Attachment 1 to Item 10.3.2.

Fine Scale Vegetation Mapping Report - Hawkesbury February 2025

Date of meeting: 11 March 2025
Location: Council Chambers
Time: 6:30pm

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Report

Fine Scale Vegetation Mapping in Hawkesbury LGA

Hawkesbury City Council

14 February 2025

Draft only

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

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Hawkesbury City Council

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

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1 INTRODUCTION

In the light of recent declines in Koala (*Phascolarctos cinereus*) populations across NSW (NSW DPE 2022) and subsequent legislative changes to Koala preservation measures, Hawkesbury City Council is intending to develop a Koala Plan of Management (KPoM) for Koala conservation purposes. To identify potential Koala habitat, a detailed vegetation extent mapping layer will be required. That will be achieved through a fine scale vegetation mapping completed within this project.

In 2018 Hawkesbury City Council (HCC) finalised the vegetation mapping for the extent of the Local Government Area (LGA) based on vegetation modelling and rigorous ground truthing. This layer has been reviewed by NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) in the light of HCC's intention to develop a KPoM. The review concluded that the layer provides sufficient quality for the vegetation distributions within the LGA, however the layer should be updated to the Eastern NSW Plant Community Type classification.

Based on the above, in an Ordinary Meeting in December 2023 HCC resolved that:

"Council endorses the new approach to obtaining high quality vegetation mapping for the purpose of a Koala Plan of Management by:

1. *Using Council's existing vegetation mapping;*
2. *Engaging a botanical expert to cross-reference Council's existing mapping with Plant Community Type mapping available from the Department Planning and Environment and Water on Bio-Net, and;*
3. *Conducting botanical ground-truthing surveys to proof mapping and establish high quality accuracy."*

HCC engaged Water Technology to undertake the works as above. A high-quality vegetation mapping layer will be generated for the purpose of future development of a KPoM and to assist in informing future land use planning. The study area will be the extent of the HCC LGA and excludes land under tenure of NSW National Parks and Wildlife Service, Forestry Corporation of NSW, Biodiversity Conservation Trust, etc. In close collaboration with HCC and DCCEEW, we combined technical expertise from Water Technology's Waterways and Ecology Team and Spatial Team to deliver the required outputs.

1.1 Scope of the Project

The following tasks are required to fulfil HCC's requirements:

- Update the 2018 HCC mapping classification to the Eastern NSW Plant Community Types classification;
- Collect all floristic site data, existing vegetation mapping reports and any other data to be used to verify and confirm vegetation communities on ground and to assist with updating the 2018 vegetation mapping;
- Consultation with Hawkesbury City Council to negotiate access to sites within the study area to validate vegetation mapping with field survey;
- Update any linework in the mapping to reflect changes in cover type such as clearing and update spatial inaccuracies (vegetation extant) and other errors in the original mapping;
- Update the condition attribution in the original mapping where possible; and
- A final report outlining methods, data, results, and any recommendations.

This report covers the last dot point above, and includes a description for each of the steps listed above. A detailed description of the mapping methodology, field work and ground truthing efforts, and the resulting vegetation extent layer are included herein. It also discusses limitations to the project.

2 BACKGROUND

2.1 Study Area

Hawkesbury LGA extends from the Hawkesbury River Valley north to Yengo National Park, with its administrative centre in Windsor 55 kilometres north-west of Sydney's CBD. It is the largest LGA in the Sydney Metropolitan Region, covering approximately 2,776 km².

The study area for this vegetation mapping project includes all land within Hawkesbury Local Government Area (LGA) that is under Council jurisdiction. All National Parks estate as well as Forestry Corporation land is excluded from the study area. Figure 2-1 demonstrates the final study area and any land which was excluded.

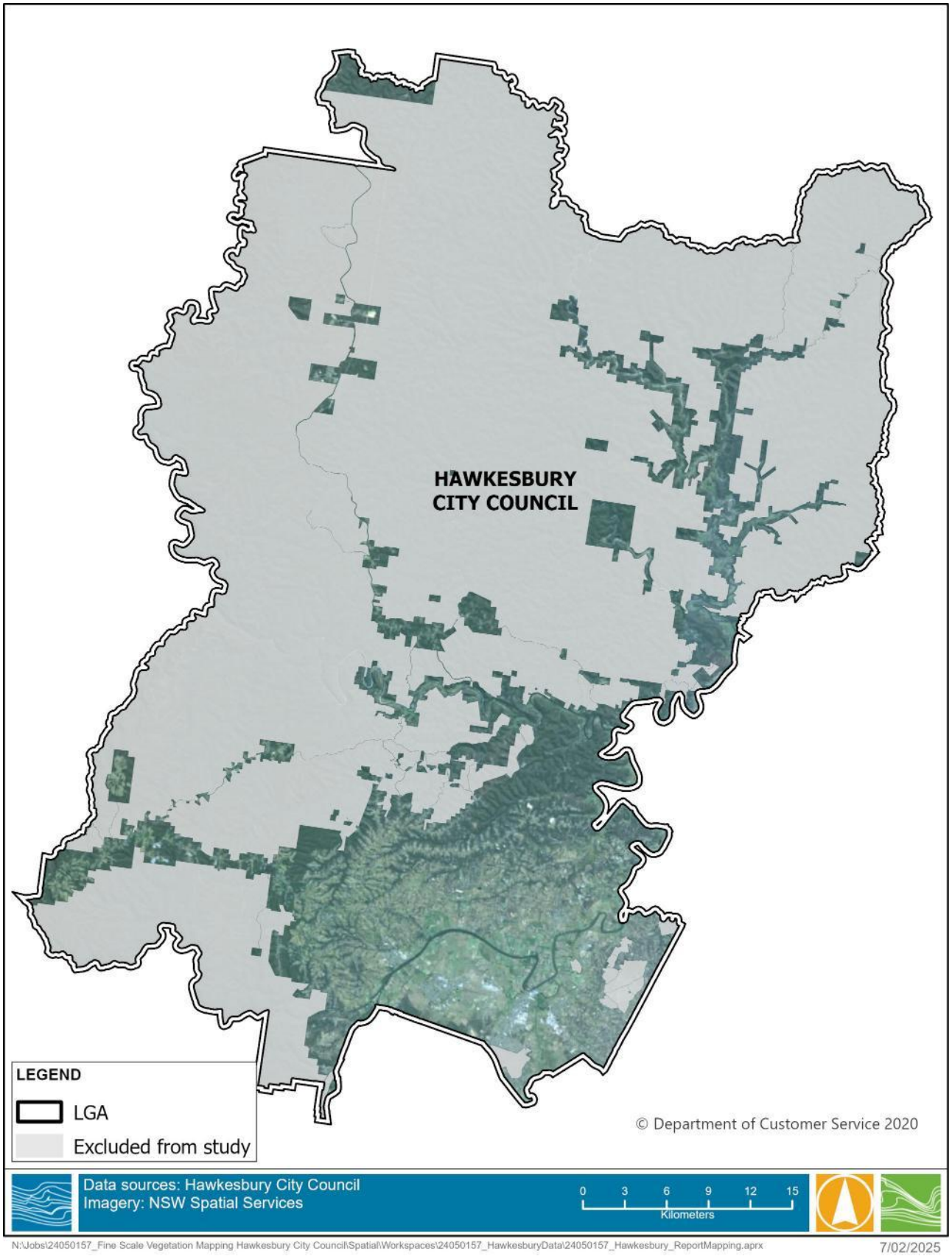

Figure 2-1 Study Area

The Hawkesbury region is characterised by diverse ecosystems, including fertile floodplains around the Hawkesbury River, undulating hills, rugged escarpments, and vegetated ridges. Its varied geography plays a significant role in shaping the environmental characteristics of the region.

The region's topography supports a wide range of ecosystems, from rainforests and dry sclerophyll forests to grasslands and heathlands. These environments are home to a rich biodiversity, including 238 threatened flora and fauna species and 49 threatened ecological communities. Many of these species and habitats are in decline, facing pressures from habitat loss, pollution, climate change and more. Implementing conservation efforts is critical for the future health of the environment and the sustainability of the region.

