NVC Rangelands Desktop Assessment Tool for the Cooper-Eromanga Basin

Technical Summary

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The Rangelands Desktop Assessment Tool (DAT) is an application to rapidly assess Native Vegetation Council (NVC) Significant Environmental Benefit (SEB) values for clearance and offset applications in the Cooper-Eromanga Basin region. The Rangelands DAT method uses a combination of information derived from the existing Rangelands Assessment Manual (RAM) and Scoresheet method (Native Vegetation Branch 2017), *Flora and fauna communities of the Cooper-Eromanga Basin* study (Figure 1, Hobbs *et al.* 2017), and Landsat satellite fractional cover and water observations from space data.

This application dramatically reduces the cost of these assessments by virtually eliminating the need for on-ground surveys and detailed reports required under the alternate RAM and Scoresheet method. The Rangelands DAT application also provides uniform and consistent assessment results which eliminates biases or errors which would result from field observations influenced by variations in seasonal conditions or consultants' knowledge, interpretation and ecological skills. One of the greatest strengths of the DAT is that provides mapping of important ecological assets and permits forward planning to minimise environmental risks and costs of new developments in the region. The application is strongly supported by major energy industry operators in the Cooper-Eromanga Basin region. Rangelands DAT information is available at a spatial resolution of 30 x 30 metres.

Native vegetation clearance and offset assessments

NVC RAM SEB values are calculated using a Scoresheet using field observations of Vegetation Condition Scores (VCS) multiplied by a Landscape Context Score (LCS) factor and a Conservation Significance Score (CSS) factor. The RAM Scoresheet is based on assessments of the following variables:

Landscape Context Scores (block factor)

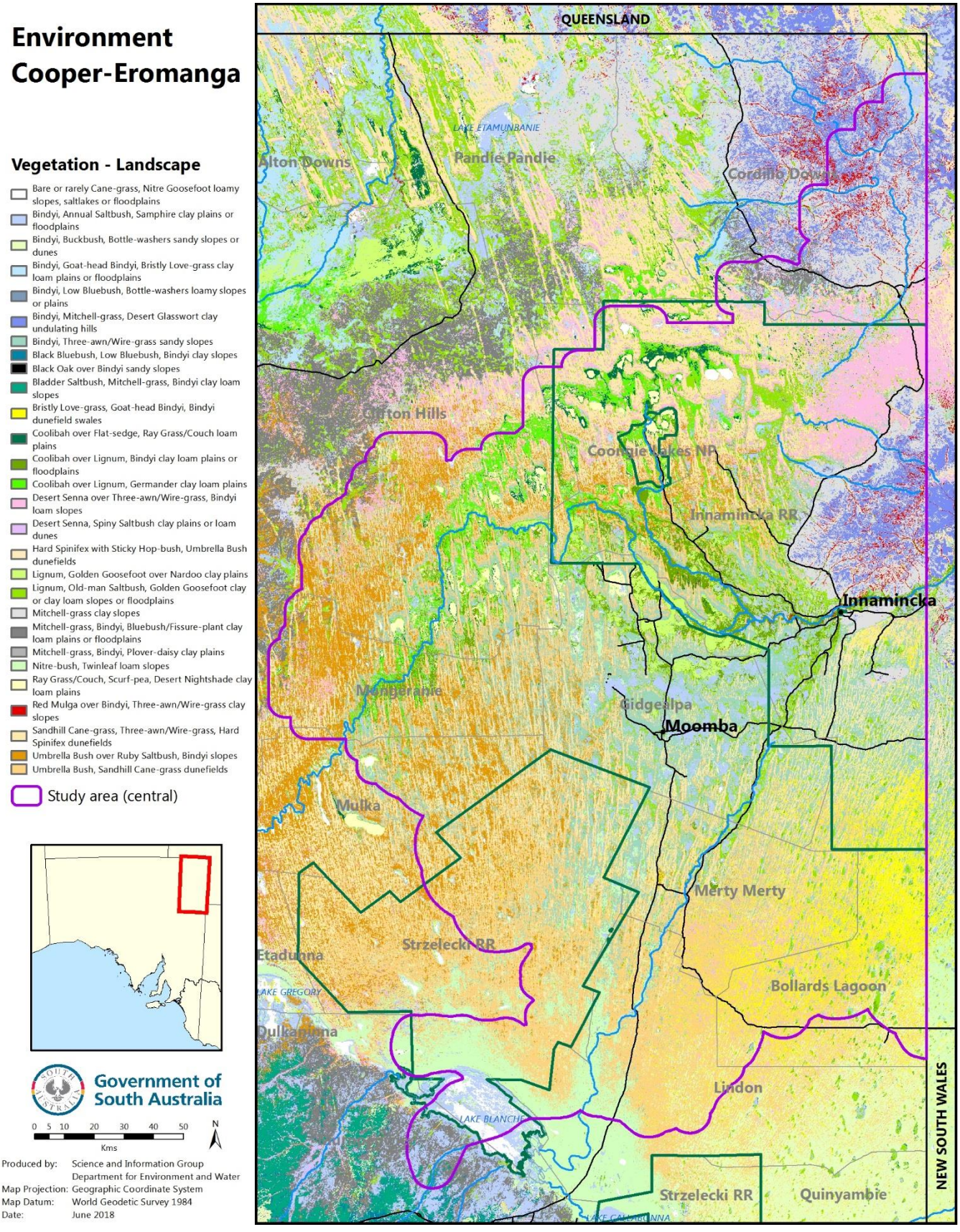
- Number of landform features within block (i.e. topographic diversity)
- Size of the block (hectares)
- % native vegetation protected in IBRA subregion (i.e. regional conservation areas)
- Wetland or riparian habitat present (i.e. presence, persistence of water)

Vegetation Condition Scores (points)

- Biotic disturbance indicators (i.e. trees, shrubs, palatability, understorey, litter)
- Physical disturbance indicators (i.e. bare soils, erosion)
- Vegetation stratum (i.e. tall trees/shrubs, shrubs, low shrubs, perennial grasses)
- Introduced plant species (i.e. declared species, introduced species density)
- Vegetation utilisation (i.e. proportion of plants eaten)

Conservation Significance Score (conservation factor)

- Threatened ecological community or ecosystem (i.e. National [AUS] EPBC Act, SA provisional listing)
- Threatened plant species present (i.e. National [AUS] EPBC Act, SA NPWS Act)
- Potential habitat for threatened animal species (i.e. National [AUS] EPBC Act, SA NPWS Act)



#Energy industry activities are typically found within the "central" part of the study area (i.e. 43 646 km²)

Figure 1. Main vegetation and landscape types (i.e. ecotypes) of the Cooper-Eromanga Basin region of South Australia

Environmental values

Each individual metric used in NVC RAM SEB assessments was reviewed (Hobbs *et al.* 2018), to determine if equivalent information could be derived from recent ecological research in the region (i.e. *Flora and fauna communities of the Cooper-Eromanga Basin* study, Hobbs *et al.* 2017), digital elevation models (DEM), and remotely-sensed information on vegetation/soil/water cover and dynamics (e.g. Landsat Fractional Cover Index [FCI] & Water Observations from Space [WOfS]).

Vegetation-landscape unit mapping and attributes (Ecotypes)

The *Flora and fauna communities of the Cooper-Eromanga Basin* study (Hobbs *et al.* 2017) provides mapping (Figure 1) and summary information that can be used estimate many environmental values for each ecotype and to stratify analyses of remotely-sensed estimates of vegetation and soil conditions.

Landsat fractional cover data

Seasonal (i.e. summer, autumn, winter, spring) quarterly data was collated for the period 2008 to 2017. The fractional cover data represent proportions of green ("photosynthetically active vegetation", PV) and dry ("non-photosynthetically active vegetation", NPV) vegetation and bare soil (BS) for each 30m grid cell for each season and year. The mean, minimum and maximum of each cover type was calculated over 2008 to 2017 period to represent various vegetation and soil attributes.

Benchmarks for environmental conditions

Ecotype statistics (e.g. summaries of ground surveys of vegetation structure, species associations) have been used to identify typical or benchmark conditions for some environmental values. Some generic Landsat cover estimates (e.g. mean green vegetation cover) are useful benchmarks for vegetation structure or perenniality. Further analyses of spatial variations in satellite cover data for each ecotype (e.g. "moving-window, best-on-offer" within a 10km radius) can be used to identify locally relevant benchmarks in satellite cover. These analyses using "relative cover" calculations provide a more powerful identification of locations with poorer than expected conditions resulting from management activities, total grazing pressure or changing soil health.

Conversion of rangeland scores from categorical data to continuous variables

Many variables within the RAM Scoresheet use categorical (i.e. class) data to determine fixed environmental values. Where feasible, these classes have been converted to continuous variables to provide fairer interpretations of data. Examples of these conversions can be found in Figure 2.

Significant environmental benefits metrics

A summary of comparisons between existing RAM significant environmental benefits (SEB) metrics, and Rangelands DAT equivalents derived from ecotype mapping and data (Hobbs *et al.* 2017), digital elevation model data and Landsat satellite data are presented in Table 1. More detailed information on the derivation of Rangelands DAT metrics are found in Table 2.

Maps of the main three SEB score components (i.e. Landscape Context, Vegetation Condition, Conservation Significance) are found in Figure 3, Figure 4 and Figure 5. More information and mapping on the underlying score components can be found in Appendix B. The final map of the Rangelands DAT's SEB Unit Biodiversity Score environmental values can be viewed in Figure 6.

Extracting Unit Biodiversity Score values for application areas

Vegetation descriptions and Unit Biodiversity Scores (UBS) for targeted application areas (i.e. block) are readily determined using standard geographic information system (GIS) functions. Polygons of targeted areas are located over gridded environmental data (30m resolution), and statistics are generated on the proportion of each vegetation type within the application area and mean SEB Unit Biodiversity Score for the block.

Table 1. Summary of significant environmental benefit metrics and desktop assessment tool equivalents for evaluating native vegetation clearance and offset applications in the Cooper-Eromanga Basin region of South Australia

Significant environmental benefit metrics (RAM) [data type]	Desktop assessment tool equivalents (DAT) [data type]
Landscape Context Scores (block factor)	
Number of landform features within block (i.e. topographic diversity) [categorical]	Digital elevation model landform class diversity [categorical]
Size of the block (hectares) [categorical]	Size of the block [continuous]
Percent of native vegetation protected in IBRA subregion (i.e. regional conservation areas) [categorical]	Percent of native vegetation protected in IBRA subregion [continuous]
Wetland or riparian habitat present (i.e. presence, persistence of water) [categorical]	Landsat water observations, percent of records [continuous]
Vegetation Condition Scores (site scores)	
Biotic disturbance indicators [categorical] a. Overstorey (i.e. trees, shrubs, palatability) b. Understorey (i.e. low shrubs, grass, forbs, litter)	Landsat green vegetation cover [continuous] a. Perennial green vegetation cover [continuous] b. Under-canopy green vegetation growth [continuous]
Physical disturbance indicators (i.e. bare soils, erosion) [categorical]	Landsat maximum green vegetation cover, relative condition using ecotype and local area benchmarks [continuous]
Vegetation stratum (i.e. tall trees/shrubs, shrubs, low shrubs, perennial grasses) [categorical]	Ecotype typical vegetation structure [categorical + continuous]
Introduced plant species (i.e. declared species, introduced species density) [categorical]	Assumed absence [categorical]
Vegetation utilisation (i.e. proportion of plants eaten) [continuous]	Landsat mean total vegetation cover, relative condition using ecotype and local area benchmarks [continuous]
Conservation Significance Score (conservation factor)	
Threatened ecological community or ecosystem (i.e. National [AUS] EPBC Act, SA provisional listing) [continuous]	Ecotype matching [categorical]
Threatened plant species present (i.e. National [AUS] EPBC Act, SA NPWS Act) [continuous]	Ecotype typical priority flora species [continuous]
Potential habitat for threatened animal species (i.e. National [AUS] EPBC Act, SA NPWS Act) [continuous]	Ecotype typical priority fauna species [continuous]

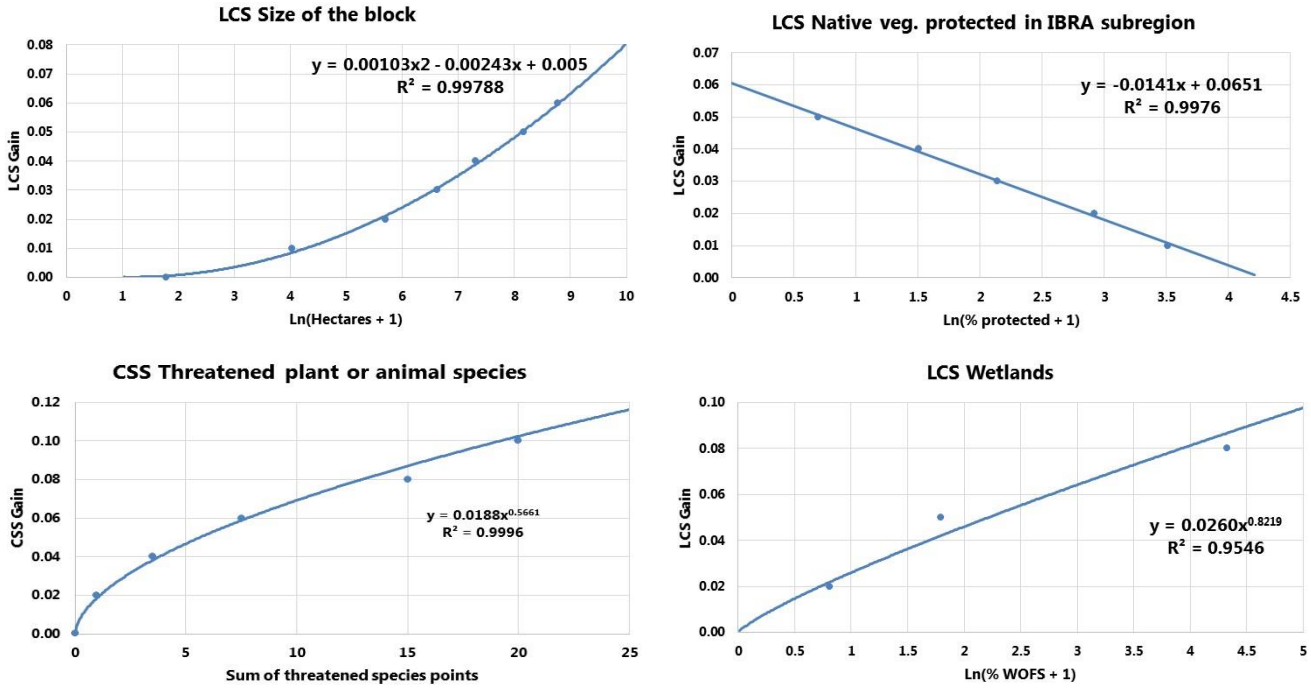


Figure 2. Conversions of categorical environmental data to continuous values used in the Rangeland DAT application in the Cooper-Eromanga Basin region of South Australia

