i>Hydrocotyle tripartita</i>	<10
<i>Ludwigia peploides</i>	<10
<i>Juncus usitatus</i>	<10
<i>Phragmites australis</i>	<10
Other native vegetation	
Trees	Grasses
<i>Melaleuca decora</i>	<i>Lachnagrostis filiformis</i>
Shrubs	<i>Paspalum distichum</i>
<i>Persicaria lapathifolia</i>	<i>Hemarthria uncinata</i>
<i>Persicaria hydropiper</i>	Ground covers
<i>Persicaria strigosa</i>	<i>Juncus usitatus</i>
<i>Acacia parramattensis</i>	<i>Carex appressa</i>
<i>Persicaria orientalis</i>	<i>Alternanthera denticulata</i>
	<i>Velleia lyrata</i>

Fauna noted: White-faced heron, Australian Reed Warbler, Willie Wagtail, Red-bellied black snake

VEGETATION MAPPING AND LAND USE

Observed land use	%
Bushland	25-50
Peri-Urban Mixed	10-25
Pasture/Grazing	25-50



Mapped Vegetation

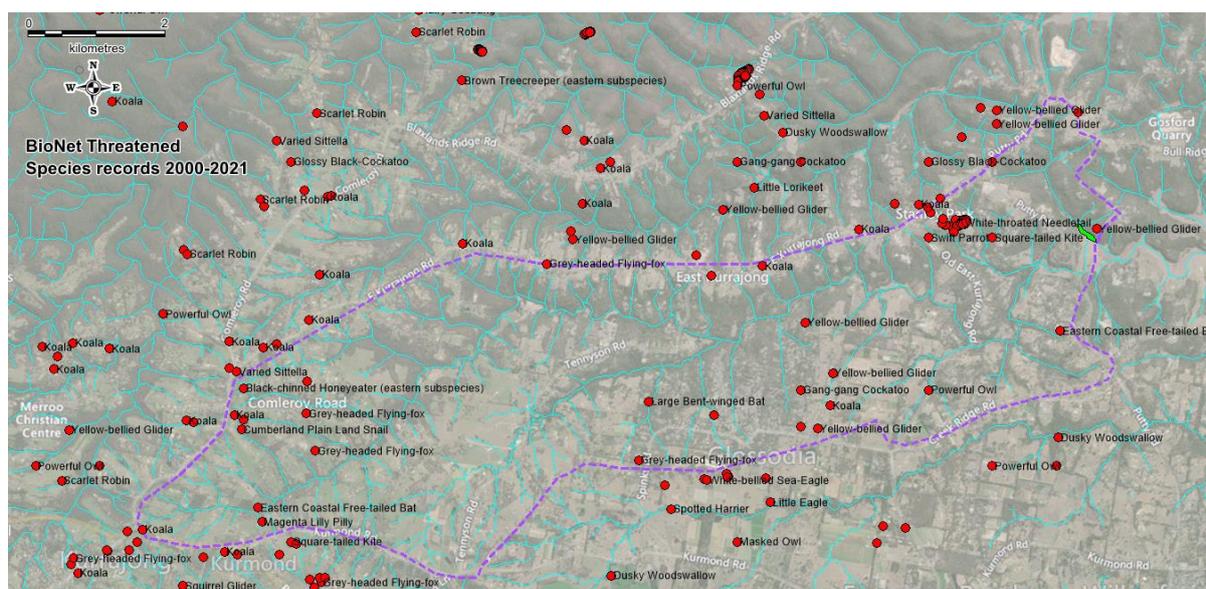
- Shale Sandstone Transition Forest (High Sandstone Influence)
- Transition Woodland (Roberts 1999)
- Unclassified Vegetation
- Wetland
- Woodland (Roberts 1999)

0 100 200
Meters



VEGETATION MAPPING HAWKESBURY LGA 2007 E3958

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	White-throated Needletail	<i>Hirundapus caudacutus</i>	P	V,C,J,K	9
Aves	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V,P		1
Aves	Little Eagle	<i>Hieraetus morphnoides</i>	V,P		3
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		8
Aves	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V,P,3		13
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		26
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	2
Aves	Turquoise Parrot	<i>Neophema pulchella</i>	V,P,3		3
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		2
Aves	Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V,P		1
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		6
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		8
Aves	Scarlet Robin	<i>Petroica boodang</i>	V,P		1
Mammalia	Koala	<i>Phascolarctos cinereus</i>	V,P	V	4
Mammalia	Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V,P		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		10
Mammalia	Squirrel Glider	<i>Petaurus norfolcensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	9
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		7
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		3
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		2
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		5
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		1
Flora	Magenta Lilly Pilly	<i>Syzygium paniculatum</i>	E1	V	3
Flora	Hairy Geebung	<i>Persoonia hirsuta</i>	E1,P,3	E	3

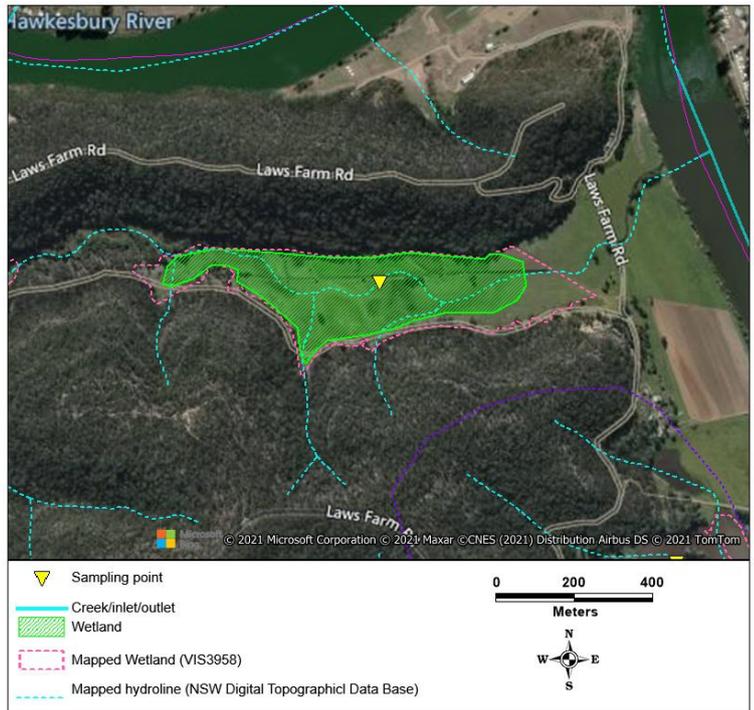
TEATREE SWAMP

Overall Score (0-10) 3.1

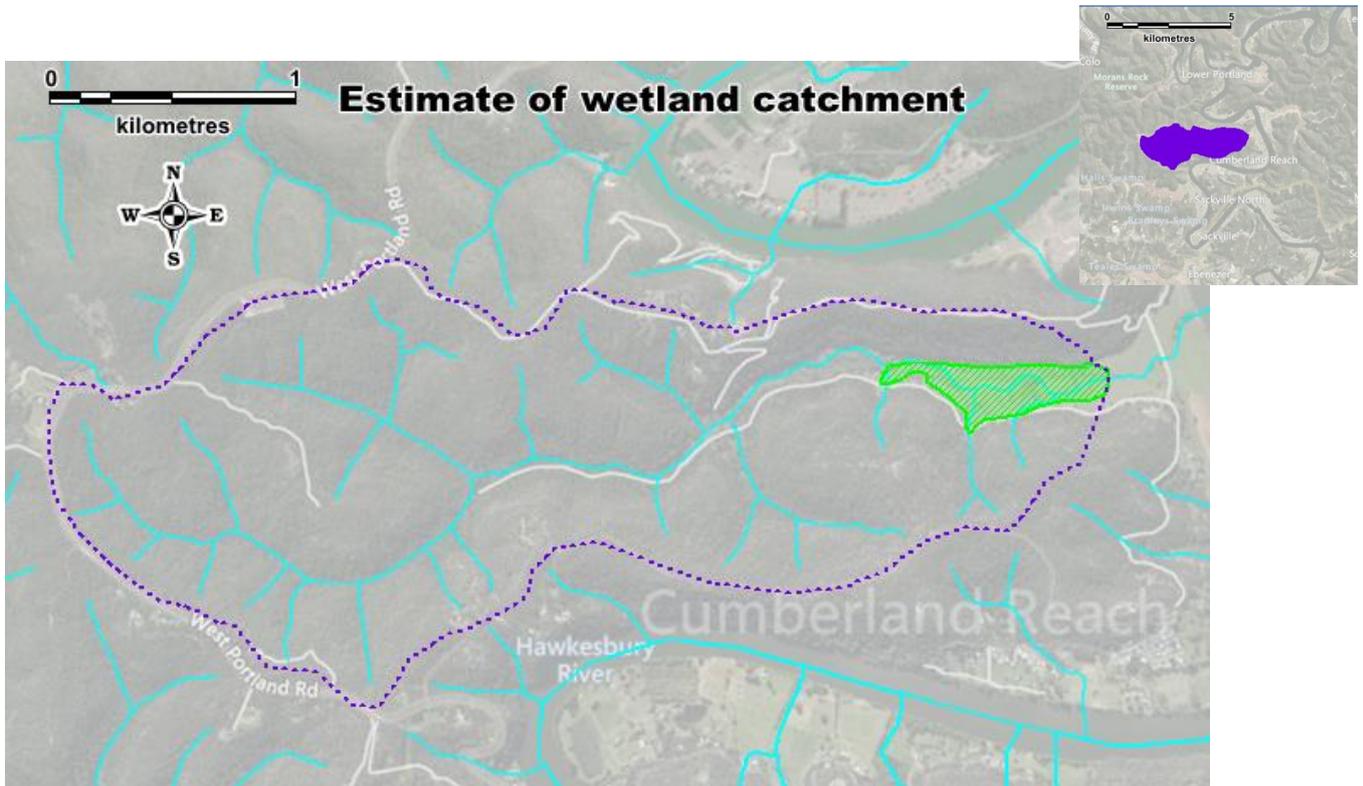
Latitude	██████████
Longitude	██████████
Address	Laws Farm Road, Lower Portland
Catchment (ha)	463

Wetland category	natural
Water quality	fair
Site features Landuse	0.0
Site features offsite issues	8.5
Site features onsite issues	3.0
Vegetation	1.1
Habitat features -surrounds	7.5
Habitat features -wetland	2.5
Bank undercutting	5.0
Bank collapse	5.0

The wetland is a shallow sedge swamp surrounded by forested wetland fed from a large forested catchment. Surrounding land use is mainly forested with areas of pasture managed by a single landholder. The lower section is channelised to maintain pastures for grazing.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 29/01/2021:

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Senecio madagascariensis</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Rumex obtusifolius</i>	<10
<i>Setaria viridis</i>	<10
<i>Conyza sp.</i>	<10
<i>Ludwigia peruviana</i>	<10
<i>Verbena bonariensis</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Consider fencing upper section to restrict grazing, or adopt rotational grazing

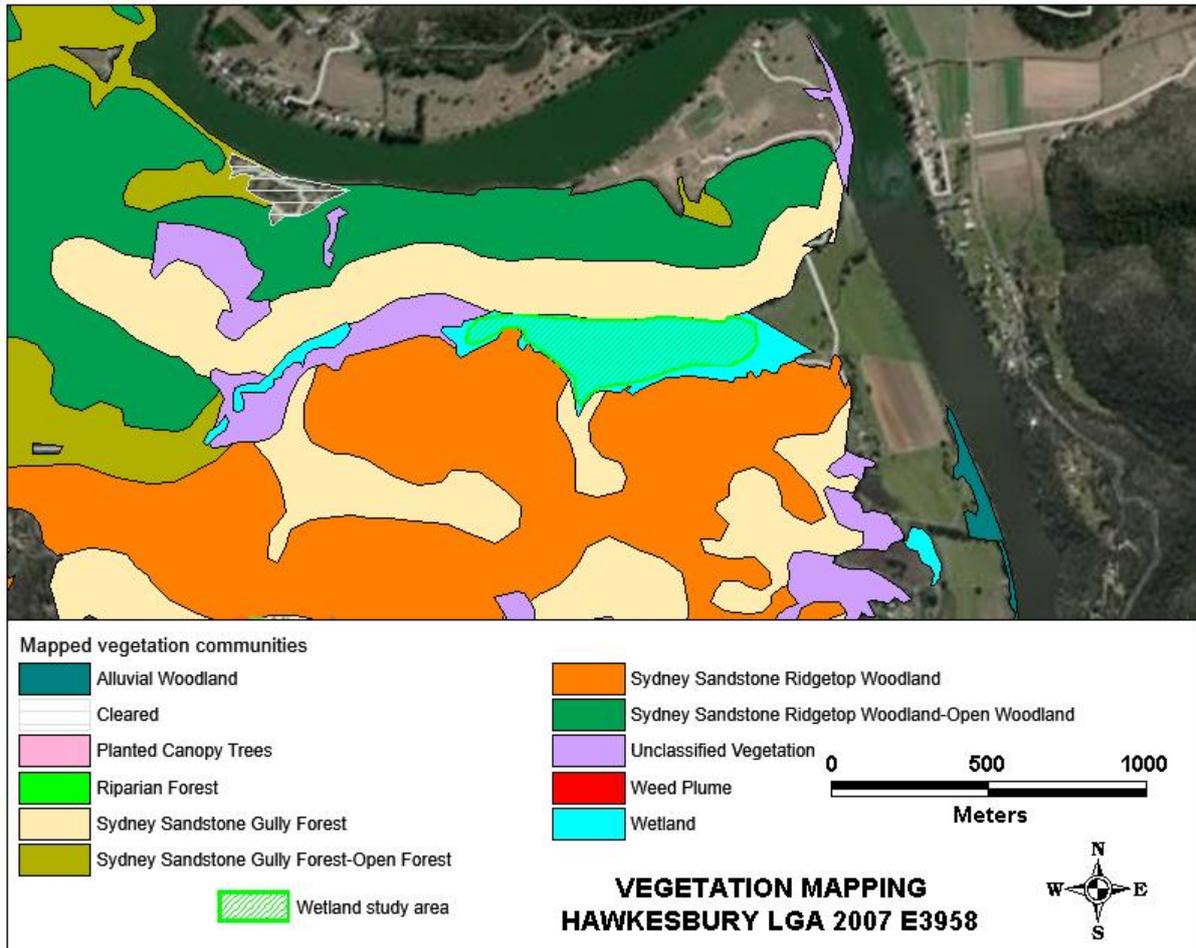
Priority weed

ASSETS 29/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Hydrilla verticillata</i>	>75	<i>Eriochloa pseudoacrotricha</i>
<i>Ludwigia peruviana</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Myriophyllum aquaticum</i>	<10	<i>Oplismenus aemulus</i>
		<i>Paspalum distichum</i>
		<i>Microlaena stipoides</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca linariifolia</i>	<i>Persicaria lapathifolia</i>	<i>Centella asiatica</i>
<i>Eucalyptus amplifolia</i>	<i>Persicaria hydropiper</i>	<i>Cyperus flaccidus</i>
<i>Eucalyptus tereticornis</i>		<i>Hydrocotyle sibthorpioides</i>
<i>Angophora floribunda</i>		<i>Juncus usitatus</i>
<i>Eucalyptus robusta</i>		<i>Viola hederacea</i>

Fauna noted: Straw-necked Ibis, Masked Lapwing, Australian Magpie, White-faced heron

