Design, development and implementation of NEDS

Redland City Council

3 May 2012

Stage 2 - NEDS Development Report

Natural Environment Decision Support

Stage 2 - NEDS Development Report

Natural Environment Decision Support

Prepared for

Redland City Council

Prepared by

AECOM Australia Pty Ltd
Level 8, 540 Wickham Street, PO Box 1307, Fortitude Valley QLD 4006, Australia
T +61 7 3553 2000 F +61 7 3553 2050 www.aecom.com
ABN 20 093 846 925

3 May 2012

60224191

AECOM in Australia and New Zealand is certified to the latest version of ISO9001 and ISO14001.

Quality Information

Document Stage 2 - NEDS Development Report

Ref 60224191

Date 3 May 2012

Prepared by Vlatka Varagic and Antoine Burdett

Reviewed by Phillip Hawes, Con Lokkers, Chris Spain, David Klapp

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	20/03/2012	Preliminary Draft Report		
B	03/05/2012	RCC, BAAM and further AECOM peer review		

Table of Contents

List of Figures

List of Tables

Abbreviations

Australian Height Datum	AHD
Biodiversity Assessment and Management Pty Ltd	BAAM
Biodiversity Assessment and Mapping Methodology	BAMM
Biodiversity Planning Assessment	BPA
Department of Environment and Heritage Protection, formerly DERM	DEHP
Department of Environment and Resource Management	DERM
Department of Local Government and Planning	DLGP
Digital Cadastral Database	DCDB
Environmental Inventory	EI
Environmental Inventory Version 4	EIv4
Geographic Information Systems	GIS
High Value Regrowth	HVR
Light Detection and Ranging	LiDAR
Multiple-Criteria Analysis	MCA
Natural Environment Decision Support System	NEDS
Redland City Council	RCC
Redland Planning Scheme	RPS
Regional Ecosystems	RE
Wetlands Management Areas	WMA

Executive Summary

From the understanding gathered in Stage One of the Natural Environment Decision Support System (NEDS) project and the outcomes from extensive consultation with key stakeholders, Redland City Council (RCC), Biodiversity Assessment and Management (BAAM) and AECOM. NEDS has been designed and developed to provide an expression of Conservation Value within the Redlands Local Government Agency boundary, superseding the Environmental Inventory v4 (EIv4).

This report presents an overview of the NEDS Geodatabase, primary data layers, supplementary data layers and the NEDS geo-processing tool produced.

Also included are potential future amendments for consideration.

In accordance with recommendations from Stage One NEDS has been designed to incorporate the following key elements:

- Automation is required to ensure consistent and repeatable processes allowing defensible results. Processes should be auditable and transparent.
- Leverage existing RCC ESRI GIS technical environment and ensure design is flexible to allow for future changes in legislation etc.
- Interpretation of outputs is critical; they must be easily understood and comprehended, however should be based on sound scientific foundations.
- Decision factors, weightings, inputs and criteria need to be clearly defined, i.e. the business rules (scientific foundations) to apply to NEDS.
- Keep it Simple – for ease of maintenance and extendibility. Ensure NEDS is extendable and future proofed (flexible and adaptable to change).
- Ensure refinement of NEDS scope is effectively managed throughout the development phase through stakeholder consultation, scope management, and documentation of outcomes, such as signed minutes of meetings and workshops.

1.0 Purpose

The purpose of this report is to provide an overview of the datasets used within the NEDS Geodatabase and the methodology applied to generate the Conservation Value Geoprocessing Tool. Potential amendments to NEDS, either data or tool related have also been highlighted as future work to be considered.

2.0 Scope

NEDS Purpose

RCC currently has a mapped database containing the Environmental Inventory (EI) of habitats and their relative ecological functions and significance.

Current EI mapping represents historical information that remains a valuable resource to inform the planning and management of ecologically significant areas in the Redland LGA. However, the existing Environmental Inventory (EIv4) is not capable of update, hence information is out of date and layers are incompatible with different resolutions. It was also indicated that the EIv4 cannot be interrogated for detailed information and that categories are not easy to interpret.

Therefore the purpose of NEDS is to provide an expression of Conservation Value, superseding EIv4. The output will be used to inform decision makers in the generation of policy. A spatial expression of final policy will be created by RCC and used to disseminate information internally and externally. The expression of Conservation Value has been designed to be easily comprehensible, i.e. readily understood and easily interpreted.

RCC require a tool that is easily maintained, extensible and future-proofed. This design goal has been enforced via a “keep it simple” philosophy. Furthermore, NEDS has the ability to cater for the application of “what-if” scenarios.

RCC GIS Environment

RCC currently utilises the following ESRI suite of software to deliver GIS services to the council and public:

- Microsoft Windows XP Build 2600 SP3 (PC operating system)
- ArcGIS Desktop 9.2 SP6 (GIS desktop software)
- ArcSDE 9.2 on SQL Server 2000 and 2005 (Enterprise RDBMS with ESRI based spatial engine)
- Microsoft .Net application linked to ArcIMS 9.2 (for RediMap web-based GIS)
- Microsoft Source Safe (for version management of scripts, database views, etc).

It was evident from the Stage One review that this technology suite is an appropriate platform on which NEDS is to be built and operated. NEDS has therefore been developed using this technology environment.

Final Scope

As a result of the outcomes from extensive consultation with key stakeholders, Redland City Council (RCC), Biodiversity Assessment and Management (BAAM) and AECOM, NEDS has been refined from the original scope. Therefore the output from NEDS is no longer an update of EIv4, rather is now an expression of Conservation Value.

Figure 1 depicts the final scope of NEDS.

Recommendations from Stage 1 also included a model for “Enhancement Potential”, which was to be delivered as a simple extension of the “Conservation Value” model. However, Council has excluded this component during the current phase due to a lack of appropriate data being available to make it a robust model.