Table 2. Descriptions of significant environmental benefit metrics and desktop assessment tool equivalents for evaluating native vegetation clearance and offset applications in the Cooper-Eromanga Basin region of South Australia

Rangelands Significant Environmental Benefit (SEB), Unit Biodiversity Score (UBS) components	Max. value	Current RAM metrics	Weight or +gain	Max. score or factor	Rangelands DAT metrics	Source data [calculation]
Landscape Context Scores (LCS), Block factor		**1 + Sum of LCS gains**	**+ 0.25 max.**	**1.25**	**Mapping and Landsat satellite cover.** *Landscape Context Score (LCS), Total factor*	Landscape Context Score (LCS) [*Total factor* = 1 + Sum of LCS gains]
Number of landform features within block (Class: 1 = 0.01pts, 2 = 0.03pts, >2 = 0.06pts)	**>2**	**Count land types** [categorical]	**+ 0.06**	**1.06**	**Digital elevation model landform class diversity**. *LCS Landforms per hectare gain* [categorical]	Topographic wetness index classification (Hobbs *et al.* 2017). Count of landscape strata within surrounding 1 hectare [*LCS Landforms per hectare gain*, class: 1 = +0.01 pts; 2 = +0.03 pts; >2 = +0.06 pts]
Size of the block (ha) (Class: <10ha = 0; 10-<100ha = 0.01pts; 100-<500ha = 0.02pts; 500-<1000ha = 0.03pts; 1000-<2000ha = 0.04pts; 2000-5000 = 0.05pts; >5000pts = 0.06pts)	**>5000**	**Area** [categorical]	**+ 0.06**	**1.06**	**Size of the block.** *LCS Block size gain* [continuous]. Continuous metric preferred rather than class data.	Area of mapped polygon (ha) [*LCS Block size gain*, if Area <10ha then = 0, else = (0.00103 x Area^2) - (0.00243 x Area) + 0.005]
Percent of native vegetation protected in IBRA subregion (Class: 0-2% = 0.05pts; >2-5% = 0.04pts; >5-10% = 0.03pts; >10-25% = 0.02pts; >25% = 0.01pts)	**0**	**Current NVC tables (%)** [categorical]	**+ 0.05**	**1.05**	**Percent of native vegetation protected in IBRA subregion.** *LCS Protected area gain* [continuous]	Existing NVC data (% protected, Native Vegetation Branch 2017) [*LCS Protected area gain* = (-0.0141 x Ln(%protected+1)) + 0.0651]
Wetland or riparian habitat present Does the block contain a wetland feature?	**Presence**	**Presence / Absence** [categorical]	**+ 0.08**	**1.08**	**Landsat water observations, percent of records.** *LCS Wetlands gain* [continuous]. Presence of surface water. Unified continuous metric used rather than class data.	Landsat Water Observations from Space (WOfS 1987-2015, % records; Geoscience Australia 2015) [*LCS Wetlands gain* = 0.0260 x (Ln(WOfS+1))$^{0.8219}$]
a. Permanent or semi-permanent = 0.08pts Contains water for at least 6 months of the year	Presence	Estimated based on observer	+ 0.08	1.08		
b. Occasionally contains water = 0.05pts Contains water approximately once every 5 years	Presence	Estimated based on observer	+ 0.05	1.05		
c. Very occasionally contains water = 0.02pts Contains water approximately once every 20 years	Presence	Estimated based on observer	+ 0.02	1.02		

Rangelands Significant Environmental Benefit (SEB), Unit Biodiversity Score (UBS) components	Max. value	Current RAM metrics	Weight or +gain	Max. score or factor	Rangelands DAT metrics	Source data [calculation]
Vegetation Condition Scores (VCS), Site score		**Sum of VCS scores**		**70**	**Landsat satellite cover and ecotype information.** *Vegetation Condition Score (VCS), Total*	Landsat satellite 2008-2017 Fractional Cover (TERN AusCover 2018). Ecotype information (Hobbs *et al.* 2017). [*Vegetation Condition Score (VCS), Total* = Sum of VCS scores]
Biotic disturbance indicators Sites with trees and large shrubs only	**4**	**Presence / Absence**	**2.5**	**10**	**Landsat green vegetation cover,** photosynthetically-active vegetation (PV). *VCS Biotic disturbance indicators score* [continuous]	**Landsat mean and maximum green vegetation cover** [*VCS Biotic disturbance indicators score* = Perennial green vegetation cover + Under-canopy green vegetation growth]
a. Presence of palatable shrubs or perennial grasses under the canopy of tree/shrub >3m	2	Presence / Absence	2.5	5	*a. Perennial green vegetation cover* [continuous] (i.e. tree, shrub, grass cover)	Mean green vegetation cover (PV_{Mean}) [a. Perennial green vegetation cover score = 5 x Ln(PV_{Mean}+1) / Ln(100+1)]
b. Presence of mostly intact litter mats under canopy of tree/shrub >3m tall (>50% of tree canopy area has intertwined litter or shrub cover)	2	Presence / Absence	2.5	5	*b. Under-canopy green vegetation growth* [continuous] (i.e. ephemeral biomass and non-bare soils)	Difference between maximum and mean green vegetation cover ($PV_{Maximum}$ - PV_{Mean}) [b. Under-canopy green vegetation growth score = 5 x Ln(($PV_{Maximum}$ - PV_{Mean})+1) / Ln(100+1)]
Physical disturbance indicators	**6**	**Presence / Absence**	**3**	**18**	**Landsat maximum green vegetation cover, relative responsiveness to rainfall** using ecotype and local area benchmarks. *VCS Physical disturbance indicator score* [continuous]. Unified metric (a+b+c), class data not used.	**Maximum green vegetation cover** ($PV_{Maximum}$). Relative responsiveness to rainfall (index 0-1) where maximum green vegetation cover ($PV_{Maximum}$) at each location is compared to each Ecotype's 90 percentile value in 10km radius) [*VCS Physical disturbance indicator score* = 18 x Relative responsiveness to rainfall index]
a. Prevalence of large patches of bare soil (> 5m x 5m) that shows no signs of productive capacity (i.e. ephemeral plant litter, stems etc.)	2	0 (Dominant) / 1 (Minor) / 2 (None)	3	6		
b. Evidence of animal tracks, vehicle tracks or other physical disturbance to the natural land surface	2	0 (Dominant) / 1 (Minor) / 2 (None)	3	6		
c. Destabilised creek channel banks (if present), characterised by no vegetation or stabilizing roots, deflation and bank erosion. Inspect banks on both sides of channels.	2	0 (Dominant) / 1 (Minor) / 2 (None)	3	6		

Rangelands Significant Environmental Benefit (SEB), Unit Biodiversity Score (UBS) components	Max. value	Current RAM metrics	Weight or +gain	Max. score or factor	Rangelands DAT metrics	Source data [calculation]
Vegetation stratum	**4**	**Presence / Absence** Can be negative for absent but expected types, range from -8 to +16	**4**	**16**	**Ecotype typical vegetation structure.** *VCS Vegetation stratum score* [categorical + continuous]	Presence and cover defined by ecotype descriptive data (Hobbs *et al.* 2017), see Table 3. [*VCS Vegetation stratum score* = Sum of individual stratum scores]
a. Trees/shrubs >3m	1	-0.5 (absent) to +1 (present)	4	4	*a. Ecotype typical 'TreeCover' + 'MalleeCover'*	[Tree score = If ('TreeCover' + 'MalleeCover') >=10% then = 4, else = 4 x ('TreeCover' + 'MalleeCover') / 10]
b. Shrubs 1- 3m	1	-0.5 (absent) to +1 (present)	4	4	*b. Ecotype typical 'ShrubCover'*	[Shrub score = If 'ShrubCover' >=10% then = 4, else = 4 x 'ShrubCover' / 10]
c. Low shrubs <1m & hummock grasses	1	-0.5 (absent) to +1 (present)	4	4	*c. Ecotype typical 'LowShrubCover'*	[Low shrub score =If 'LowShrubCover' >=10% then = 4, else = 4 x 'LowShrubCover' / 10]
d. Perennial tussock grasses with basal areas >30mm	1	-0.5 (absent) to +1 (present)	4	4	*d. Ecotype typical 'GrassCover' + 'SedgeCover'*	[Grass score = If ('GrassCover' + 'SedgeCover') >=10% then = 4, else = 4 x ('GrassCover' + 'SedgeCover') / 10]
Introduced plant species	**4**	**Presence / Absence**	**2.5**	**10**	**Assumed absence.** *VCS Introduced plant species score* [categorical]	Cannot be determined accurately from satellite data [*VCS Introduced plant species score*, default value = 10]
a. Declared species present?	1	0 (present) to 1 (absent)	2.5	2.5		
b. Introduced species dominate (>50% of vegetation cover)	1	0 (present) to 1 (absent)	2.5	2.5		
c. Moderate invasion of introduced species (5 to 50% of the vegetation cover)	1	0 (present) to 1 (absent)	2.5	2.5		
d. Very sparse to nil introduced species present (<5% of vegetation cover)	1	0 (present) to 1 (absent)	2.5	2.5		
Vegetation Utilisation Score	**20**	**Mean utilisation score** of all species records with each species score weighted on generic palatability lookup table	variable weights (palatability x utilisation matrix) with age class modifier	**26**	**Landsat mean total vegetation cover, relative condition** using ecotype and local area benchmarks. Includes mean green (photosynthetically-active vegetation, PV) and dry (non-photosynthetically-active vegetation, NPV). *VCS Vegetation utilisation score* [continuous]	**Mean total vegetation cover** (PV_{Mean} + NPV_{Mean}). Relative vegetation condition (index 0-1) where mean total vegetation cover (PV_{Mean} + NPV_{Mean}) at each location is compared to each Ecotype's 90 percentile value in 10km radius) [*VCS Vegetation utilisation score* = 26 x Relative vegetation condition index]

Rangelands Significant Environmental Benefit (SEB), Unit Biodiversity Score (UBS) components	Max. value	Current RAM metrics	Weight or +gain	Max. score or factor	Rangelands DAT metrics	Source data [calculation]
Conservation Significance Score (CSS), Conservation factor		**1 + Sum of CSS gains**	**+ 0.5 max.**	**1.5**	**Ecotype associated communities and species.** *Conservation Significance Score (CSS), Total factor* [continuous]	Ecotype information (Hobbs *et al.* 2017). See Table 4. [*Conservation Significance Score (CSS), Total factor* = 1 + Sum of CSS gains]
Is the vegetation association considered a threatened ecological community or ecosystem?	**1**	**Presence / Absence,** maximum category	**+ 0.3 max.**	**+ 0.3**	**Ecotype matching.** *CSS Threatened ecological community gain* [categorical]	Defined by ecotype vegetation descriptive data matched to TEC lists in Rangelands Assessment Manual [*CSS Threatened ecological community gain* = highest gain of a, b, c, d or e]
a. State (Provisional List of Threatened Ecosystems of SA) Rare community (0.05 pt)	1	Presence	+ 0.05	+ 0.05	*a. Ecotype partial match*	Only *Acacia cambagei* Low Open Woodland over *Typhonium aff. alismifolium* and *Nicotiana truncata* lining arid watercourses on gypseous plains in CEB region [partial match to Ecotype 09]
b. State (Provisional List of Threatened Ecosystems of SA) Vulnerable community	1	Presence	+ 0.1	+ 0.1	*b. Ecotype partial match*	Only *Acacia aneura* Low Woodland on sand plains in CEB region [partial match to Ecotype 08, 22]
c. State (Provisional List of Threatened Ecosystems of SA) Endangered community	1	Presence	+ 0.15	+ 0.15	*c. Ecotype match / partial match*	Only Freshwater wetlands in CEB region [match to Ecotype 10, 11, 12, 14, 18, 19, 29, partial 17]
d. Nationally (EPBC Act) Vulnerable community	1	Presence	+ 0.2	+ 0.2	*d. Not applicable*	Nil in CEB region
e. Contains a Nationally (EPBC Act) Endangered or Critically Endangered community	1	Presence	+ 0.3	+ 0.3	*e. Present but very infrequent in CEB study area*	Only mound springs vegetation in CEB (Endangered). Existing mapping in NatureMaps
Number of threatened plant species recorded for within the site *If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.	**Not limited**	**Presence / Absence**	**1-20 points**	**0.1** (based on sum of status class counts x weights)	**Ecotype typical priority flora species.** *CSS Threatened plant species gain* [continuous]	Presence defined by ecotype associated species tables. Species by highest status class only*. Threatened plant species points = Sum of plant species status class counts x weights [*CSS Threatened plant species gain* = 0.0188 x (Total threatened plant species points)$^{0.5661}$]
a. State Rare species recorded	Not limited	Count of species present	1	Not limited	*a. Ecotype associated SA Rare species [count]*	[SA R points = Count of SA Rare species x status class weight]
b. State Vulnerable species recorded	Not limited	Count of species present	2.5	Not limited	*b. Ecotype associated SA Vulnerable species [count]*	[SA V points = Count of SA Vulnerable species x status class weight]
c. State Endangered recorded	Not limited	Count of species present	5	Not limited	*c. Ecotype associated SA Endangered species [count]*	[SA E points = Count of SA Endangered species x status class weight]
d. Nationally Vulnerable species recorded	Not limited	Count of species present	10	Not limited	*d. Ecotype associated AUS Vulnerable species [count]*	[AUS VU points = Count of AUS Vulnerable species x status class weight]
e. Nationally Endangered or Critically endangered species recorded	Not limited	Count of species present	20	Not limited	*e. Ecotype associated AUS Endangered or Critically endangered species [count]*	[AUS EN CE points = Count of AUS Endangered or Critically endangered species x status class weight]