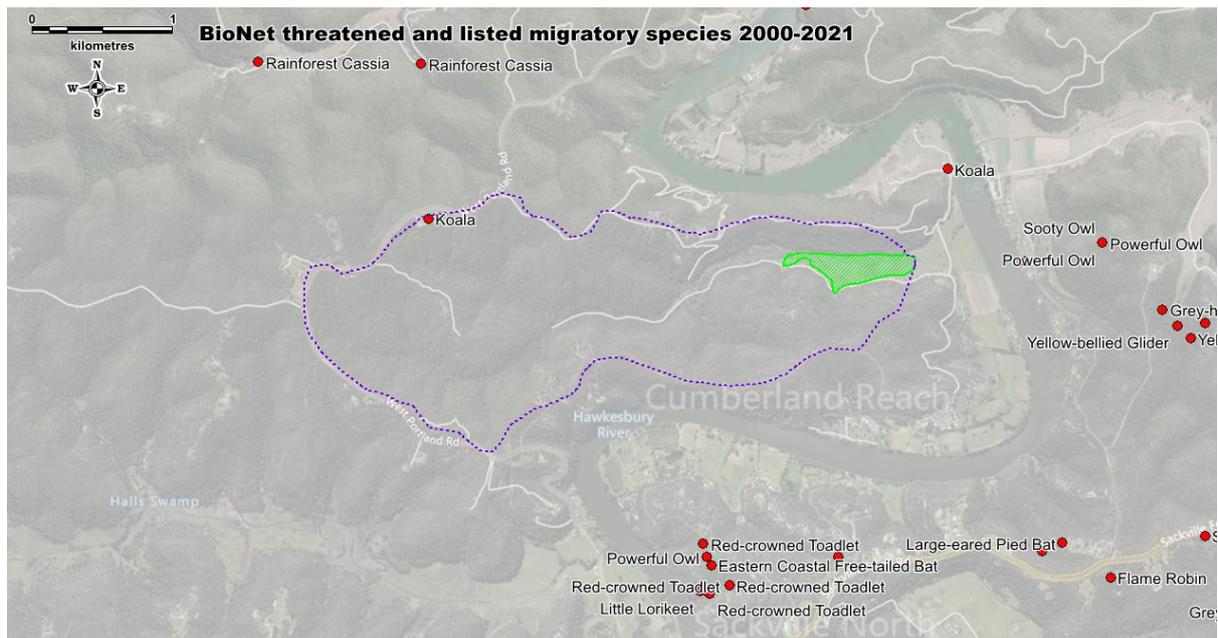
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	25-50
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Koala	Phascolarctos cinereus	V,P	V	1



IMAGE 1 Straw-necked Ibis in the paddock beside the lower wetland

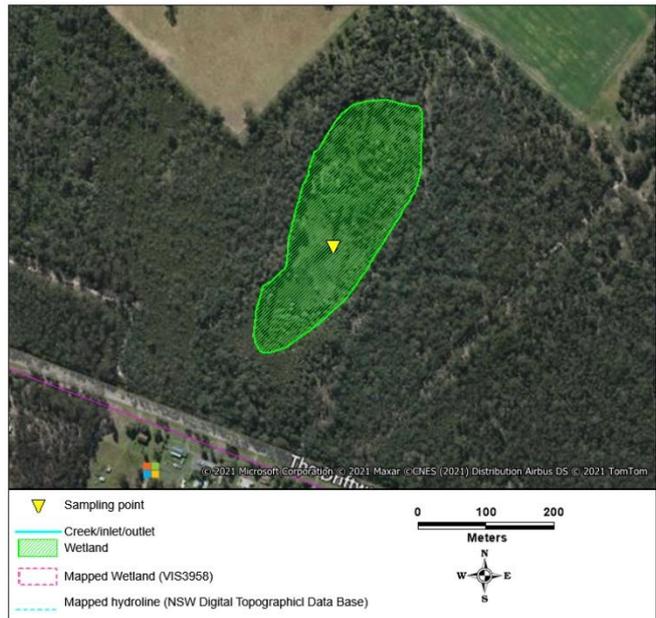
THE DRIFTWAY EAST

Overall Score (0-10) 6.9

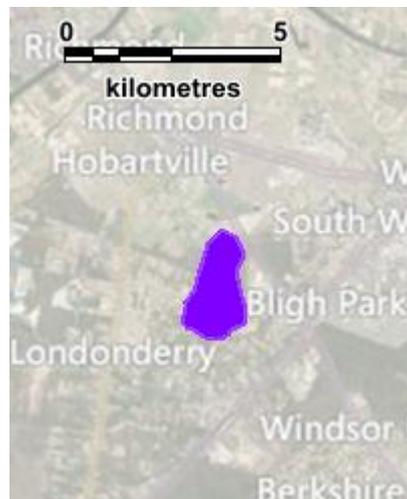
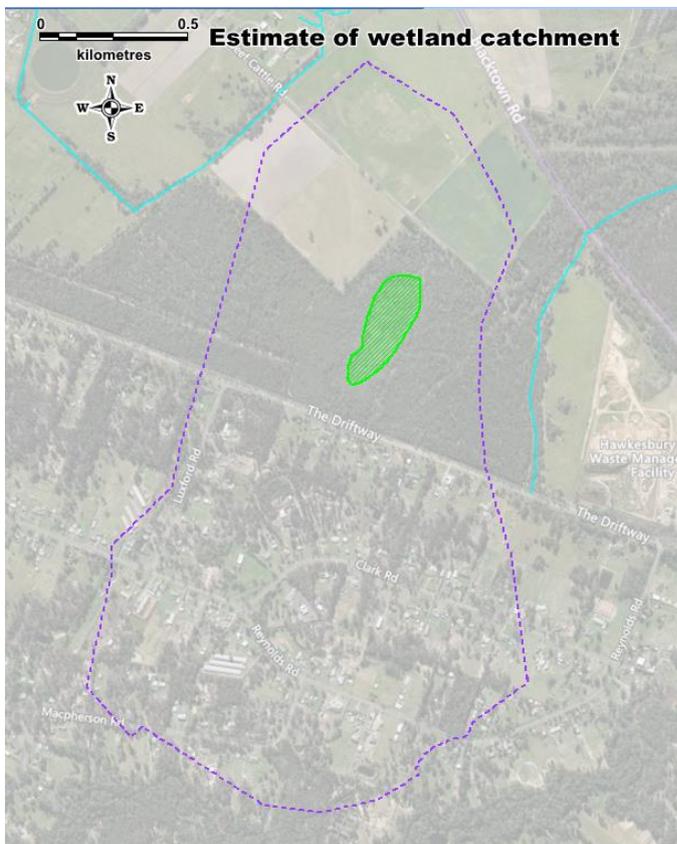
Latitude	-33.628469
Longitude	150.763892
Address	Western Sydney University, Hawkesbury Campus
Catchment (ha)	247

Wetland category	natural
Water quality	fair
Site features Landuse	10.0
Site features offsite issues	9.0
Site features onsite issues	5.0
Vegetation	5.0
Habitat features -surrounds	8.8
Habitat features -wetland	6.2
Bank undercutting	10.0
Bank collapse	10.0

The wetland is a shallow sedge swamp surrounded by forested wetland that floods rapidly and dries rapidly. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 04/02/2021: (left) small shallow open water in the centre of the swamp, (top right) this is mainly a sedge swamp, (bottom right) paperbarks are mostly around the edge of the swamp

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
WEED SPECIES (TOP 10)	DENSITY
<i>Ehrharta erecta</i>	<10
<i>Setaria viridis</i>	<10
<i>Lactuca saligna</i>	<10
<i>Solanum nigrum</i>	<10
<i>Bidens pilosa</i>	<10
<i>Ludwigia peruviana</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Maintain existing overall good condition

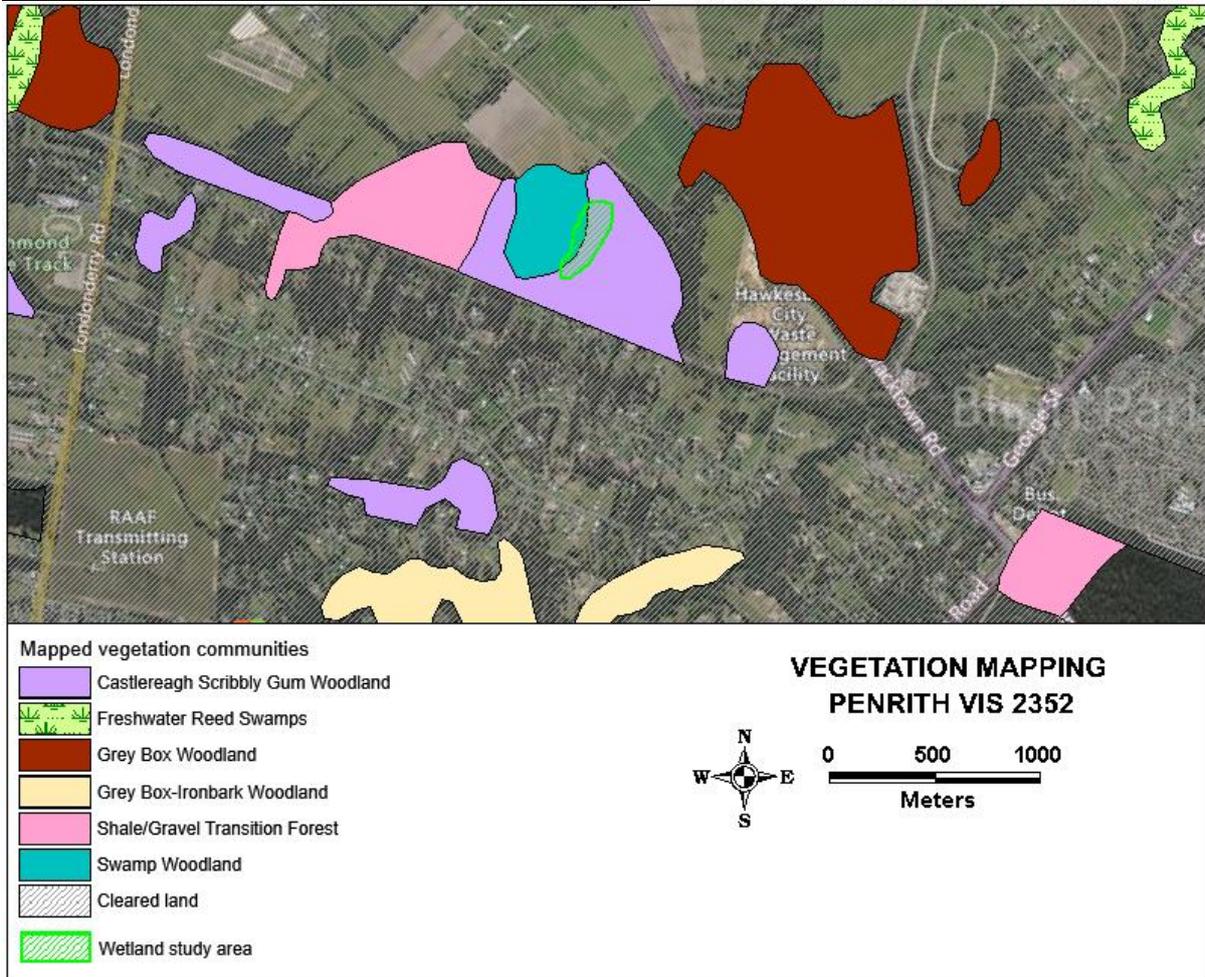
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Philydrum lanuginosum</i>	<10	<i>Paspalum distichum</i>
<i>Isotoma fluviatilis</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Hydrocotyle tripartita</i>	<10	
<i>Juncus usitatus</i>	<10	
<i>Ranunculus inundatus</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca decora</i>	<i>Callistemon citrinus</i>	<i>Alternanthera denticulata</i>
<i>Eucalyptus amplifolia</i>	<i>Callistemon linearis</i>	<i>Centella asiatica</i>
<i>Melaleuca ericifolia</i>	<i>Persicaria lapathifolia</i>	<i>Velleia lyrata</i>
	<i>Persicaria hydropiper</i>	<i>Cyperus flaccidus</i>
		<i>Cheilanthes sieberi</i>

Fauna noted: White-faced heron, Willie Wagtail, Spotted Marsh Frog

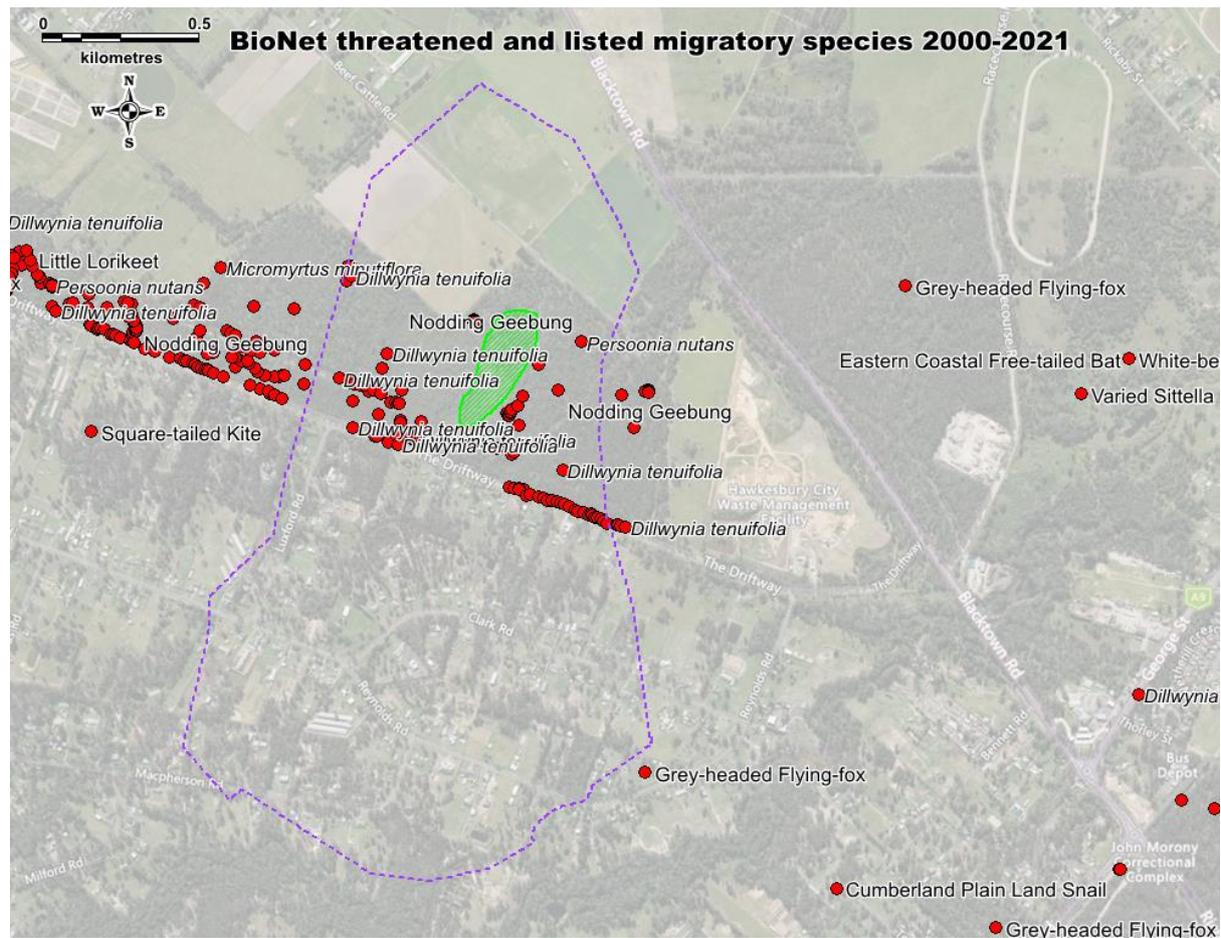
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	>75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		1
Flora		<i>Dillwynia tenuifolia</i>	V		96
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	6