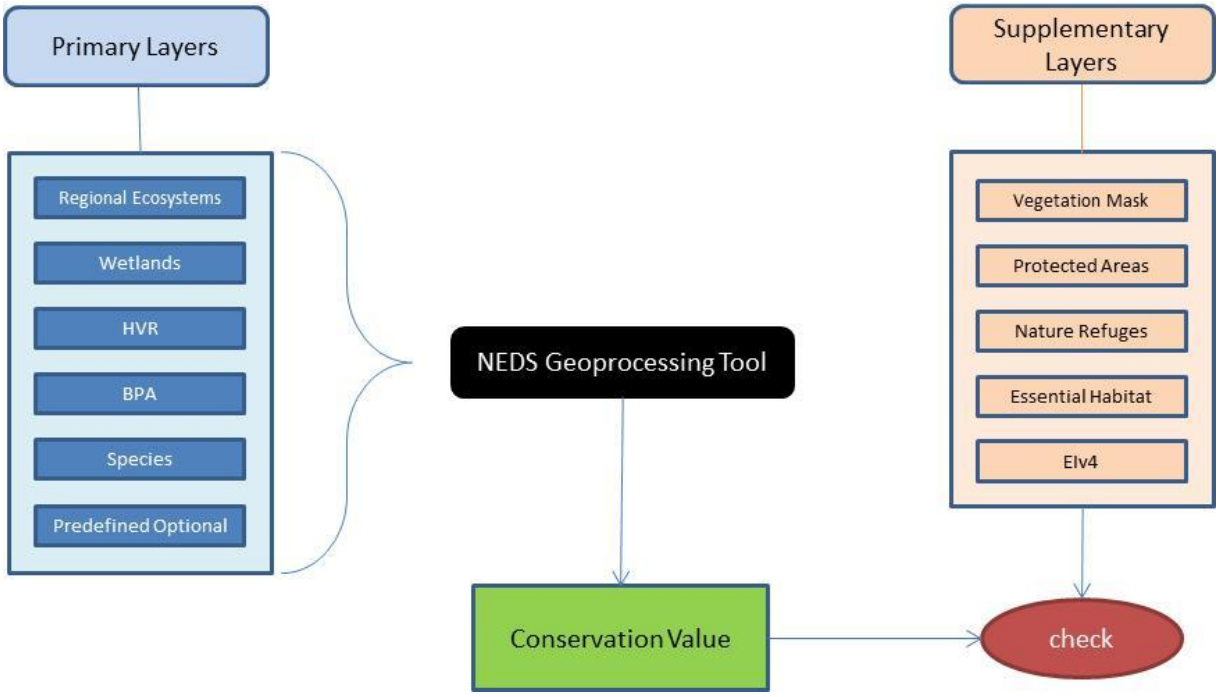

Figure 1 NEDS Scope

The deliverables of Stage Two are:

1. This Report, outlining the primary and secondary data layers articulated above, including process and methodology followed for data production (where relevant) and the NEDS geo-processing tool.
2. NEDS Geodatabase incorporating primary data layers, i.e. those that are required as input into NEDS, and a number of supplementary data layers, for the purposes of overlay against the output of NEDS. Note that these supplementary layers do not form part of the NEDS process, however provide value when overlayed on top of the NEDS output to value-add the quality assurance process an aid in decision making.
3. NEDS Geo-processing tool for the production of a “Conservation Value” data layer. This tool has been packaged within the NEDS Geodatabase as a script based on the Python programming language.

   Note that whilst the original intent was to utilise Model builder and incorporate scripting only if and where required, given the complexity of attributes within the input data layers and the need to keep the tool easy-to-use, Python has been used, as Model Builder was not capable of achieving the same result.
4. Vegetation mask (raster) data layers based on RCC supplied Light Detection and Ranging (LiDAR) data.
5. Initial species data layer (contained within the NEDS Geodatabase as a primary layer).

3.0 Geodatabase Structure

Geodatabases are employed to effectively support council's spatial needs. Continued use of Geodatabases as a spatial data management platform is a logical choice for NEDS. For the purpose of NEDS, a File Geodatabase has been identified as a suitable implementation option, with the flexibility to be incorporated into an SDE based enterprise database in the future should that be a requirement. Use of a File Geodatabase maintains simplicity whilst allowing storage of large datasets.

Figure 2 shows the structure of the NEDS Geodatabase.