Rangelands Significant Environmental Benefit (SEB), Unit Biodiversity Score (UBS) components	Max. value	Current RAM metrics	Weight or +gain	Max. score or factor	Rangelands DAT metrics	Source data [calculation]
Potential habitat for threatened animal species (number observed or recorded) for the site *If a species has both a State (NP&W Act) and National (EPBC Act) rating, it's only recorded for its National rating.	**Not limited**	**Presence / Absence**	**1-20 points**	**0.1** (based on sum of status class counts x weights)	**Ecotype typical priority fauna species.** *CSS Threatened animal species gain* [continuous]	Presence defined by ecotype associated species tables. Species by highest status class only*. Threatened animal species points = Sum of animal species status class counts x weights [*CSS Threatened animal species gain* = 0.0188 x (Total threatened animal species points)$^{0.5661}$]
a. State Rare species observed or locally recorded	Not limited	Count of species likely to use habitat	1	Not limited	*a. Ecotype associated SA Rare species [count]*	[SA R points = Count of SA Rare species x status class weight]
b. State Vulnerable species observed or locally recorded	Not limited	Count of species likely to use habitat	2.5	Not limited	*b. Ecotype associated SA Vulnerable species [count]*	[SA V points = Count of SA Vulnerable species x status class weight]
c. State Endangered species observed or locally recorded	Not limited	Count of species likely to use habitat	5	Not limited	*c. Ecotype associated SA Endangered species [count]*	[SA E points = Count of SA Endangered species x status class weight]
d. Nationally Vulnerable species observed or locally recorded	Not limited	Count of species likely to use habitat	10	Not limited	*d. Ecotype associated AUS Vulnerable species [count]*	[AUS VU points = Count of AUS Vulnerable species x status class weight]
e. Nationally Endangered or Critically endangered species observed or locally recorded	Not limited	Count of species likely to use habitat	20	Not limited	*e. Ecotype associated AUS Endangered or Critically endangered species [count]*	[AUS EN CE points = Count of AUS Endangered or Critically endangered species x status class weight]

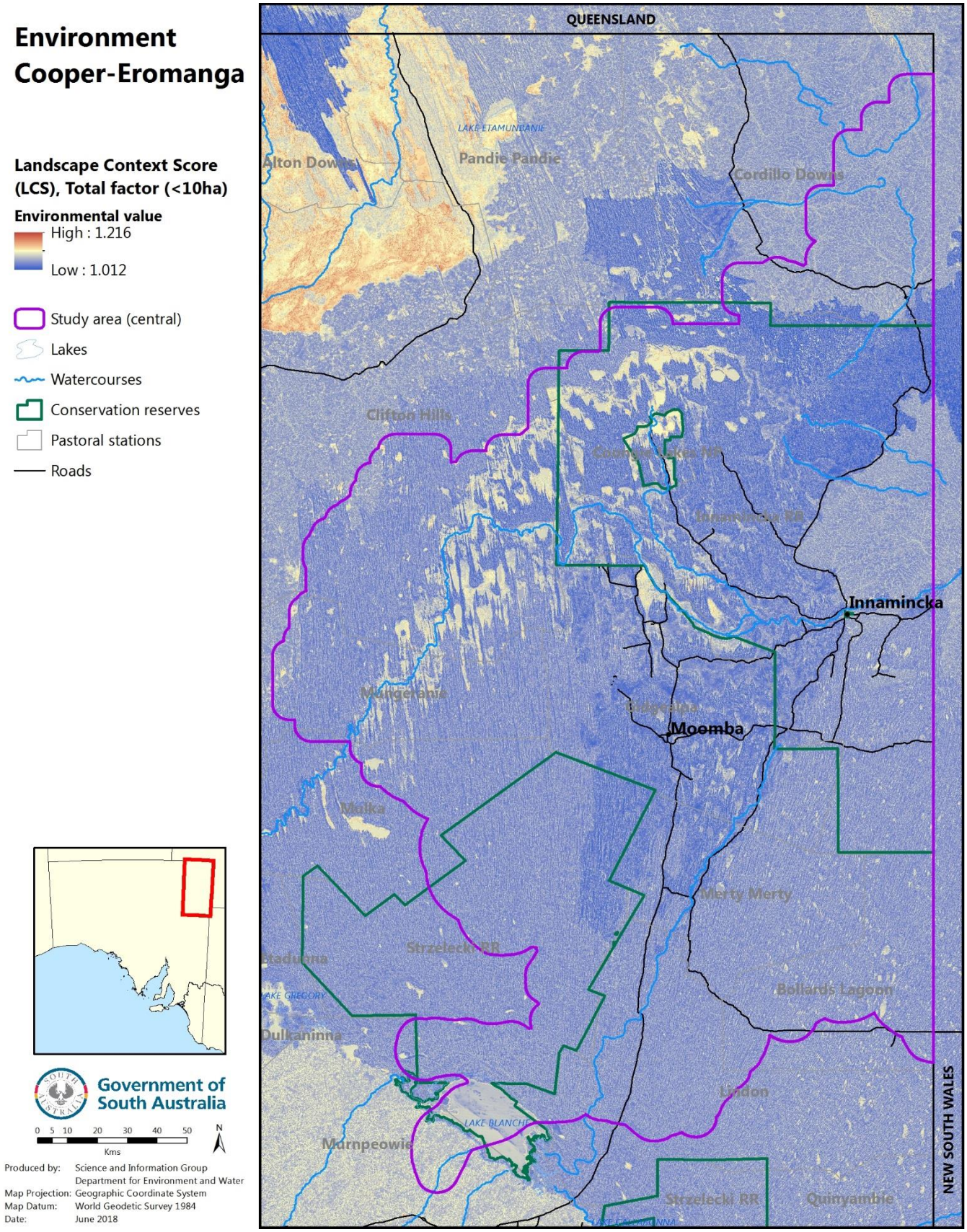


Figure 3. The distribution of Landscape Context Score (LCS) environmental values used by the Rangeland DAT application in the Cooper-Eromanga Basin region of South Australia

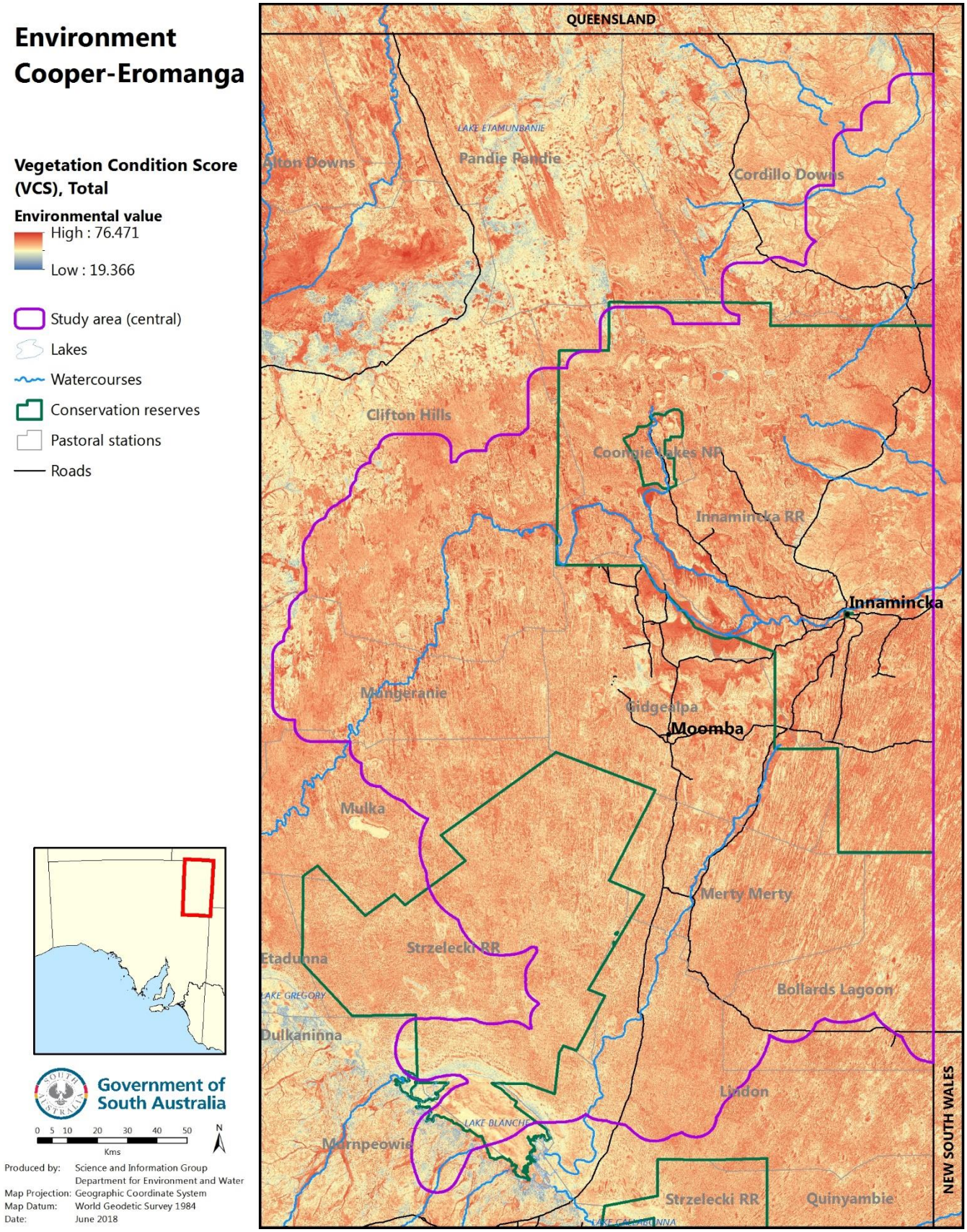


Figure 4. The distribution of Vegetation Condition Score (VCS) environmental values used by the Rangeland DAT application in the Cooper-Eromanga Basin region of South Australia

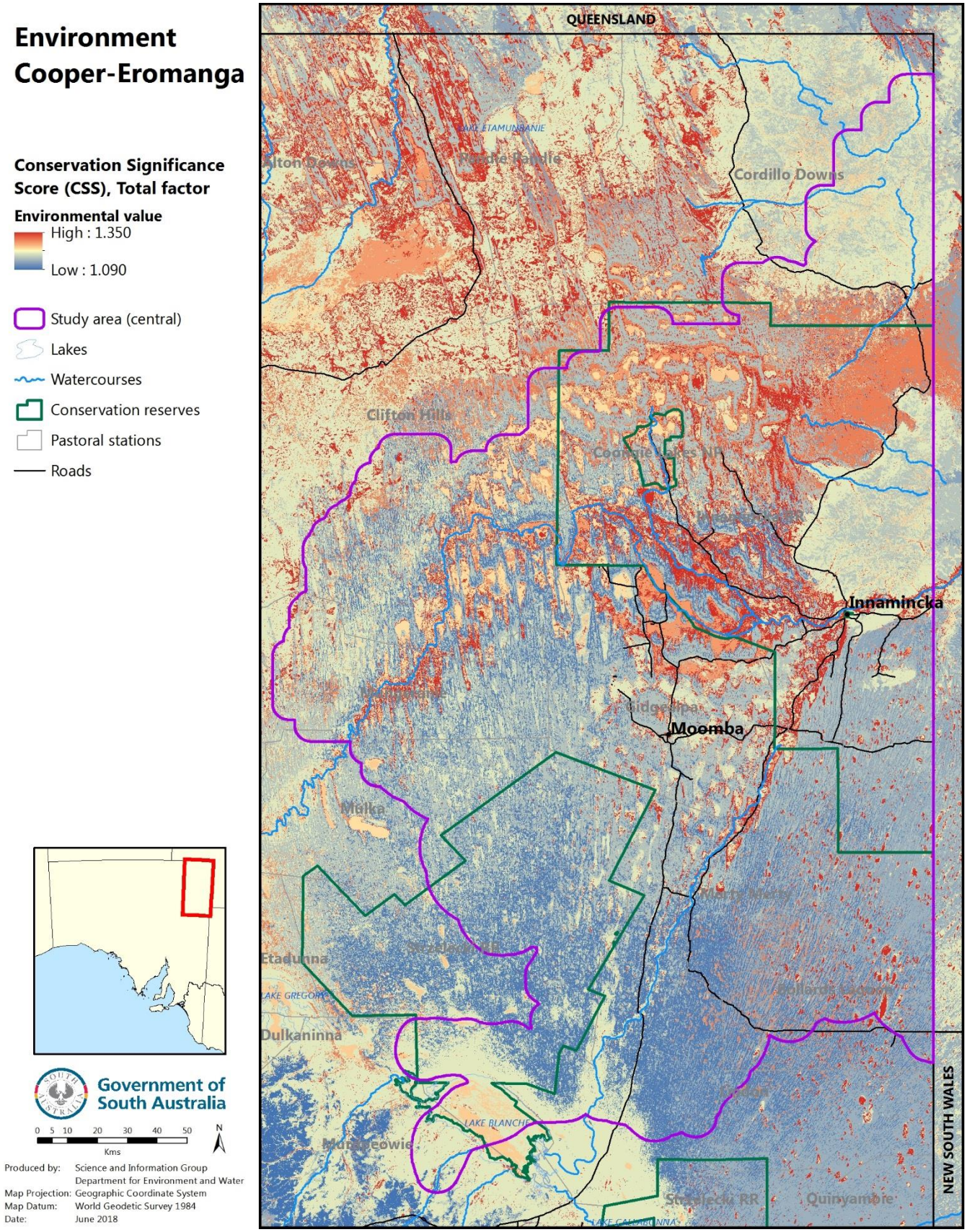


Figure 5. The distribution of Conservation Significance Score (CSS) environmental values used by the Rangeland DAT application in the Cooper-Eromanga Basin region of South Australia

