

PART B – NES ANALYSIS

Part B of the assessment report provides an in-depth analysis in relation to the key matters of national environmental significance (identified in Section 1.1) that may potentially be impacted by the Program. For each matter the following issues are addressed:

- the values of the matter in relation to the Growth Centres (e.g. distribution, presence, important areas etc);
- potential impacts to the matter;
- proposed measures to mitigate and manage potential impacts;
- proposed offset measures; and
- the conservation outcome for the matter.

DRAFT EPBC ACT OFFSETS POLICY

To provide context for the discussion on offsets, a summary of the Commonwealth Government's approach to offsets under the EPBC Act is provided.

The Draft EPBC Act Offsets Policy (DEWHA 2007) defines offsets as, “*actions taken outside a development site that compensate for the impacts of that development - including direct, indirect or consequential impacts*”. They provide an opportunity to achieve environmental gains and are a tool that can help achieve the principles of ecologically sustainable development where there are impacts to the environment (DEWHA 2007).

The Draft EPBC Act Offsets Policy emphasises that “*offsets are not applicable to all approvals under the EPBC Act... They should not be applied where the impacts of a development are considered to be minor in nature or could reasonably be mitigated*”.

Offsets can either be categorised into either direct or indirect offsets. DEWHA (2007) describes these as:

- Direct offsets = actions aimed at on-ground maintenance and improvement of habitat or landscape values. For example, long term protection of existing habitat or restoration of degraded habitat.
- Indirect offsets = the range of other actions that improve knowledge, understanding and management leading to improved conservation outcomes. For example, contributions to relevant research or implementing recovery actions.

The Draft EPBC Act Offsets Policy establishes eight principles for the use of offsets:

1. *Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted.*
2. *A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents.*
3. *Environmental offsets should deliver a real conservation outcome.*

4. *Environmental offsets should be developed as a package of actions - which may include both direct and indirect offsets.*
5. *Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'.*
6. *Environmental offsets should be located within the same general area as the development activity.*
7. *Environmental offsets should be delivered in a timely manner and be long lasting.*
8. *Environmental offsets should be enforceable, monitored and audited.*

Where offsets are considered relevant for a matter of national environmental significance, they are discussed within the context of the above principles.

4 Threatened ecological communities

4.1 THREATENED ECOLOGICAL COMMUNITIES

Three ecological communities listed under the EPBC Act are present within the Growth Centres. These include:

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest;
- Shale Sandstone Transition Forest; and
- Turpentine Ironbark Forest in the Sydney Basin Bioregion.

Western Sydney has a long history of intensive agricultural and urban uses, which have significantly reduced the extent and biodiversity of its native vegetation (Tozer 2003). Each of these EPBC listed communities has been highly fragmented across their range and the quality and ecological viability of remaining remnants is variable.

From an impact assessment perspective, it is important to be able to identify areas with greater biodiversity value and long-term ecological viability. This improves the understanding of the ecological community's occurrence, the nature and severity of impacts and helps to focus conservation effort.

Good indicators of the biodiversity value and ecological viability of remnants of these EPBC listed communities are the size and shape of the patch, and the level of connectivity with other native vegetation within the landscape.

REMNANT SIZE AND SHAPE

It is well established in scientific literature that larger patches of remnant vegetation are more likely to show increased species richness and have a better prospect of long-term viability (Renjifo 1999; Parkes et al 2003; Rothley et al 2004). This observation is largely due to the fact that bigger remnants are less susceptible to "edge effects", which contribute significantly to the degradation of vegetation fragments. Examples of edge effects which are particularly problematic across Western Sydney include the introduction of weeds and exotic species that reduce flora and fauna diversity by displacing native species; dumping of rubbish; introduction of domestic animals; increased disturbance from pedestrian access and recreational uses; and inappropriate water, sewer and stormwater management leading to erosion.

When considering impacts from edge effects, it is also important to take remnant shape into account in addition to size. Long, linear patches, such as those often found along roadsides, may comprise a large area, but will have a greater edge to area ratio, which increases the potential for edge effects to reduce their biodiversity value.

CONNECTIVITY

A key consideration in biodiversity conservation is the extent of connectivity or vegetation corridors within the landscape. Vegetation corridors facilitate the movement of flora and fauna and thereby contribute to available habitat for these species (DECC 2008a).

Faunal presence on the Cumberland Plain has been severely depleted due to the extent of clearing and fragmentation of vegetation (DECCW 2009b). Many mammal species declined to extinction in the decades after settlement and bird species diversity collapsed across most of Western Sydney in the 1970s. For this reason, the preservation of connectivity across the Cumberland Plain is less relevant than in other parts of Australia.

However, connectivity is still considered an important attribute for flora species (Parkes 2003). Connectivity is known to increase pollination and spread of propagules among individuals and populations and will enable exchanges between habitats that may become fragmented (TSSC 2008). For this reason, areas of the EPBC listed communities that serve a connectivity function within the landscape are considered to have increased biodiversity value.

ASSESSING BIODIVERSITY VALUE AND ECOLOGICAL VIABILITY

As part of the Biodiversity Certification process for the Growth Centres, a Conservation Plan was prepared (Growth Centres Commission 2007). This Conservation Plan included an assessment of the biodiversity value and viability of native vegetation within the Growth Centres. A method, consistent with the *DEC Working Draft Guidelines for Biodiversity Certification*, was developed to identify areas of “Biodiversity Value – Higher Long Term Management Viability” (HMV).