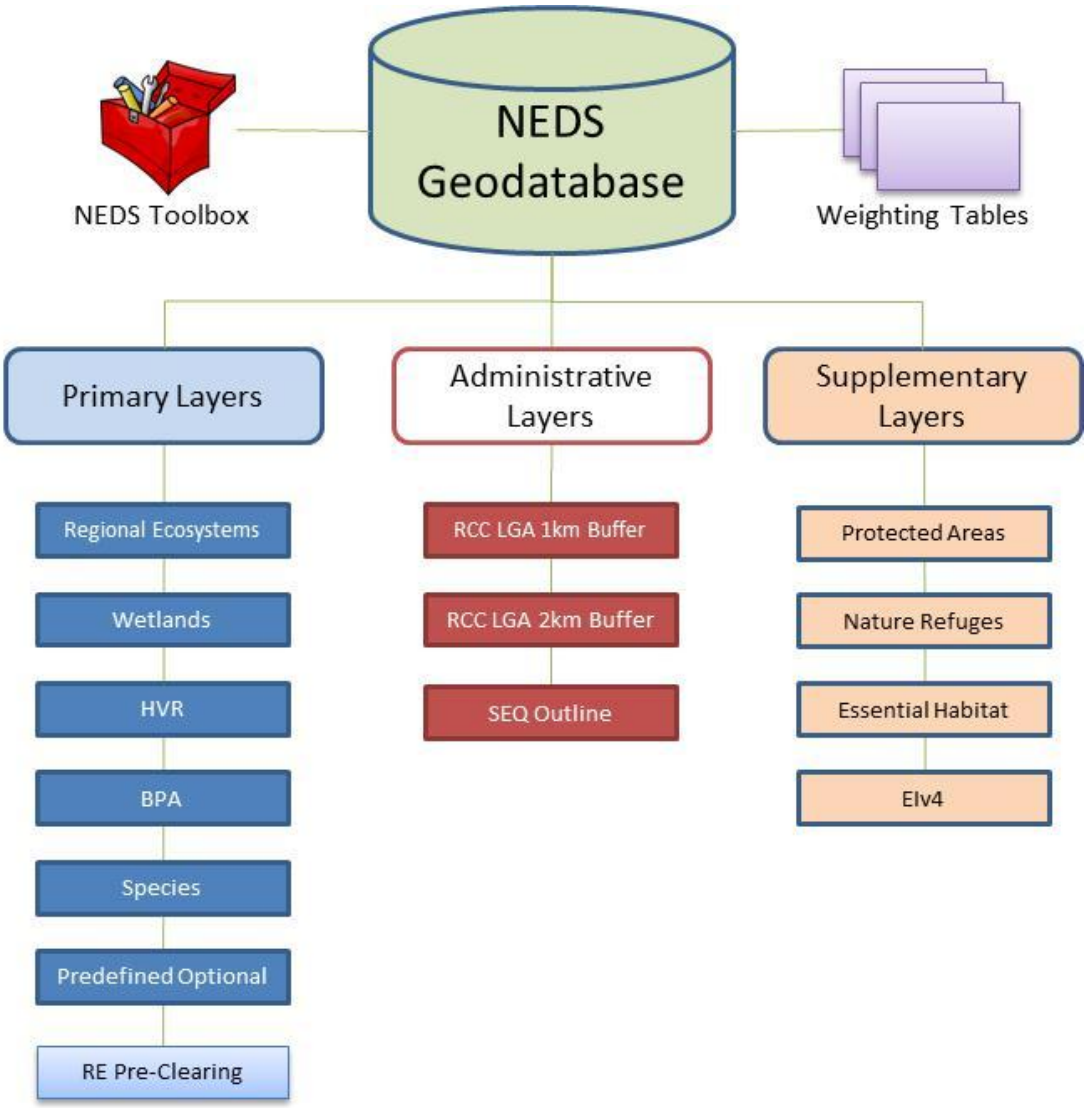

Figure 2 Geodatabase Structure

Due to the nature and size of the Vegetation Mask data, this has not been incorporated into the Geodatabase, rather it is provided separately.

3.1 Primary Data Layers

The selection of primary layers was conducted using a systematic review of Queensland's spatial data, containing major environmental and conservation values. The availability, priority, requirements of data completeness, currency, spatial and non-spatial accuracy was also considered in the selection process. In addition, the datasets that could not be modelled suitably in NEDS were identified at this stage and formed the secondary data layers. The spatial extent incorporates the whole of the Redland Local Government Area including the mainland, Coochiemudlo Island, North Stradbroke Island and the Southern Moreton Bay Islands.

Whilst the original scope recommended the spatial extent of the mapping (project area) to be extended one kilometre beyond the Redland City Council boundary into the local government areas of Gold Coast City Council, Logan City Council and Brisbane City Council, the extent has been increased a further kilometre to more clearly demonstrate the connectivity of conservation values into the surrounding areas.

The following datasets were identified as critical input to the NEDS geo-processing tool.

3.1.1 Regional Ecosystems (RE) Version 6.0

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The survey and mapping of vegetation communities and regional ecosystems for more than two-thirds of Queensland has been completed for both pre-clearing and remnant vegetation distributions at a scale of 1:100,000. The part of the Southeast Queensland mapped at a scale of 1:50,000 was used to populate the NEDS Geodatabase.

Two status ratings have been developed for remnant RE's. The biodiversity status of an RE is assigned by DEHP and is based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem. This differs from the VM Act status, which is only based on an assessment of the pre-clearing and remnant extent of an RE. For the purposes of NEDs, the conservation value of a remnant RE has been considered using its biodiversity status, not its status under the VM Act.

Data source: State of Queensland (DEHP) 2009.

Refer to Appendix C for metadata relating to the RE dataset.

3.1.2 Wetlands

Wetlands support a diversity of plants and animals that depend on one another for food and shelter. In the south-east, the upper Noosa River, Pumicestone Passage and much of Moreton Bay are outstanding wetlands for nature, recreation and fish breeding. The ecological significance and legislative status of wetlands are assessed at international, national and state scales. The following three Wetlands datasets were used for NEDS.

Input Datasets

RAMSAR

The Convention on Wetlands of International Importance especially as Waterfowl Habitat (also known as the RAMSAR Convention) is an intergovernmental treaty that provides a framework for national action and international cooperation on the conservation and wise use of wetlands (EPA, 1999). The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) protects Australian RAMSAR wetlands as a Matter of National Environmental Significance (MNES). RAMSAR wetlands are also protected under the Queensland *Environmental Protection Act* 1994 (EP Act).

Data source: State of Queensland (DEHP) 2006.

Refer to Appendix C for metadata relating to RAMSAR.

Wetlands Management Areas (WMA)

Referable wetlands are predominantly natural wetlands classified as High Ecological Significance (HES) and General Ecological Significance (GES) by the DEHP. Wetland Protection Areas (WPAs) are predominantly natural wetlands of HES within catchments of the Great Barrier Reef (GBR). Wetland Management Areas (WMAs) include wetlands of GES within the Great Barrier Reef catchment and wetlands of GES and HES in other parts of Queensland.

Data source: State of Queensland (DEHP) 2007.

Refer to Appendix C for metadata relating to WMA.