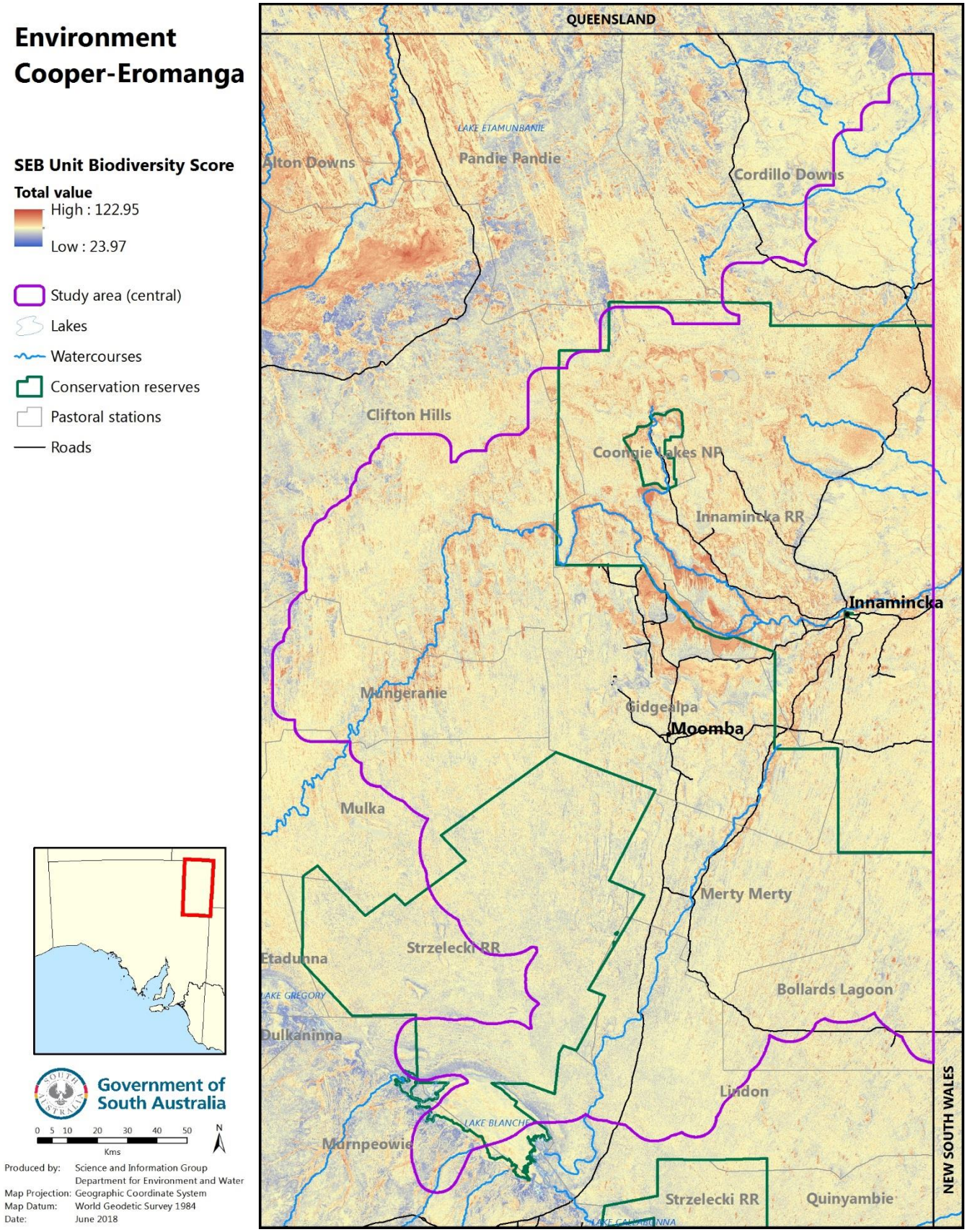


Figure 6. The distribution of Significant Environmental Benefit (SEB) Unit Biodiversity Score (UBS) values used by the Rangeland DAT application in the Cooper-Eromanga Basin region of South Australia

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Appendices

A. Rangelands DAT ecotype reference tables for vegetation stratum and conservation significance values

Table 3. Vegetation stratum by ecotype scores used by the Rangeland DAT application for evaluating native vegetation clearance and offset applications in the Cooper-Eromanga Basin region of South Australia

	Vegetation stratum points				
ID, Ecotype name	**Total score**	*Tree*	*Shrub*	*Low shrub*	*Grass*
1, Mitchell-grass, Bindyi, Bluebush/Fissure-plant clay loam plains or floodplains	**9.05**	*0.30*	*0.75*	*4.00*	*4.00*
2, Bladder Saltbush, Mitchell-grass, Bindyi clay loam slopes	**8.61**	*0.11*	*0.50*	*4.00*	*4.00*
3, Mitchell-grass, Bindyi, Plover-daisy clay plains	**9.33**	*0.04*	*1.29*	*4.00*	*4.00*
4, Bindyi, Mitchell-grass, Desert Glasswort clay undulating hills	**8.18**	*0.00*	*0.18*	*4.00*	*4.00*
5, Desert Senna, Spiny Saltbush clay plains and loam dunes	**14.14**	*2.14*	*4.00*	*4.00*	*4.00*
6, Black Bluebush, Low Bluebush, Bindyi clay slopes	**9.78**	*0.22*	*1.56*	*4.00*	*4.00*
7, Bindyi, Buckbush, Bottle-washers sandy slopes	**10.67**	*1.15*	*1.52*	*4.00*	*4.00*
8, Desert Senna over Three-awn/Wire-grass, Bindyi loam slopes	**11.91**	*1.07*	*2.84*	*4.00*	*4.00*
9, Red Mulga over Bindyi, Three-awn/Wire-grass clay slopes	**14.52**	*4.00*	*2.52*	*4.00*	*4.00*
10, Coolibah over Lignum, Bindyi clay loam plains or floodplains	**16.00**	*4.00*	*4.00*	*4.00*	*4.00*
11, Lignum, Golden Goosefoot over Nardoo clay plains	**10.90**	*1.07*	*4.00*	*4.00*	*1.84*
12, Coolibah over Lignum, Germander clay loam plains	**16.00**	*4.00*	*4.00*	*4.00*	*4.00*
13, Bindyi, Goat-head Bindyi, Bristly Love-grass clay loam plains or floodplains	**11.33**	*1.88*	*1.45*	*4.00*	*4.00*
14, Lignum, Old-man Saltbush, Golden Goosefoot clay or clay loam slopes or floodplains	**12.02**	*0.43*	*3.60*	*4.00*	*4.00*
15, Bristly Love-grass, Goat-head Bindyi, Bindyi dunefield swales	**10.23**	*0.97*	*1.26*	*4.00*	*4.00*
16, Nitre-bush, Twinleaf loam slopes	**7.11**	*0.24*	*1.56*	*4.00*	*1.31*
17, Bare or rarely Cane-grass, Nitre Goosefoot loamy slopes, salt lakes or floodplains	**8.29**	*1.34*	*1.13*	*3.23*	*2.59*
18, Ray Grass/Couch, Scurf-pea, Desert Nightshade clay loam plains	**8.67**	*0.56*	*0.11*	*4.00*	*4.00*
19, Coolibah over Flat-sedge, Ray Grass/Couch loam plains	**14.76**	*4.00*	*2.76*	*4.00*	*4.00*
20, Bindyi, Annual Saltbush, Samphire clay plains or floodplains	**8.81**	*0.05*	*1.03*	*4.00*	*3.73*
21, Mitchell-grass clay slopes	**8.78**	*0.50*	*0.27*	*4.00*	*4.00*
22, Black Oak over Bindyi sandy slopes	**12.45**	*2.83*	*1.71*	*3.90*	*4.00*
23, Bindyi, Low Bluebush, Bottle-washers loamy slopes or plains	**8.53**	*0.13*	*0.39*	*4.00*	*4.00*
24, Sandhill Cane-grass, Three-awn/Wire-grass, Hard Spinifex dunefields	**10.74**	*0.52*	*2.22*	*4.00*	*4.00*
25, Bindyi, Three-awn/Wire-grass sandy slopes	**10.15**	*0.45*	*1.69*	*4.00*	*4.00*
26, Umbrella Bush, Sandhill Cane-grass dunefields	**10.40**	*0.40*	*2.62*	*3.39*	*4.00*
27, Hard Spinifex with Sticky Hop-bush, Umbrella Bush dunefields	**14.13**	*2.13*	*4.00*	*4.00*	*4.00*
28, Umbrella Bush over Ruby Saltbush, Bindyi slopes	**12.98**	*0.98*	*4.00*	*4.00*	*4.00*
29. Water (>75% of time)	**0.00**	*0.00*	*0.00*	*0.00*	*0.00*

Table 4. Conservation significance by ecotype score gain values used by the Rangeland DAT application for evaluating native vegetation clearance and offset applications in the Cooper-Eromanga Basin region of South Australia

	Conservation Significance Score						
		Threatened community		Threatened species			
Ecotype name	**Total gain**	Gain	Status[#]	Plant gain	Animal gain	*Plant points*	*Animal points*
1, Mitchell-grass, Bindyi, Bluebush/Fissure-plant clay loam plains or floodplains	**0.20**	0	*No*	0.10	0.10	*54*	*82*
2, Bladder Saltbush, Mitchell-grass, Bindyi clay loam slopes	**0.09**	0	*No*	0.02	0.07	*1*	*10*
3, Mitchell-grass, Bindyi, Plover-daisy clay plains	**0.16**	0	*No*	0.06	0.10	*7*	*21*
4, Bindyi, Mitchell-grass, Desert Glasswort clay undulating hills	**0.17**	0	*No*	0.07	0.10	*11*	*17.5*
5, Desert Senna, Spiny Saltbush clay plains and loam dunes	**0.14**	0	*No*	0.04	0.10	*3*	*52.5*
6, Black Bluebush, Low Bluebush, Bindyi clay slopes	**0.18**	0	*No*	0.10	0.08	*36.5*	*13*
7, Bindyi, Buckbush, Bottle-washers sandy slopes	**0.15**	0	*No*	0.05	0.10	*5.5*	*41*
8, Desert Senna over Three-awn/Wire-grass, Bindyi loam slopes	**0.30**	0.1	*SA Vulnerable (part)*	0.10	0.10	*24.5*	*32*
9, Red Mulga over Bindyi, Three-awn/Wire-grass clay slopes	**0.25**	0.05	*SA Rare (part)*	0.10	0.10	*24.5*	*27.5*
10, Coolibah over Lignum, Bindyi clay loam plains or floodplains	**0.35**	0.15	*SA Endangered*	0.10	0.10	*55.5*	*48.5*
11, Lignum, Golden Goosefoot over Nardoo clay plains	**0.28**	0.15	*SA Endangered*	0.05	0.08	*5*	*14*
12, Coolibah over Lignum, Germander clay loam plains	**0.24**	0.15	*SA Endangered*	0.02	0.07	*1*	*11*
13, Bindyi, Goat-head Bindyi, Bristly Love-grass clay loam plains or floodplains	**0.20**	0	*No*	0.10	0.10	*36*	*55*
14, Lignum, Old-man Saltbush, Golden Goosefoot clay or clay loam slopes or floodplains	**0.35**	0.15	*SA Endangered*	0.10	0.10	*31*	*118.5*
15, Bristly Love-grass, Goat-head Bindyi, Bindyi dunefield swales	**0.15**	0	*No*	0.05	0.10	*5.5*	*32.5*
16, Nitre-bush, Twinleaf loam slopes	**0.20**	0	*No*	0.10	0.10	*25*	*43*
17, Bare or rarely Cane-grass, Nitre Goosefoot loamy slopes, salt lakes or floodplains	**0.25**	0.15	*SA Endangered (part)*	0.00	0.10	*0*	*18*
18, Ray Grass/Couch, Scurf-pea, Desert Nightshade clay loam plains	**0.24**	0.15	*SA Endangered*	0.02	0.07	*1*	*10*
19, Coolibah over Flat-sedge, Ray Grass/Couch loam plains	**0.28**	0.15	*SA Endangered*	0.03	0.10	*2*	*29*
20, Bindyi, Annual Saltbush, Samphire clay plains or floodplains	**0.20**	0	*No*	0.10	0.10	*46*	*72.5*
21, Mitchell-grass clay slopes	**0.20**	0	*No*	0.10	0.10	*50.5*	*42*
22, Black Oak over Bindyi sandy slopes	**0.28**	0.1	*SA Vulnerable (part)*	0.08	0.10	*12*	*20*
23, Bindyi, Low Bluebush, Bottle-washers loamy slopes or plains	**0.19**	0	*No*	0.09	0.10	*14.5*	*25.5*
24, Sandhill Cane-grass, Three-awn/Wire-grass, Hard Spinifex dunefields	**0.17**	0	*No*	0.07	0.10	*11*	*39.5*
25, Bindyi, Three-awn/Wire-grass sandy slopes	**0.17**	0	*No*	0.07	0.10	*11.5*	*39.5*
26, Umbrella Bush, Sandhill Cane-grass dunefields	**0.10**	0	*No*	0.00	0.10	*0*	*42*
27, Hard Spinifex with Sticky Hop-bush, Umbrella Bush dunefields	**0.14**	0	*No*	0.04	0.10	*4.5*	*35.5*
28, Umbrella Bush over Ruby Saltbush, Bindyi slopes	**0.20**	0	*No*	0.10	0.10	*21*	*46*
29. Water (>75% of time)	**0.25**	0.15	*SA Endangered*	0.00	0.10	*0*	*123*

[#]Colour denotes freshwater wetlands (pale blue) and partial or saline wetlands (buff).