In the assessment, areas of HMV were identified using the following criteria:

- Status – vegetation that is within an endangered ecological community.
- Condition – good quality vegetation based on existing mapping.
- Size – vegetation remnants that are equal to or greater than 4 ha. This threshold was chosen after taking into account the fragmented nature of the remaining vegetation on the Cumberland Plain, the relative biodiversity values of larger patches compared to smaller patches in Western Sydney, and the likely pressures on small remnants within the Growth Centres once they are surrounded by intensive urban development.
- Landscape context (connectivity) – based on an analysis of the proportion of vegetation cover at the regional and local scale using the Biometric methodology (Gibbons et al 2005). A remnant was considered to have good connectivity if there was 30% or greater vegetation cover within both a 0.55km and 1.75km radius of the patch. The 30% threshold was chosen given the fragmented nature of Cumberland Plain vegetation and given the available evidence that suggests significant declines in biodiversity values once 70% of the landscape has been cleared (Freudenberger et al 1997).
- Threats – the influence of future surrounding land use was taken into consideration in two ways:
 - Identifying all remnants with high edge to area ratios (long thin strips of vegetation) as having lower management viability. This was determined if the perimeter:area ratio of a remnant was greater than the perimeter:area ratio of a 100 m wide polygon equivalent;
 - Applying a 50 m disturbance buffer within the edge of remnant patches where they bordered future development areas identified by the Growth Centres SEPP. If the buffering reduced the overall size of the patch below the 4ha threshold it was then excluded.

The Growth Centres support seven threatened ecological communities listed under the NSW TSC Act covering a total area of 3,686 ha (Growth Centres Commission 2007). The results of the management viability assessment found that, of this area, 584 ha comprises HMV vegetation. This HMV vegetation is broadly located in two areas: within the Air Services site at Shanes Park in the North West Growth Centre; and within the Kemps Creek Nature Reserve in the South West Growth Centre.

These areas of HMV comprise the best quality vegetation with the greatest long-term viability across the Growth Centres. Any impact or loss to this vegetation would be considered highly significant and therefore needs to be avoided.

The vast majority of native vegetation within the Growth Centres does not meet the HMV criteria. However, it is important to recognise that this methodology does not conclude that the remaining areas that support endangered ecological communities within the Growth Centres are unviable or without biodiversity value. This remaining vegetation is still highly variable in terms of quality and conservation value.

For the purposes of this strategic assessment, a methodology adapted from that of the Conservation Plan has been applied to further describe the occurrence of the three EPBC listed communities within the Growth Centres. This enables a more detailed understanding of the condition and viability of the communities, the degree of potential impacts and the adequacy of measures to avoid, mitigate and offset these impacts.

The methodology is consistent with that used in the Conservation Plan to identify areas of HMV, and then modifies the criteria to identify areas of “Biodiversity Value - Moderate Long-term Management Viability” and areas of “Reduced Biodiversity Value – Low Long-term Management Viability”.

ASSESSMENT OF MANAGEMENT VIABILITY WITHIN THE GROWTH CENTRES

Areas within the Growth Centres that support one of the three EPBC listed communities have been classified according to whether they have:

- Biodiversity Value – Higher Long-term Management Viability (HMV);
- Moderate Biodiversity Value – Moderate Long-term Management Viability (MMV); and
- Reduced Biodiversity Value – Low Long-term Management Viability (LMV).

These categories were assigned using the following criteria.

Biodiversity Value – Higher Long-term Management Viability

- Condition (where relevant) - good quality vegetation based on existing mapping.
- Size – vegetation remnants that are equal to or greater than 4 ha. This threshold was chosen after taking into account the fragmented nature of the remaining vegetation on the Cumberland Plain, the relative biodiversity values of larger patches compared to smaller patches in Western Sydney, and the likely pressures on small remnants within the Growth Centres once they are surrounded by intensive urban development. The 4 ha threshold was applied in the Conservation Plan (GCC 2007) and is supported by work on fragmentation which suggests that remnant area is the best predictor of species richness (Drinnan 2005).
- Landscape context (connectivity) – based on an analysis of the proportion of vegetation cover at the regional and local scale using the Biometric methodology (Gibbons et al 2005). A remnant was considered to have good connectivity if there was 30% or greater vegetation cover within both a 0.55 km and 1.75 km radius of the patch. The 30% threshold was chosen given the fragmented nature of Cumberland Plain vegetation and given the available evidence that suggests significant declines in biodiversity values once 70% of the landscape has been cleared (Freudenberger et al 1997).

- Threats – the influence of future surrounding land use was taken into consideration in two ways:
 - Identifying all remnants with high edge to area ratios (long thin strips of vegetation) as having lower management viability. This was determined if the perimeter:area ratio of a remnant was greater than the perimeter:area ratio of a 100 m wide polygon equivalent;
 - Applying a 50 m disturbance buffer within the edge of remnant patches where they bordered future development areas identified by the Growth Centres SEPP. If the buffering reduced the overall size of the patch below the 4ha threshold it was then excluded.

Moderate Biodiversity Value – Moderate Long-term Management Viability

The same set of criteria used to identify HMV has been used to identify MMV, with a modification to the Landscape context (connectivity) criteria as follows:

- Landscape context (connectivity) – based on an analysis of the proportion of vegetation cover at the regional and local scale using the Biometric methodology (Gibbons et al 2005). A remnant was considered to have moderate connectivity if there was 15% or greater vegetation cover within both a 0.55 km and 1.75 km radius of the patch.

Reduced Biodiversity Value – Low Long-term Management Viability

All areas within the Growth Centres that support one of the three EPBC listed communities that do not meet the criteria for HMV or MMV are considered to be of reduced biodiversity value and have low long-term management viability.

A detailed analysis of the presence, potential impacts and conservation measures for each of the three EPBC listed communities in relation to the proposed Growth Centres is provided in the following section. The results of the viability assessment are provided as part of this analysis.

It is also important to recognise that in terms of the landscape context (connectivity) criteria for MMV and LMV that the vegetation across the Growth Centres is highly fragmented, mainly in private ownership and is currently unmanaged for conservation purposes. This therefore means that the management viability ascribed in this report will decline and reduce overtime.