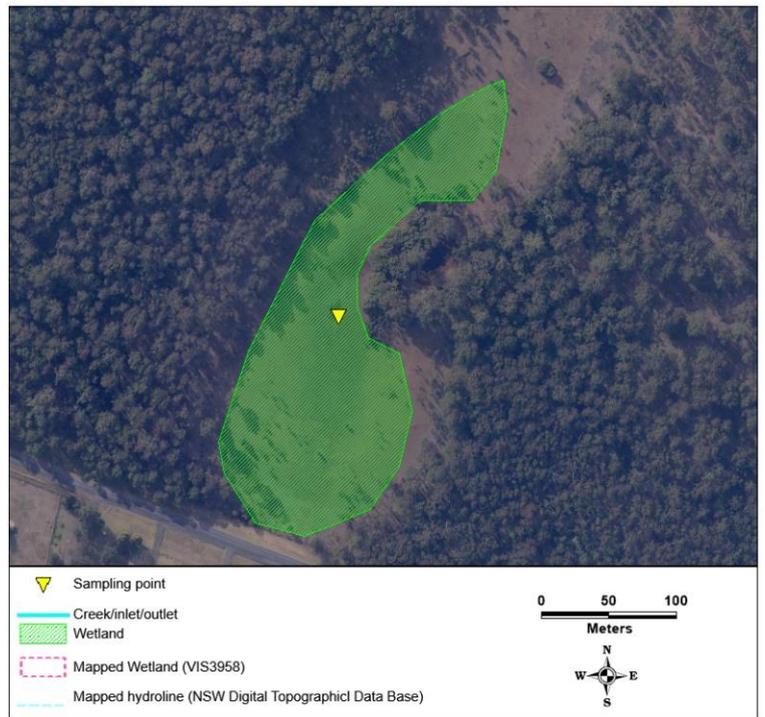
THE DRIFTWAY WEST

Overall Score (0-10) 7.7

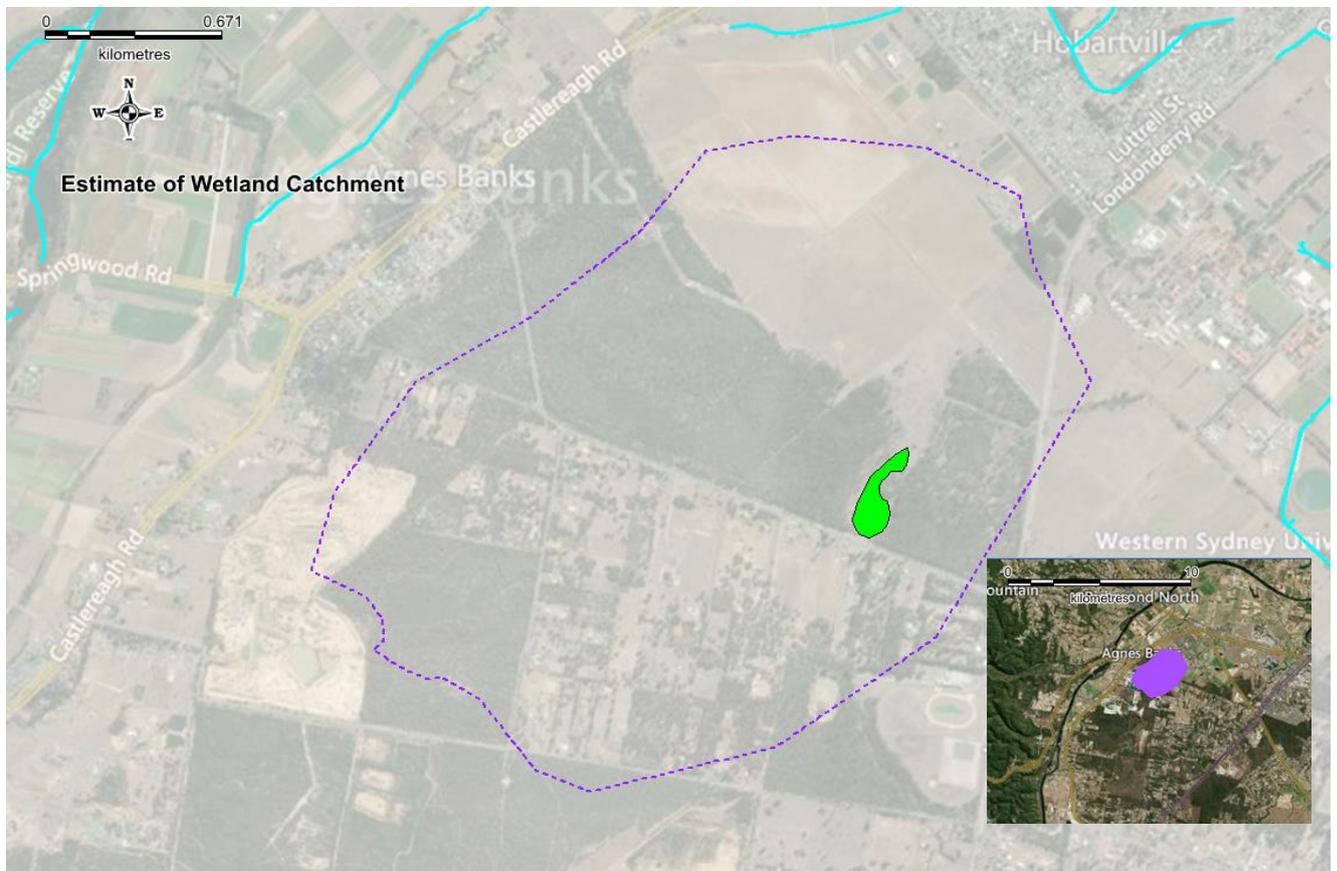
Latitude	-33.619243
Longitude	150.731409
Address	Western Sydney University, Hawkesbury Campus DP39768 Lot 181
Catchment (ha)	464

Wetland category	natural
Water quality	fair
Site features Landuse	7.6
Site features offsite issues	9.1
Site features onsite issues	5.0
Vegetation	7.2
Habitat features -surrounds	8.8
Habitat features -wetland	7.8
Bank undercutting	10.0
Bank collapse	10.0

The wetland is a shallow sedge swamp surrounded by forested wetland that floods rapidly and dries rapidly. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 1 Site 04/02/2021

ISSUES	
LANDHOLDER IDENTIFIED	
ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Rubus fruticosus aggregate species</i>	<10
<i>Lactuca serriola</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Sida rhombifolia</i>	<10
<i>Bidens pilosa</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Maintain existing overall good condition

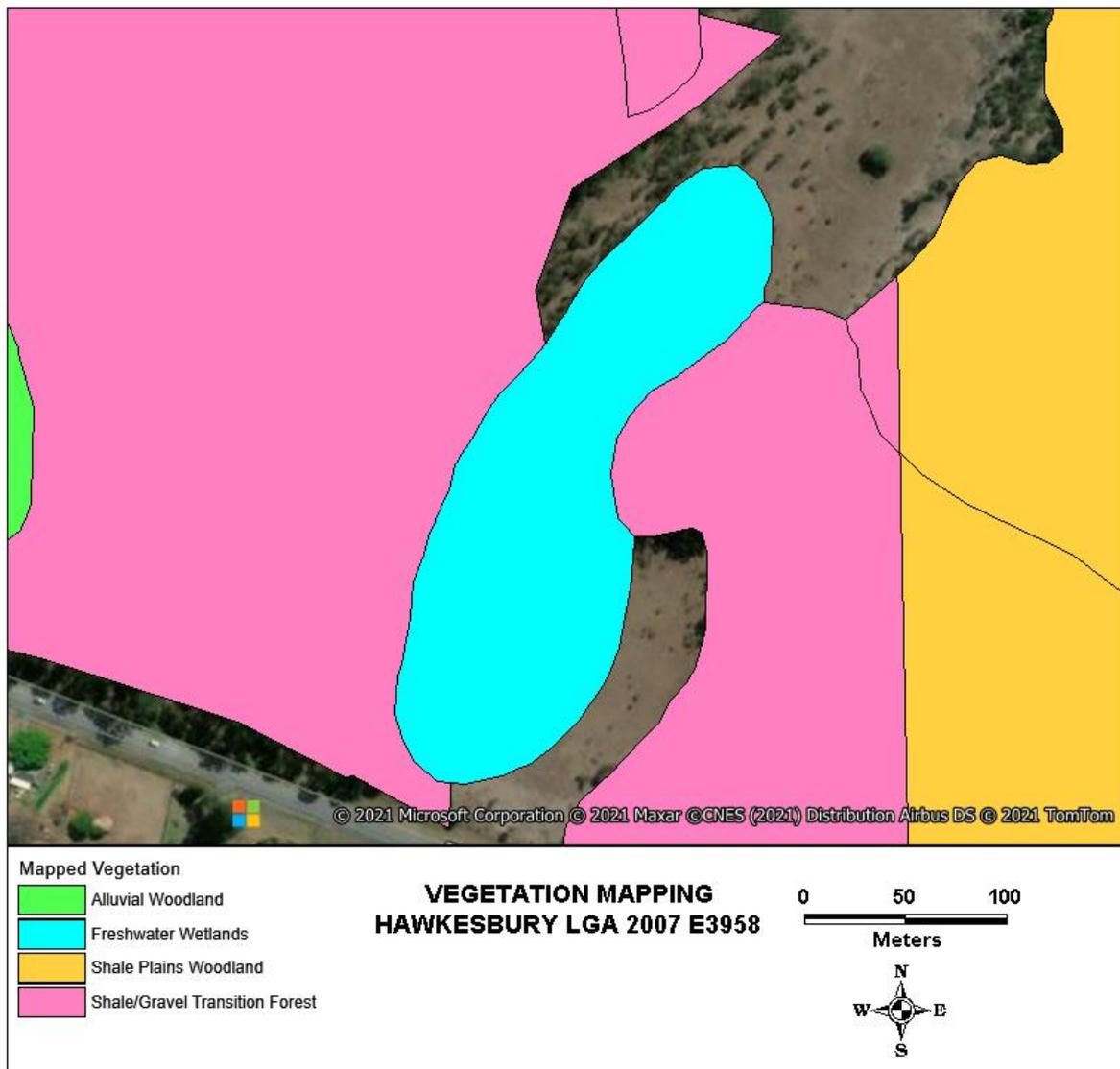
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY	
Macrophytes present	Density
<i>Philydrum lanuginosum</i>	<10
<i>Ranunculus inundatus</i>	<10
<i>Isotoma fluviatilis</i>	<10
<i>Ludwigia peploides</i>	<10
<i>Juncus usitatus</i>	<10
Other native vegetation	
Trees	Grasses
<i>Melaleuca decora</i>	<i>Lachnagrostis filiformis</i>
<i>Eucalyptus amplifolia</i>	<i>Glyceria australis</i>
<i>Eucalyptus tereticornis</i>	<i>Paspalum distichum</i>
Shrubs	Ground covers
<i>Callistemon citrinus</i>	<i>Centella asiatica</i>
<i>Persicaria decipiens</i>	<i>Juncus usitatus</i>
	<i>Velleia lyrata</i>
	<i>Hydrocotyle tripartita</i>
	<i>Alternanthera denticulata</i>
	<i>Juncus prismatocarpus</i>

Fauna noted: Spotted Marsh Frog, Common Froglet, Superb Fairywren

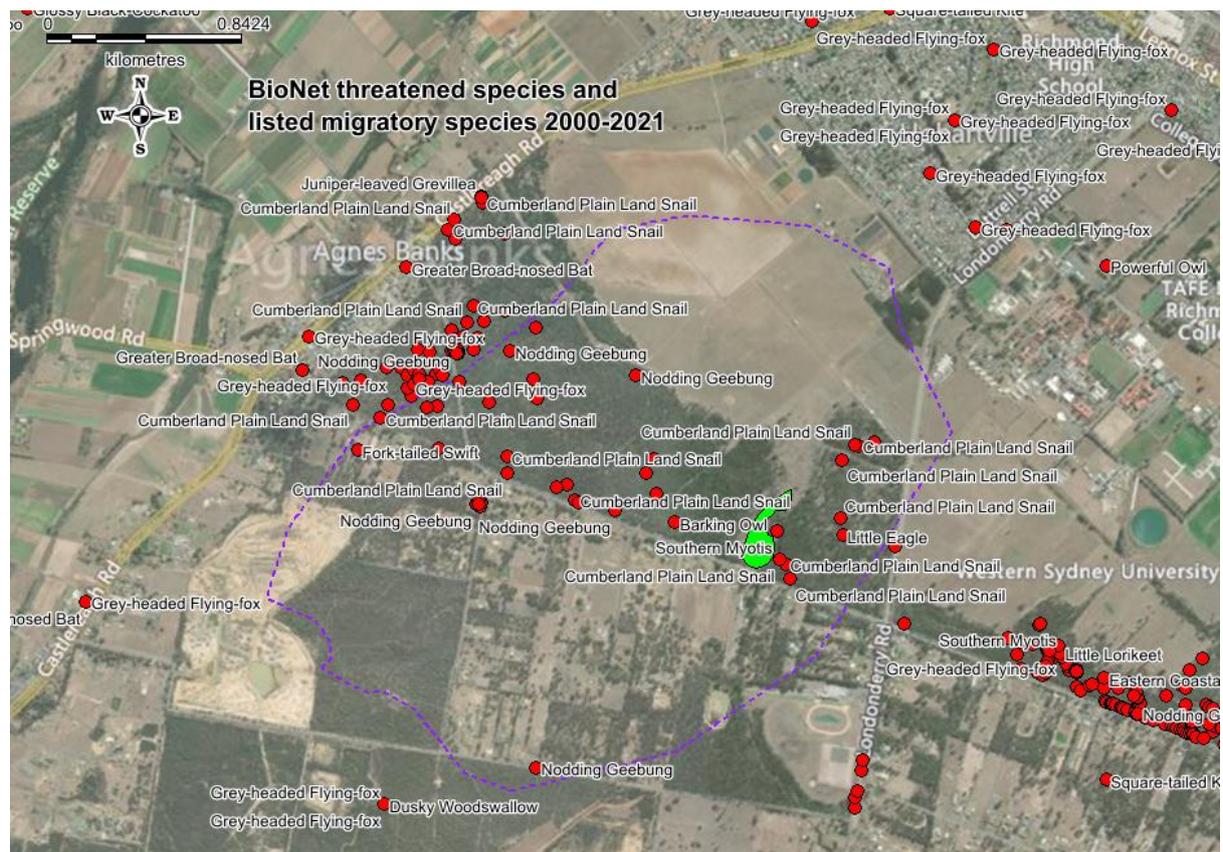
VEGETATION MAPPING AND LAND USE

Observed land use	%
Bushland	50-75
Peri-Urban Mixed	10-25
Pasture/Grazing	10-25



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

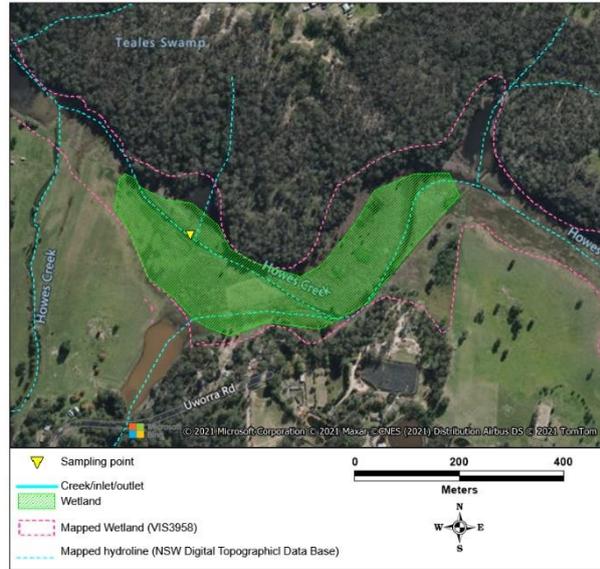
Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Fork-tailed Swift	<i>Apus pacificus</i>	P	C,J,K	1
Aves	Little Eagle	<i>Hieraetus morphnoides</i>	V,P		1
Aves	Barking Owl	<i>Ninox connivens</i>	V,P,3		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		1
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		19
Flora		<i>Dillwynia tenuifolia</i>	V		3
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	27
Flora		<i>Pimelea curviflora var. curviflora</i>	V	V	1

