



Hornsby Vegetation Map Update 2017 Report

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Abbreviations

Abbreviation	Description
ABS	Australian Bureau of Statistics
API	Aerial Photo Interpretation
BGH	Blue Gum High
EPBC	Commonwealth <i>Environmental Protection and Biodiversity Conservation Act 1996</i> .
HSC	Hornsby Shire Council
LGA	Local Government Area
MGA	Map Grid Australia
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
RFS	NSW Rural Fire Service
TEC	Threatened Ecological Community (includes Endangered and Critically Endangered Ecological communities)
TSC	NSW <i>Threatened Species Conservation Act 1994</i>
VIS	NSW Vegetation Information System

Executive summary

The Hornsby Vegetation Map 2017 provides current information on the native vegetation in the study area. **Previous Hornsby Vegetation mapping was completed in 2008.** There are substantial changes in the mapped polygons on the urban-bushland boundary based on the updated imagery and map rules. New mapping thresholds are designed to address Council's information needs arising from new regulations governing vegetation management in NSW, in particular the 10/50 bushfire protection rule. These were developed in consultation with Council and tested in a trial area prior to mapping.

The map has been compiled using visual aerial photo interpretation of 2014 imagery and botanical review. New field work has included collect rapid floristic data at selected survey locations. The update incorporates other sources of field survey and vegetation mapping completed between 2008 and 2017. The map is approximately 1:25,000 scale.

The Hornsby Vegetation Map 2017 applies the existing, accepted vegetation classification established in Smith and Smith Hornsby Vegetation Map 2008 Update. Two updates are provided with the addition of a new code for mixed 'urban native/ exotic' patches (consistent with Sydney Metropolitan vegetation mapping that overlaps part of the study area (OEH 2015)) and an updated classification equivalence table necessitated by changes to NSW plant community types. Modified, predominantly native vegetation has been attributed with the closest, applicable native vegetation and denoted as disturbed. In areas identified as 'urban native/ exotic' the proportion of exotics is highly variable. Field validation is recommended to support land management decisions in these areas.

The 2017 map has identified 17,005 ha of vegetation including 664 ha of EEC and 653 ha of 'urban native/ exotic' vegetation in the study area. In addition, the map includes 231 ha of potential relic EEC subject to field validation. A direct comparison of changes to vegetation extent between 2008 and 2017 are not possible due to differing map methods.

All maps have limitations and field validation is recommended for detailed site planning and to verify the presence of vegetation types, particularly communities or species listed under the NSW *Threatened Species Conservation Act 1994* or Commonwealth *Environmental Protection and Biodiversity Conservation Act 1996*. Air photo interpretation is limited to a 'birds eye view' and may not detect changes in vegetation composition observable from field survey. Approximately 21% of the map has been validated by current and previous authors.

It is recommended that the Hornsby Vegetation Map 2017 is reviewed after one year in circulation. This will provide an opportunity to collate user feedback and identify minor edits required and any major revisions arising. Changes to the NSW PCT database may be incorporated at that time.

1 Introduction

Hornsby Shire Council required updated vegetation mapping to better inform the development of conservation measures and support ecologically sustainable development in the Shire.

Hornsby Shire Council (HSC) commissioned Eco Logical Australia (LGA) to update of the Local Government Area (LGA) vegetation map. Prior to this update, the principle, LGA wide vegetation map used by Council was Smith & Smith Native Vegetation Communities of Hornsby Shire 2008 Update. Council required a consistent, shire-wide, current vegetation map to reflect changes in the amount of vegetation since 2008, to incorporate additional, detailed vegetation studies that have been completed in the interim and to address Council's information needs arising from new regulations governing vegetation management in NSW.

1.1 Objectives

The objectives of this project were to:

- Create a current, consistent map of extant native vegetation of the study area based on recent aerial photography provided by Council
- Capture vegetation polygons by aerial photo interpretation applying new map rules
- Attribute new polygons applying the existing Smith & Smith 2008 vegetation classes where applicable
- Define thresholds for vegetation to be applied in (separate) Bushfire Prone Analysis
- Identify links to EPBC/TSC Act listed Threatened Ecological Communities (EECs), Keith Class and Sydney vegetation map unit (Benson 1986, 1992, Benson and Howell 1994, Ryan et al. 1996)
- Use mapping methods consistent with OEH Vegetation Mapping Methodology
- Provide clean GIS data compatible with Councils system (ESRI ArcGIS) in GDA94 MGA Zone 56 Projection.