Note - The area calculations for each ecological community have a tolerance of 1 to 2 hectares. This variation derives from rounding error and the potential fine scale deviations inherent in GIS area measurements.

4.2 CUMBERLAND PLAIN SHALE WOODLANDS AND SHALE GRAVEL TRANSITION FOREST

4.2.1 ECOLOGICAL COMMUNITY DESCRIPTION

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest is listed as a critically endangered ecological community under the EPBC Act.

The community represents occurrences of the coastal plain grassy eucalypt woodlands that are endemic to the shale hills and plains of the Sydney Basin Bioregion in NSW. The shale hills and plains woodlands exhibit a variable structure from open woodland to forest. The shale eucalypt woodlands in this region can also grade into forest structures where gravel overlies the shale substrate, which is why the listed community incorporates this Shale Gravel Transition Forest vegetation component.

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest tends to occur on flat to undulating or hilly terrain, at elevations up to around 350 metres above sea level. The community is primarily associated with clay soils derived from Wianamatta Shale; although it may also occur on other soil groups such as Holocene Alluvium in well drained areas, soils derived from the Mittagong Formation, and on rare occurrences, on Hawkesbury Sandstone or Aeolian Deposits. The Shale Gravel Transition Forest component of the community tends to be associated with shale soils with high concentrations of iron-indurated gravel or overlain by tertiary alluvium.

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest mainly occurs in the Cumberland sub-region. The community lies in a coastal valley rain shadow that occupies the driest part of the Cumberland Plain. The region typically has a mean annual rainfall of between 700 and 900 mm and tends to have higher maximum temperatures and lower minimum temperatures than surrounding areas.

The community structure is variable, ranging from open grassy woodland to forest, with the understorey varying from predominantly grassy to predominantly shrubby. This structure may include an upper tree layer, lower tree layer, shrub layer and a ground layer, although one or more of these layers may be absent or degraded depending on the site. Disturbances such as clearing, fire and grazing regimes largely influence the structure and diversity of the community. The majority of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest represents regrowth. After clearing, the tree canopy may remain sparse or may regrow to form dense stands of saplings and small trees, which are typically associated with a ground layer of reduced cover and diversity (NSW Scientific Committee 2008).

It is important to note that for the community to meet the definition of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest under the EPBC Act, an upper tree layer must always be present (with projected foliage cover of canopy trees being 10% or more), as well as either a shrub or ground layer. This is different to the definition under the NSW TSC Act.

Grey Box *Eucalyptus moluccana* and Forest Red Gum *Eucalyptus tereticornis* are the dominant canopy trees, with Narrow-leaved Ironbark *Eucalyptus crebra*, Spotted Gum *Corymbia maculata* and Thin-leaved Stringybark *Eucalyptus eugenioides* occurring less frequently. A lower tree layer consisting of young eucalypts of upper tree canopy species and species of *Acacia*, *Exocarpus* and *Melaleuca* may be present. The understorey layer is dominated by Blackthorn *Bursaria spinosa*, and it is common to find abundant grasses such as Kangaroo Grass *Themeda australis* and Weeping Meadow Grass *Microlaena stipoides* var *stipoides* (TSSC 2008b).

In addition to a set of key diagnostic criteria relating to locality, soil type, structure and species presence, the EPBC definition of the community includes four condition categories that provide guidance for when a patch of the community retains sufficient conservation values to be considered as a matter of national environmental significance. The four categories are outlined in Table 6 below.

Table 6: Condition thresholds for patches that meet the EPBC description for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest ecological community.

Category and rationale	Thresholds
A. Core thresholds that apply under most circumstances: patches with an understorey dominated by natives and a minimum size that is functional and consistent with the minimum mapping unit size applies in NSW.	Minimum patch size is ≥ 0.5 ha; AND $\geq 50\%$ of the perennial understorey vegetation cover is made up of native species
OR	
B. Larger patches which are inherently valuable due to their rarity	The patch size is ≥ 5 ha; AND $\geq 30\%$ of the perennial understorey vegetation cover is made up of native species.
OR	
C. Patches with connectivity to other large native vegetation remnants in the landscape	The patch size is ≥ 0.5 ha; AND $\geq 30\%$ if of the perennial understorey vegetation cover is made up of native species AND The patch is contiguous with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) that is ≥ 5 ha in area.
OR	
D. Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain.	The patch size is ≥ 0.5 ha in size. AND $\geq 30\%$ of the perennial understorey vegetation cover is made up of native species AND The patch has at least one tree with hollows per hectare or at least one large tree (> 80 cm dbh) per hectare from the upper tree layer species.

Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest is floristically similar to a number of other Grassy Woodland communities within the Sydney region (Text Box 1). The EPBC listed community is most similar to the woodlands found on moderately fertile soils with relatively dry climates across the Sydney Basin. These woodlands occur in the Hunter Valley, the Capertee Valley and the tablelands.

RELATIONSHIP TO THE NSW LISTING OF THE COMMUNITY

The EPBC definition of the community generally corresponds to two threatened ecological communities listed under the NSW TSC Act. These include the “Cumberland Plain Woodland in the Sydney Basin Bioregion”, which comprises the majority of the EPBC listed ecological community, and the “Shale Gravel Transition Forest in the Sydney Basin Bioregion” which generally accounts for the Shale Gravel Transition Forest component of the EPBC listed community.

The floristic composition of the two listings is the same. For this reason, much of the research undertaken in relation to the NSW listed community is generally applicable to the EPBC listed community. Where the EPBC and NSW listings diverge is in the application of the condition thresholds and the fact that derived grasslands and shrublands can be included under the NSW listing, while under the EPBC listing, tree layer species must be present. These differences have led to a need to adapt some of the existing NSW information for the purposes of this strategic assessment.