Approximately 70% of the Hawkesbury LGA is covered by national parks, conservation areas, and reserves, which help protect the region's diverse ecosystems. Notable protected areas include the Blue Mountains, Wollemi, Yengo, and Dharug National Parks, as well as the Parr State Conservation Area and the Windsor Downs Nature Reserve. Areas protected and managed as part of the National Parks estate have not been assessed or mapped as part of this project.

Water-based ecosystems are a key feature of the Hawkesbury LGA's landscape. The LGA is divided by five major river systems—the Hawkesbury, Nepean, Colo, Grose, and Macdonald Rivers—along with numerous creeks, wetlands and catchments. These waterways are important both for the biodiversity and sustaining the local ecosystems, but also for recreation and cultural values.

Traditional Custodians in the region maintain a strong cultural connection to these rivers, highlighting their importance as both natural and cultural assets. Proper management of these water systems is vital to ensure their sustainability and resilience in the face of environmental challenges.

Despite the significant natural beauty of the Hawkesbury, the region faces ongoing environmental challenges. The diverse geography leads to regular flooding and bushfires, which provides natural fluctuation and stresses to the local ecosystems. The natural environment has adapted to these disturbances over centuries, but with the increased anthropogenic pressures on the environment increases the stress, the ecosystems are left more vulnerable to degradation.

2.2 Strategic Context

In recent years a noticeable decline in the NSW koala populations has sparked a series of actions and policy updates with the aim to halt the downward trajectory. In 2022 the NSW koala populations threat status was changed from 'Vulnerable' to 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as well as under NSW *Biodiversity Conservation Act 2016* (BC Act). The National Recovery Plan for the koala was released in 2022 by the federal Department of Agriculture, Water and the Environment (DAWE), and the NSW Koala strategy was released by NSW Department of Planning and the Environment (DPE) in the same year. Updates to koala habitat protection in the NSW State Environmental Planning Policy (Biodiversity and Conservation) 2021 (BC SEPP) were made in both 2020 and 2021.

This project is initiated by federal and state level regulation above. Below is described the local strategic and planning context for this project.

2.2.1 New South Wales Koala Strategy

The NSW Koala Strategy (DPE, 2022) provides a framework of actions for a five year period, 2022-2027, to secure important koala habitat, reduce threats, and engage communities and local expertise to deliver koala conservation works across New South Wales. The four pillars within the framework include:

- Koala habitat conservation;
- Supporting local communities to conserve koalas;

- Improving the health and safety of koalas; and
- Building our knowledge of koalas.

The NSW Government is investing in the strategy with the aim of doubling koala numbers in New South Wales by 2050.

Action 2.3 under the NSW Koala Strategy is to engage 10+ local councils and provided them with support to develop koala habitat maps. As a first step in the process, an updated vegetation map is required to reflect the distribution of vegetation communities across the LGA.

The mapping within this project adheres to the quality and accuracy requirements outlined by DCCEEW, and in consultation with DCCEEW throughout the mapping process, in accordance with Action 2.3 "*Supporting councils to deliver Koala Habitat Maps*" from Pillar 2 in the NSW Koala Strategy.

2.2.2 Conformance to the Hawkesbury Community Strategic Plan 2022-2042

The Hawkesbury Strategic Plans 2022-2042 is a Council strategic document which overarches all other Council policies and plans. The purpose of the document is to identify the community's priorities and aspirations, while considering the issues and pressures as well as resources availability.

The proposal of this project is consistent with the following Long-Term Community Objectives set out within the Hawkesbury Community Strategic Plan 2022-2042:

Protected Environment and Valued History:

- 2.2 *Value, protect and enhance out natural land-based environment with an emphasis on using local resources and key partnerships*.
- 2.4 *Encourage and enable our community to make more sustainable choices*.

Reliable Council:

- 4.7 *Encourage informed planning, balanced growth and community engagement.*

2.2.3 Hawkesbury Local Strategic Planning Statement 2040

The Hawkesbury Local Strategic Planning Statement 2040 sets out a 20 year vision for land use in the Hawkesbury LGA. It identifies the special characteristics of the Hawkesbury that contribute to its identity, the shared community values which are to be maintained and enhanced, and how growth and change will be managed into the future. The proposal of this project is consistent with the following actions in the Hawkesbury Local Strategic Planning Statement 2040:

- Planning Priority 11: Protect our rivers, creeks and areas of high biodiversity and environmental values.
  - Action 11.1 *Protect and enhance natural assets and ensure the biodiversity of the Hawkesbury is identified and preserved*.
  - Action 11.2 *Ensure development at the interface of areas of significant biodiversity has minimal environmental impact*.
  - Action 11.5 *Prepare and implement a biodiversity strategic framework and investigate and investigate changes to the Hawkesbury Local Environmental Plan and Development Control Plan, to improve management of biodiversity including koala habitat*.

2.2.4 Hawkesbury Environmental Sustainability Strategy

Council adopted the Hawkesbury Environmental Sustainability Strategy on 11 July 2023. The Strategy outlines a plan to guide Council and the Hawkesbury community's capacity for living more sustainably and protecting

the natural and built environments of the region. The proposal of this project is consistent with the following actions in the Hawkesbury Environmental Sustainability Strategy:

- Action 1.2 *Gather baseline data on the current state of our land-based ecosystems*.
- Action 1.3 *Identify and map land-based habitat corridors*.
- Action 1.6 *Extend partnership, collaboration and volunteering opportunities land-based conservation and restoration (e.g. Bushcare, Citizens Science, schools and research institutes), with priority given to threatened and endangered species*.

2.2.5 Western City District Plan, Greater Sydney Commission

The Western City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney. It covers the Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly LGAs.

This project is consistent with Planning Priority W14 "*Protecting and enhancing bushland and biodiversity*", Action 72:

Protect and enhance biodiversity by:

a. Supporting landscape-scale biodiversity conservation and the restoration of bushland corridors

b. managing urban bushland and remnant vegetation as green infrastructure

c. *managing urban development and urban bushland to reduce edge-effect impacts*.

3 METHODOLOGY AND DATA

3.1 Consultation with Council and NSW DCCEEW

This project is undertaken by HCC and supported by NSW DCCEEW. The collaboration with DCCEEW is essential to ensure consistency in the mapping process and outcomes across the state.

An inception meeting between HCC and Water Technology, with expert advice from NSW DCCEEW, was held at the initiation of the project. The mapping process suggested by DCCEEW was implemented throughout the project to the degree possible or feasible, and consultation with DCCEEW through HCC was ongoing.

Regular updates were sent to HCC by Water Technology, and HCC were consulted in any decisions to be made around details in the mapping process.

3.2 Spatial Analysis

The primary aim for this component of the project was to produce a spatially accurate vegetation extent layer with accurate Eastern NSW PCT classifications (where PCT is Plant Community Type), ideally using Council's 2018 vegetation mapping dataset plus any findings from ground truthing field work conducted for this project.

3.2.1 Testing methodology

A number of possibilities were considered and tested for producing spatially accurate vegetation extents, including:

- DCCEEW provided an example for mapping woody vegetation extent from a previous project (Cessnock Council)

(https://www.environment.nsw.gov.au/research-and-publications/publications-search/environmental-lands-study-for-cessnock-local-government-area)

- Water Technology trialled using LiDAR point cloud data (classified vegetation strikes) to extract and map woody vegetation extent, as demonstrated in Figure 3-1.