This report documents the technical mapping methods used to capture updated vegetation boundaries and assign vegetation types. The native vegetation types in the 2017 map have been previously defined in Smith & Smith 2008 and are not reproduced here. One additional vegetation type is defined in this report in **Section 2.1**.

1.2 Study Area

The survey area included the Hornsby Local Government Area, excluding National Parks estate (Berowra Valley National Park, Marramarra National Park, Muogamarra Nature Reserve, Long Island Nature Reserve and Ku-ring-gai Chase National Park). Hornsby Local Government Area is located 25 km north west of Sydney, NSW. The LGA covers 46,211 ha and has an estimated population of 168,614 people (ABS 2014). The location of the study area is shown in **Figure 1**.



Figure 1: Location of Study Area

1.2.1 Previous vegetation surveys & mapping

There is a rich legacy of botanical surveys in the study area. The major, recent studies are listed in **Table 1**. The Smith & Smith vegetation classification was influenced by work from Benson (1986, 1992) and Benson & Howell (1994) as well as other flora studies.

Table 1: Previous Vegetation Maps

Survey	Author	Year
Remote Sensing analysis report and spatial data	Fugro LADS Corporation Pty Ltd	2015
Vegetation Assessment for Proposed Hornsby Mountain Bike Track	Smith & Smith	2012
The Native Vegetation of the Sydney Metropolitan Area	OEH	2009
Remnant Trees in the Urban District of Hornsby Shire	Smith & Smith	2009
Native Vegetation Communities of Hornsby Shire: 2008 Update	Smith & Smith	2008
Remnant Trees in the Southern Rural District of Hornsby Shire	Smith & Smith	2008
Urban Tree Study	Skelton	2008
Native Vegetation Communities of Hornsby Shire: 2007	Smith & Smith	2007
Endangered ecological community mapping project	Lembit	2005
Hornsby Shire threatened biota conservation plan.	ESP Ecological Surveys & Planning	1999

1.3 Limitations

The updated vegetation mapping is based on visual aerial photo interpretation of vegetation patterns with a discreet survey effort. Not all polygons have been surveyed to verify vegetation type present. All air photo interpretation is limited to a 'birds eye view' and may not detect understorey changes observable from field survey.

Vegetation is mapped at approximately 1:25,000 scale. Field validation is recommended for detailed site planning and to verify the presence of potential listed Threatened Ecological Communities (TEC). The vegetation map may be updated over time.

2 Methods

2.1 Existing classification

The vegetation map update 2017 has assigned vegetation types defined in Smith & Smith (2008a). For new and reclassified polygons (denoted in the GIS table), the 2017 map applied the closest fit vegetation type based on the floristics, structural characteristics and position in landscape. **Table 2** lists the Hornsby vegetation community types and corresponding profile in Smith & Smith 2008a.

In addition to the existing vegetation classes, one additional class has been added. “Remnant Vegetation – to check” is defined as

areas with evidence of both exotic and native species in the upper or lower strata situated in a built environment.

This definition is consistent with the unit mapped as “Urban/Native Exotic” in the Sydney Metropolitan Vegetation Mapping (OEH 2015). These polygons have modified structural or floristic characteristics and may include weeds, regrowth, canopy gaps, part clearing, dieback, cultivated exotic species or native plantings in urban or rural residential areas. Potential Sydney Blue Gum High Forest or Sydney Shale Transition Forest were tagged with relevant native vegetation codes pending field validation. Areas of predominantly native vegetation with evidence of structural modifications were assigned to relevant native vegetation code and annotated as ‘disturbed, modified understorey’.