B. Rangelands DAT application components

The following series of maps represent the translation of Landsat satellite data, and ecotype summary information provided by the "Flora and fauna communities of the Cooper-Eromanga Basin" study (Hobbs *et al.* 2017), into metrics equivalent to those used within the Native Vegetation Council's field-based Rangelands Assessment Scoresheet (Native Vegetation Branch 2017).

Landscape Context Score (LCS), Total factor (<10ha)

LCS Landforms per hectare (gain)

LCS Protected area (gain)

LCS Wetlands (gain)

Vegetation Condition Score (VCS), Total

VCS Biotic disturbance indicators (score) = *Perennial green veg. (score)* + *Under-canopy green veg. growth (score)*

VCS Physical disturbance indicators (score)

VCS Vegetation stratum (score)

VCS Introduced plant species (score)

VCS Vegetation utilisation (score)

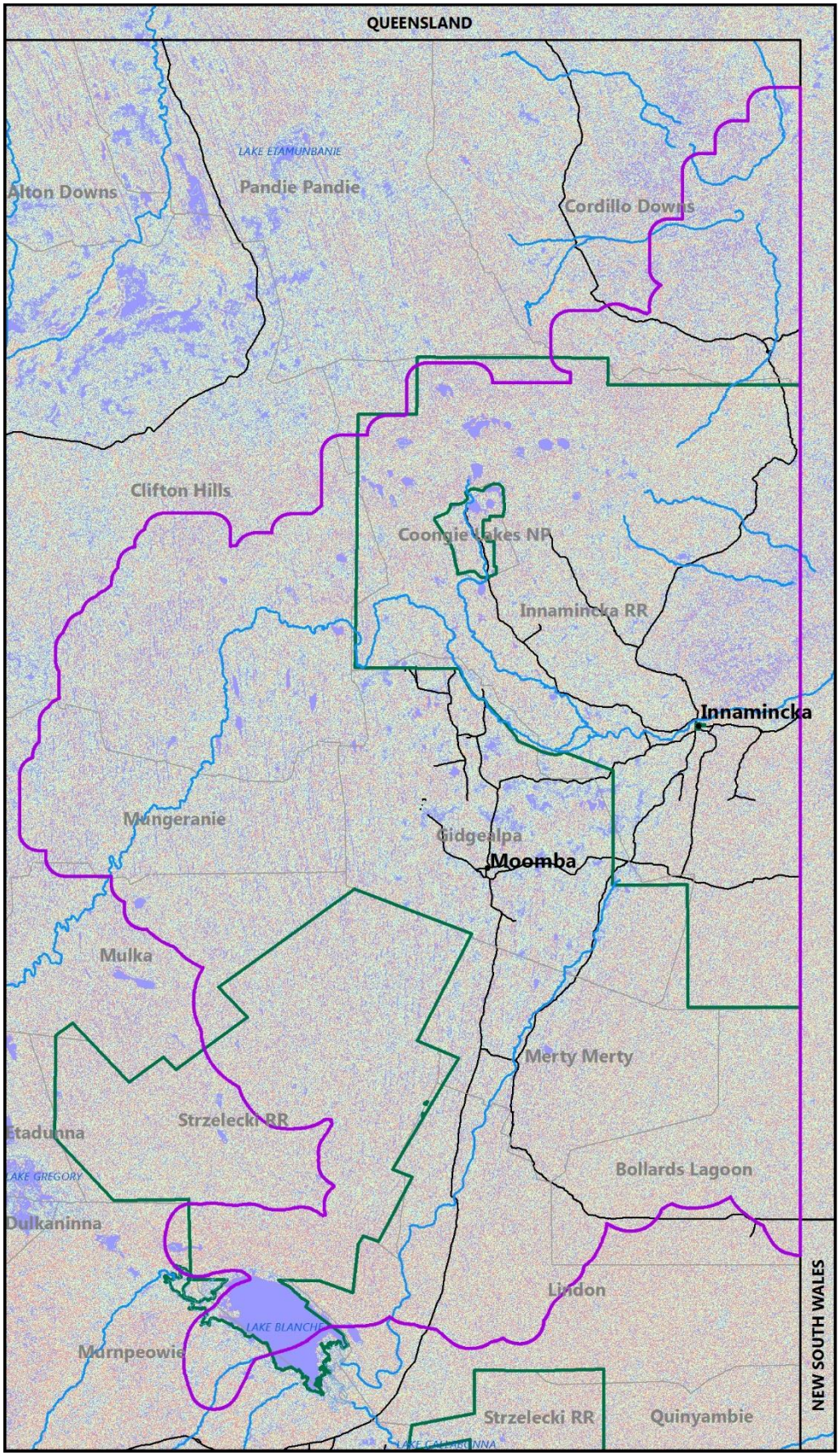
Conservation Significance Score (CSS), Total factor

CSS Threatened ecological community (gain)

CSS Threatened plant species (gain)

CSS Threatened animal species (gain)

Environment Cooper-Eromanga



LCS Landforms per hectare (gain)

Environmental value

- 0.06 (high)
- 0.03
- 0.01 (low)
- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

N

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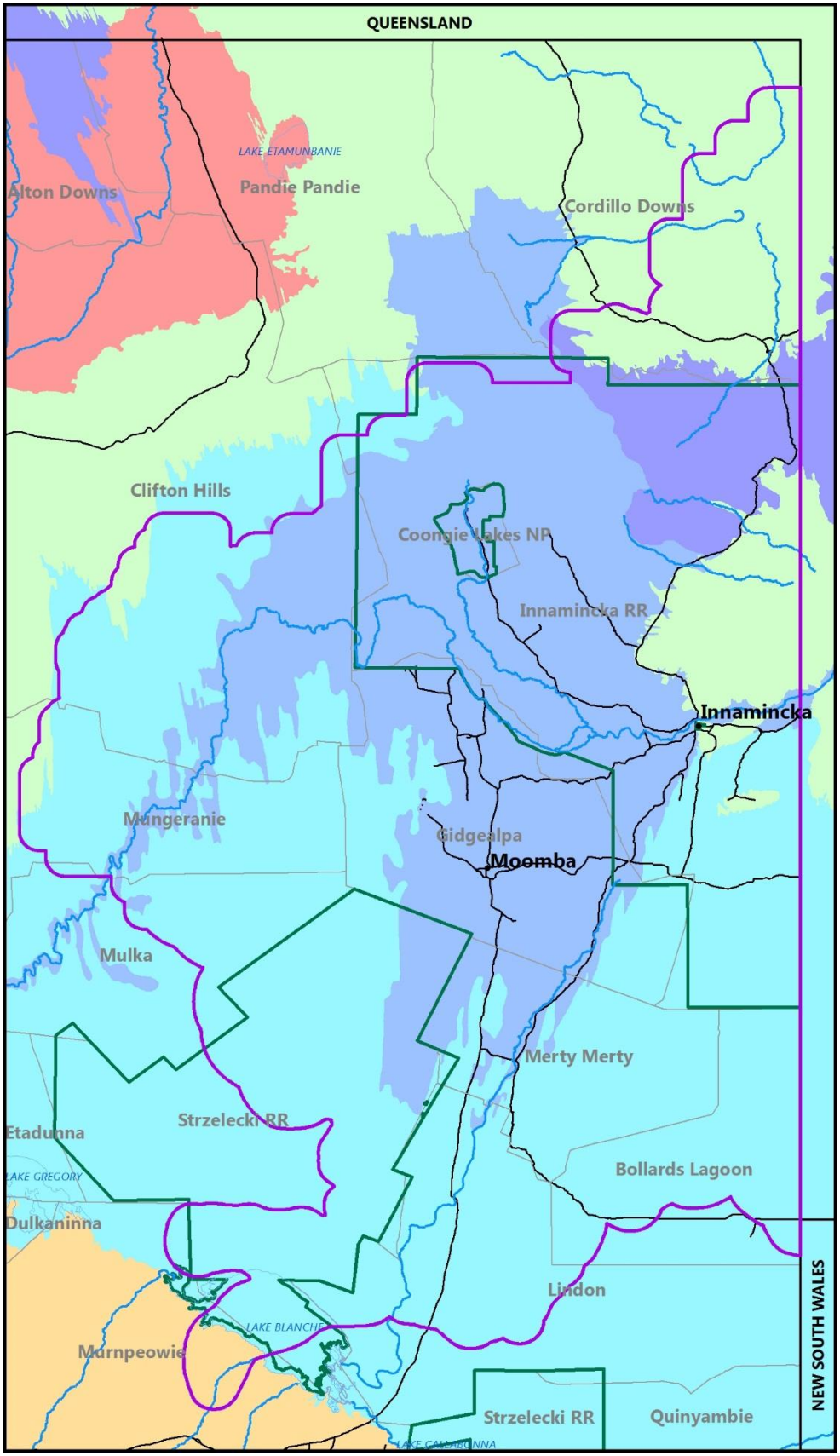
Date: June 2018

Environment
Cooper-Eromanga



LCS Protected area (gain)

Environmental value

High : 0.065

Low : 0.002

Study area (central)

Lakes

Watercourses

Conservation reserves

Pastoral stations

Roads

Government of South Australia

0 5 10 20 30 40 50

Kms

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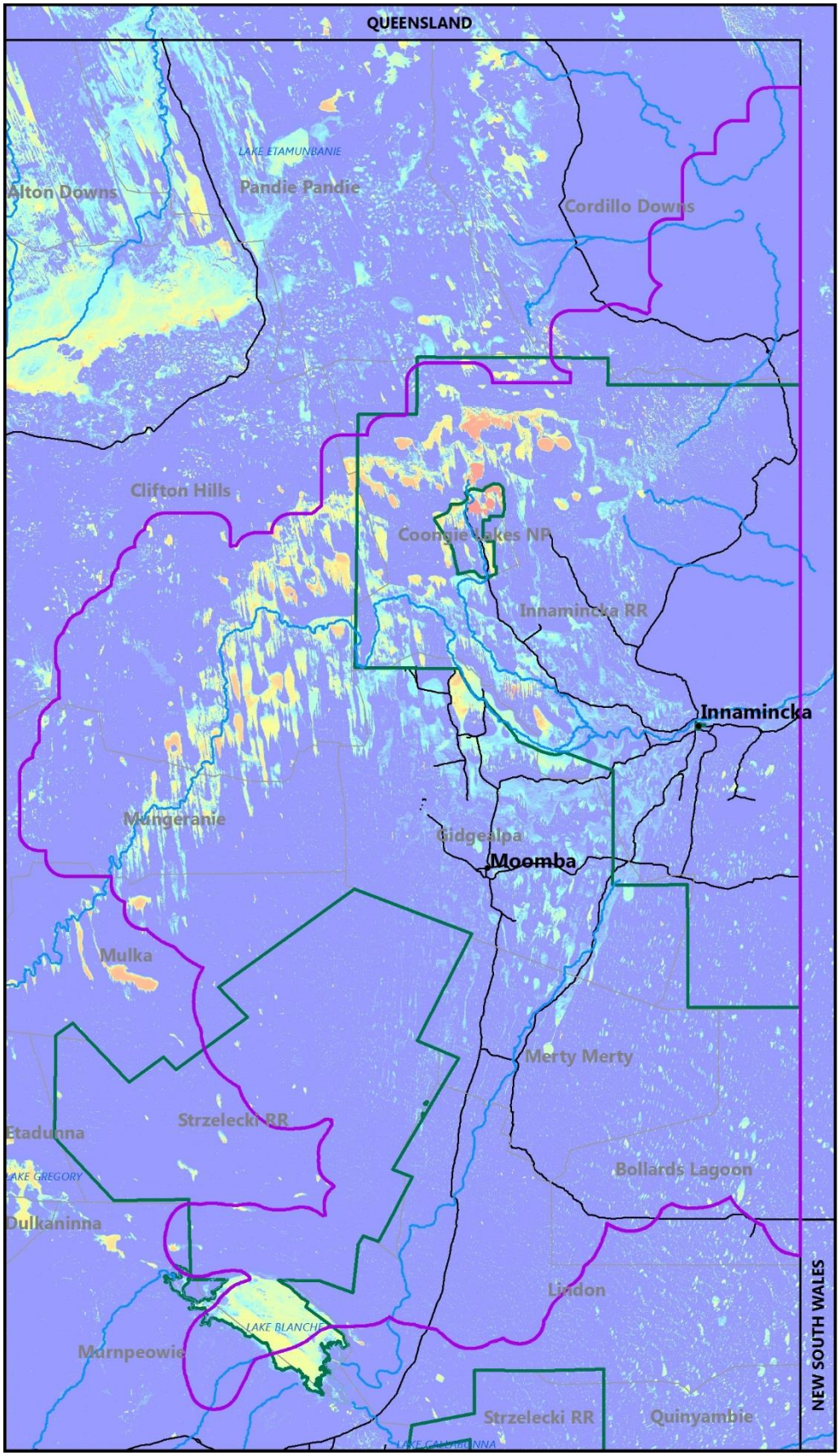
Environment Cooper-Eromanga