Directory of Important Wetlands (DIWA)

The Directory of Important Wetlands in Australia (DIWA) identifies and classifies nationally important wetlands within three broad categories - marine and coastal zone wetlands, inland wetlands and human-made wetlands (Environment Australia, 2001, Miller and Deacon, 2005, DSEWPC, 2010a). The directory and associated updates provide detailed descriptions of all DIWA wetlands.

Data source: State of Queensland (DEHP) 2007.

Refer to Appendix C for metadata relating to DIWA.

Combining the Wetlands Data Layers

The NEDS tool processing algorithm combines all three wetlands layers into a single layer. Each wetland polygon in the output layer may correspond to one, two or all three overlapping input polygons.

A field “DataSource” is generated (along with corresponding value from the Wetlands_Weighting table) by selecting the highest ranked overlapping input polygon for each output polygon, based on the following rank order:

1. RAMSAR (highest)
2. WMA
3. DIWA (lowest)

This process is performed on-the-fly when NEDS is run such that the input data can be updated when a new version is available without having to prepare the data manually to achieve the required data structure. This process also clips the wetlands output layer to the defined 2km buffer.

DIWA data has been excluded from Conservation Value scores in the present model as it is mapped at a very coarse scale and often includes large areas of non-wetland habitats. However, it has been retained for possible future analysis.

Figure 3 refers to the process undertaken.

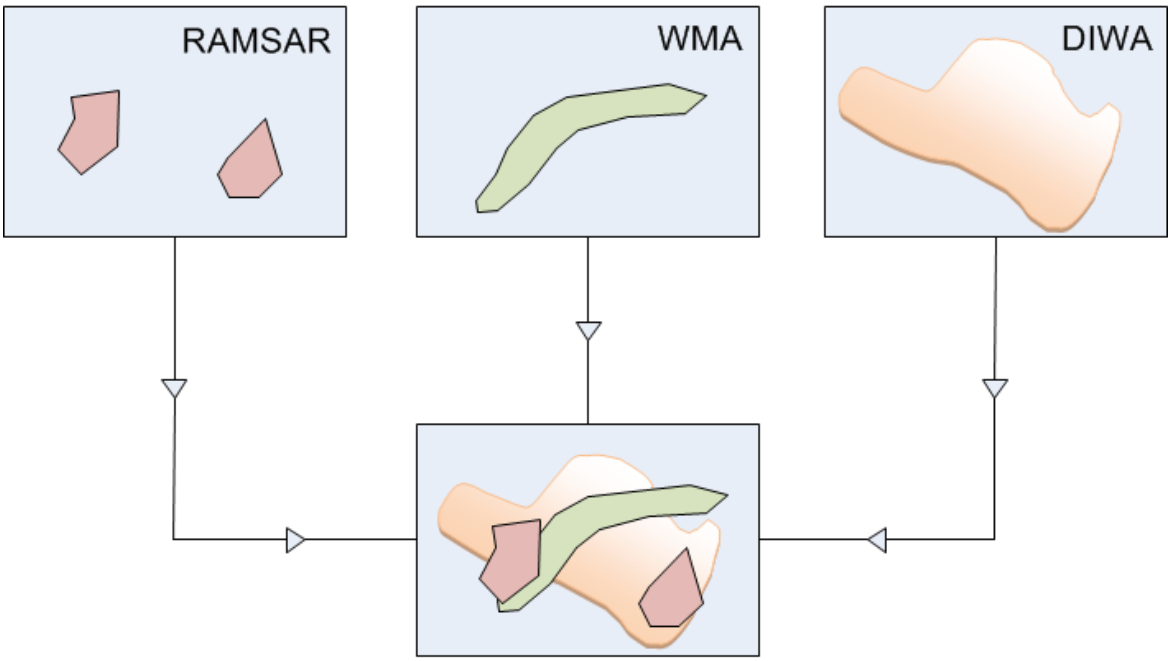

Figure 3 Wetlands layers are combined into a single layer with intersecting polygons

3.1.3 Species

The species layer is an amalgamation and synthesis of data from the Herbarium, Museum and RCC observations, with variable quality and spatial accuracy.

Species selected from these datasets were those plants and animals listed as:

a) Critically Endangered, Endangered, Vulnerable or Conservation Dependent under the EPBC Act or

b) Endangered, Vulnerable or Near Threatened under the NC Act, or listed under the "Back on Track" species prioritisation framework (DEHP 2009)[1]. Records of listed marine vertebrates were excluded.

Refer to Appendix A (Data Dictionary) for metadata relating to the Species dataset.

Input Datasets

RCC Observations

RCC Observations is a dataset provided by RCC containing various sightings of species in the Redland area.

Data source: RCC (supplied 2012).

Queensland Herbarium (HERBRECS)

HEBRECS is a verified database with locality data of plant specimens collected throughout Queensland as well as other areas of Australia and PNG. This database is administered by the Queensland Herbarium. It is an Oracle relational database including taxon names and specimen data and specifies the spatial accuracy and age of each record. Details of the habit and habitat of the specimen are also often provided.

Data source: Queensland Herbarium (supplied 2012 on request).

Refer to Appendix C for metadata relating to HERBRECS data.

[1] Reference: DEHP 2009, Back on Track Species Prioritisation Framework. http://www.derm.qld.gov.au/wildlife-ecosystems/wildlife/back_on_track_species_prioritisation_framework/index.html. Accessed 23/4/2012.

Queensland Museum Zoology Data

The Queensland Museum holds an electronic database associated with its zoological collections. This database includes taxonomic and locality data for living and fossil faunas throughout Queensland as well as other areas in the Indo-west Pacific. Only areas between two latitudes and longitudes (in degrees and minutes) can be searched. Resultantly, records are not spatially accurate..

Data source: Queensland Museum (supplied 2012 on request).

No metadata provided with request, contact Queensland Museum.