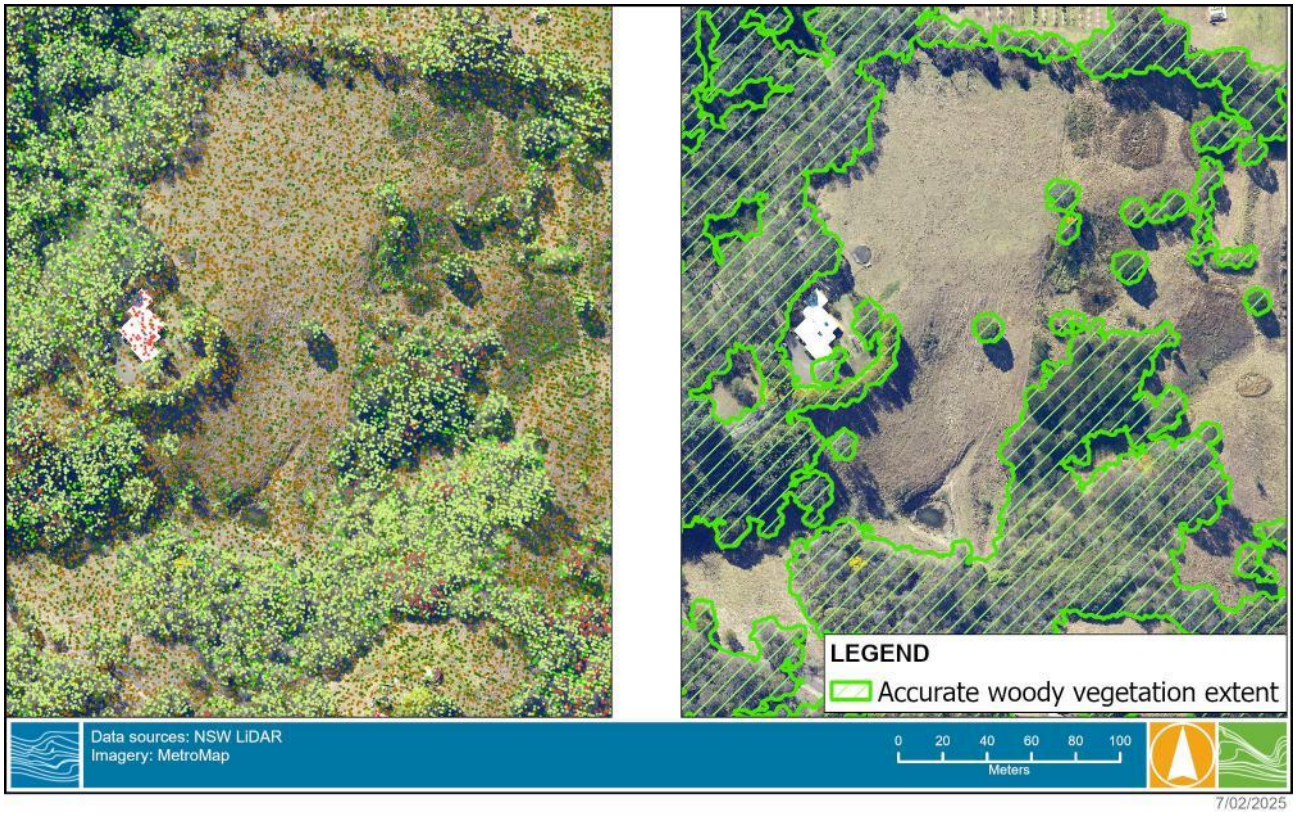

Figure 3-1 Extracting vegetation extent from LiDAR Point Cloud

- HCC provided a classified vegetation extent dataset, however, this did not cover the full study area).

All three possible methods were found to produce a woody vegetation extent layer that is much more spatially accurate than the existing State Vegetation Type Map (SVTM) :a regional-scale map of the 3 levels of the NSW vegetation classification hierarchy" or Council 2018 vegetation mapping, as demonstrated in Figure 3-2.

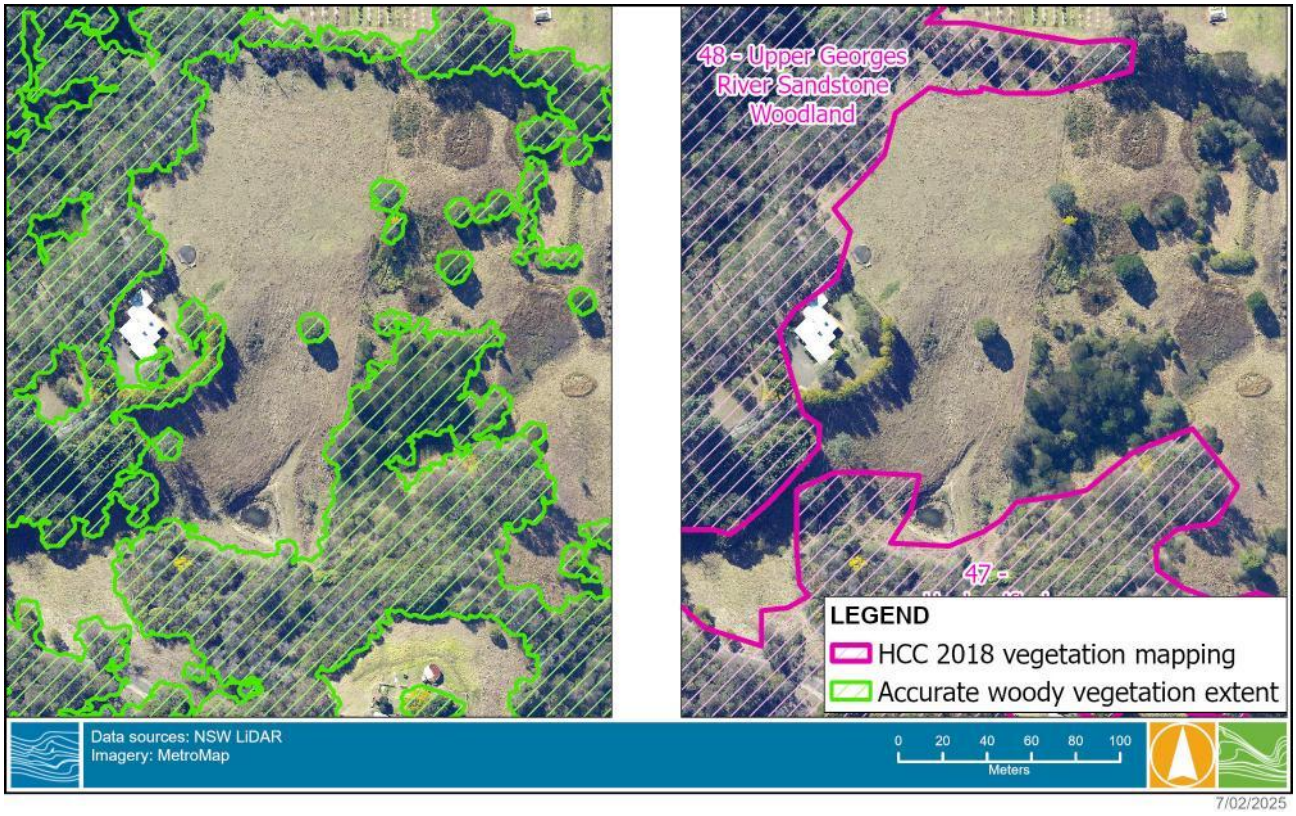

Figure 3-2 Comparison of LiDAR vegetation extent with existing 2018 mapping

- The project opted to go with the LiDAR method due to full coverage of study area. DCCEEW confirmed they agreed with the Water Technology approach.

3.2.2 Producing accurate woody vegetation extent with LiDAR

LiDAR projects were downloaded and processed to produce a *raw* vegetation extent product across the entire study area. This process involved the following steps

- Download the necessary LiDAR projects and convert LAZ files to LAS
- Develop LAS Datasets for each project
- Filter LAS dataset to only include 'High Vegetation' class; and
- Converted to a 2m resolution raster/polygon

Additional processing steps were then undertaken to produce the final accurate woody vegetation extent layer

- Removed small, disconnected portions < 100m² (i.e. portions smaller than an individual large tree). This step was confirmed with DCCEEW and HCC for suitable scale; and
- Filled holes in the polygon < 100m² and smoothed polygon edges

3.2.3 Attributing PCT classes to new woody vegetation extent layer

This step involved transferring PCT classification information to the new accurate vegetation extent layer. Council's 2018 vegetation mapping and the statewide SVTM product, reflecting the current state-wide PCT mapping, were both considered for this task.