UPPER HOWES

Overall Score (0-10) **6.4**

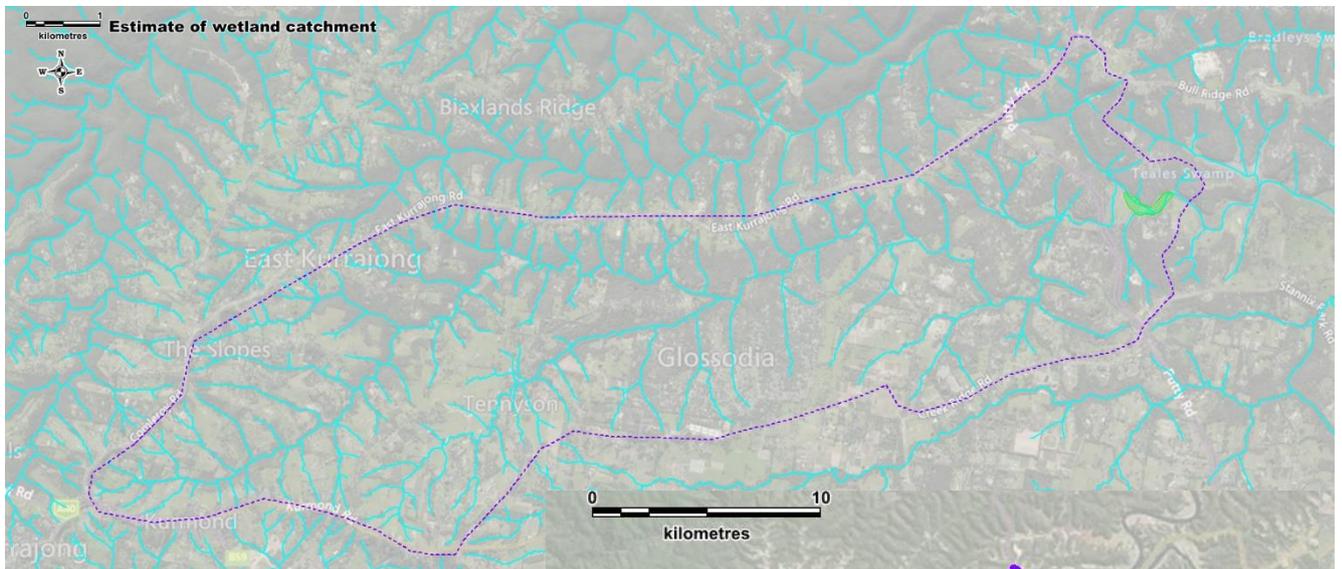
Latitude	██████████
Longitude	██████████
Address	Uworra Rd, Wilberforce
Catchment (ha)	4517

Wetland category	natural
Water quality	poor
Site features Landuse	7.0
Site features offsite issues	8.1
Site features onsite issues	0.4
Vegetation	7.7
Habitat features -surrounds	5.0
Habitat features -wetland	7.7
Bank undercutting	5.0
Bank collapse	5.0

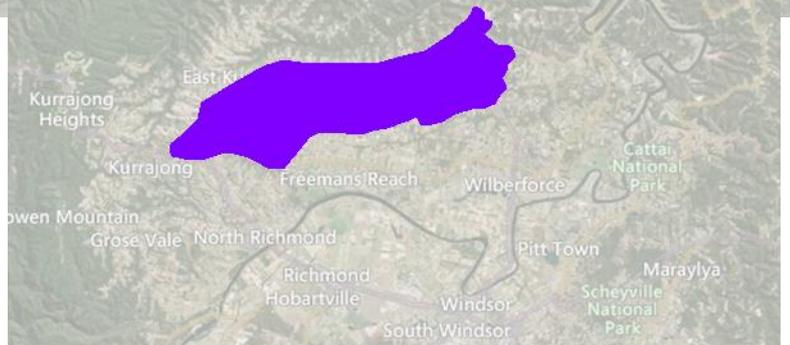


MAP 1 Wetland and sampling location

The wetland is a shallow sedge swamp surrounded by forested ridgetop to the north and cleared and grazed paddocks to the south. Surrounding land use is partly forested and partly small acreage holdings. This wetland is connected to other adjoining wetlands.



MAP 2 Approximate catchment of study site with (inset) overview catchment location





IMAGES 16/03/2021: (left) the swamp is a sedge swamp below a forested ridge, (top right) the wetland is partly fenced but extends into the paddock (bottom right) sedge swamp in the paddock

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum urvillei</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Lactuca serriola</i>	<10
<i>Gymnocoronis spilanthoides</i>	10-25
<i>Senecio madagascariensis</i>	<10
<i>Bidens pilosa</i>	<10
<i>Cyperus congestus</i>	<10
<i>Paspalum dilatatum</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Extend fenced wetland area, establish offline watering points

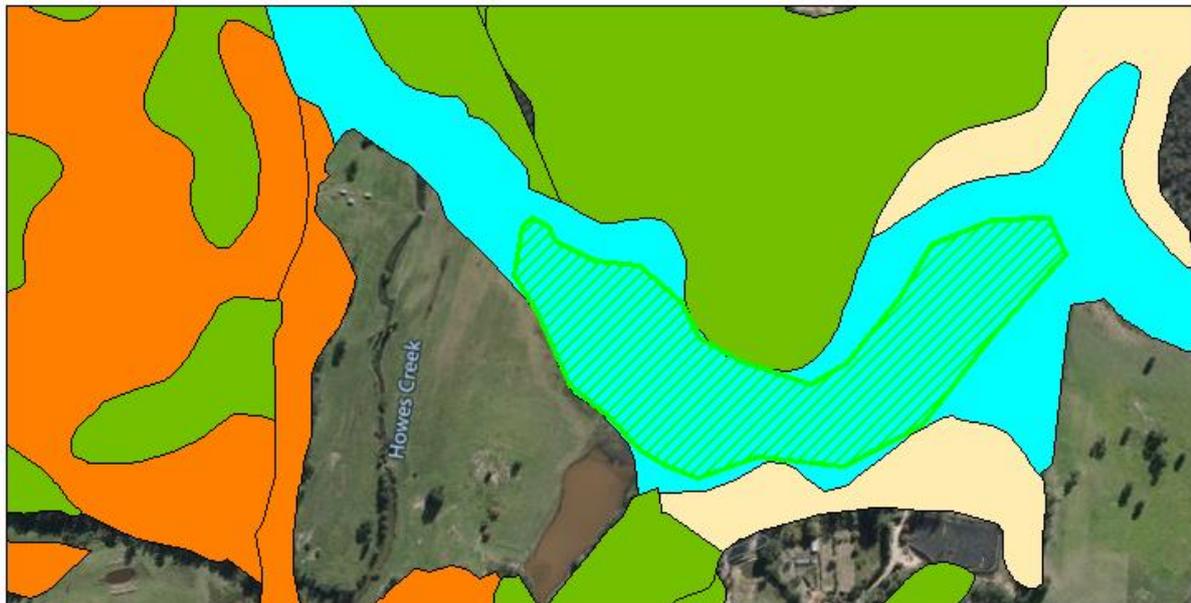
Priority weed

ASSETS 16/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Lepironia articulata</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Ludwigia peploides</i>	<10	<i>Paspalum distichum</i>
<i>Juncus usitatus</i>	<10	<i>Hemarthria uncinata</i>
<i>Phragmites australis</i>	<10	
<i>Typha orientalis</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca decora</i>	<i>Persicaria lapathifolia</i>	<i>Juncus usitatus</i>
	<i>Persicaria hydropiper</i>	<i>Carex appressa</i>
	<i>Persicaria strigosa</i>	<i>Alternanthera denticulata</i>
	<i>Acacia parramattensis</i>	<i>Velleia lyrata</i>

Fauna noted: White-faced heron, Australian Wood Duck, Willie Wagtail, Pacific Black Duck, Red-bellied Black Snake

VEGETATION MAPPING AND LAND USE

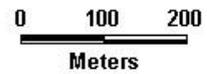
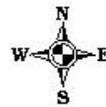
Observed land use	%
bushland	25-50
peri-urban mixed	25-50
pasture/grazing	25-50



Mapped vegetation communities

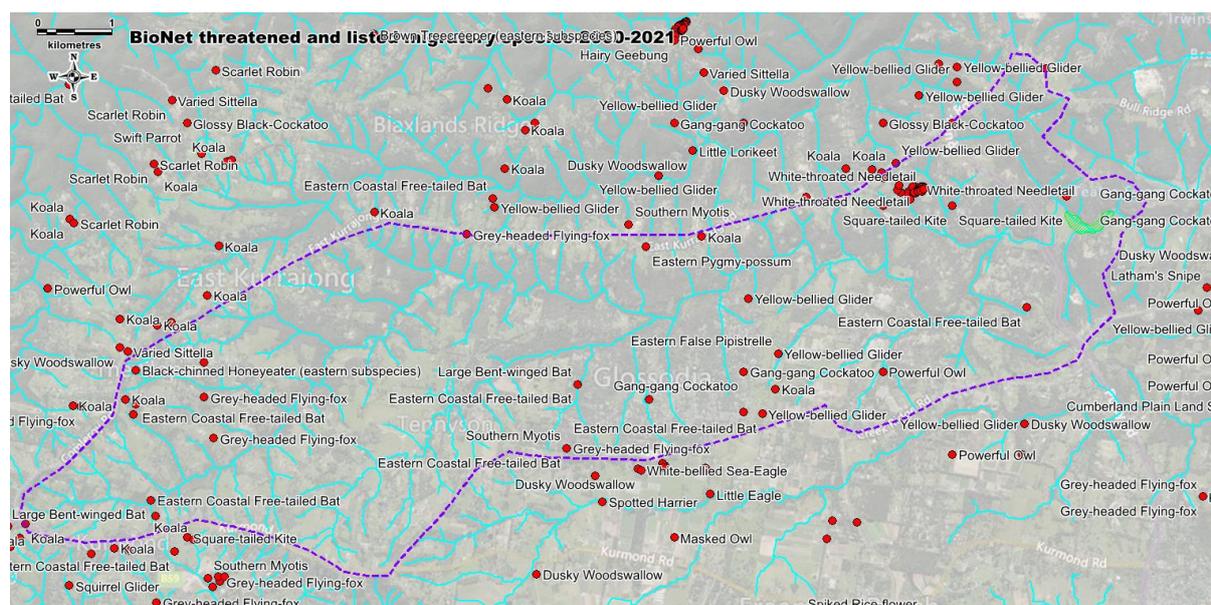
-  Shale Sandstone Transition Forest (High Sandstone Influence)
-  Transition Woodland (Roberts 1999)
-  Unclassified Vegetation
-  Wetland
-  Woodland (Roberts 1999)
-  Wetland study area

VEGETATION MAPPING HAWKESBURY LGA 2007 E3958



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	White-throated Needletail	<i>Hirundapus caudacutus</i>	P	V,C,J,K	9
Aves	White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	V,P		1
Aves	Little Eagle	<i>Hieraetus morphnoides</i>	V,P		3
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		8
Aves	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V,P,3		13
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		26
Aves	Swift Parrot	<i>Lathamus discolor</i>	E1,P,3	CE	2
Aves	Turquoise Parrot	<i>Neophema pulchella</i>	V,P,3		3
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		2
Aves	Black-chinned Honeyeater (eastern subspecies)	<i>Melithreptus gularis gularis</i>	V,P		1
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		6
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		8
Aves	Scarlet Robin	<i>Petroica boodang</i>	V,P		1
Mammalia	Koala	<i>Phascolarctos cinereus</i>	V,P	V	4
Mammalia	Eastern Pygmy-possum	<i>Cercartetus nanus</i>	V,P		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		10
Mammalia	Squirrel Glider	<i>Petaurus norfolcensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	9
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		7
Mammalia	Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	V,P		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		3
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		2
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		5
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		1
Flora	Magenta Lilly Pilly	<i>Syzygium paniculatum</i>	E1	V	3
Flora	Hairy Geebung	<i>Persoonia hirsuta</i>	E1,P,3	E	3

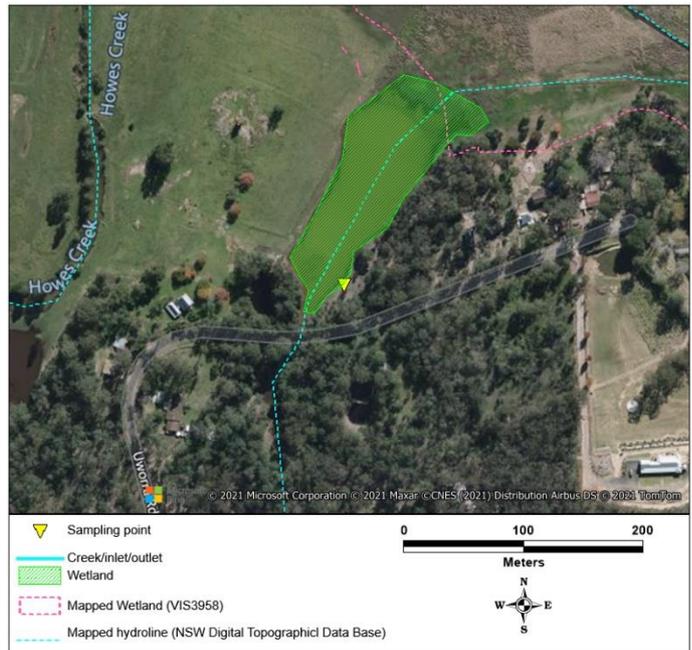
UWORRA LAGOON

Overall Score (0-10) **5.2**

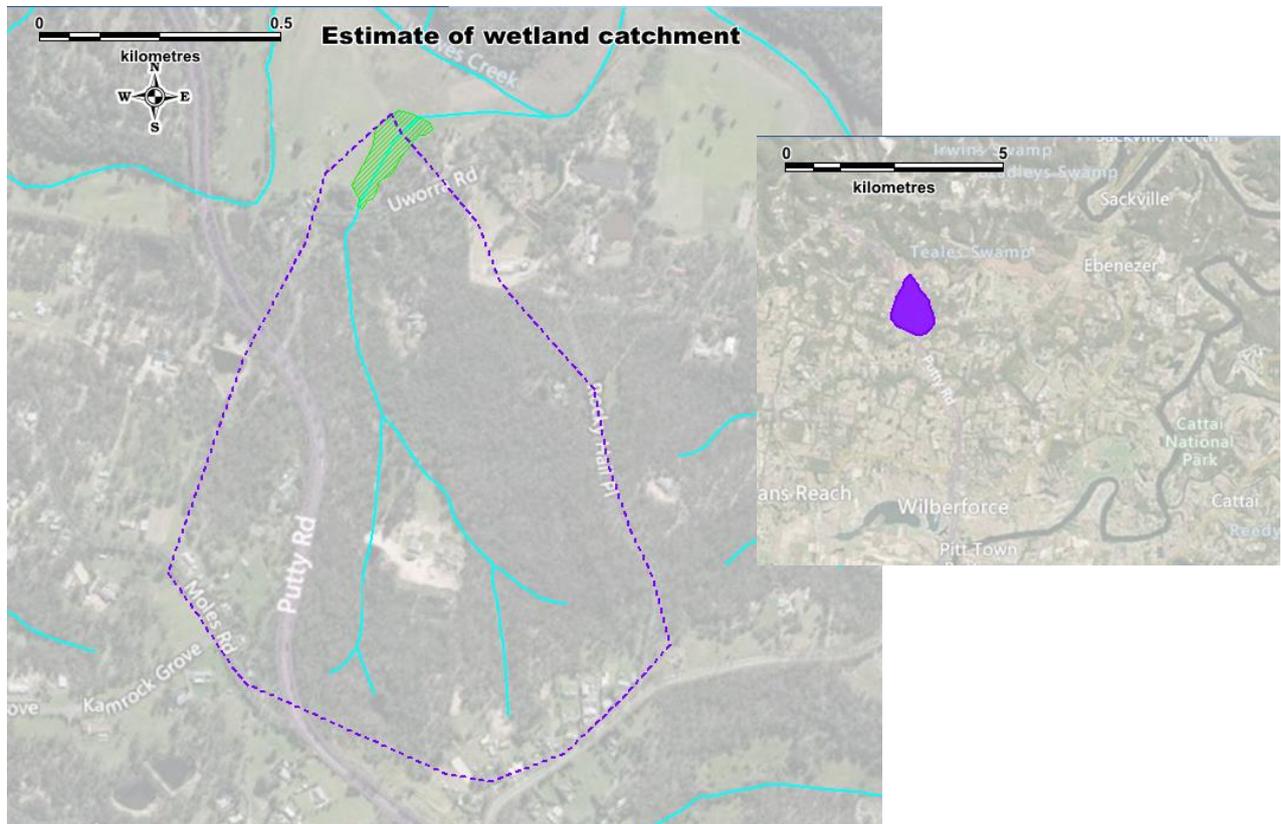
Latitude	██████████
Longitude	██████████
Address	Uworra Rd, Wilberforce
Catchment (ha)	85