Excluded Datasets

Other datasets relevant to species of conservation significance were considered for NEDs, but were excluded for a variety of reasons. These datasets included:

- Koala habitat mapping layers, produced by DEHP. Koala records are contained in the species dataset, therfore specific koala mapping was considered an unnecessary duplication of values. Nevertheless, koala data could be added to NEDS using the optional layer, if required.
- Essential habitat mapping, produced by DEHP. Essential habitat is vegetation where a species that is listed as Endangered, Vulnerable or Near Threatened under the NC Act has been recorded. However, the dataset was considered unsuitable for NEDs as it does not include all species listed under state and commonwealth legislation and does not identify the species within each mapped habitat area (in its currently available form).

Methodology

The process undertaken to generate the Species data was conducted using ESRI ® ArcGIS 10 software and is described in detail in Appendix B.

Conceptually, the process is articulated in Figure 4.

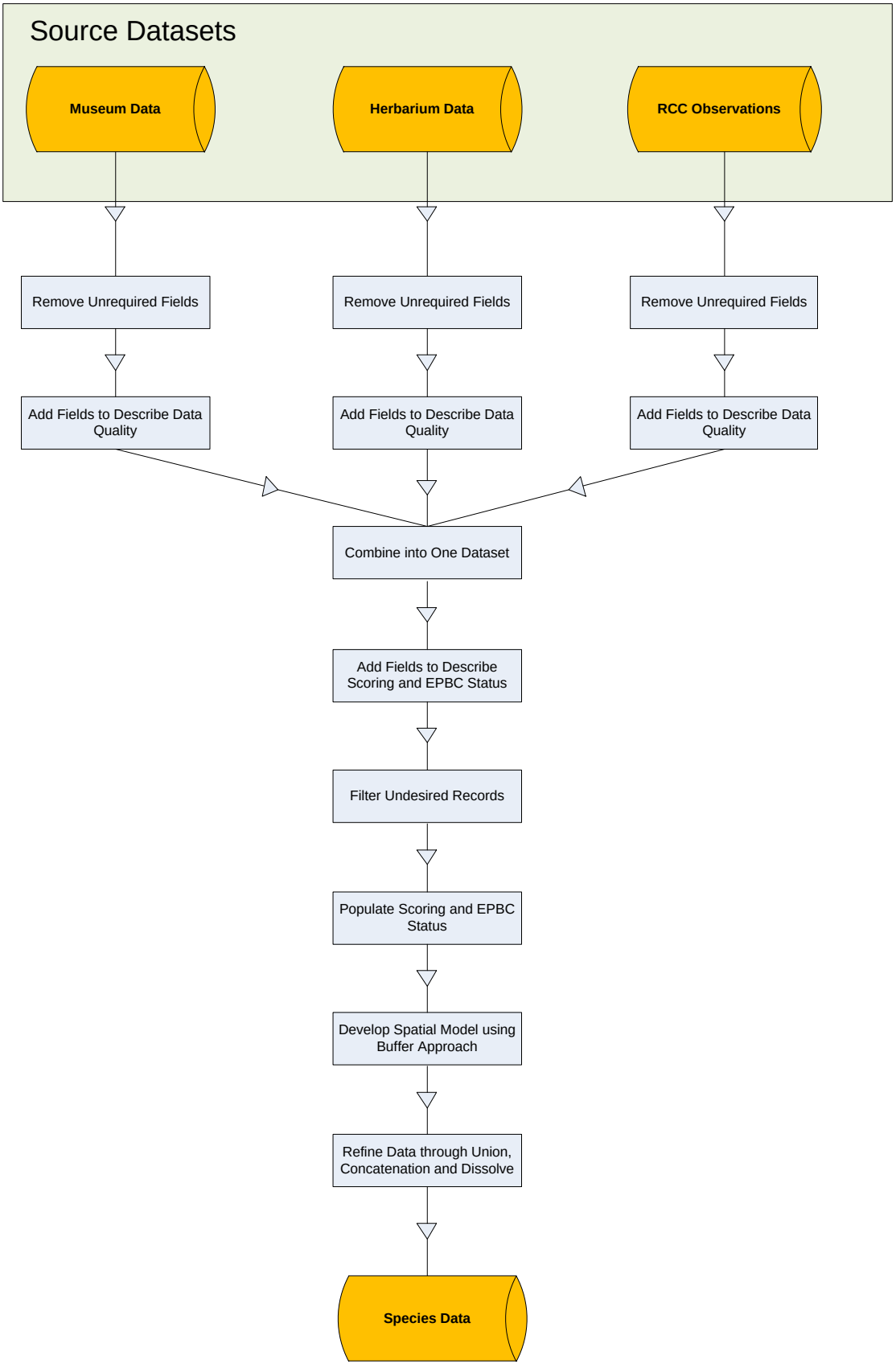

Figure 4 Species Synthesis

3.1.4 Biodiversity Planning Assessment (BPA) Version 3.5 – South East Queensland

The BPA dataset was developed by DEHP to assess biodiversity values at the landscape scale in Queensland. The BPA for the Southeast Queensland Bioregion is based primarily on 1:100 000 scale remnant RE mapping (Version 2.0) produced by the Queensland Herbarium. It ranks areas of remnant vegetation into state, regional and local biodiversity significance, using a range of ecological criteria including size, rarity, diversity, fragmentation, habitat condition, resilience, threats, habitat for EVNT species and ecosystem processes. The NEDS model incorporates tract size (i.e. the size of patches of remnant vegetation) from the BPA.

Data source: State of Queensland (DEHP) 2009.

Refer to Appendix C for metadata relating to the BPA dataset.