Table 2: Hornsby Vegetation Communities

Hornsby vegetation community	Profile description (page in Smith & Smith 2008a)
Coachwood Rainforest	15
Grey Myrtle Rainforest	16
Blackbutt Gully Forest	24
Angophora-Red Mahogany Forest	25
Blue Gum Shale Forest	17
Blue Gum Diatreme Forest	18
Blue-leaved Stringybark Diatreme Forest	21
Blackbutt-Rough-barked Apple Forest	27
Rough-barked Apple-Forest Oak Forest	26
Narrow-leaved Apple Slopes Forest	28
Turpentine-Ironbark Forest	22
Duffys Forest	23
Shale/Sandstone Transition Forest	30

Shale Gravel Transition Forest	29
Angophora Woodland	35
Bloodwood-Scribbly Gum Woodland	32
Silvertop Ash-Scribbly Gum Woodland	33
Narrow-leaved Scribbly Gum Woodland	34
Peppermint-Angophora Forest	31
Narrow-leaved Apple Gully Forest	36
Grey Gum-Scribbly Gum Woodland	37
Yellow Bloodwood Woodland	38
Scribbly Gum Open-woodland/Heath	39
Rock Platform Heath	40
Sandstone Swamp	41
Forest Red Gum River-flat Forest	20
Rough-barked Apple River-flat Forest	19
Swamp Oak Floodplain Forest	45
Floodplain Paperbark Scrub	43
Floodplain Reedland	44
Swamp Mahogany Forest	42
Mangrove Swamp	46
Coastal Saltmarsh	47
Urban Native/ Exotic	N/A

2.2 Baseline Data

The data sets listed in

Table 3 were appended together to create a single working footprint for the updated mapping. Overlapping polygons and gaps created in this process were resolved with new mapping.

Table 3: Baseline data layer inputs

Data set	Application
Smith_Smith_Vegetation_Communities_2008	Appended together to create a single working footprint for the updated mapping
Smith_Smith_Remnant_Trees_Urban_2008	
Smith_Smith_Remnant_Trees_Rural_2008	

2.3 Map Rules

An agreed set of map rules was developed in consultation with Council to guide mappers in consistent collection of vegetation information across the Shire.

- Minimum polygon size of 0.25 ha (except for potential EEC) – used as guidelines only. Polygons under this size threshold are not culled
- Min canopy cover 5% (per Smith & Smith 2007)
- Street trees not generally be mapped unless they form >0.25 ha
- Occurrence of single/isolated trees that may be candidate EEC are delineated in polygons less than 0.25ha. Field surveys are advisable
- Minimum polygon width of 20m, except for linear features such as visible roads and drainage lines
- Maximum gap of contiguous vegetation of 100m – in line with bushfire prone mapping categories
- No min canopy height
- Scale of data capture 1:5,000 or finer
- NPWS Estate to be excluded from mapping
- Edge matching to Ku-ring-gai vegetation mapping
- Native vegetation classification after Smith & Smith (2008a)
- Non native vegetation >0.25ha to be labelled “Remnant Vegetation - *to check*”

Field surveys followed similar guidelines and recorded natural, remnant trees with modified understorey but no greater than 100 m from adjacent native vegetation patch, with a native vegetation type.

The map rules were informed by guidelines to Mapping Bushfire Prone Land Mapping (RFS 2015). RFS definition of ‘bushfire prone’ excludes

- “single areas of vegetation less than 1 hectare in area and greater than 100 metres separation from other prone areas,
- multiple small, vegetation patches (>.25ha) not within 30 metres of each other;
- narrow strips of vegetation (<20m width) regardless of length and not within 20 metres of other prone areas or
- areas of “managed grassland”.

A trial area was mapped initially to verify map rules and mapping procedures matched Council’s information needs.

2.4 Mapping Process

Mapping was undertaken systematically across the study area starting with air photo interpretation followed by botanical review. The methods applied are broadly consistent with the Interim Vegetation Map Standards (OEH 2010).

2.4.1 Air Photo Interpretation

The purpose of Aerial Photo Interpretation (API) is to identify and capture vegetation boundaries. API is the process of delineating and assigning categories to features appearing on aerial photography (Keith 2004, OEH 2010, Lillesand, Kiefer and Chipman 2015). Characteristics of vegetation condition that may be observed from air photos include structural intactness where canopy is open e.g. modified understorey, canopy density (per type), weediness where major infestations are observed e.g. dominated by exotic species, diversity of observable species and mixed age cohorts.

API was based on aerial images taken in 2014 and provided in mosaic form by Council. The landscape was divided into a grid for working purposes and the base 2008 vegetation map was first systematically reviewed against the current imagery for differences requiring delineation. Where an edit was required the interpreter digitized the updated polygon boundary and assigned a 1st pass attribute based on:

- Spectral characteristics observed
- Adjacent vegetation types
- Topographic position in landscape
- Substrate – soil and/or geology
- Landuse context

Attribution was also informed by existing, available studies where possible. Identification of street trees and urban patches was assisted by Council's Street Tree Database (authors unrecorded 2013), Smith & Smith (2008b), Skelton (2008) and Lembit (2006).