Wetland category	natural
Water quality	poor
Site features Landuse	6.2
Site features offsite issues	7.1
Site features onsite issues	0.4
Vegetation	5.2
Habitat features -surrounds	6.3
Habitat features -wetland	6.0
Bank undercutting	5.0
Bank collapse	5.0

The wetland is a shallow open water lagoon constructed on a tributary of Howes Creek that floods rapidly and dries rapidly. Surrounding land use is mainly cleared and grazed with small areas of forest and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 16/03/2021: (left) the open water lagoon is surrounded by paddocks, (top right) small areas of vegetation have been retained, (bottom right) heritage infrastructure has been retained on this site

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Paspalum dilatatum</i>	<10
<i>Rumex obtusifolius</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Lactuca serriola</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Senecio madagascariensis</i>	<10
<i>Bidens pilosa</i>	<10
<i>Cyperus congestus</i>	<10
<i>Paspalum urvillei</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control environmental weeds
- Restrict stock access to the wetland, fence around wetland area, establish offline watering points
- Revegetate surrounding banks

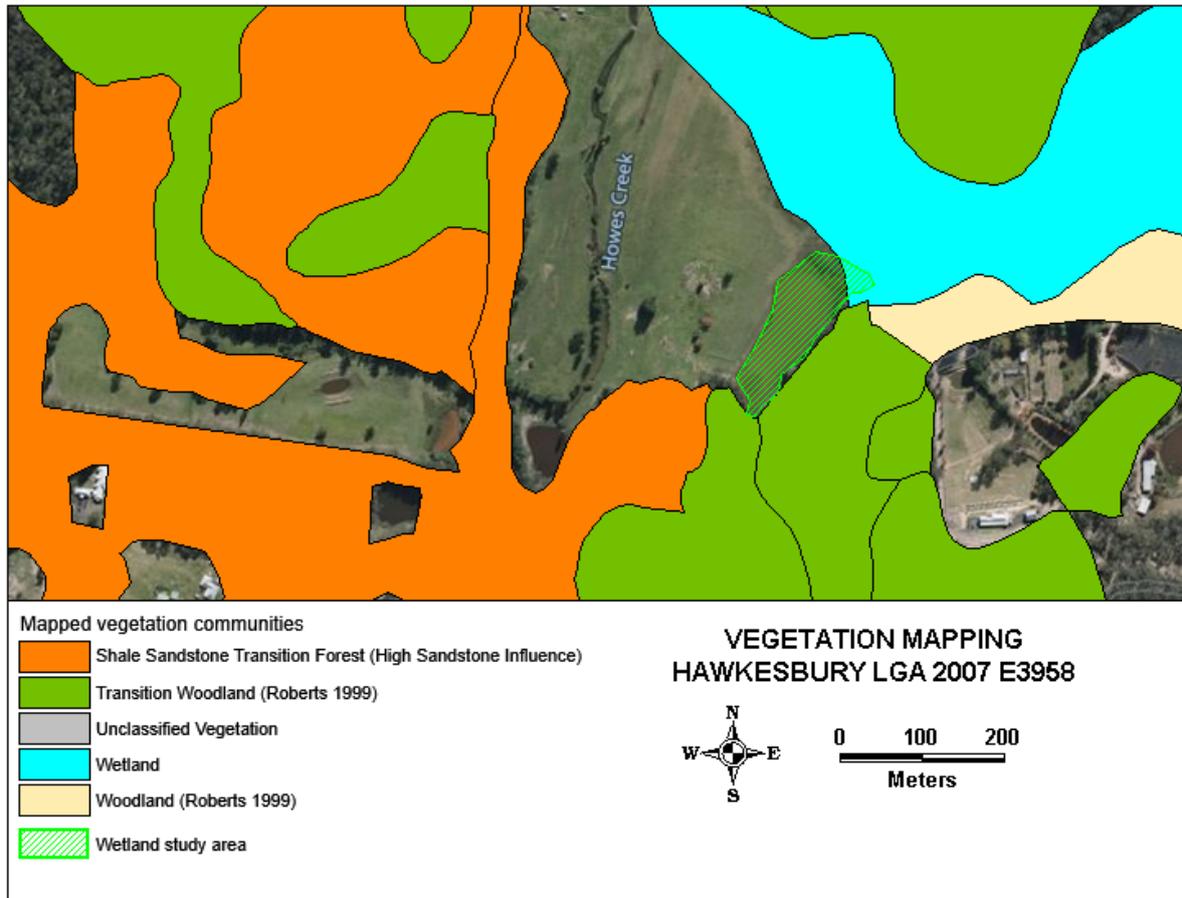
Priority weed

ASSETS 16/03/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
None noted		<i>Lachnagrostis filiformis</i>
		<i>Paspalum distichum</i>
		<i>Hemarthria uncinata</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus amplifolia</i>	<i>Acacia parramattensis</i>	<i>Juncus usitatus</i>
<i>Melaleuca decora</i>	<i>Persicaria lapathifolia</i>	<i>Carex appressa</i>
	<i>Persicaria strigosa</i>	<i>Alternanthera denticulata</i>
		<i>Velleia lyrata</i>

Fauna noted: White-faced heron, Australian Wood Duck, Chestnut Teal, Pacific Black Duck, Eurasian Coot, Little Black Cormorant

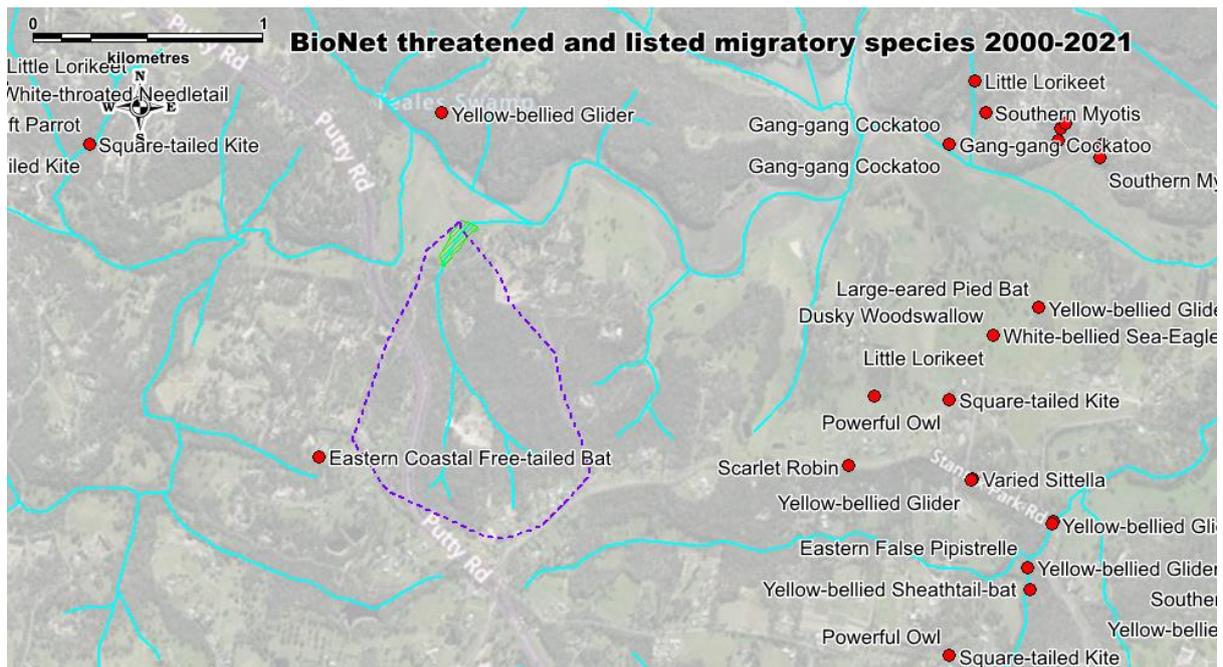
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	10-25
peri-urban mixed	25-50
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Nil					



IMAGE 1 Flocks of waterbirds include numerous Pacific Black Ducks



IMAGE 2 Chestnut Teals and their chicks swim with the Pacific Black Ducks



IMAGE 3 White-faced Herons forage around the wetland edges



IMAGE 4 Little Pied Cormorants dry their wings on old fence posts in the wetland

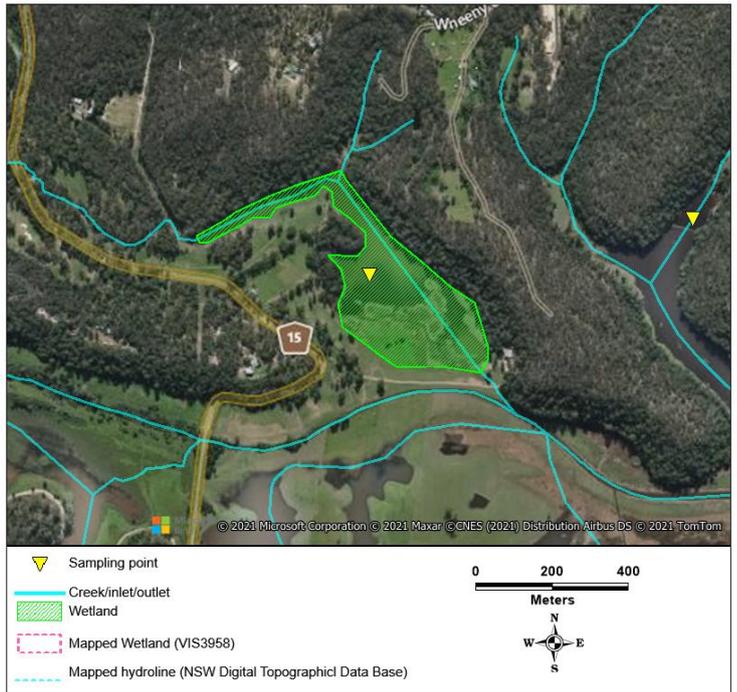
WHEENY LAGOON

Overall Score (0-10) **6.2**

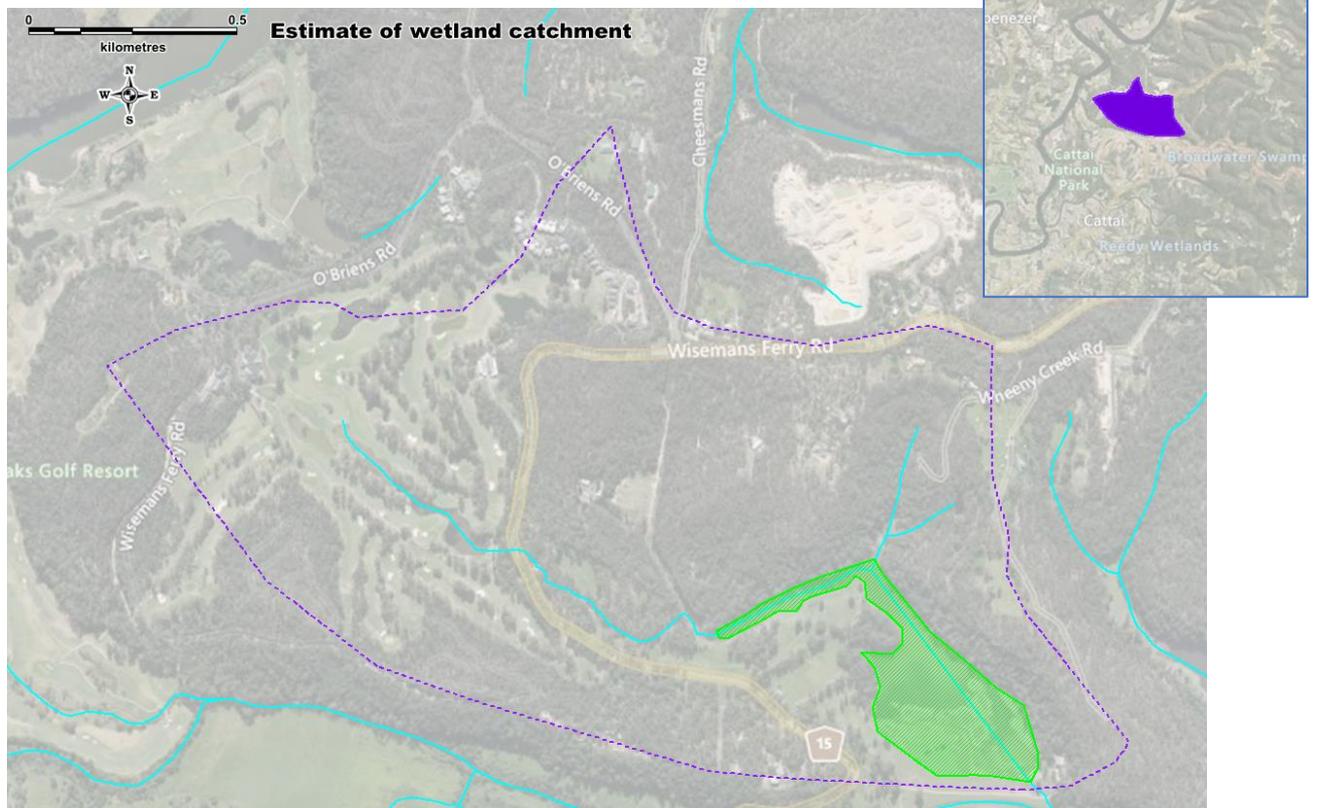
Latitude	██████
Longitude	██████
Address	Wisemans Ferry Road
Catchment (ha)	202

Wetland category	natural
Water quality	fair
Site features Landuse	9.4
Site features offsite issues	9.0
Site features onsite issues	6.0
Vegetation	3.7
Habitat features -surrounds	10.0
Habitat features -wetland	7.5
Bank undercutting	0.0
Bank collapse	10.0

The wetland is a large but shallow wetland with around half open water and half dense stands of macrophytes. Surrounding land use is mainly forested with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 21/01/2021: (left) the wetland is a mosaic of open water and dense reeds beds, (top right) west side has mown lawn under native trees, (bottom right) east side is fully forested up the ridge

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Thunbergia alata</i>	<10
<i>Solanum linnaeanum</i>	<10
<i>Tradescantia albiflora</i>	10-25
<i>Ehrharta erecta</i>	10-25
<i>Conyza sp.</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Sonchus oleraceus</i>	<10

Recommended works:
<ul style="list-style-type: none"> • Weed control required for priority control weeds • Control of environmental weeds to prevent spread to downstream areas • Maintain existing overall good condition