APPROACH USED TO MAP THE COMMUNITY ACROSS THE CUMBERLAND PLAIN

The NSW Department of Environment, Climate Change and Water (DECCW) has gathered a substantial amount of data over the last 12 years which they have used to map the distribution and extent of native vegetation across the Cumberland Plain. This data has been adapted for the purposes of this strategic assessment to address the definition and condition categories of the EPBC listing of the community.

The NSW mapping information was derived through a process of field survey, modelling and aerial photograph interpretation (API). This methodology generated a vegetation layer across the Cumberland Plain containing information about patch size, extent of canopy cover, canopy species composition and understorey species composition. Further detail about the methodology used in deriving the original NSW maps can be found in the following report: *NSW National Parks and Wildlife Service Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain (2002)*.

The approach used to derive maps of the EPBC listed community is considered to adequately determine presence and extent of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest in order to address the requirements of a strategic assessment under the EPBC Act, noting that there will always be some uncertainty when attempting to correlate mapped vegetation types with quantitative condition thresholds. Most importantly, the approach used is not expected to underestimate the extent of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest. Where some minor error in vegetation extent may occur, this is expected to be on the side of over-predicting rather than under-predicting the amount of the community present.

The approach used to map the community distinguishes the condition categories of A, B and C. The method was unable to identify areas of condition category D, which are the patches containing large mature trees or trees with hollows. This limitation was accepted for the following reasons:

- Much of the remaining Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest is re-growth which means there are very few areas that would qualify as condition D.
- Any area that would qualify as condition D is expected to be captured in the mapped extent as one of the other three condition categories.

THREATS TO THE COMMUNITY AND CURRENT DISTRIBUTION ACROSS THE CUMBERLAND PLAIN

The original extent of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest has been significantly reduced across the Cumberland Plain due to agricultural and urban uses following European settlement. A field survey undertaken by Tozer (2003) coupled with detailed interpretation of colour aerial photography from 1997-1998, determined that only 9 percent of the original extent (pre-1750) of the NSW listed community remained with greater than 10% canopy cover, with a further 14% remaining as scattered trees across the landscape (NPWS, 2002a; NPWS, 2002d).

A more recent study by the NSW Scientific Committee and Simpson (2008) re-assessed the status of the NSW listed community in order to determine changes in distribution since November 1998. Comparing the 1997-1998 mapping undertaken by Tozer (2003) with orthorectified digital photography obtained in 2007, it was found that the remaining extent of the community had declined by approximately 442 ha or around 5.2% of its distribution nine years ago (NSW Scientific Committee and Simpson 2008). Such clearing is likely to be a consequence of dispersed, small-scale loss associated with urban, industrial and rural development.

This clearing is the main threat to the community across the Cumberland Plain. Clearing leads to increasingly isolated remnants. In the context of a surrounding matrix of agricultural, peri-urban and urban land uses, this fragmentation places the community under additional pressure from weed invasion, altered fire regimes due to arson, excessive nutrients from urban run-off and fertilizer use, grazing, altered hydrology, dumped refuse, and the introduction of domestic animals. Loss of connectivity is also known to degrade habitat for fauna and flora species by reducing movements and opportunities for exchanges between habitats.

Weed invasion is a particularly threatening process impacting on Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest. There are a variety of weed species of perennial grasses, vines, scramblers and woody shrub across the Cumberland Plain that displace native species, reducing native flora and fauna biodiversity within the community. Two weed species of particular significance are the African Olive and Bridal Creeper. Both species are highly competitive and appear able to suppress native understorey species (Tozer 2003). African Olive has the ability to permanently change the structure of the ecological community through dense mid-canopy formation. Once established, both of these species require intensive long-term management.

Currently, there is a total of around 10,703 ha of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest across the Cumberland Plain. This remaining bushland, shown in Figure 29, is highly fragmented in nature. It exists as around 1,727 fragmented patches with an average patch size of approximately 6 ha. 74% of all remnants are less than 5 ha in size but only contribute to 17% of the total area of habitat. The largest remaining patch is around 478 ha in size.

The majority of the extent of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest occurs under private land tenure.

The community occurs across a number of local government areas including Auburn, Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Hills Shire, Holroyd, Liverpool, Parramatta, Penrith and Wollondilly (TSSC 2008b).