API assigned each polygon a confidence rating to identify areas for botanical validation. Polygons were created or reshaped following the agreed map rules. In some areas, interpretation also cross referenced 2015 canopy mapping by OEH and/or Fugro to distinguish vegetation patches in mixed landscapes. Fugro developed a 2m Canopy map of vegetation above 3m height using multispectral Imagery and LiDAR analysis (Fugro LADS 2015).

A separate 'patch' was captured where the area displayed different vegetation characteristics to the adjacent polygon, was >0.25 ha and did not contain canopy gaps >100m. Where the new vegetation was observed to have similar characteristics to adjacent polygons the original polygon was reshaped. Where native vegetation patches contained a highly modified understorey the disturbance was annotated in the map table.

The label 'urban native / exotic' was applied to new capture polygons greater than 0.25 hectares in size where there was evidence of both exotic and native species in the upper or lower strata.

2.4.2 Field Survey

Botanical field surveys were used to identify or confirm vegetation types. Surveys were undertaken, between September 2017 and November 2017, by a qualified botanist. Rapid floristic surveys used a standard field proforma and all data collected digitally. Rapid floristic surveys record the dominant species present in each stratum, information on the landscape context, vegetation type and a photo point. A full list of survey attributes is listed in **Table 4**.

Field surveys were completed on public land including roadside reserves and Council reserves. The new field survey data augmented previous survey data which was also referenced where available to inform attribution.

Table 4: Rapid floristic attributes surveyed

Attribute	Explanation
Date	Date of survey
Recorder	Initials of ecologist undertaking survey
Site Number	Sequential site number per day
Location	Street, suburb reference
Emergent	List scientific name of any dominant species present in emergent stratum (first 4 letters of genus and species)
Tallest	
Mid 1	
Mid 2	
Low 1	
Low 2	
Terrain	Similar to landscape element - alluvial, depression, drainage, flats, dunes, swale, floodplain, hillcrest, hillslope, low hills, steep slopes, ridge, river bank, swale, wetland – to guide API collection
Substrate	Geological process or broad formation (to differentiate EEC presence)
Aspect	N, NE, E, SE, S, SW, W, NW
Slope	if present
Veg Condition	note structural and floristic intactness
Weed cover	% cover
Disturbance	Modified floristic assemblage, modified structure, modified environment eg access tracks
Photo	Photo number
Notes	Notes
Threatened	Threatened flora species observed
Veg Community	Potential equivalent Smith & Smith type(s)
EEC	EEC (candidate/related)

2.4.3 Validation

A 1st pass attribute was assigned to all polygons with a confidence rating. Confidence was rated highest where the polygon was surveyed or previously validated. Moderate confidence was assigned where the vegetation appearance was similar to adjacent confirmed polygon, matches topology, elevation and geology. All other areas were tagged as limited confidence and subject to botanical review. The botanical review started with desktop analysis with reference to:

- Species knowledge and distribution patterns
- Investigation of aerial imagery of adjacent polygons and similar landform and geological characteristics
- Investigation of alternative imagery on Google maps, Google street view and Six Maps. 1943 aerial photographs on Six Maps provided a useful indication of regrowth status
- Investigation of other vegetation studies (where available)

Residual query areas were targeted for field survey where they were accessible. A 2nd pass attribute was assigned following field survey results.

In addition to target areas, the review also sampled a random selection of polygons assigned higher confidence to check attribution was assigned correctly.

Additional field surveys were completed with Hornsby Shire Council staff to identify species present within a subset of areas labelled “Remnant vegetation – to check”. This field work informed attribution in the final map. The field surveys also informed how Council may capture the results of field inspections undertaken as part of routine environmental management services by Council staff for continual map validation and periodic updates.

3 Results

The results of the native vegetation map update 2017 are shown in **Figure 2**. In total 80% of polygons were edited or updated. This includes 3294 new polygons captured. The 2017 map depicts 33 native vegetation communities and 1 urban native/exotic map unit. 28 of the communities are significant at national, State, regional or local level (Smith & Smith 2008a, HSC 2006).