Water Technology reviewed both sources of vegetation mapping and opted to use SVTM mapping because it has suitable PCT class attributes, whereas Council's 2018 layer does not have readily useable or transferable PCT class attributes due to lack of information about the vegetation classes used. This is further discussed in section 5.2 of this report.

PCT class attributes were transferred to the new extent layer by way of a spatial overlay. Additional spatial processing was then completed to *clean-up* the result of this overlay, to address issues arising from the significant difference in spatial accuracy of the two datasets. Figure 3-3 demonstrates the difference in spatial accuracy between the two datasets.

Figure 3-3 New vegetation extent layer (green outlines) over existing SVTM PCT Mapping (brow shading)

3.2.4 Addressing areas which remain unclassified

Following this process, some *unclassified* bits of vegetation remained, due to portions of the accurate vegetation extent layer being completely outside the SVTM mapping. These portions generally fell under one of the following categories:

1. Trees in urbanised/residential areas in between houses (likely planted and/or exotic)
2. Rows of trees along the middle of road corridors (this is due to a particular anomaly of the SVTM PCT layer)
3. Rows of trees along the edge of road corridors (possibly pine trees or native); and
4. Individual isolated trees

Examples of these unclassified portions are shown in red in Figure 3-4.

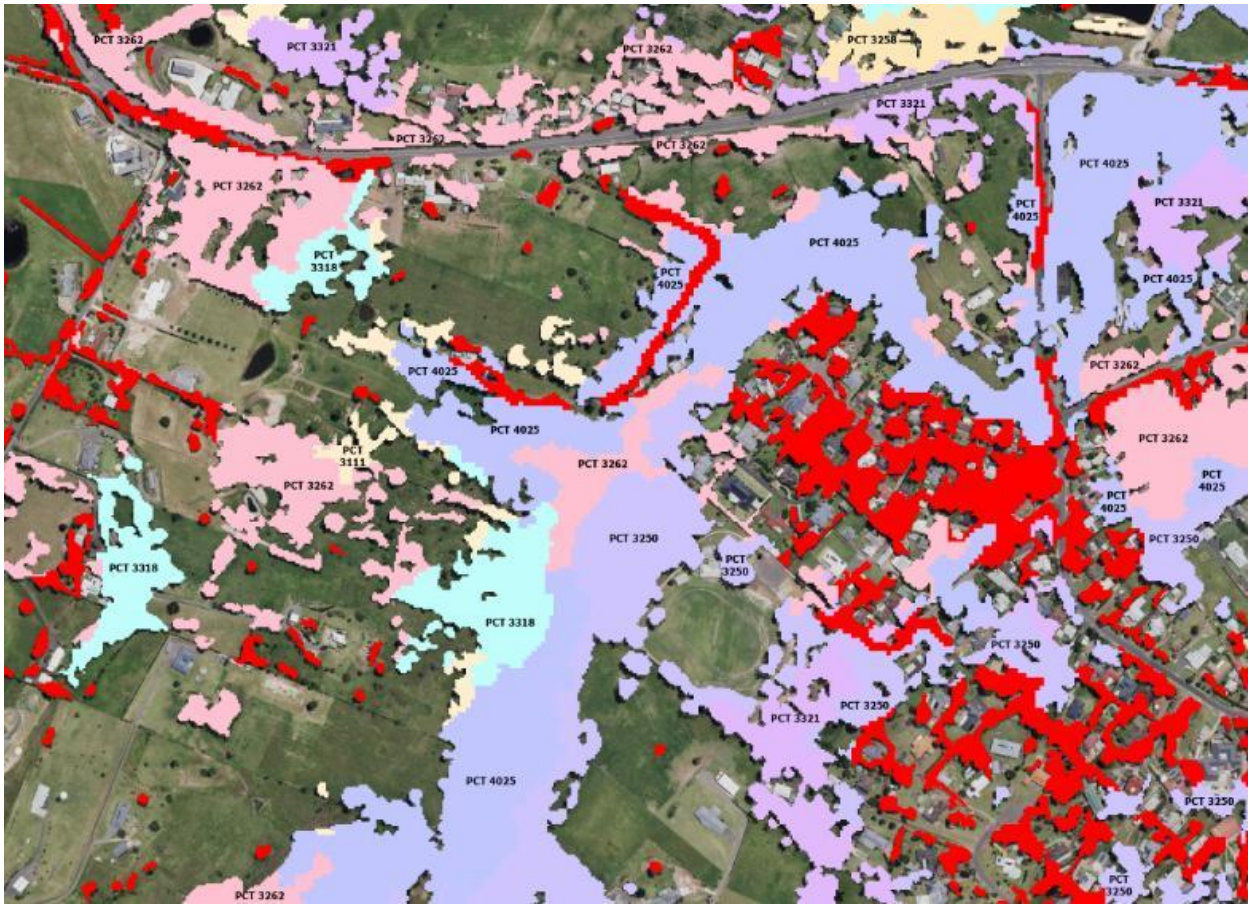

Figure 3-4 Examples of unclassified portions of vegetation (red)

The following approaches were proposed by Water Technology to address these unclassified portions of the layer:

1. Remove trees located between houses in higher density residential areas from the layer;
2. Merge rows of unclassified trees along the middle of road corridor into surrounding class;
3. Leave rows of trees on the side of roads as unclassified (to be verified during field work ground-truthing where possible); and
4. Leave individual trees as unclassified (to be verified during field work where possible).

3.2.5 HCC review

At this stage, a review of the layer was undertaken by HCC, including reviewing proposed steps for dealing with the unclassified portions.

- HCC agreed with the proposed approach to remove trees in urban areas, leave isolated trees as unclassified, and absorb the unclassified areas along the middle of road corridors into the surrounding PCT class.
- HCC requested using the 2018 vegetation mapping polygons for delineating the internal PCT class boundaries, given the 2018 layer was produced to a higher level of spatial detail than the statewide SVTM layer. This option was tested but was found to result in too much generalisation of the PCT classes in some areas.

In lieu of this approach, the project team opted to remove any potentially over-accurate (i.e. unrealistically small) portions of a particular PCT class < 2,000 m² which are within a surrounding class, by absorbing them into the surrounding class. These potentially over-accurate portions existed as a result of using the SVTM layer to assign PCT class.

A suite of A3 field maps were produced to assist with the field work component of the project, which was aimed at ground truthing the mapped PCT classes and assessing their condition.

The A3 portrait sized field maps covered the entire study area at a scale of 1:10,000, and contained the mapped PCT classes, plus location of Crown land. The field map index and an example of one field map are demonstrated in Figure 3-5 and Figure 3-6 respectively.