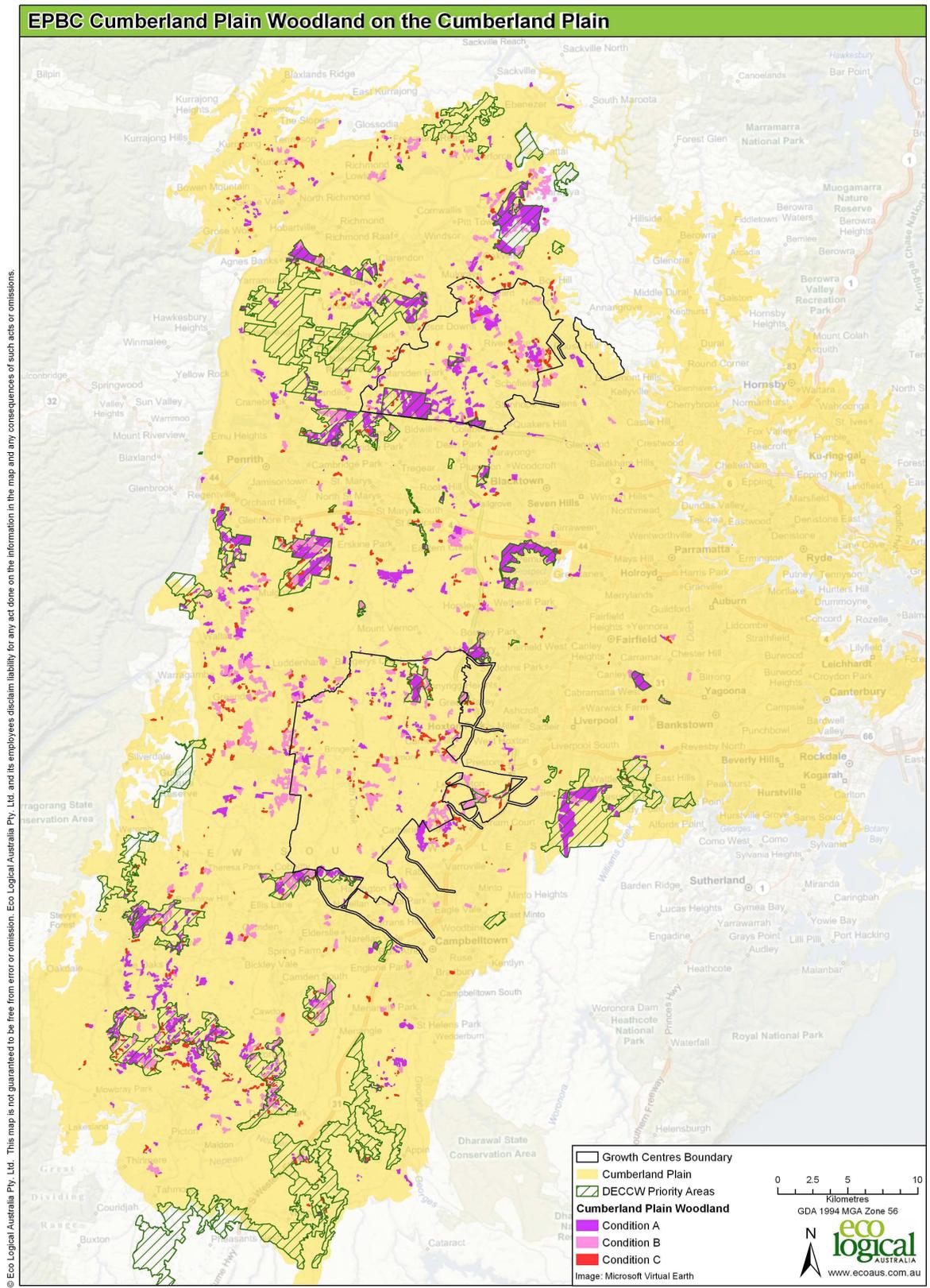


Figure 29: Distribution of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest across the Cumberland Plain

Note - The DECCW Priority Areas in this map are those areas identified as Priority Conservation Lands in the draft Cumberland Plain Recovery Plan. They differ slightly from the priority areas on the Cumberland Plain identified in the Hawkesbury Nepean Catchment Action Plan (2008).

BIODIVERSITY VALUE AND ECOLOGICAL VIABILITY OF THE COMMUNITY

The biodiversity value of patches of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest varies throughout the Cumberland Plain. As outlined in the introduction to this chapter, past and existing land uses, and pressures from the surrounding landscape, have strongly influenced the condition of remnants and their ecological viability in the long-term.

The biodiversity value and ecological viability of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest has been determined across the community's range using the criteria described in Section 4.1 and illustrated in Figure 30. The condition categories outlined in the EPBC Act definition of the community are not hierarchical, for example condition category A does not necessarily have a higher biodiversity value than condition category C. For this reason, "condition" was not considered to be a relevant criterion to the assessment.

This analysis found that, of the 10,703 ha of extant Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest, approximately 2,875 ha (or 27%) comprises areas of HMV; 3,592 ha (or 33%) comprises areas of MMV; and 4,235 ha (or 40%) comprises areas of LMV.