The relationship between native vegetation communities of Hornsby Shire and other vegetation classifications has been updated to reflect changes to the NSW Plant Community Type classification and EEC listings since 2008. The classification equivalence is provided in **Appendix A**.

The 2017 map has identified 17,005 ha of vegetation including 664 ha of EEC and 653 ha of 'Remnant Vegetation - to check' vegetation in the study area. The new map rules applied have broadened the definition of vegetation mapped to include vegetation on the peri urban boundary. This has increased the total amount of vegetation mapped by 1506 ha. The new map captures 231 ha of potential, modified EEC. A detailed summary of the extent of each vegetation community in comparison to 2008 mapping is provided in **Appendix B**.

The conservation status of *Angophora Woodlands* has changed to regionally significant for the Sydney Basin bioregion. *Angophora Woodlands* was previously classified as locally significant based on the Hornsby Shire Council Biodiversity Conservation Strategy 2006 (Smith & Smith 2008). *Angophora woodland* has a relatively small distribution of 62 ha in Hornsby LGA and it is not currently listed under the TSC Act or EPBC Act.

Angophora Woodlands is equivalent to NSW Plant Community Type (PCT) 1778 Smooth-barked Apple - Coast Banksia / Cheese Tree open forest on sandstone slopes on the foreshores of the drowned river valleys of Sydney (BVT HN655; ME65). The pre-European extent of this PCT was 6480 ha and the current extent is 648 ha. Therefore, there is only 10% of this community remaining. Over 90% of this PCT has been cleared in the Hawkesbury Nepean and Sydney Metro Catchment Management Areas. Based on the level of past clearing of PCT 1778 within the Sydney Basin bioregion it is considered that this community should be upgraded to a classification of 'regionally significant'.

Approximately 21% of the map has been validated by current and previous authors. 214 areas were validated by Eco Logical Australia in the development of this draft. 28 sites could not be surveyed without accessing private land.

A copy of all digital files are provided to Council for integration into Council's GIS and document system including the updated 2017 vegetation map, updated vegetation look up table, metadata, field survey data and geo-referenced photos.