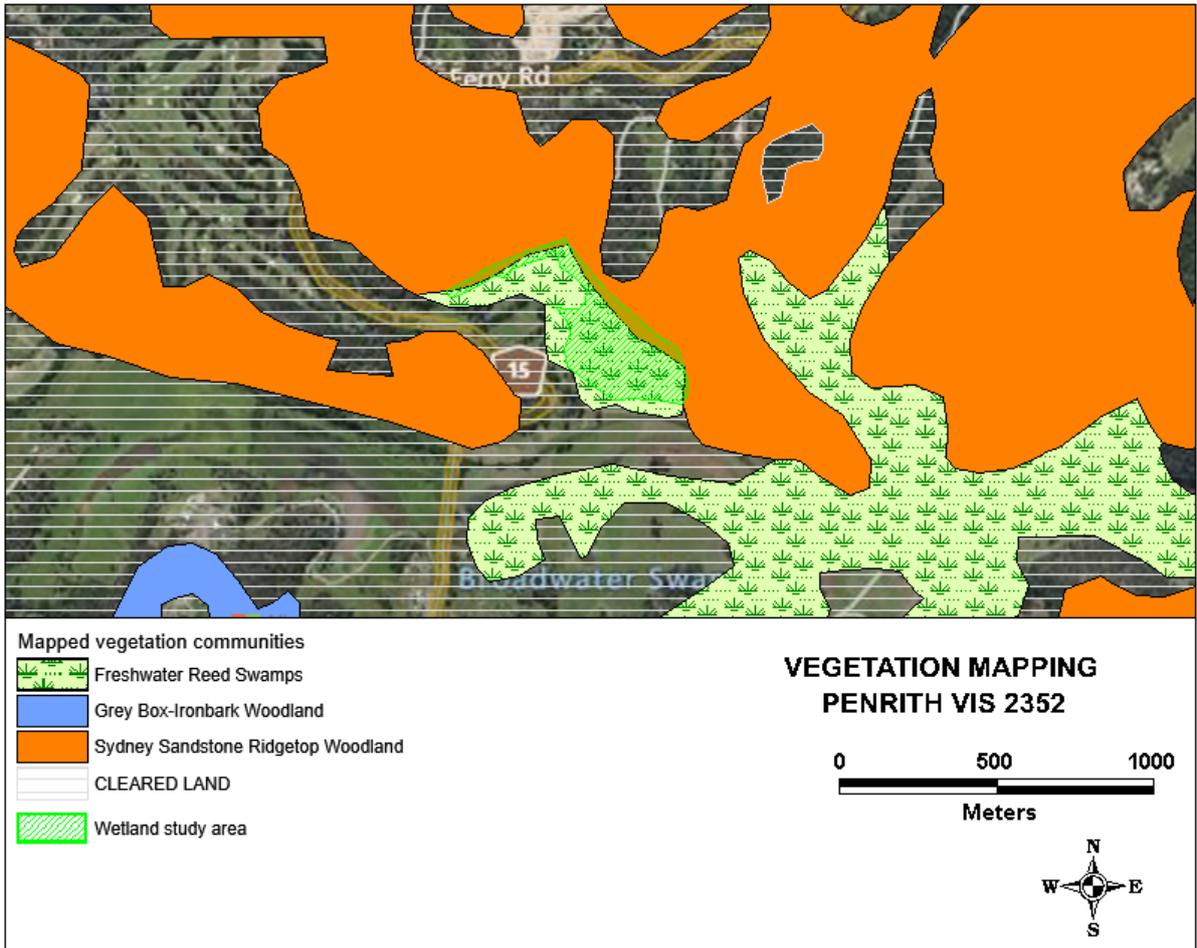
Priority weed – none noted

ASSETS 21/01/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Bolboschoenus caldwellii</i>	25-50	<i>Eriochloa pseudoacrotricha</i>
<i>Typha orientalis</i>	<10	<i>Lachnagrostis filiformis</i>
		<i>Oplismenus aemulus</i>
		<i>Paspalum distichum</i>
		<i>Microlaena stipoides</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Melaleuca linariifolia</i>	<i>Bursaria spinosa</i>	<i>Centella asiatica</i>
<i>Eucalyptus amplifolia</i>	<i>Persicaria lapathifolia</i>	<i>Cyperus flaccidus</i>
<i>Casuarina glauca</i>		<i>Hydrocotyle sibthorpioides</i>
<i>Angophora floribunda</i>		<i>Juncus usitatus</i>
<i>Eucalyptus tereticornis</i>		<i>Viola hederacea</i>

Fauna noted: Australasian Darter, Black Swan, Eastern Great Egret, Australian Reed Warbler, Australian Pelican, Australasian Swamphen, Grey Teal

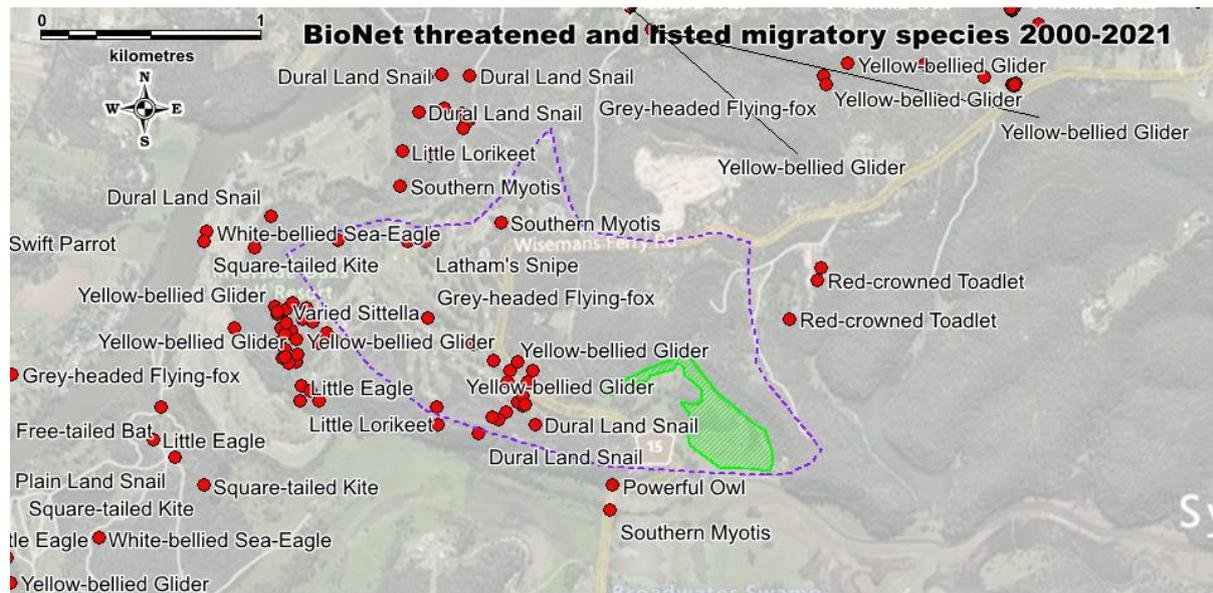
VEGETATION MAPPING AND LAND USE

Observed land use	%
bushland	50-75
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Latham's Snipe	<i>Gallinago hardwickii</i>	P	J,K	1
Aves	Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	V,P,3		2
Aves	Powerful Owl	<i>Ninox strenua</i>	V,P,3		1
Mammalia	Yellow-bellied Glider	<i>Petaurus australis</i>	V,P		11
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	2
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		1
Mammalia	Southern Myotis	<i>Myotis macropus</i>	V,P		2
Mammalia	Little Bent-winged Bat	<i>Miniopterus australis</i>	V,P		1
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		1
Gastropoda	Dural Land Snail	<i>Pommerhelix duralensis</i>	E1	E	4
Flora	Scrub Turpentine	<i>Rhodamnia rubescens</i>	E4A		1



IMAGE 1 Grey teals



IMAGE 2 water quality testing with landholder



IMAGE 3 Eastern Great Egret and Australian Swamphen foraging along macrophyte edge



IMAGE 4 Woody debris on swamp edge

YARRAMUNDI LAGOON

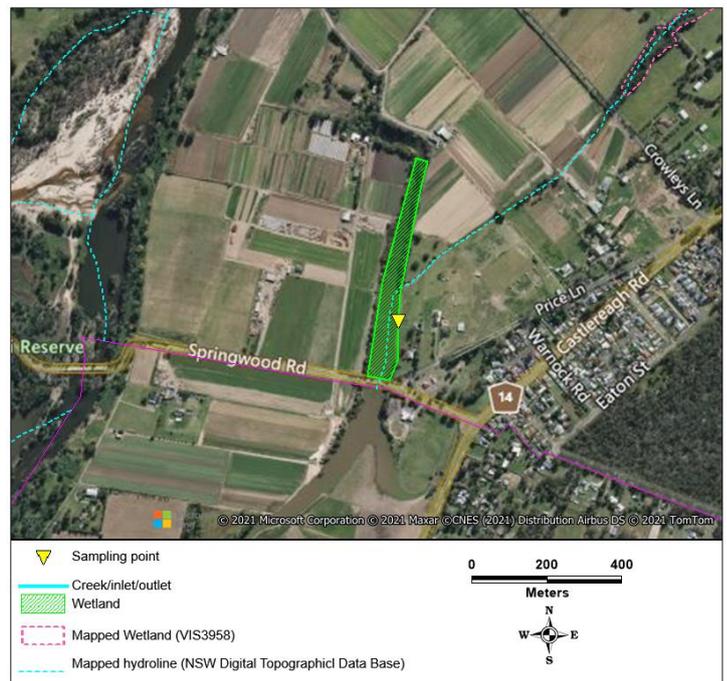
Overall Score (0-10)

4.2

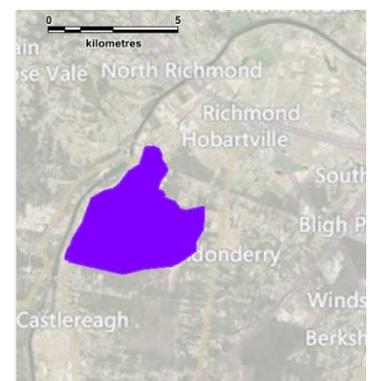
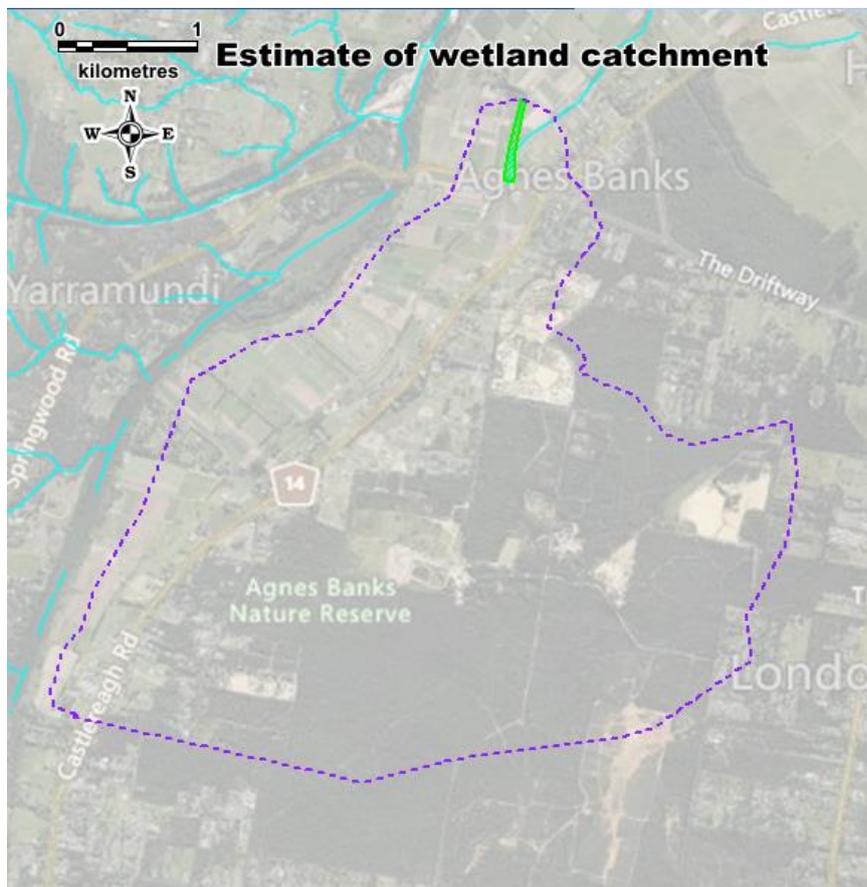
Latitude	██████████
Longitude	██████████
Address	Price Lane, Yarramundi
Catchment (ha)	1481

Wetland category	natural	modified
Water quality		fair
Site features Landuse		3.3
Site features offsite issues		7.0
Site features onsite issues		6.0
Vegetation		3.0
Habitat features -surrounds		6.3
Habitat features -wetland		7.4
Bank undercutting		0.0
Bank collapse		0.0

The wetland is an open water lagoon that discharges via a formalised channel, with a strip of weeds and plantings along the western edge. Surrounding land use is mainly cleared for market gardens with small areas of pasture and peri urban residential development.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGE 1 Site 04/12/2020

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Fence off the wetland to restrict stock access, establish offline watering points

Priority weed

ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Alternanthera phyloxerooides</i>	10-25
<i>Eichhornia crassipes</i>	<10
<i>Ludwigia peruviana</i>	<10
<i>Lycium ferocissimum</i>	<10
<i>Cortaderia selloana</i>	<10
<i>Arundo donax</i>	<10
<i>Cynodon dactylon</i>	10-25
<i>Cenchrus clandestinus</i>	10-25
<i>Salix fragilis</i>	<10
<i>Anredera cordifolia</i>	<10

LANDHOLDER IDENTIFIED ISSUES Concerns about lack of alligator weed control. Previously sprayed annually by Council it has remained untreated for 3 years and infests large parts of lagoon. Flooding events spread propagules onto vegetable and turf farms nearby and downstream requiring control throughout the chain of ponds. Immediately upstream the weed is treated by Penrith City Council. Additional concerns regarding carp damage to lagoon banks causing undercutting and tree collapse (on west side- turf farm).

ASSETS 04/12/2020 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Phragmites australis</i>	<10	<i>Microlaena stipoides</i>
		<i>Bothriochloa macra</i>
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Angophora floribunda</i>		<i>Centella asiatica</i>
<i>Casuarina glauca</i>		<i>Glycine microphylla</i>

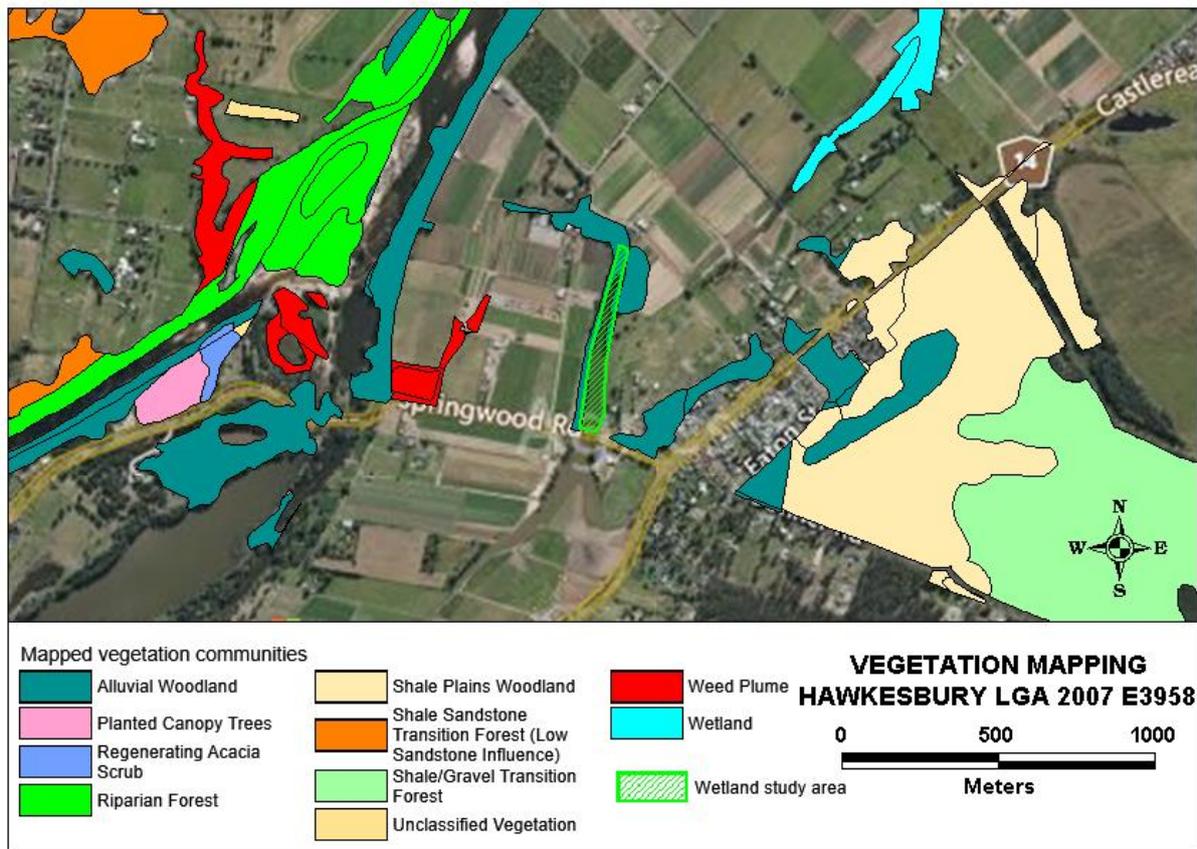
Fauna noted:

Common name	Name	Count
Birds		
Australasian Darter	<i>Anhinga novaehollandiae</i>	6+young (breeding)
Australasian Swamphen	<i>Porphyrio melanotus</i>	3

Australian Wood Duck	<i>Chenonetta jubata</i>	26
Dusky Moorhen	<i>Gallinula tenebrosa</i>	5+young (breeding)
Great Cormorant	<i>Phalacrocorax carbo</i>	1
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	14?+young (breeding)
Magpie-lark	<i>Grallina cyanoleuca</i>	4+young (breeding)
Masked Lapwing	<i>Vanellus miles</i>	6 (breeding)
Pacific Black Duck	<i>Anas superciliosa</i>	6+young (breeding)
Willie Wagtail	<i>Rhipidura leucophrys</i>	2 (breeding)
Reptiles		
Eastern Water Dragon	<i>Intellegama leseurii</i>	1

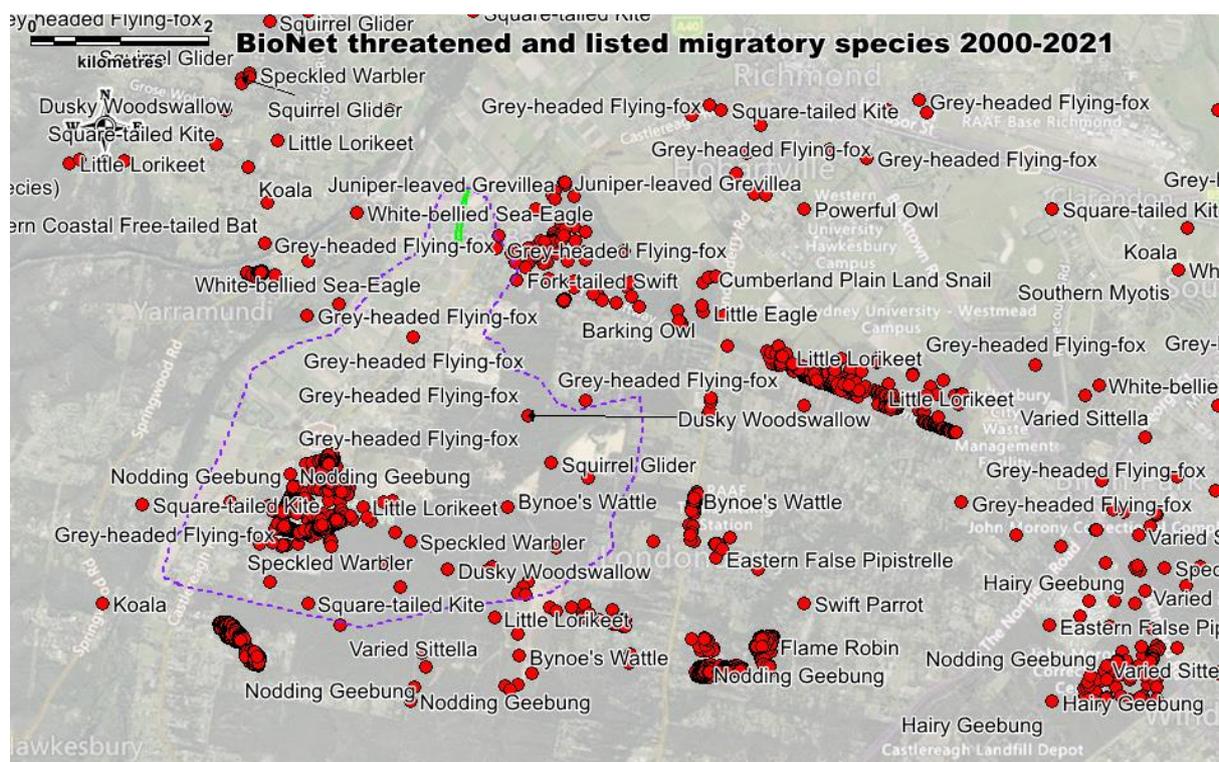
VEGETATION MAPPING AND LAND USE

Observed land use	%
market gardens	25-50
pasture/grazing	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Aves	Square-tailed Kite	<i>Lophoictinia isura</i>	V,P,3		1
Aves	Little Lorikeet	<i>Glossopsitta pusilla</i>	V,P		1
Aves	Masked Owl	<i>Tyto novaehollandiae</i>	V,P,3		1
Aves	Speckled Warbler	<i>Chthonicola sagittata</i>	V,P		2
Aves	Varied Sittella	<i>Daphoenositta chrysoptera</i>	V,P		6
Aves	Dusky Woodswallow	<i>Artamus cyanopterus cyanopterus</i>	V,P		3
Mammalia	Squirrel Glider	<i>Petaurus norfolcensis</i>	V,P		1
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	18
Mammalia	Eastern Coastal Free-tailed Bat	<i>Micronomus norfolkensis</i>	V,P		6
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		5
Mammalia	Large Bent-winged Bat	<i>Miniopterus orianae oceanensis</i>	V,P		7
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		3
Flora	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora subsp. viridiflora</i>	E2		1
Flora		<i>Allocasuarina glareicola</i>	E1	E	2

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Flora		<i>Dillwynia tenuifolia</i>	V		16
Flora	Bynoe's Wattle	<i>Acacia bynoeana</i>	E1	V	3
Flora		<i>Micromyrtus minutiflora</i>	E1	V	8
Flora	Juniper-leaved Grevillea	<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	V		1
Flora	Hairy Geebung	<i>Persoonia hirsuta</i>	E1,P,3	E	1
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	630



IMAGE 1 Alligator weed and tree collapse evident on western bank (area forms part of a rookery)



IMAGE 2 Eastern Water Dragon

IMAGE 3 Outflow channel, with priority control weeds spreading downstream



IMAGE 4 6 Little Pied Cormorants and 1 Australasian Darter at nest



IMAGE 5 Australasian Darter pair near nest (young inset)

YARRAMUNDI PADDOCKS EAST

Latitude	-33.602557
Longitude	150.733997
Address	Yarramundi Paddocks, WSU
Catchment (ha)	127

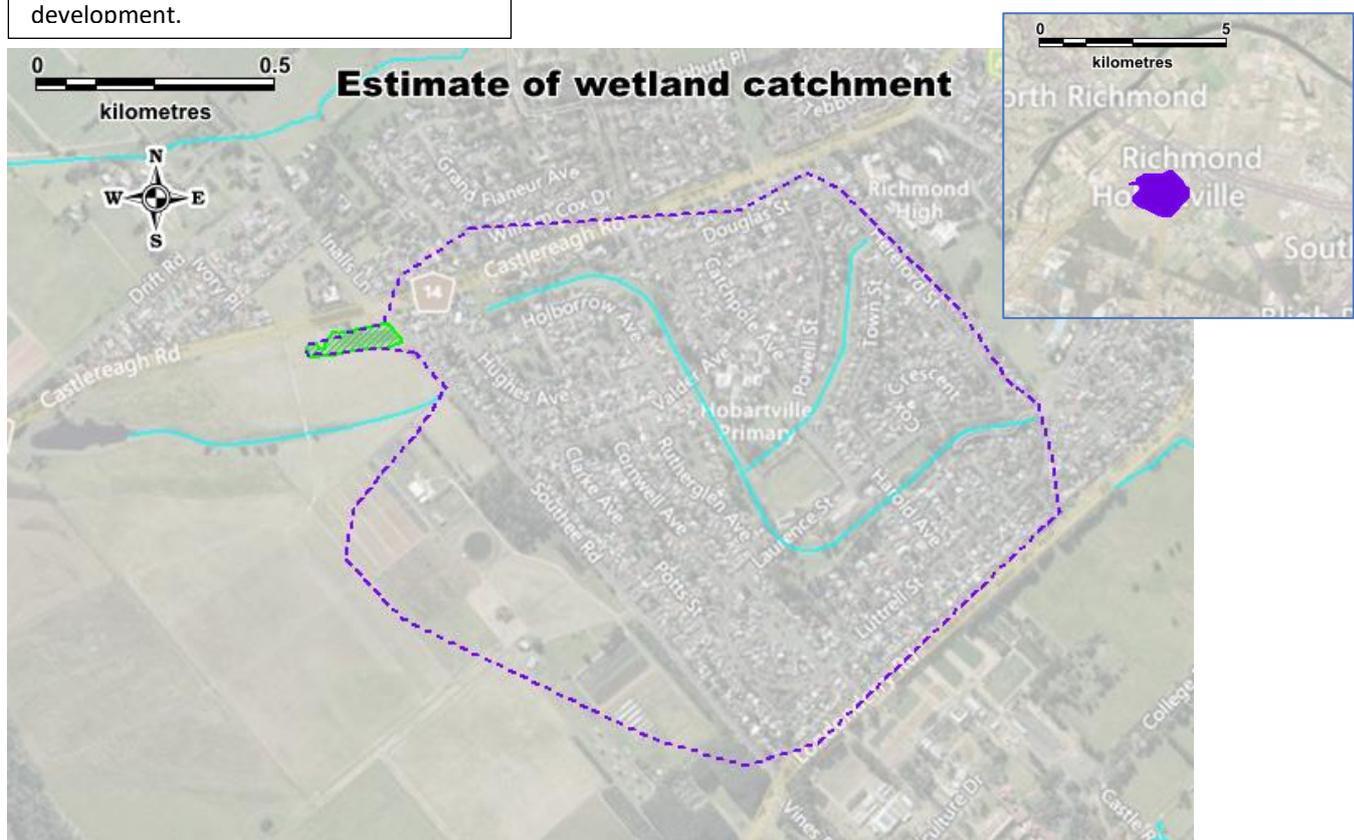
Wetland category	natural	modified
Water quality		poor
Site features Landuse		5.3
Site features offsite issues		6.2
Site features onsite issues		3.0
Vegetation		7.5
Habitat features -surrounds		2.5
Habitat features -wetland		3.3
Bank undercutting		5.0
Bank collapse		5.0

The wetland is a small shallow open water swamp surrounded fringing macrophytes and fed by stormwater runoff from the reticulated piped network. Surrounding land use is cleared for pasture or extensive areas of urban residential development.

Overall Score (0-10) 5.5



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 04/02/2021: (left) small open water wetland surrounded by fringing macrophytes, (top right) *Ludwigia peruviana*, (bottom right) *Eichhornia crassipes*

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Eichhornia crassipes</i>	10-25
<i>Ludwigia peploides</i>	<10
<i>Cenchrus clandestinus</i>	<10
<i>Senecio madagascariensis</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Echinochloa crus-galli</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Consider fencing to restrict stock access
- Revegetate surrounding banks
- Monitor for detrimental upstream impacts

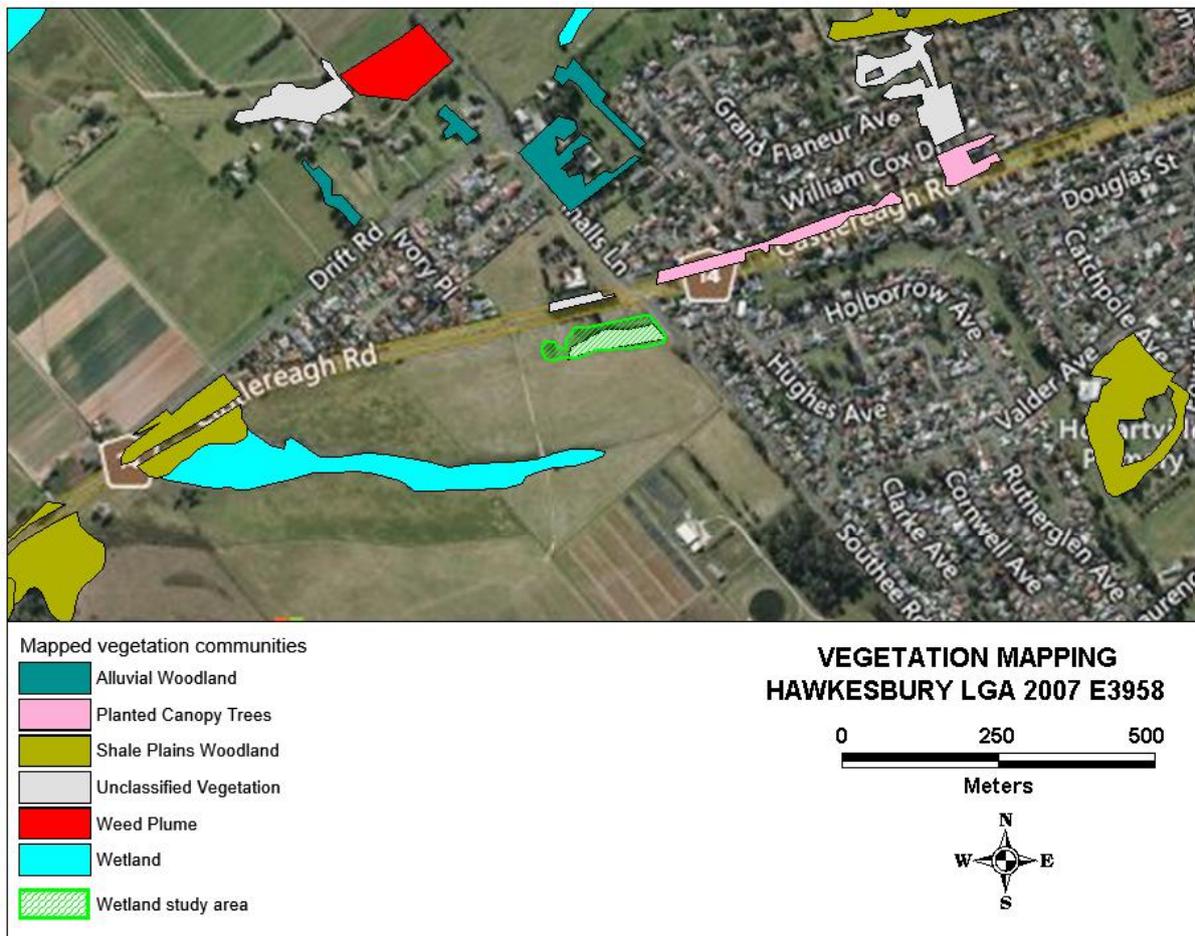
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Eichhornia crassipes</i>	10-25	None noted
<i>Lemna spp.</i>	10-25	
<i>Ludwigia peploides</i>	<10	
<i>Marsilea mutica</i>	<10	
<i>Isotoma fluviatilis</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
None noted	<i>Persicaria lapathifolia</i>	<i>Alternanthera denticulata</i>
		<i>Juncus usitatus</i>
		<i>Cyperus sanguinolentis</i>

Fauna noted: Australian Wood Duck, Pacific Black Duck, White-faced heron, Yellow-billed Spoonbill, Grey Teal