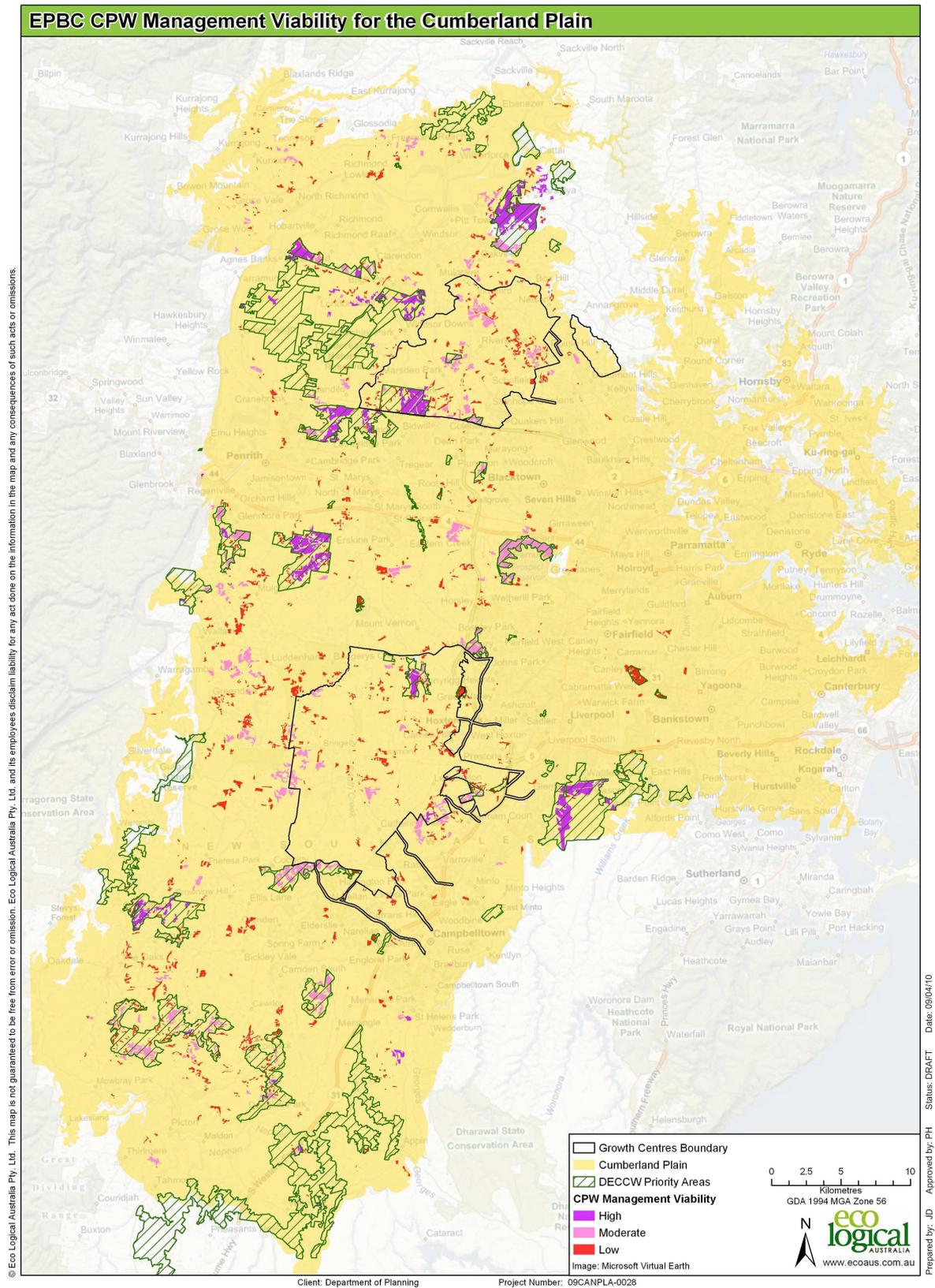


Figure 30: Biodiversity value and ecological viability of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest across the Cumberland Plain

Note - The DECCW Priority Areas in this map are those areas identified as Priority Conservation Lands in the draft Cumberland Plain Recovery Plan. They differ slightly from the priority areas on the Cumberland Plain identified in the Hawkesbury Nepean Catchment Action Plan (2008).

4.2.2 CUMBERLAND PLAIN SHALE WOODLANDS AND SHALE GRAVEL TRANSITION FOREST WITHIN THE GROWTH CENTRES

There is a total of approximately 2,185 ha of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres. This area comprises around 1,067 ha of EPBC condition A, 912 ha of EPBC condition B and 207 ha of EPBC condition C. The area of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres comprises around 20% of the remaining total distribution of the community.

Table 7 provides a detailed breakdown of the amount of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres. These areas are shown in Figure 31 and Figure 32.

Table 7: Amount (ha) of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres

Area	EPBC Condition Category			Total
	A (ha)	B (ha)	C (ha)	
NW Growth Centre	811	244	82	1137
SW Growth Centre	256	668	125	1048
North West Precincts				
Alex Avenue	0	19	0	19
Area 20	0	0	9	9
Box Hill	0	8	4	11
Box Hill Industrial	0	0	0	0
Colebee	1	0	4	6
Marsden Park	330	6	7	342
Marsden Park Industrial	105	13	1	118
Marsden Park North	80	37	4	121
North Kellyville	0	0	1	1
Riverstone	128	50	12	190
Riverstone East	60	75	24	159
Riverstone West	0	0	0	0
Schofields	6	0	0	6
Shanes Park	22	5	3	30
Vineyard	7	31	13	51
West Schofields	72	2	0	74
South West Precincts				
Austral	13	25	18	56
Bringelly	3	29	1	33
Catherine Fields	4	14	6	23
Catherine Fields North	5	57	1	63
East Leppington	9	72	9	89
Edmondson Park	9	91	13	112

Future Industrial	18	46	10	75
Kemps Creek	21	26	9	56
Leppington	2	0	0	2
Leppington North	15	8	6	29
Lowes Creek	25	90	3	118
Marylands	0	0	2	2
North Bringelly	4	19	1	25
North Rossmore	22	16	5	43
Oran Park	1	1	0	2
Rossmore	10	39	14	63
Turner Road	0	5	1	6
Western Sydney Parklands	83	29	130	242
Road corridors	0	6	4	10
<i>Total</i>	1067	912	207	2185

The total area of 2,185 ha of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres is highly fragmented, consisting of 349 separate patches. The North West Growth Centre, although smaller in size, contains a greater area of the listed community across fewer patches compared with the South West Growth Centre. There are 158 patches within the North West Growth Centre ranging in size from 0.01 of a hectare to 159 ha with an average patch size of approximately 7 ha. The South West Growth Centre contains 236 patches ranging in size from 0.001 of a hectare to 87 ha, with an average patch size of approximately 4 ha. It is noted however, that predominantly the patches are much smaller than the average patch size.

An assessment of the biodiversity value and ecological viability of the Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres has been undertaken using the criteria outlined in the introduction to this section. The results of this assessment are presented in Table 8 and illustrated in Figure 33 and Figure 34.

Table 8: Amount (ha) of HMV, MMV and LMV of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres

Area	Biodiversity Value and Ecological Viability			Total
	HMV	MMV	LMV	
NW Growth Centre	276	436	425	1137
SW Growth Centre	114	361	573	1048
North West Precincts				
Alex Avenue	0	0	19	19
Area 20	0	0	9	9
Box Hill	0	0	11	11
Box Hill Industrial	0	0	0	0
Colebee	0	1	5	6
Marsden Park	270	9	63	342
Marsden Park Industrial	5	77	36	118

Marsden Park North	0	100	20	121
North Kellyville	0	0	1	1
Riverstone	0	130	61	190
Riverstone East	0	54	105	159
Riverstone West	0	0	0	0
Schofields	0	0	6	6
Shanes Park	0	0	30	30
Vineyard	0	15	35	51
West Schofields	0	51	24	74
South West Precincts				
Austral	3	0	52	56
Bringelly	0	21	12	33
Catherine Fields	0	1	22	23
Catherine Fields North	0	45	18	63
East Leppington	21	44	24	89
Edmondson Park	0	53	59	112
Future Industrial	0	37	38	75
Kemps Creek	7	13	35	56
Leppington	0	0	2	2
Leppington North	0	14	15	29
Lowes Creek	0	97	21	118
Marylands	0	0	2	2
North Bringelly	0	0	25	25
North Rossmore	0	0	43	43
Oran Park	0	1	1	2
Rossmore	0	0	63	63
Turner Road	0	0	6	6
Western Sydney Parklands	83	29	130	242
Road corridors	0	6	4	10
<i>Total</i>	390	797	998	2185