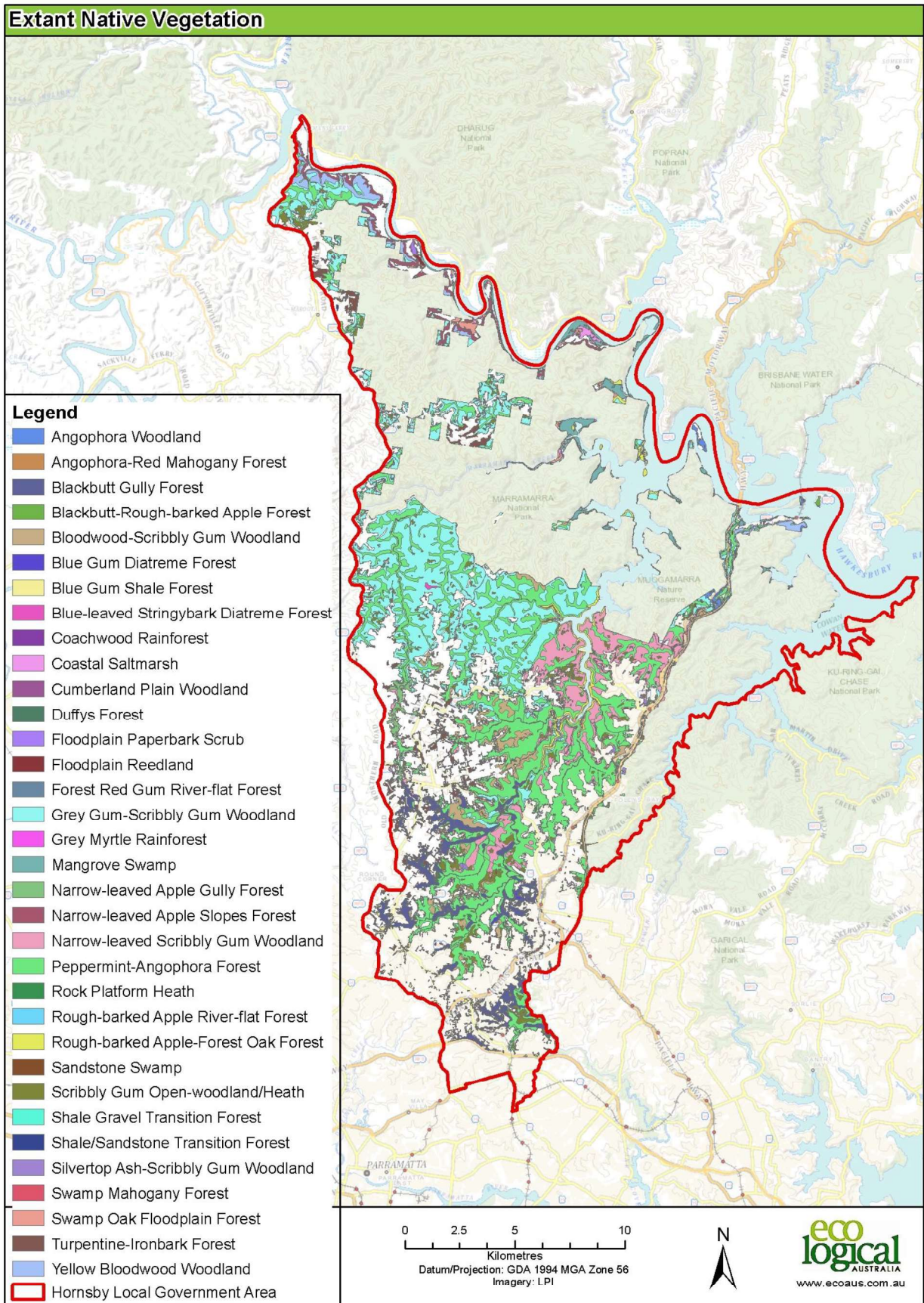


Figure 2: Hornsby Extant Native Vegetation Update 2017

4 Discussion & Recommendations

The 2008 vegetation map used the definition of native from State Environmental Planning Policy 19 Bushland in Urban Areas. This definition only includes vegetation where the understorey had native component that could regenerate (i.e. presence of understorey). The 2017 map applies a broader vegetation definition and has consequently captured more polygons of remnant vegetation, particular in the urban and rural residential boundaries with bushland. Due to the difference in map thresholds it is not possible to compare the extent of vegetation mapped between 2008 and 2017.

The NSW Scientific Committee determinations of some Threatened Ecological Communities include highly modified relics of the original community. For example the final determination for Blue Gum High Forest noted that

Highly modified relics of the community persist as small clumps of trees without a native understorey. All remnants of the community are now surrounded by urban development. Consequently, the distribution of Blue Gum High Forest is severely fragmented. Fragmentation of habitat contributes to a very large reduction in the ecological function of the community. (NSW Scientific Committee 2007).

The 2017 maps relics of all EECs, including Blue Gum High Forest (BGH) and Blue Gum Diatreme Forest denoted in the attribute table with an 'r'. This will help Council manage this threatened vegetation community and protect relictual occurrences. Whilst *Eucalyptus saligna* (BGH) and *Eucalyptus grandis* appear similar from air photos, *Eucalyptus grandis* is more likely to be planted in landscaped areas and as street trees.

The conservation status of *Angophora Woodlands* is upgraded to regionally significant based on the NSW Plant Community Type equivalent. It is recommended Council review and adopt explicit definitions of local significance and regional significance to assist in consistent interpretation and application across all vegetation in Hornsby LGA.

Almost all patches have exotics in varying dominance. Weed management continues to be a significant challenge in managing the natural bushland. This is a collective responsibility of all landholders and occupiers and is particularly important in areas of relictual EEC. In areas identified as 'urban native/exotic' the proportion of exotics is highly variable. Field validation is recommended to support land management decisions in these areas.

The 2017 map update has provided new, updated API for external vegetation boundaries and attributed observed changes to vegetation structure. Stereoscopic API was not required for this project. Smith & Smith used stereoscopic API to assist delineating vegetation types in contiguous remnants in certain terrain and this attribution was carried forward into the 2017 update (2008a).

It is recommended that the Hornsby Vegetation Map 2017 is reviewed after one year in circulation. This will provide an opportunity to collate user feedback and identify minor edits required and any major revisions arising. Changes to the NSW PCT database may be incorporated at that time. It is recommended Council develop a standard field data protocol to capture results of routine site inspections for the purposes of informing attribution updates on the vegetation map.

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