3.1.5 High Value Regrowth (HVR) Version 2

This dataset describes areas of non-remnant woody vegetation to be used for vegetation management purposes. These areas are derived from the DEHP Remote Sensing Centre 2006 Foliage Projective Cover (FPC) mapping and 1989 to 2007 'Woody Change' product mapping. DEHP processed this data to remove small urban parcels of land and areas subject to cropping, horticulture and manufacturing and commercial uses; and remnant areas identified in RE mapping current at the time of compilation. The mapping has a map scale of 1:100000 and a minimum mapping area of 2 hectares in the South-East Queensland, Central Queensland Coastal and Wet Tropics.

As the HVR layer does not contain any information on conservation status or ecosystem type, the NEDS geoprocessing tool intersects this layer with the RE pre-clearing layer and transfers attributes such as BP_Status which is subsequently used as the weighting field. The processing steps are:

- Merge DEHP pre-clearing RE layer to identify the probable RE before clearing
- Classify HVR polygons using the Biodiversity Status of the pre-clearing RE.

Data source: State of Queensland (DEHP) 2011.

Refer to Appendix C for metadata relating to the HVR dataset.

3.1.6 Optional Layer

The concept of the “optional” layer is to allow flexibility in terms of the input data sets for NEDS. The NEDS tool allows for an optional data layer to be included in the geoprocessing should RCC desire to incorporate one. This is user configurable such that any layer can be substituted.

Should an optional layer be utilised, the following criteria must be followed:

- The optional feature class must be within one of the feature datasets contained in the NEDS.gdb to ensure the same spatial reference and coordinate precision.
- The feature class must have an integer field named 'Weight'.
- Weighting on these features is not performed by the tool and must be populated prior to execution of the tool.
- The feature class must only be polygon data.
- The feature class must be prefixed with “NEDS_”, which will be removed in the output (for example NEDS_catchments becomes catchments).
- If more than one data layer is prefixed with “NEDS_”, the tool will only use the first layer it comes across.

3.2 Supplementary Data Layers

3.2.1 Vegetation Mask (LiDAR)

To aid in data quality assurance checks of the NEDS output and in the overall decision making process, a dataset has been developed to represent high vegetation within the Redland area. This dataset contains a set of rasters representing the height, distribution and density of vegetation across the Redlands area.

The provided rasters have been derived from LiDAR provided by RCC. The following points have been noted:

- No metadata has been provided with the LiDAR.
- The data was found to have a density of 1 to 2 points per square metre and classified into ground and buildings, with vegetation and other points left unclassified (class = 10).
- The ground classification had been manually edited.
- The building classification appears to have had automatic classification only with a high rate of misclassification. A significant portion of building points are unclassified and to a lesser degree some vegetation is misclassified as buildings.

A set of multi-spectral ortho-rectified images was also provided with a ground pixel spacing of 20 cm.

Methodology

Using the TNTMips spatial modelling environment, a script was developed to generate the following rasters from the LiDAR at one metre ground pixel spacing:

- DEM - Ground surface.
- DSM - Highest LiDAR point (ground, vegetation, building or other structure).
- Raw Canopy Surface - Highest unclassified LiDAR point (i.e. not ground or building).

An additional TNTMips script was used to generate rasters with a five metre ground pixel spacing of 5 metres representing the number of LiDAR returns from within defined strata, as a percentage of the number of LiDAR pulses on each pixel.

The defined strata (above ground level) were:

- 1 m to 3 m
- 3 m to 12 m
- 12 m to 20 m
- > 20 m.

A binary "Building Mask" raster was generated using the classified building points.

Two types of errors in the raw canopy surface needed to be corrected in order to produce an accurate vegetation mask and Canopy Height Surface. These errors were caused by:

1. Unclassified LiDAR points on buildings causing gaps in the building mask and spurious points in the Raw Canopy Surface; most buildings contained numerous gaps in the roof.
2. LiDAR points from vegetation misclassified as building points. Some large dense trees such as figs were classified as buildings and therefore were completely left out of the raw canopy surface model.

The 20 cm imagery were used to assess the LiDAR derived rasters as the raw canopy surface was refined through a succession of steps to remove errors.

Most buildings included unclassified points on the roof surface. These points caused gaps in the building mask and also created errors in the Raw Canopy Surface. The building mask was buffered by one pixel to fill the gaps and the buffered building mask was used to blank out pixels in the Raw Canopy Surface on or within 1 metre of a mapped building. A sequence of map algebra operations were applied to the LiDAR derived rasters to generate a Canopy Height Surface with a high level of accuracy. A number of customised filters were then applied to remove isolated pixels and fill gaps in tree crowns, producing the final Vegetation Height Surface.

The final raster deliverables were then exported to the ERDAS Imagine format (Vegetation Height) and ARC ASCII format (Foliage Density rasters).

In addition, colour enhancements of the vegetation height overlaid on the DEM and DSM were generated and exported to GeoJP2 format.

The final dataset consists of the following layers:

- Vegetation_Height_1m.img
- Vegetation Height Enhancement.jp2
- Vegetation Height Enhancement with Buildings.jp2
- Foliage_Density_1m_3m.asc
- Foliage_Density_3m_12m.asc
- Foliage_Density_12m_20m.asc
- Foliage_Density_gt_20m.asc.

Figure 5 depicts the “Vegetation Height Enhancement” layer (for a zoomed-in area) overlayed against aerial imagery provided by RCC.