LCS Wetlands (gain)

Environmental value

High : 0.091

Low : 0

Study area (central)

Lakes

Watercourses

Conservation reserves

Pastoral stations

Roads

Government of South Australia

0 5 10 20 30 40 50

Kms

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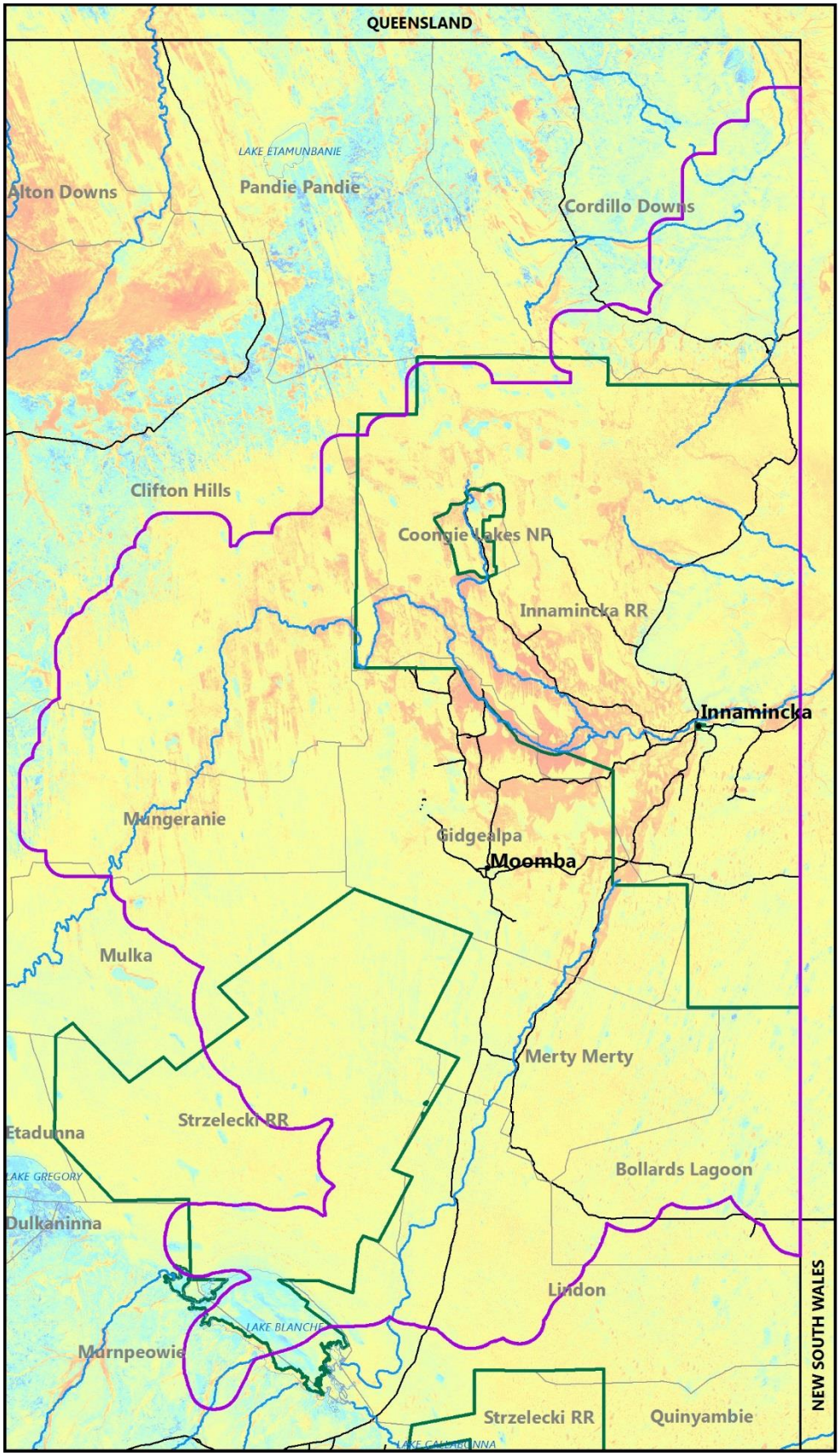
Environment Cooper-Eromanga



VCS Biotic disturbance indicators (score)

Environmental value

High : 8.503

Low : 0

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

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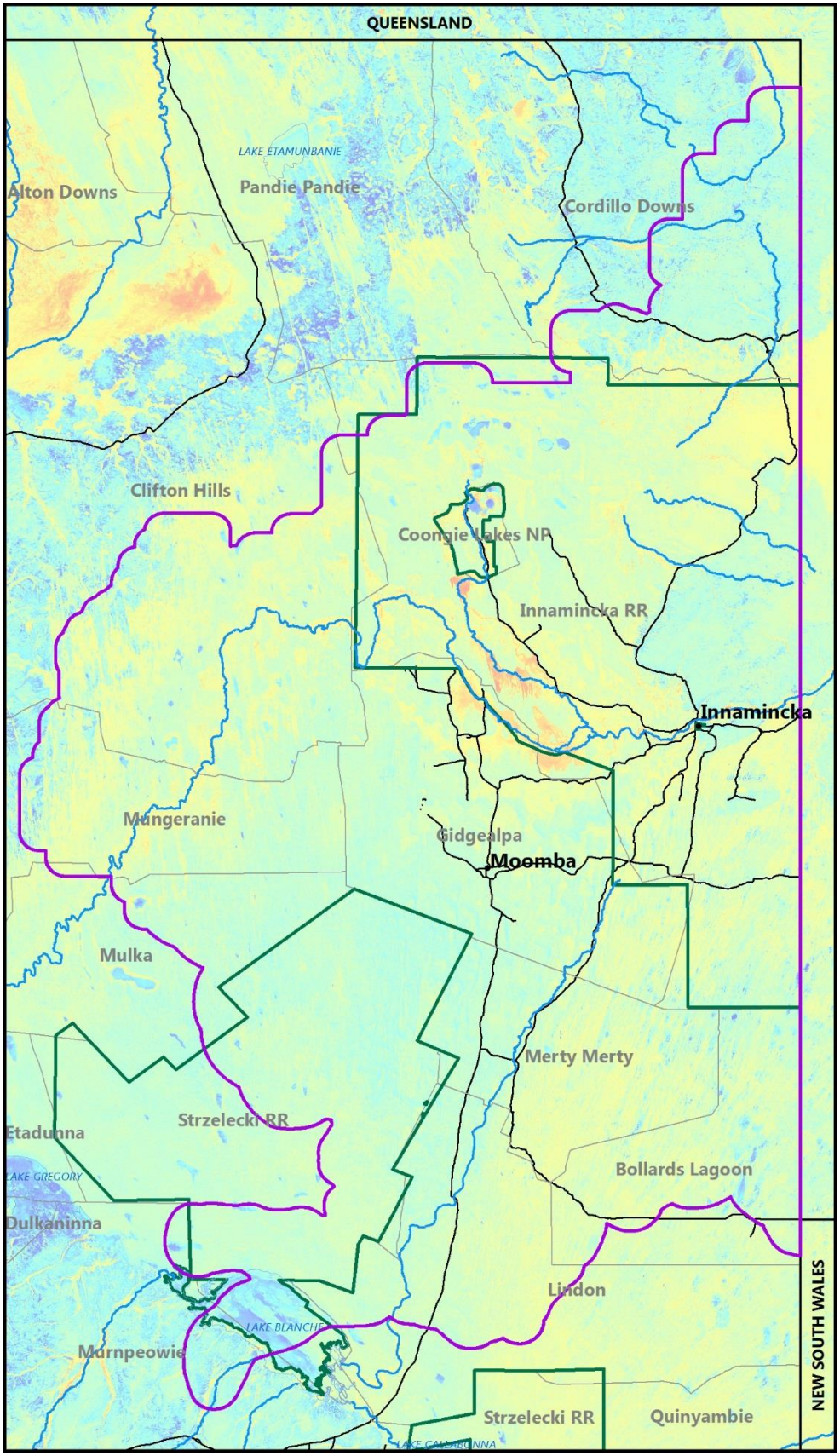
Environment
Cooper-Eromanga



VCS Biotic disturbance indicators (part), Perennial green veg. (score)

Environmental value

High : 4.464

Low : 0

Study area (central)

Lakes

Watercourses

Conservation reserves

Pastoral stations

Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

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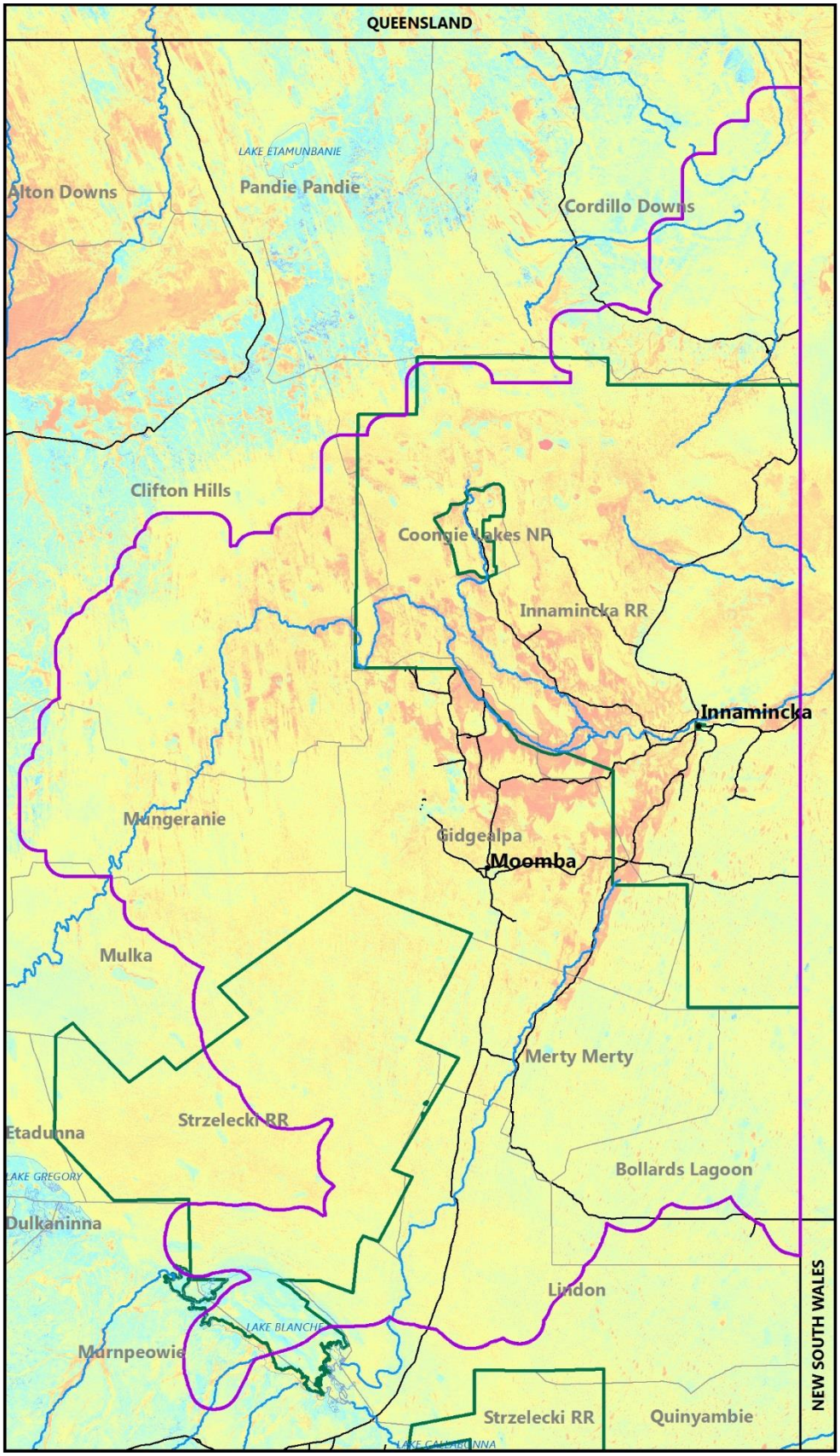
Environment
Cooper-Eromanga



VCS Biotic disturbance indicators (part), Under canopy green veg. (score)

Environmental value

High : 4.968

Low : 0

Study area (central)