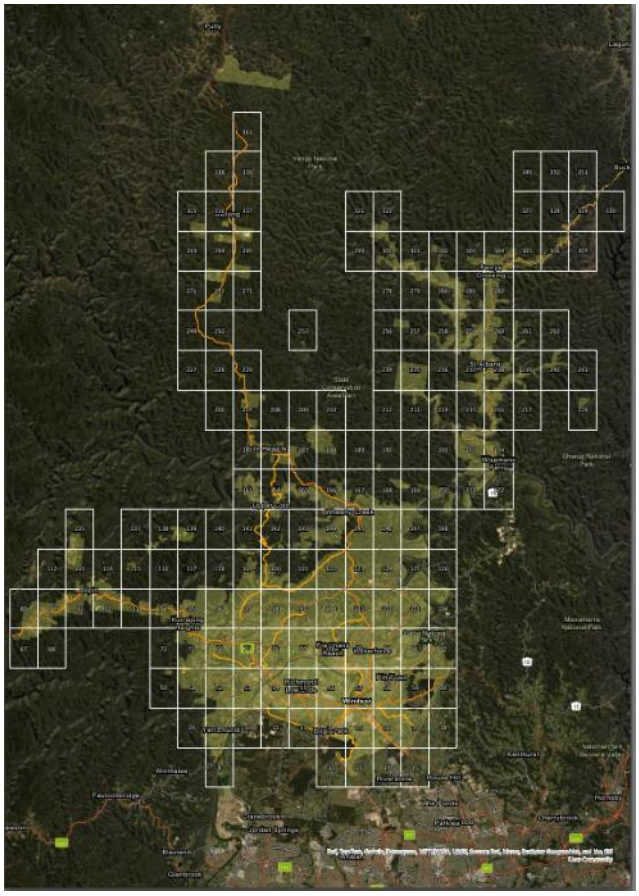

Figure 3-5 Field map index

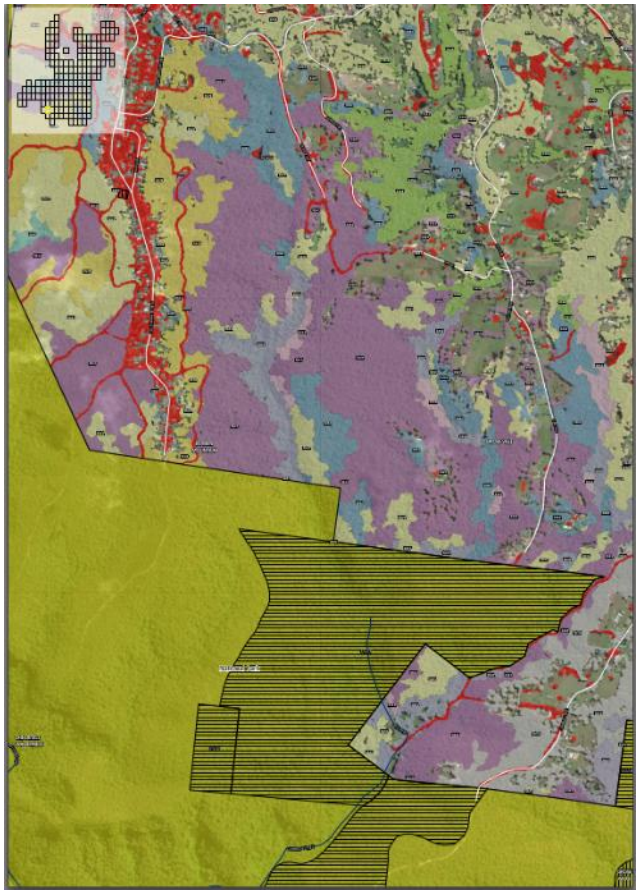

Figure 3-6 Example field map

3.3 Field work

The fieldwork for the project was undertaken during the weekdays 18-27 November 2024, led by experienced Water Technology ecologists Petra Arola, Caroline Weller and Stephanie Phillips. Water Technology employees Miriam Warren and Vanesa Posada Garcia participated in an assisting role.

Focus areas for surveys included suburbs with:

- Areas with development pressures, mainly at the outskirts of existing urban areas. This includes suburbs such as Grose Vale, Kurrajong, Comleroy, Blaxlands Ridge and East Kurrajong, and areas in between; and
- Areas of known koala populations near urbanised areas, or near areas subject to recent or future environmental pressures, e.g. bush fires. This includes suburbs such as Kurrajong Heights, Bilpin and areas towards the Blue Mountains.

The following areas were deemed as lower priority for ground truthing:

- Areas that have been subject to heavy urbanisation, agriculture or industry for a longer time; and
- Bushland areas and small more remote communities unlikely to be developed or experience increased environmental pressures. These areas include the regions surrounded by national parks in the northern and northeastern parts of the study area.

3.3.1 Field work methodology

The field work for this project had two main purposes:

1. Ground truth the mapped PCT's; and
2. Fill in PCT patches without an assigned PCT.

The methodology for each of them is described below.

1. Ground truth the mapped PCT's:

The ground truthing of PCT was done by doing rapid BAM plot assessments and collecting floristic data for each site. For the purpose of this survey and the level of detail needed to assess the accuracy of the mapped PCT, a rapid BAM plot survey was preferred over a full BAM plot survey to increase efficiency and cover more locations during the field works.

BAM plots of 20m x 20m were set up in areas of characteristic vegetation, in a total of 18 locations across the study area, covering as many PCTs as possible. Focus was placed on using areas of low weed cover and undisturbed vegetation to get a more representative evaluation. The dominant species, usually up to five (5) per stratum, were recorded along each transect along with their abundances and percentage cover. The stratum used were groundcover, mid-stratum (shrubs) and canopy cover. While on site, the vegetation on site was compared to the description for the characteristics of that vegetation community on Bionet Vegetation Classification (DCCEEW, 2024). Notes were made about any discrepancies, exotic species in the assemblage, condition of the vegetation, etc.

After the field assessment, a more detailed comparison (quantitative and qualitative) was made using the dominant species' abundance/percentage cover scores on BioNET to get a better understanding for the similarities between the mapped community structure and that on site.

2. Fill in PCT patches without an assigned PCT:

While driving between locations for the rapid BAM plots, the PCTs without an assigned PCT class along the roadsides were ground-truthed. The methodology used for assessing was a drive by at low speed or with frequent stops, to make note of the following:

1. Confirm whether the vegetation was native or exotic;
2. Make note of the condition of the vegetation; and
3. Note any other features (e.g. if suspected planted vegetation).

Based on this assessment, a decision was made for each spot to say whether it would be considered a PCT or not. Any vegetation that was exotic dominant, in very poor condition or suspected to be planted were noted as not being PCT and reflected in the vegetation mapping layer as described below. For patches of vegetation that were noted as being a PCT, a PCT class was assigned as per the procedure described in section 3.2.3 of this report. To assess the PCT in field all stratums would need to be surveyed e.g. using the methodology described above. Similarly, a rapid assessment version was opted for in this instance to cover more ground and get a better feel for the area as a whole.

The condition score collected during the roadside assessment was used to update the condition score for the vegetation mapping in the relevant locations.

The location of the BAM plots and other survey locations/findings from the field work component is shown in Figure 3-7.