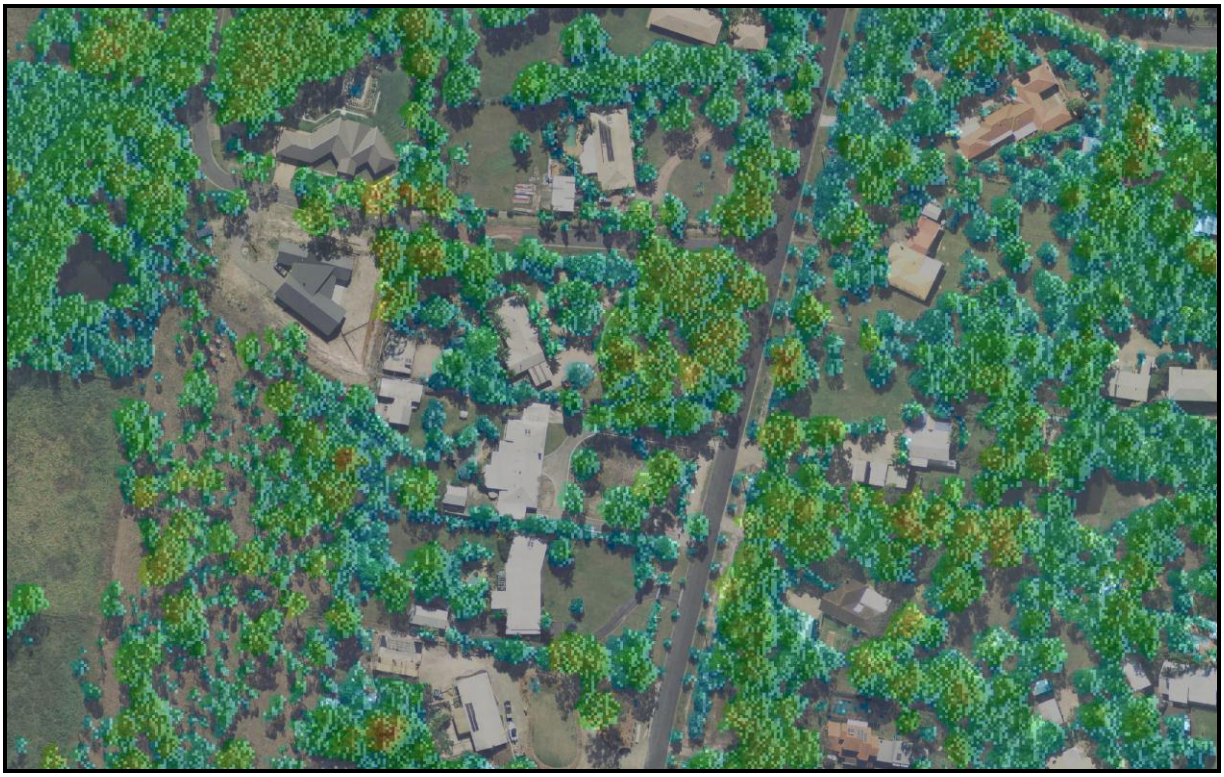

Figure 5 Vegetation Mask – Vegetation Height Enhancement

3.2.2 Protected Areas of Queensland

This dataset consists of all gazetted National Parks Scientific, National Park, National Park (Cape York Peninsula Aboriginal Land), National Park Recovery, Conservation Park, Resources Reserve, Forest Reserve, State Forest and Timber Reserve. The positional accuracy matches the accuracy of the Queensland Digital Cadastre Database (DCDB). Amendments to DCDB polygon and attribute information are based on official gazetted plans. The shapes and locations of a number of islands and some coastline have been matched to other sources.

Data source: State of Queensland (DEHP) 2011.

Refer to Appendix C for metadata relating to the Protected Areas of Queensland dataset.

3.2.3 Nature Refuges

Nature Refuges are part/s or whole of Lot/s on plan and are gazetted through a voluntary conservation agreement between the QLD government and private land owner/s. They are based in statute and are a recognised class of Protected Area as defined by the *Nature Conservation Act 1992*. Nature Refuge boundaries are primarily defined using DCDB parcels, with GPS data collected for partial boundaries. Boundaries following creeks or irregular boundaries are digitised.

Data source: State of Queensland (DEHP) 2011.

Refer to Appendix C for metadata relating to the Nature Refuges dataset.

3.2.4 Essential Habitat

Version 3.0 (polygons only) – all attribute information removed. The positional accuracy is primarily dependant on the accuracy of the Herbarium Regional Ecosystem Mapping.

Essential habitat was compiled from two primary sources:

1. Recognized species habitat models

   These are habitat models such as cassowary, ground parrot, etc that have been developed by experts. Some of the models have been developed from recent recovery planning activity and some come from application of the Biodiversity Assessment and Mapping Methodology (BAMM).

2. Essential species habitat based on species points

   This information comes from Criteria A of the BAMM. This criterion classifies areas according to their significance based on the presence of taxa listed as Endangered, Vulnerable or Near Threatened under the *Nature Conservation Act* 1992.

Data source: State of Queensland (DEHP) 2007.

Refer to Appendix C for metadata relating to the Essential Habitat dataset.

3.2.5 Environmental Inventory v4

The current database is a single ESRI shapefile with considerable associated documentation. Conservation Management Areas (CMAs) within the shapefile are currently prioritised into four categories of conservation significance (Priority, Major, General and Enhancement) and are assigned functional roles (Habitat, Corridor, Tidal, Patch etc). EIv4 has ‘evolved’ from the initial GIS mapping of CMAs and associated information for the mainland of the Redlands (by Chenoweth EPLA), through several updates undertaken by Council environmental planners including extension to North Stradbroke Island, and a ‘verification update’ of air photos and matching to Regional Ecosystem mapping in 2007 (by Chenoweth EPLA).

EIv4 represents historical information that remains a valuable resource to inform the planning and management of ecologically significant areas in the Redland LGA.

Data source: Redland City Council 2007

Refer to Appendix C for metadata relating to the EIv4 dataset.

4.0 NEDS “Conservation Value” Tool

4.1 Methodology/Process

Figure 6 shows an overview of the process being undertaken by the NEDS tool. The process can be described as a Multiple-Criteria Analysis (MCA), whereby information from several criteria (data layers) is combined (aggregated) to form a single layer of expression; and in the case of NEDS an expression of conservation value.