Lakes

Watercourses

Conservation reserves

Pastoral stations

Roads

Government of South Australia

0 5 10 20 30 40 50

Kms

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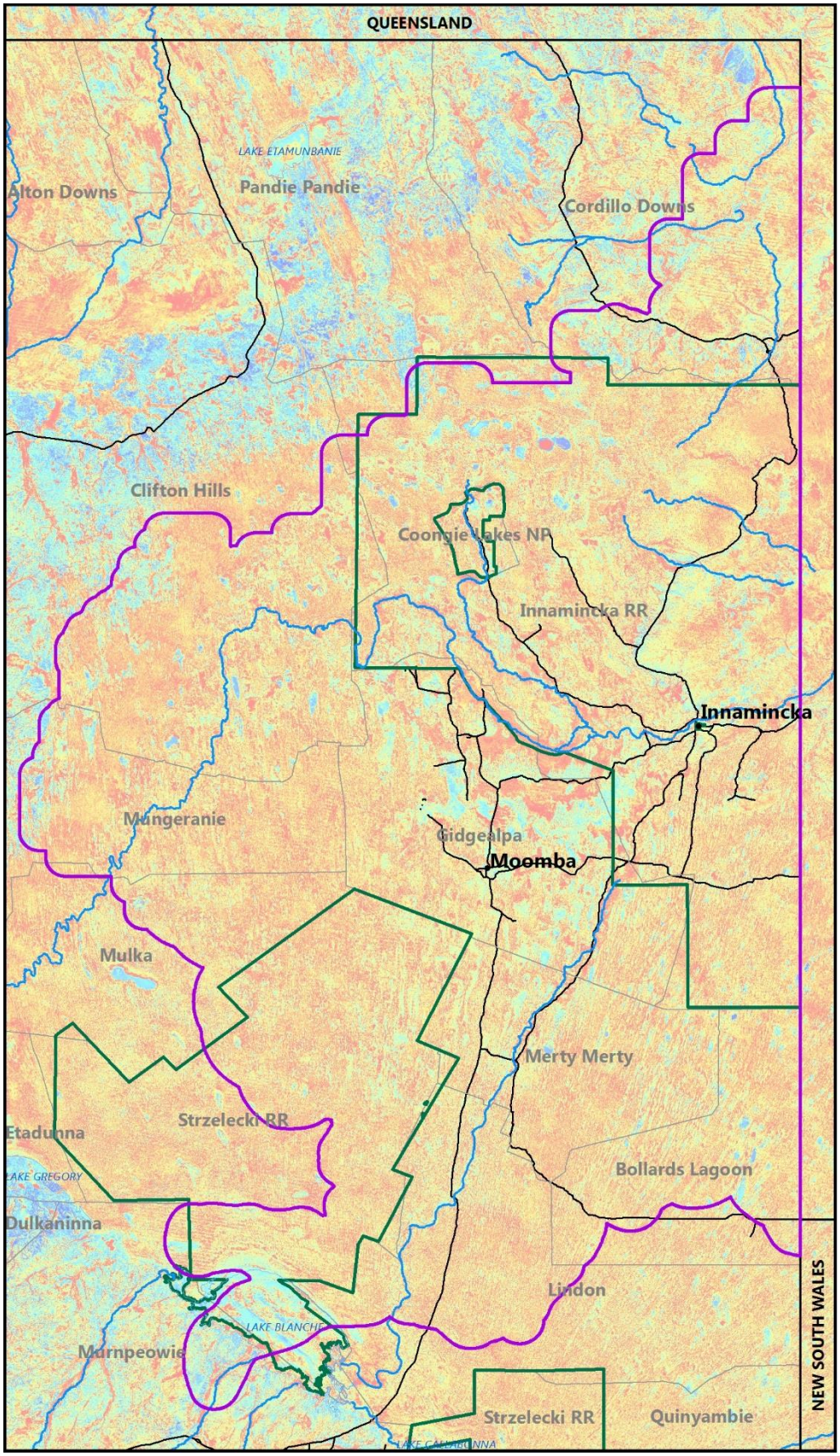
Date: June 2018

Environment
Cooper-Eromanga



VCS Physical disturbance indicators (score)

Environmental value

High : 16.000

Low : 0

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

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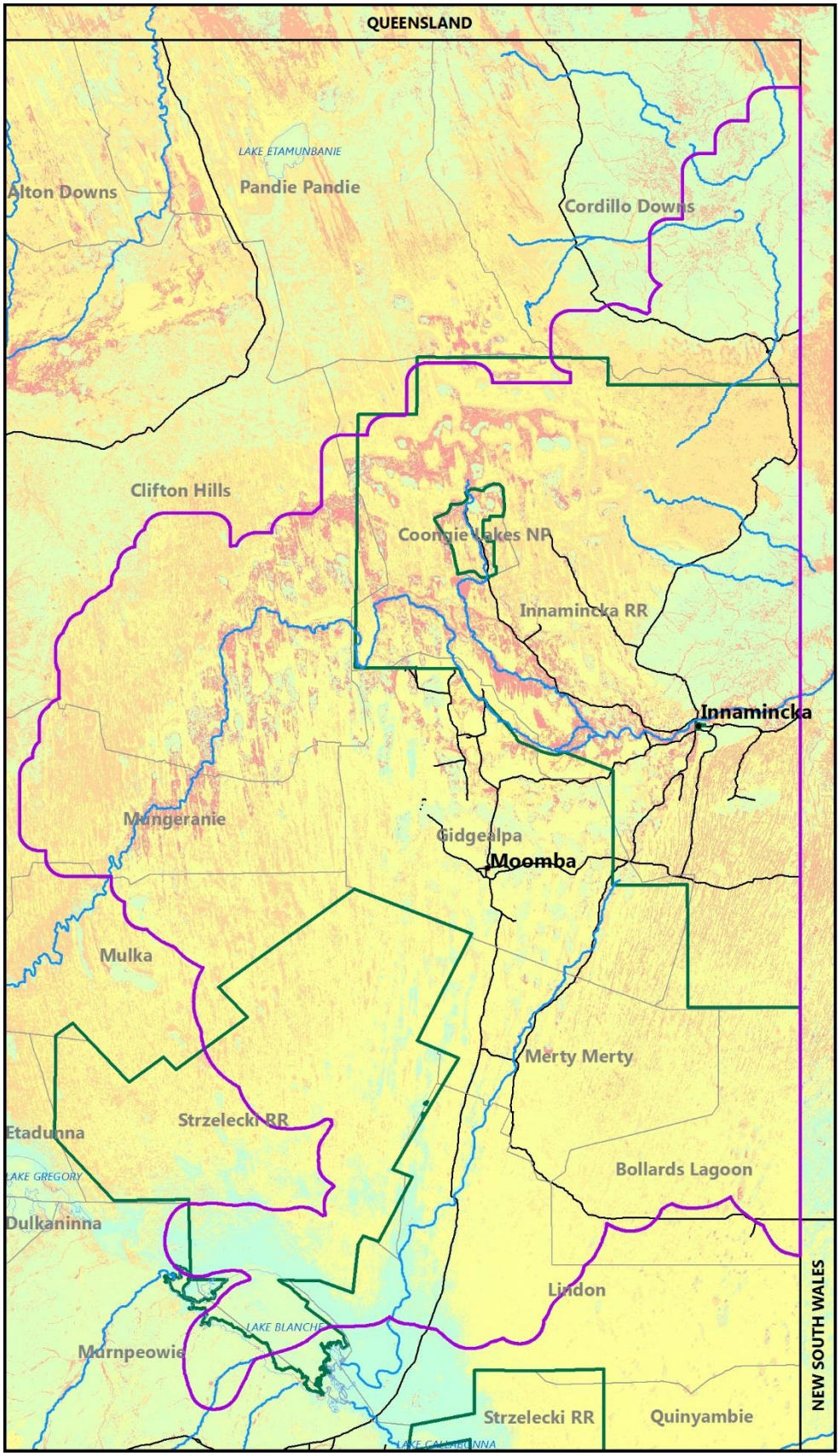
Environment Cooper-Eromanga



VCS Vegetation stratum (score)

Environmental value

High : 16.000

Low : 0

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

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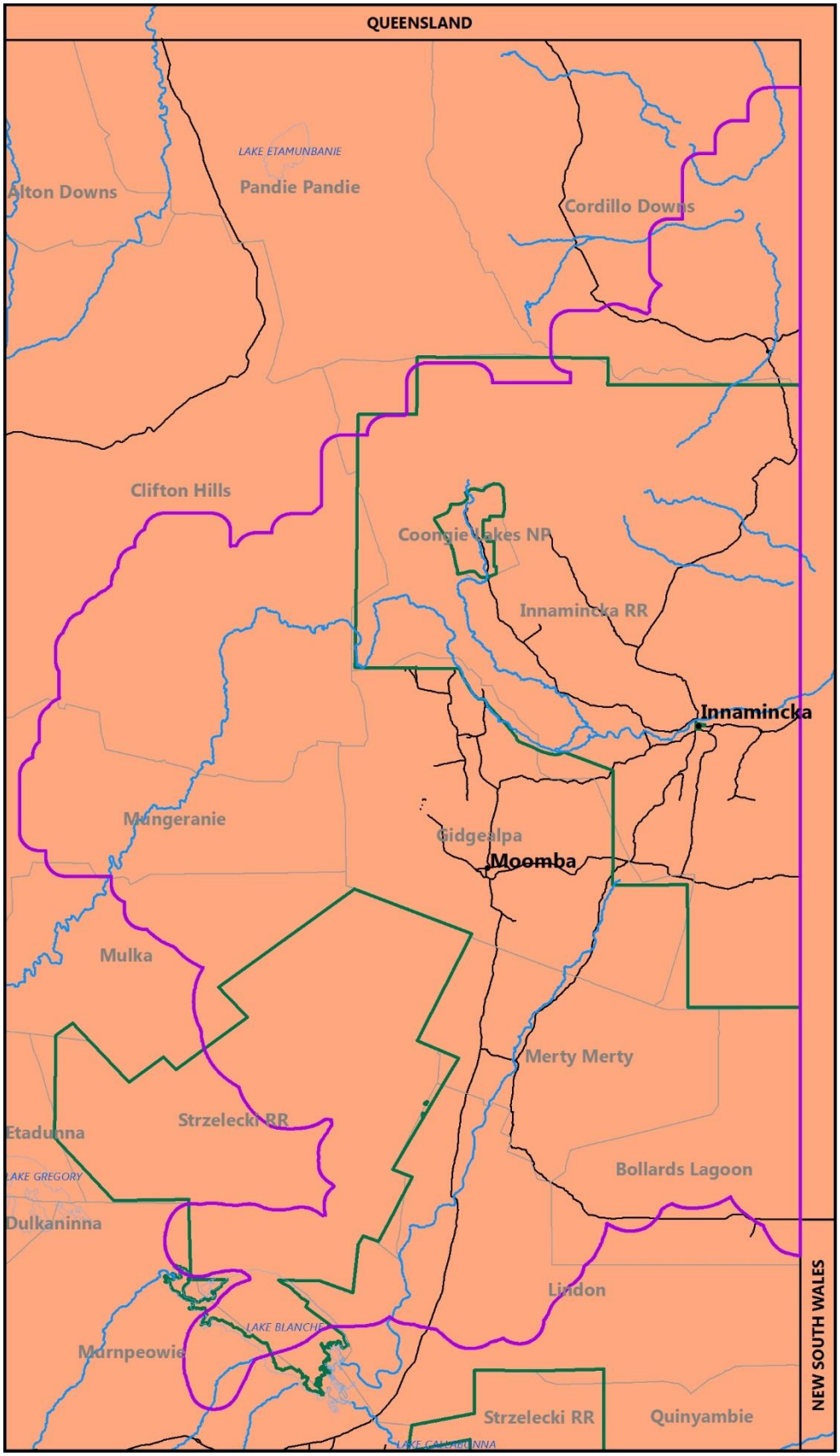
Date: June 2018

Environment Cooper-Eromanga



VCS Introduced plant species (score)

Environmental value

- 10 (high)
- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

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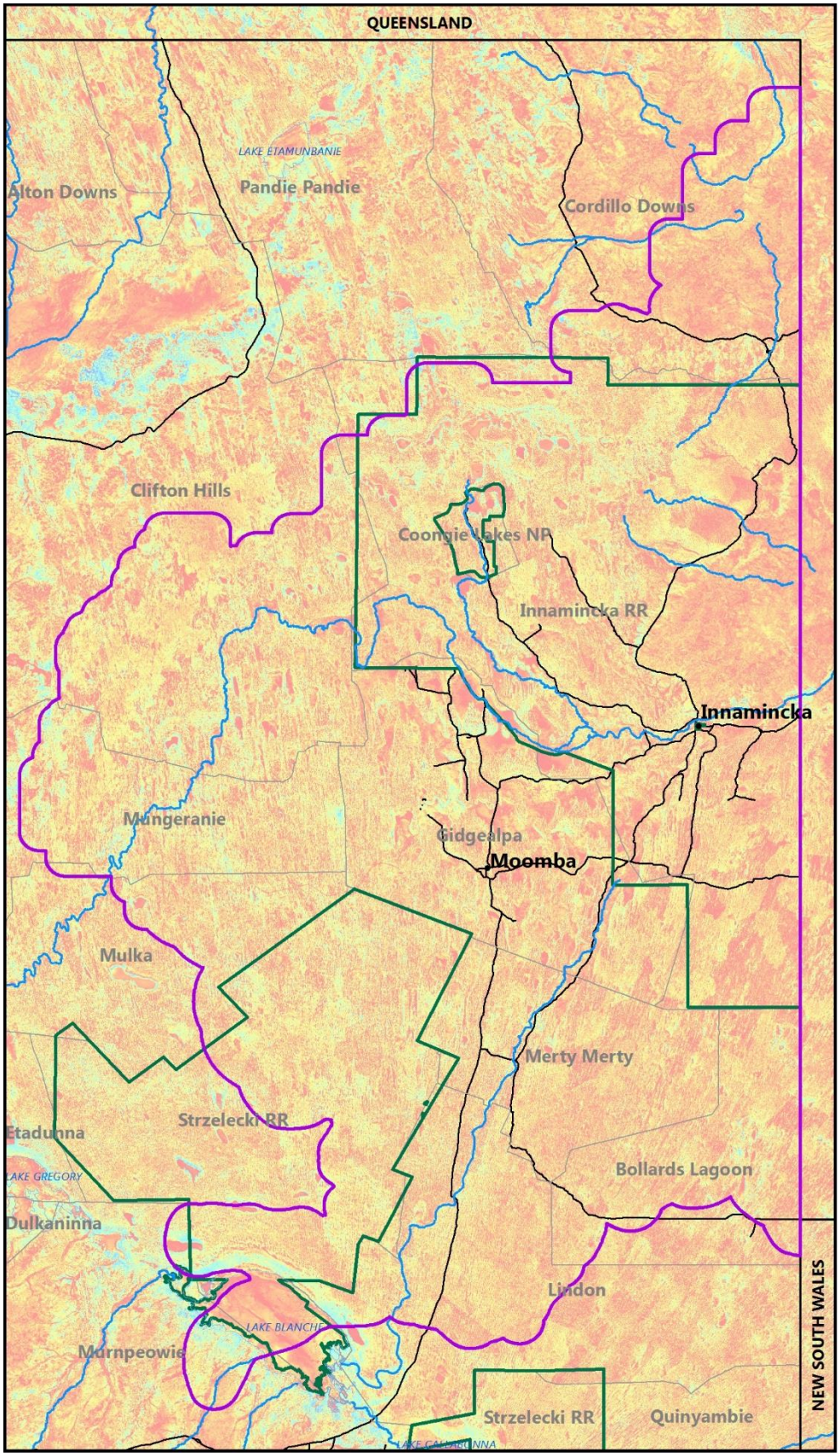
Environment Cooper-Eromanga