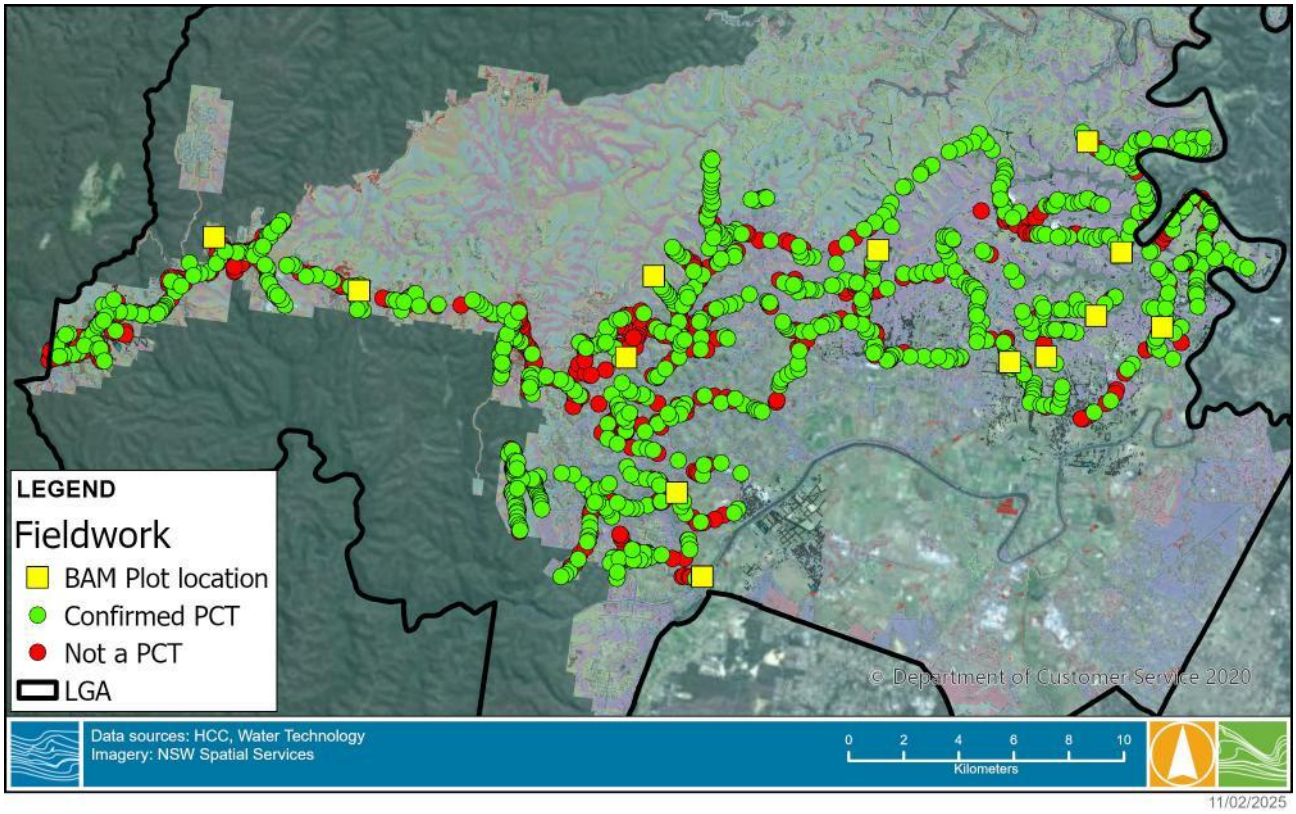

Figure 3-7 Fieldwork location and findings

3.4 Finalising Vegetation Layer

Following the field work component, a final version of the new vegetation layer was produced. The steps taken to finalise the layer included:

- Incorporate the findings from the ground truthing component of the field work into the new vegetation layer
  - Updates to PCT class where BAM plots were surveyed (if update required)
  - Removing portions of PCT from the layer which were confirmed to be primarily non-native
- Final processing to address the unclassified areas of vegetation

- Update the PCT class where possible on the remaining unclassified areas, as per the suite of rules outlined in 3.2.4. Most of those unclassified portions were absorbed into the majority surrounding PCT class.

- Add threatened ecological community (TEC) status information into the layer
  - Those PCTs which belong to a TEC were flagged. Details provided in Appendix A.
- Incorporating the existing vegetation confidence and condition ratings from Council's 2018 vegetation mapping where the two layers overlap (2018 vegetation mapping layer does not cover the full study area extent)
  - This was achieved by spatial overlay
- Add vegetation confidence and condition ratings where the Water Technology fieldwork had occurred, as per the following approach:
  - Confidence
    - PCTs which were checked during the fieldwork were given 'High' confidence rating
    - PCTs in the remaining un-visited rural areas were given 'Medium' confidence do to a medium level of disturbance and rural acitvities
    - PCTs in the remaining un-visited urban areas were given 'Low' confidence due to a high level of disturbance and urban plantings
  - Condition
    - PCTs where a high volume of weeds was observed during the fieldwork were given a 'Low' condition rating
    - PCTs where no weeds were observed during fieldwork were given a 'High' condition rating
    - All remaining PCTs were given 'Medium' condition rating

4 RESULTS

The objectives for this project were to produce a new fine-scale vegetation mapping spatial dataset for the Hawkesbury City Council. The new mapping and associated report should encompass the following key deliverables.

- Updated spatially accurate vegetation map showing PCT classes across the study area
- Conservation significance of PCTs within the study area (Threatened Ecological Communities, TECs)
- Translation tables from original 2018 vegetation mapping classification to Eastern NSW PCT classification
- Rating of the confidence in the mapping and the condition of the mapped native vegetation
- Description and limitations of the approach and methodology

4.1 Field Work Findings

The ground truthing found that the PCT on site generally reflected the mapped PCT well, with some minor deviations. One of the BAM Plot locations in the Blue Mountains had been burnt relatively recently (natural or hazard reduction) and while the canopy cover remained intact, the mid-stratum and groundcover was sparse and dominated by opportunistic species that establish quickly after fire. This location was not representative of the mapped PCT. Other locations with small deviations were those where anthropogenic (minor clearing) or environmental pressures (exotic weeds occurring) were or had been prevalent. However, the PCT mapping was deemed accurate as the native vegetation was still dominant, well established and with recruitment occurring. The condition score was still selected as high for these locations as it was higher quality and characteristic of the PCT benchmark compared to many other locations where the weeds were dominant and outcompete native species.

It is worth noting that while PCT's often have a benchmark description, the characteristics are often described more generally to include the entire area across eastern NSW where that PCT occurs. Local variation occurs depending on external factors leading to differences in species occurrences. While some variation was noted in the species dominance or species abundance for some locations, this was deemed to be within the natural range for the PCT's, as well as due to influence of the surrounding vegetation communities and some crossover of ecotones.

The roadside survey to fill in the PCT patches without an assigned PCT concluded the following:

- In general, the PCT patches without an assigned PCT class were found to have a 50/50 division as to whether they were considered PCT or not.
- The vegetation extent for the SVTM layer that was used as a base for Water technology's mapping had managed to exclude a good number of exotic vegetation patches.
- Vegetation patches in predominantly urban areas were often inconsistent with the PCT described for that location. Suburban lots were more often than not planted as gardens, using both exotic and native species.
- Vegetation that was further away from urban or developed areas were often found to be more natural, have lower disturbance, better condition, and was usually considered PCT.

4.2 Final Fine-scale Vegetation Mapping Dataset

The final vegetation mapping layer has been transferred to HCC in GIS format as follows:

- Spatial digital vector format (Esri FGDB)
- MGA Zone 56 projection
- Suitable for use within the scale range 1:1,000 – 1:3,000.

Spatial digital data of field survey locations and findings has also been provided in Esri FGDB format.

The updated vegetation mapping layer covers the full study area and includes attributes pertaining to the following information, for each portion of vegetation:

- Eastern NSW Plant Community Type (PCT) Classification
- Threatened Ecological Community status Appendix A
- Observed condition (2025).
- Confidence in PCT classification (2025)
- Extrapolated condition from 2018 mapping
- Extrapolated confidence from 2018 mapping

The PCT class and Threatened Ecological Community status attributes are demonstrated in Figure 4-1 and Figure 4-2 respectively.