The results of the biodiversity value and viability assessment found that of the 2,185 ha of extant Cumberland Plain Shale Gravel Transition Forest within the Growth Centres, approximately 18% comprises areas of Biodiversity Value – Higher Long-term Management Viability (HMV); 36% comprises areas of Moderate Biodiversity Value – Moderate Long-term Management Viability (MMV); 46% comprises areas of Reduced Biodiversity Value – Low Long-term Management Viability (LMV).

Consistent with the trend observed through the patch analysis - although smaller in size, the North West Growth Centre contains a higher proportion of HMV compared with the South West Growth Centre, indicating that the condition and ecological viability of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within this region is better. Within the North West Growth Centre, around 24% of the listed community is of HMV, while 37% is of LMV. Within the South West Growth Centre, only 11% of the listed community is of HMV, while the majority (55%) is of LMV.

This analysis also demonstrates that the Growth Centres generally represent areas of the listed community with reduced biodiversity value and viability compared with the Cumberland Plain as a whole. This is particularly true of the South West Growth Centre. That is, while 27% of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest is of HMV across its range, only 11% of the community is of HMV within the South West Growth Centre.

In addition to these values associated with size, condition and ecological viability, an important part of the picture for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the Growth Centres is the pattern of existing land tenure. Where one patch of vegetation is owned by multiple landowners, its effective level of security and prospect for protection and management is reduced for two key reasons:

- It is potentially more at risk of degradation through inconsistent land uses and management.
- Its level of regulatory protection may be reduced. This will occur where individual landowners decide to clear the listed community on their land, which in itself may not warrant environmental approval; however, this individual action still compromises the value of the patch and can lead to an outcome of “death-by-a-thousand-cuts”.

Land fragmentation is particularly relevant within the Growth Centres where there is a complex pattern of land tenure as a consequence of historical planning processes. There are more than 20,000 existing lots within the Growth Centres. Figure 35 and Figure 36 show the current cadastral boundaries within the Growth Centres and the distribution of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest.

Within the South West Growth Centre there are a total of 798 properties that contain Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest. The majority of these properties (around 72%) are between one and three hectares in size. The areas within the South West Growth Centre consisting of the larger landholdings are within the Future Industrial, North Bringelly, Lowes Creek, Marylands, Oran Park and Turner Road Precincts. Notably, there is very little Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest across these areas.

The issue of land tenure is increasingly more complicated within the North Growth Centre where there are a total of 5,398 properties that contain some amount of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest. This includes 4,836 properties (around 90%) which are less than 0.5 ha in size. The areas contributing to these numbers are generally within the Riverstone, West Schofields and Marsden Park North Precincts.

Indeed, the recent study undertaken by the NSW Scientific Committee and Simpson (2008) assessed the status of the community in order to determine changes in distribution since November 1998. It was found that the remaining extent of the NSW listed Cumberland Plain Woodlands had declined by approximately 442 ha or around 5.2% of its distribution nine years ago. Much of this clearing was unregulated and thought to be a consequence of dispersed, small-scale clearing associated with urban development. This data supports the notion that land tenure issues are likely to be reducing the efficacy of environmental regulation in the clearing of listed threatened ecological communities within Western Sydney and that keeping all remnant regardless of size is not likely to achieve a good conservation outcome for Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest.