VCS Vegetation utilisation (score)

Environmental value

High : 26.000

Low : 0.079

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

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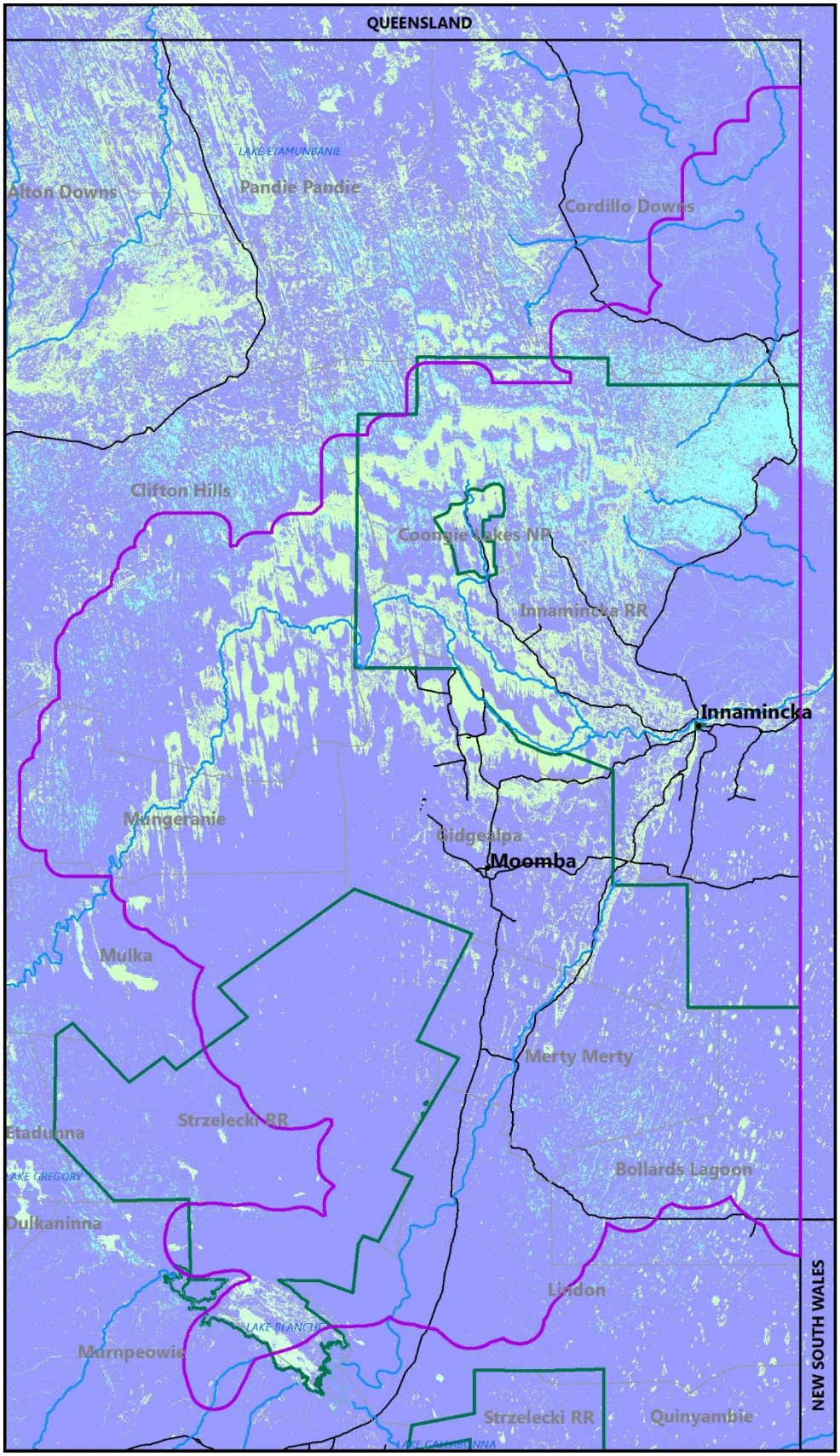
Cooper-Eromanga



CSS Threatened ecological community (gain)

Environmental value, Class

- 0.00, Not listed
- 0.15, SA Endangered
- 0.15, SA Endangered (part)
- 0.05, SA Rare (part)
- 0.10, SA Vulnerable (part)
- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

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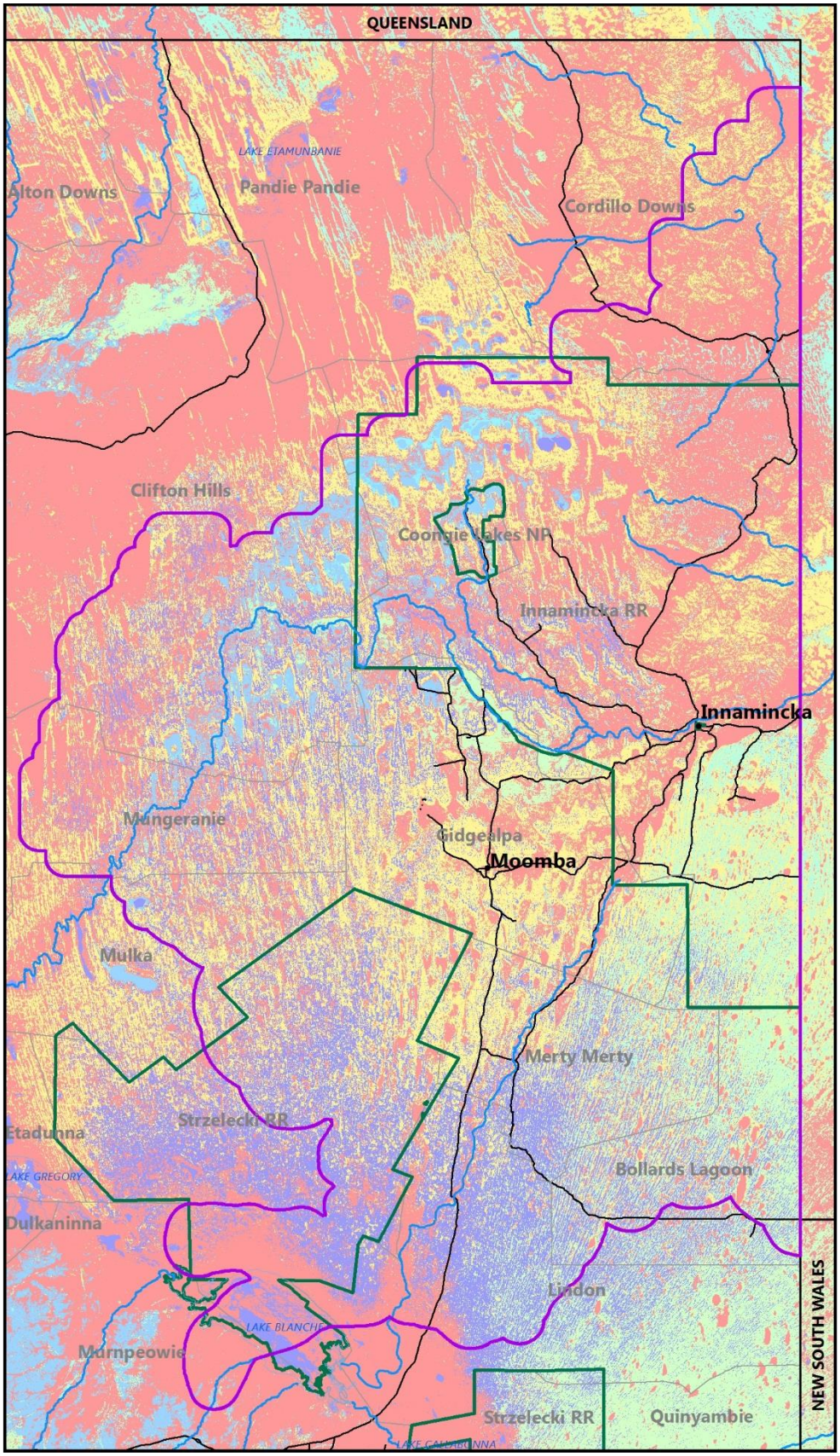
Cooper-Eromanga



CSS Threatened plant species (gain)

Environmental value

High : 0.1

Low : 0

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

0 5 10 20 30 40 50 Kms

N

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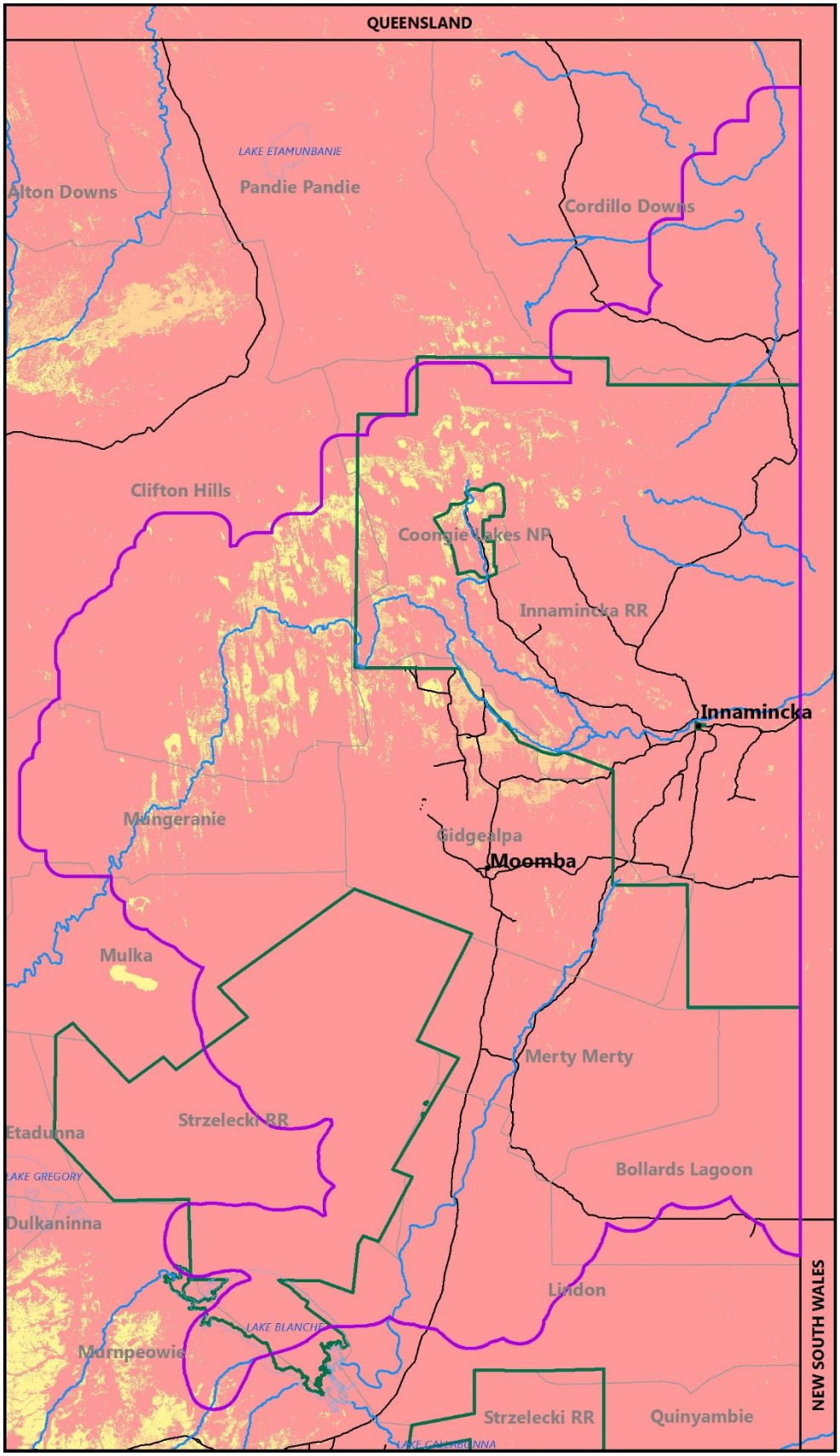
Environment Cooper-Eromanga



CSS Threatened animal species (gain)

Environmental value

High : 0.1

Low : 0

- Study area (central)
- Lakes
- Watercourses
- Conservation reserves
- Pastoral stations
- Roads

Government of South Australia

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