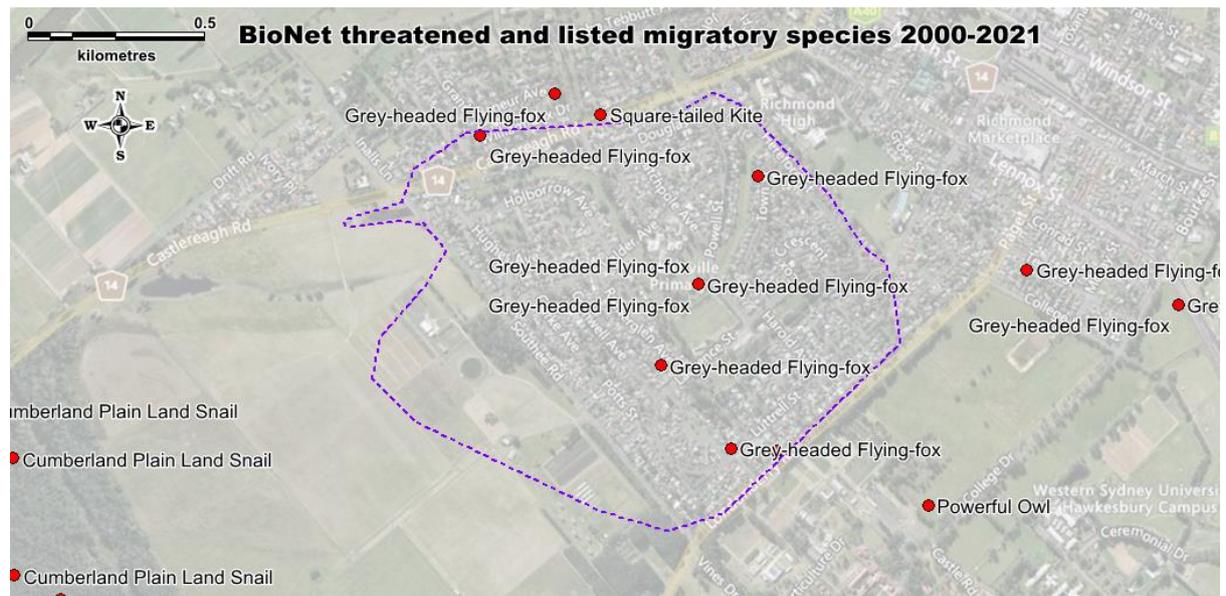
VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	25-50
residential	50-75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	6







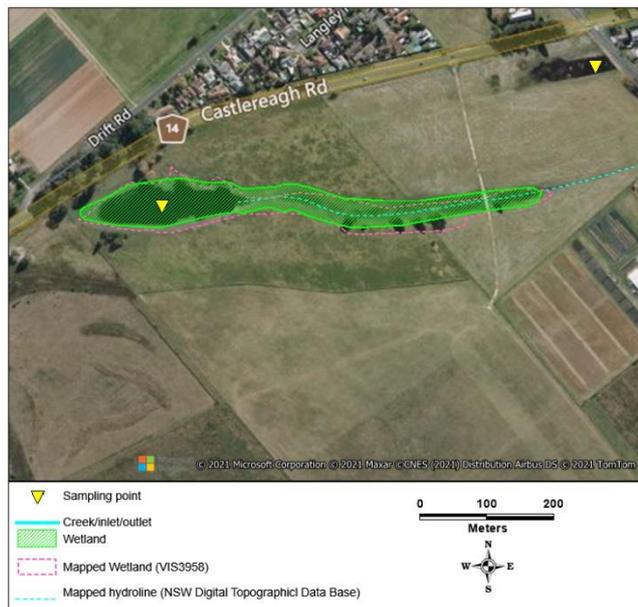
YARRAMUNDI PADDOCKS WEST

Overall Score (0-10) 3.9

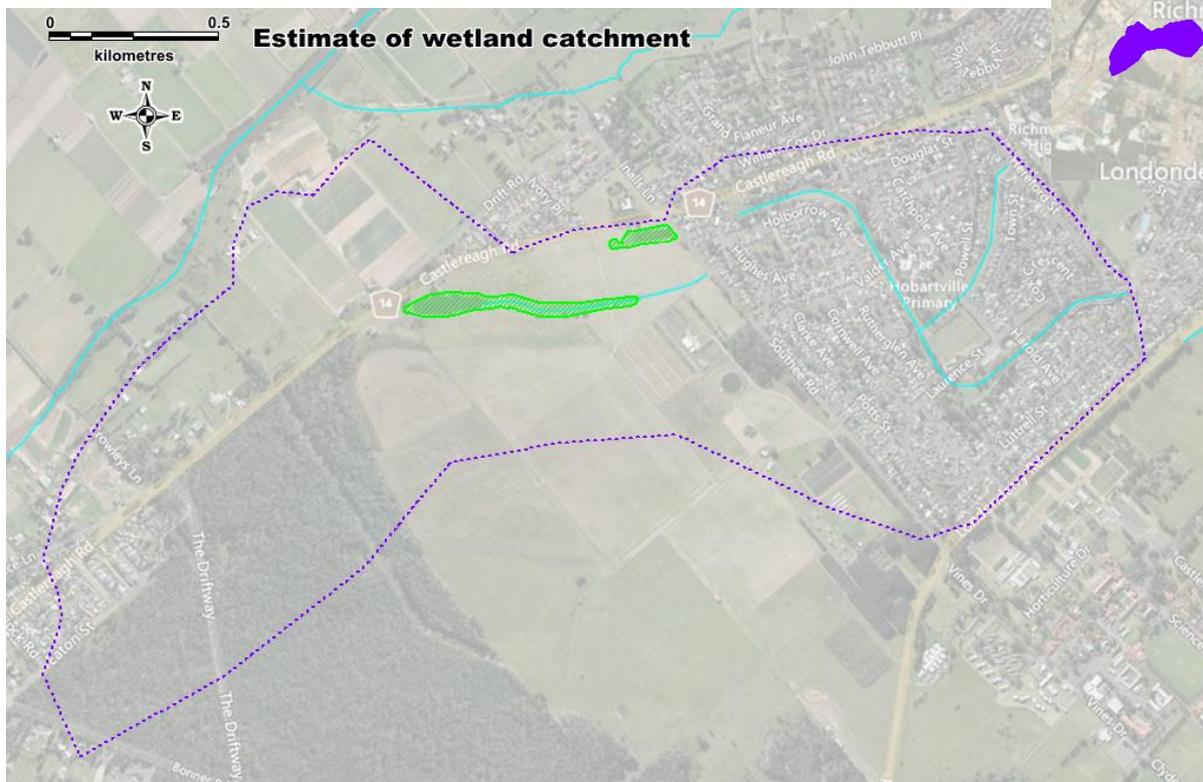
Latitude	-33.604449
Longitude	150.727019
Address	Yarramundi Paddocks, WSU
Catchment (ha)	296

Wetland category	natural	modified
Water quality		Very poor
Site features Landuse		5.0
Site features offsite issues		7.5
Site features onsite issues		2.4
Vegetation		2.5
Habitat features -surrounds		2.5
Habitat features -wetland		1.7
Bank undercutting		10.0
Bank collapse		10.0

The wetland is a shallow ephemeral swamp surrounded by small stands of fringing macrophytes. Surrounding land use is cleared pasture that is routinely grazed.



MAP 1 Wetland and sampling location



MAP 2 Approximate catchment of study site with (inset) overview catchment location



IMAGES 04/02/2021: (left) the wetland is surrounded by grazed paddocks, (top right) looking up the catchment, (bottom right) water quality impacts are evident at the lower end of the wetland

ISSUES	
LANDHOLDER IDENTIFIED ISSUES	
Nil	
WEED SPECIES (TOP 10)	DENSITY
<i>Senecio madagascariensis</i>	<10
<i>Rubus fruticosus</i> aggregate species	<10
<i>Eragrostis curvula</i>	<10
<i>Cynodon dactylon</i>	<10
<i>Conyza sp.</i>	<10
<i>Xanthium occidentale</i>	<10
<i>Cirsium vulgare</i>	<10
<i>Verbena bonariensis</i>	<10
<i>Lactuca serriola</i>	<10
<i>Trifolium repens</i>	<10

Recommended works:

- Weed control required for priority control weeds
- Control of environmental weeds to prevent spread to downstream areas
- Consider fencing to restrict access by stock, and install offline watering points

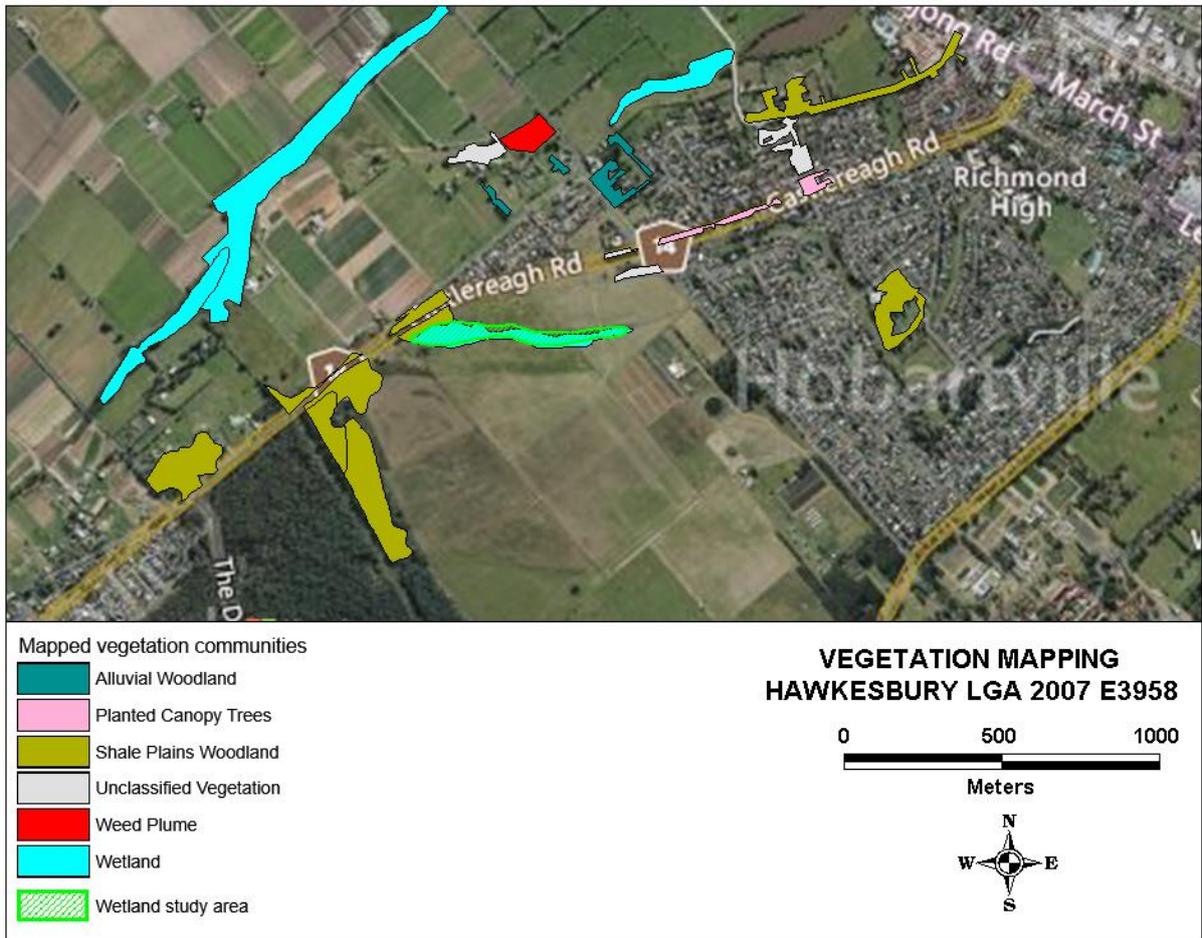
Priority weed

ASSETS 04/02/2021 SNAPSHOT SURVEY		
Macrophytes present	Density	Grasses
<i>Marsilea hirsuta</i>	<10	<i>Lachnagrostis filiformis</i>
<i>Juncus usitatus</i>	<10	
<i>Ludwigia peploides</i>	<10	
<i>Lemna spp.</i>	<10	
Other native vegetation		
Trees	Shrubs	Ground covers
<i>Eucalyptus amplifolia</i>	<i>Bursaria spinosa</i>	<i>Centella asiatica</i>
	<i>Persicaria lapathifolia</i>	<i>Alternanthera denticulata</i>

Fauna noted: Australian Wood Duck, Pacific Black Duck, Australasian Darter, White-faced heron, Masked Lapwing

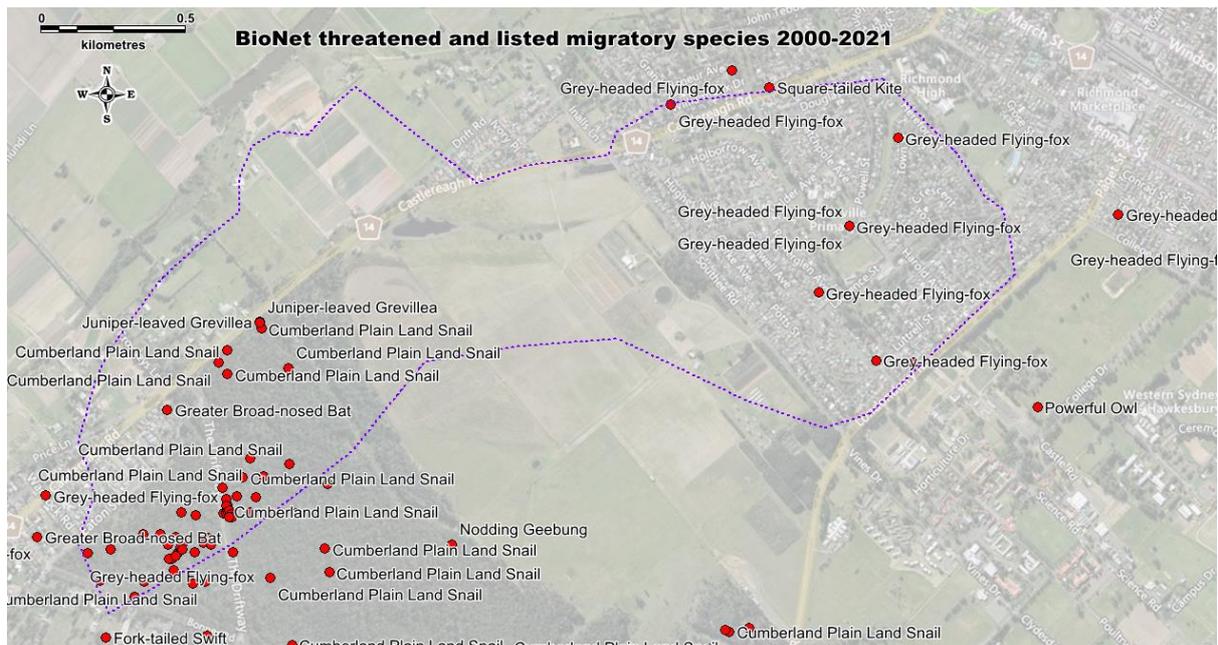
VEGETATION MAPPING AND LAND USE

Observed land use	%
pasture/grazing	>75



MAP 3 Mapped vegetation communities

THREATENED SPECIES AND LISTED MIGRATORY SPECIES: BIONET RECORDS 01/01/2000 – 2021



MAP 4 Threatened and migratory species near the subject site

TABLE 3 Threatened and migratory species in the wetland subcatchment (BioNet)

Class Name	Common Name	Scientific Name	NSW Status	Comm Status	Count
Mammalia	Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	V,P	V	9
Mammalia	Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	V,P		1
Gastropoda	Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E1		24
Gastropoda	Dural Land Snail	<i>Pommerhelix duralensis</i>	E1	E	1
Flora		<i>Dillwynia tenuifolia</i>	V		1
Flora	Juniper-leaved Grevillea	<i>Grevillea juniperina subsp. juniperina</i>	V		2
Flora	Nodding Geebung	<i>Persoonia nutans</i>	E1,P	E	22



IMAGE 1 A family of Australian Wood Ducks forage in the grass



IMAGE 2 Catchment setting in Yarramundi Paddocks, WSU



IMAGE 3 Masked Lapwings were territorial on terrestrial banks



IMAGE 4 White-faced Heron foraging along the edge of the wetland