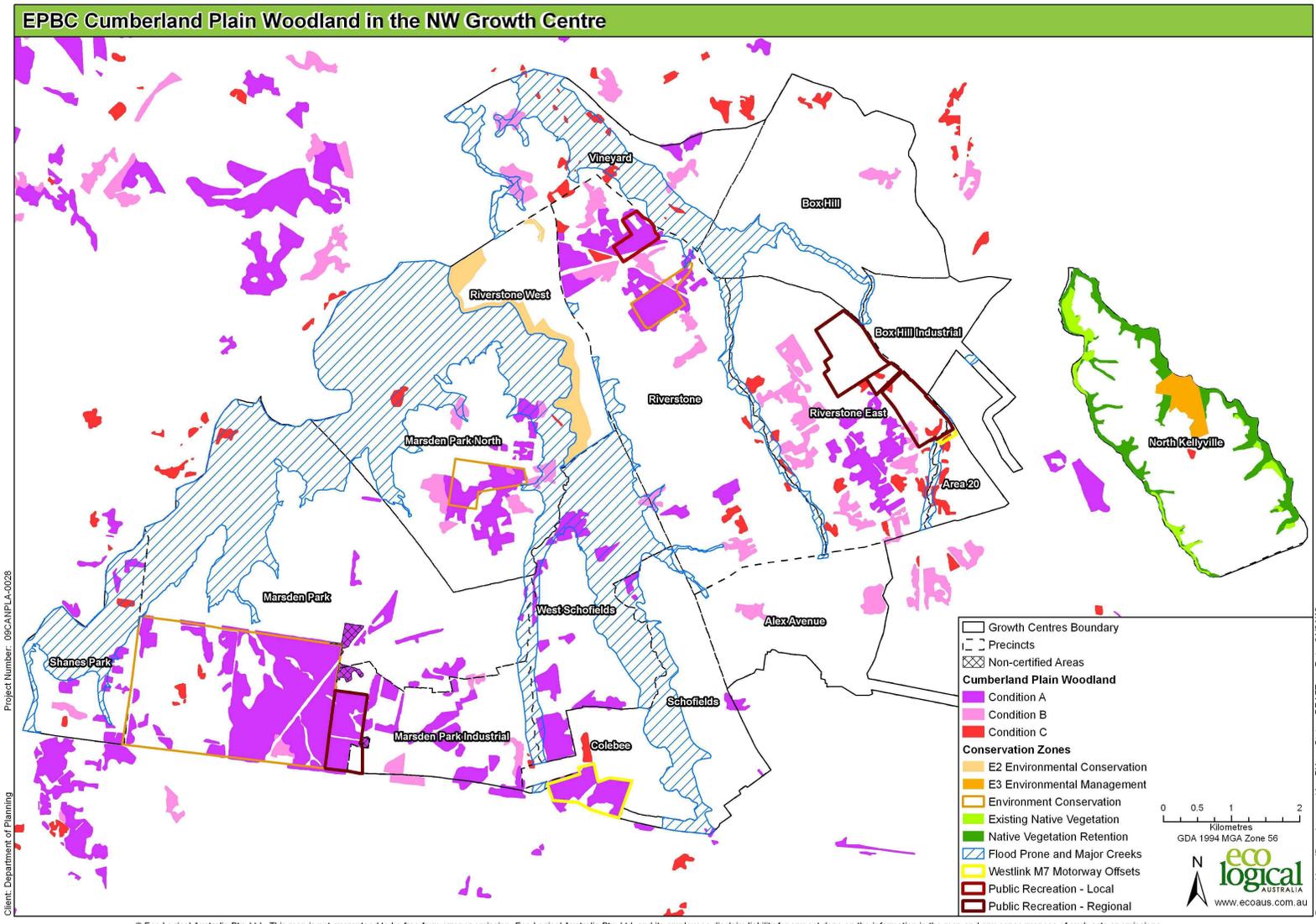


Figure 31: Distribution of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the North-West Growth Centre

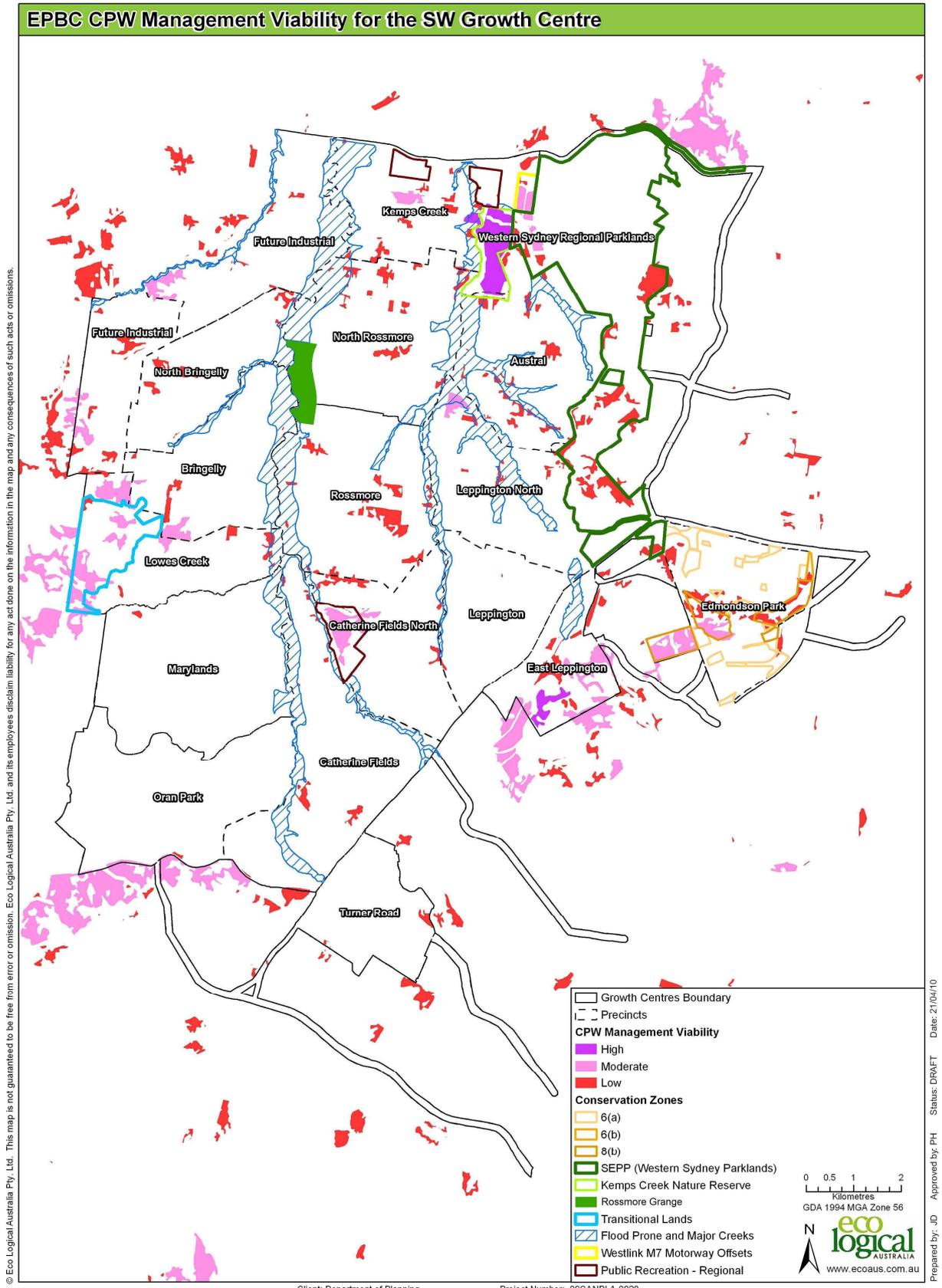


Figure 32: Distribution of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest within the South West Growth Centre