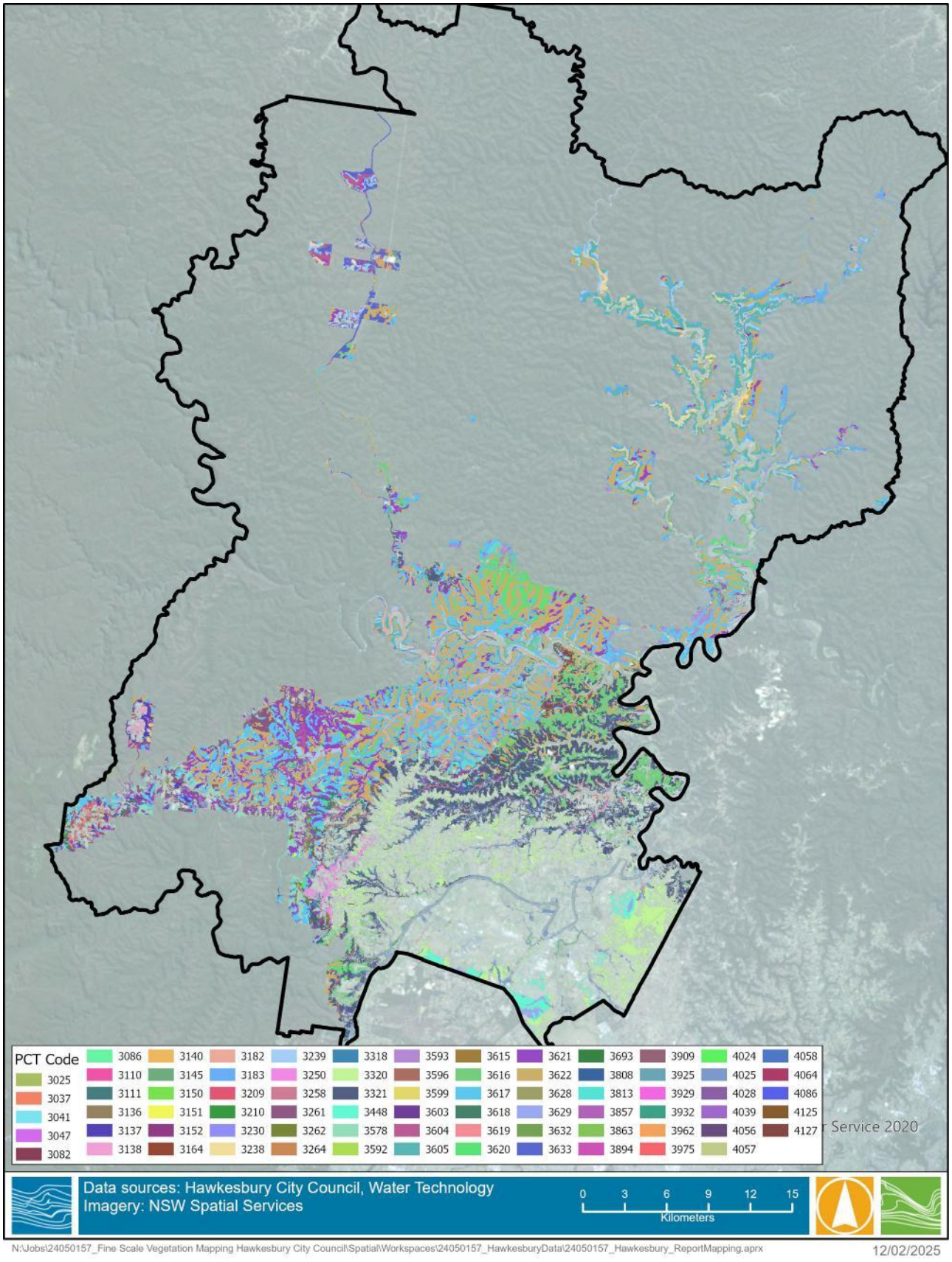

Figure 4-1 Final vegetation community layer – mapped by PCT

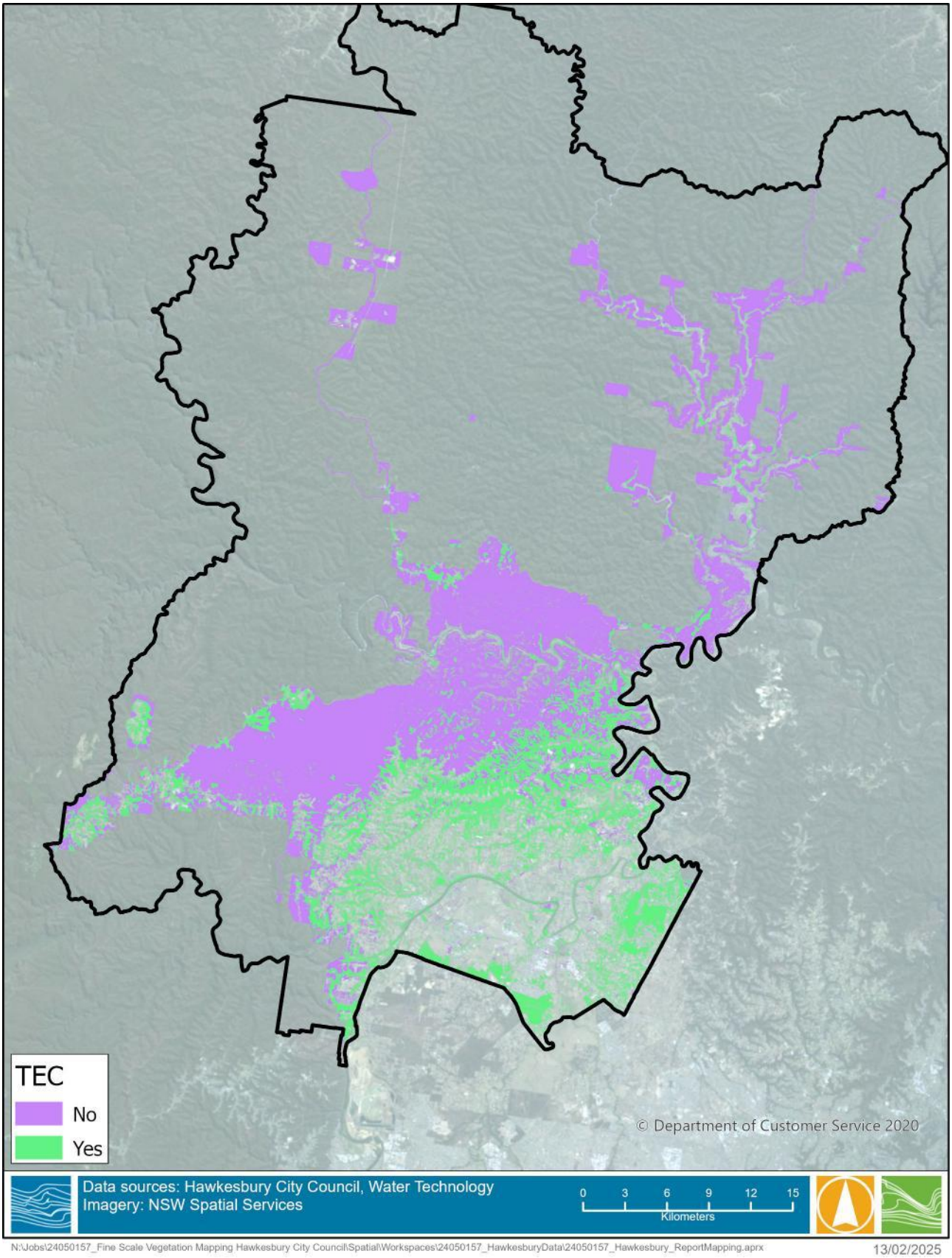

Figure 4-2 Final vegetation class layer – mapped by TEC

5 LIMITATIONS

5.1 Research Summary

A research summary was not provided for the vegetation/PCT related studies within the study area as the previous research within the area was limited to one report provided by Council: *Hawkesbury Strategic Planning Prioritisation of Council Lands* (Ecological Australia, 2020). This report was considered within this report and project for confirming PCTs in a number of reserves within the study area.

5.2 Translate 2018 Vegetation Communities to PCTs

The final report or other accompanying documentation for the 2018 vegetation mapping was not available for review for the purposes of this report.

Due to lack of information about the vegetation categories used in the vegetation mapping, the floristic character and vegetation formation, classification and general description of each community remained unclear. The following vegetation classification systems were considered and explored for adherence to the 2018 mapping:

- Keith 2009 vegetation classification
- Previous PCT types

However, the classes include broad descriptions such as "*22 - Rainforest*" as well as specific and local descriptions such as "*17 - Mellong Woodland - Poorly drained*". Additionally non-standard categories such as "*20 – Plantation*" and "*21 – Planted Canopy Trees*" were used. Based on this, it appears that the vegetation classes may be a combination of high-level classes and detailed classes best fit to describe the local environment. While this is likely a good and appropriate approach for describing the local vegetation communities, the works on reclassifying the vegetation classes into PCTs would be a guessing game without having some form of description of characteristics or species inclusion for each vegetation class on hand.

5.3 Plot to PCT Tool

The Plot to PCT Tool was intended to be used for a sample of BAM plots to confirm the field surveyed PCT was consistent with the mapped PCT. To use the online tool and formatting data to fit the tool, the person needs to be a licenced user on Bionet, which is completed via an online registration where a form is sent to DCCEEW to action and set up the account in the person's name.

Multiple attempts were made at registering to be a licenced user, for multiple persons or organisations, however no response was received from DCCEEW. Water Technology ecologists were not granted registration as a licenced user during the course of this project after multiple attempts.

The Plot to PCT Tool would only be used to confirm the PCTs in an objective assessment. A qualitative assessment of the PCT characteristics compared to the mapped PCT characteristic, and comparing abundance scores for species should provide a good enough base to confirm/reject the PCT as present.

5.4 Spatial Processing Accuracy

The project team opted to use LiDAR point-cloud data for producing an accurate woody vegetation extent. The accuracy of this product is therefore dependent on the accuracy of the various LiDAR projects which were used. The latest available LiDAR data was used in all parts of the study area.

5.5 Field Work Coverage

The field work component of this project was scoped to a specific number of days and therefore could not cover the entire study area. The targeted areas for field work were discussed and agreed upon with Council prior to commencement, and the field work covered as many of these targeted areas as possible within the given timeframe. To alleviate that issue, Google Earth Pro -Street View was utilised to determine the likelihood of native vegetation/non-native vegetation with degrees of confidence placed on the mapped PCT dependant on views and clarity.

6 SUMMARY AND RECOMMENDATIONS

This project has been undertaken as a combination of a spatial and in-field study for updating, refining and ground-truthing the vegetation mapping layer within Hawkesbury LGA. The following tasks were undertaken to achieve the above:

- Update the vegetation mapping within the study area to reflect the Eastern NSW Plant Community Types (PCT) classification;
- Collect available floristic site data, existing vegetation mapping and research to verify and confirm vegetation communities on ground;
- Consult with Hawkesbury City Council regarding areas for ground-truthing surveys;
- Update the linework in the mapping to reflect the current vegetation extent;
- Update the condition attribution in the original mapping in locations where ground-truthed; and
- Produce a final report outlining methods, data, results, as well as any recommendations.

This vegetation mapping layer was produced in collaboration with NSW DCCEEW to ensure consistencies in methodology across LGAs.

Although some of the methods planned were not able to be used, adaptations were made to provide an accurate and consolidated mapping output. Any changes to the planned project scope were done in consultation with HCC and other stakeholders as relevant, and have not compromised the mapping outcome of the project.

The 2018 Council mapping were relatively coarse and the vegetation mapping outputs for this project (with use of LiDAR) provide a more suitable scale and definition of the vegetation extent that will enable high accuracy and confidence in future Planning decisions. Existing PCT mapping was relatively accurate, even over-accurate, and minor alignment alterations were made. The majority of mapping has a high level of confidence based on all available datasets and ground truthing practices.

This vegetation map will be suitable for its intended use to identify potential koala habitat within the study area and for the assessments that could be required as a consequence. The layer is not solely focused on koala habitat identification, and is also useful for any other project where further information about the vegetation community in a location is needed. “The mapping within this project adheres to the quality and accuracy requirements outlined by DCCEEW, in accordance with Action 2.3 “*Supporting councils to deliver Koala Habitat Maps*” from Pillar 2 in the NSW Koala Strategy.

We recommend that this mapping is updated in 2035 and that it be used as a tool for preliminary assessments for any future works and as a comparison to detect unlawful vegetation removal and opportunities to HCC for future planning, native vegetation establishment and Koala Plans of Management.

7 REFERENCES

Department of Climate Change, Energy, the Environment and Water (2024). Environmental lands study for Cessnock LGA A spatial database for the Cessnock LGA.

Ecological Australia (2020a). Hawkesbury Strategic Planning Prioritisation of Council Lands.

Ecological Australia (2020b). Biodiversity Strategic Planning Framework.

NSW DPE (2022). NSW Koala Strategy. URL: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/koala-strategy-2022-220075.pdf

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APPENDIX A
PCTS WITH TEC ASSOCIATION

PCT	Act	Threat Status	Fit Status	TEC Name
3039	BC Act	CE	(Part)	Hygrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion
	BC Act	E	(Part)	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
3047	BC Act	E	(Part)	Robertson Rainforest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Robertson Rainforest in the Sydney Basin Bioregion
3078	BC Act	E	(Part)	Illawarra Subtropical Rainforest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion
3082	BC Act	E	(Part)	Western Sydney Dry Rainforest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Western Sydney Dry Rainforest and Moist Woodland on Shale
3086	BC Act	E	(Part)	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
3110	BC Act	E	(Part)	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions
	BC Act	E	(Part)	Western Sydney Dry Rainforest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Western Sydney Dry Rainforest and Moist Woodland on Shale
3136	BC Act	CE	(Equivalent)	Blue Gum High Forest in the Sydney Basin Bioregion
	BC Act	CE	(Part)	Hygrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Blue Gum High Forest of the Sydney Basin Bioregion
3137	BC Act	E	(Part)	Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion
3138	BC Act	E	(Part)	Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion
3140	BC Act	E	(Part)	Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion

PCT	Act	Threat Status	Fit Status	TEC Name
	EPBC Act	CE	(Part)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion
3145	BC Act	CE	(Part)	Elderslie Banksia Scrub Forest
	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
3209	BC Act	E	(Part)	Blue Mountains Basalt Forest in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
3210	BC Act	E	(Part)	Blue Mountains Basalt Forest in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion
3258	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
3261	BC Act	E	(Part)	Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion
	BC Act	E	(Part)	O'Hares Creek Shale Forest
	EPBC Act	CE	(Part)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion
3262	BC Act	CE	(Equivalent)	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Turpentine-Ironbark Forest of the Sydney Basin Bioregion
3315	BC Act	E	(Equivalent)	Central Hunter Ironbark-Spotted Gum-Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions
	EPBC Act	CE	(Part)	Central Hunter Valley eucalypt forest and woodland
3318	BC Act	E	(Equivalent)	Moist Shale Woodland in the Sydney Basin Bioregion

PCT	Act	Threat Status	Fit Status	TEC Name
	EPBC Act	CE	(Part)	Western Sydney Dry Rainforest and Moist Woodland on Shale
3319	BC Act	CE	(Part)	Cumberland Plain Woodland in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
3320	BC Act	CE	(Part)	Cumberland Plain Woodland in the Sydney Basin Bioregion
	BC Act	E	(Part)	Shale Gravel Transition Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
3321	BC Act	CE	(Equivalent)	Shale Sandstone Transition Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Equivalent)	Shale Sandstone Transition Forest of the Sydney Basin Bioregion
3448	BC Act	E	(Part)	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
	BC Act	E	(Part)	Shale Gravel Transition Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Cooks River/Castlereagh Ironbark Forest of the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
3593	BC Act	E	(Part)	Duffys Forest Ecological Community in the Sydney Basin Bioregion
3628	BC Act	E	(Part)	Castlereagh Swamp Woodland Community
3629	BC Act	V	(Equivalent)	Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion
3894	BC Act	V	(Part)	Blue Mountains Swamps in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Temperate Highland Peat Swamps on Sandstone
3924	BC Act	E	(Part)	Coastal Upland Swamp in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Coastal Upland Swamps in the Sydney Basin Bioregion
3925	BC Act	V	(Part)	Blue Mountains Swamps in the Sydney Basin Bioregion
	BC Act	E	(Part)	Coastal Upland Swamp in the Sydney Basin Bioregion

PCT	Act	Threat Status	Fit Status	TEC Name
	EPBC Act	E	(Part)	Coastal Upland Swamps in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Temperate Highland Peat Swamps on Sandstone
3929	BC Act	V	(Part)	Blue Mountains Swamps in the Sydney Basin Bioregion
	EPBC Act	E	(Part)	Temperate Highland Peat Swamps on Sandstone
3932	BC Act	E	(Part)	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions
	EPBC Act	E	(Part)	Temperate Highland Peat Swamps on Sandstone
3962	BC Act	E	(Part)	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	BC Act	E	(Part)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	E	(Part)	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
3975	BC Act	E	(Part)	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
4024	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
4025	BC Act	CE	(Part)	Elderslie Banksia Scrub Forest
	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	Elderslie Banksia Scrub Forest in the Sydney Basin Bioregion
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

PCT	Act	Threat Status	Fit Status	TEC Name
4028	BC Act	E	(Part)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	E	(Part)	Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community
4039	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria
	EPBC Act	E	(Part)	Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions
4056	BC Act	E	(Part)	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
4057	BC Act	E	(Part)	Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
4058	BC Act	E	(Part)	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
	EPBC Act	CE	(Part)	River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria

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