Each contributing layer contains areas (polygons) categorised according to environmental importance. A numeric rating (weighting) is applied to each category, the larger the number the more important from a conservation perspective. Each layer is rated against all categories. As there is no overall weighting between layers, the ratings must reflect the importance of one layer over another. For instance, if one layer is twice as important as the other, the highest rating for the first layer may be 10, however the highest rating for the other layer may be set at 5.

The resulting data layer produced will be derived by intersecting all the polygons in the input layers to create a synthesised set of polygons and then mathematically aggregate the ratings across all layers.

The resulting layer will include a “maximum weight” attribute which represents the maximum weight value of all the contributing data layers within each synthesised polygon. Also provided is a “total weight” attribute, representing the total sum of the “weight” values from each participating layer. This provides flexibility to symbolise the layer based on either “maximum weight” or “total weight”.

Attributes representing each participating layer’s score (weighting) is also provided for traceability.

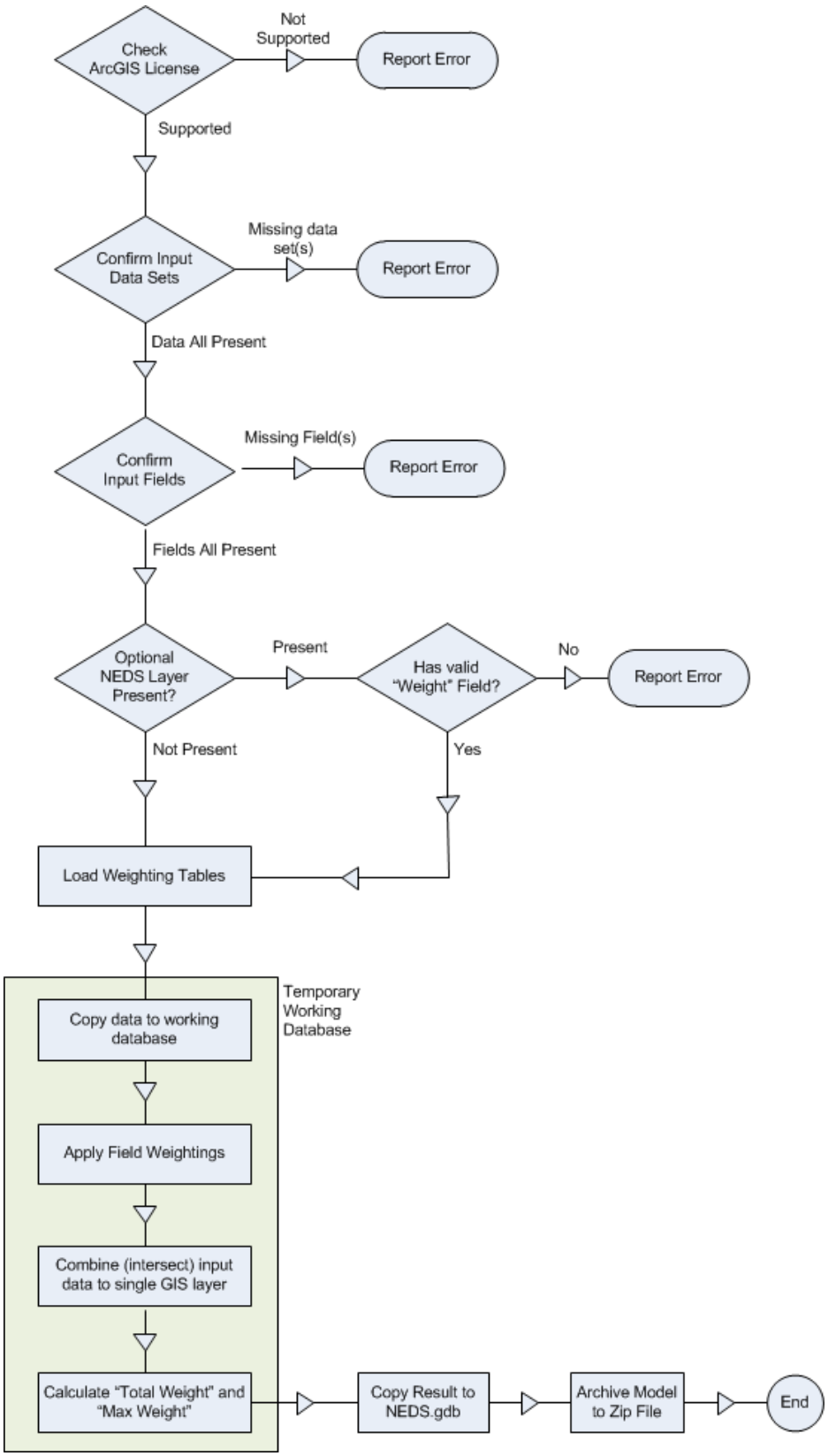

Figure 6 NEDS Conservation Value Process

In summary, the algorithm performs the following tasks.

Pre-processing

1. Check that correct level of ArcInfo licence is available.
2. Check that all the required GIS layers are included in the NEDS Geodatabase. NEDS then checks that each input layer has the necessary fields with the correct naming. This part of the code is transparent such that if State datasets such as Regional Ecosystems are updated, new versions can be readily accommodated.
3. Check to see if there is an “Optional Layer” in the NEDS geodatabase. The optional layer is identified by its name starting with “NEDS_”. If such a layer is in the Geodatabase it is checked to see that it contains a field called “Weight”, with the weightings to be applied in the MCA model.
4. Check the weighting tables and loads them into internal arrays.
5. If any of the tests described above, produce a negative result, then an informative message is produced to enable the user to identify which dataset is in error and the nature of that error.

Spatial Processing (refer steps within green rectangle shown in Figure 6)

1. Copy input layers to a temporary “working” Geodatabase and clips each layer to the project area, taking only the fields that are required subsequently.
2. For each input layer, a “Layer_Weight” field is created and populated using the weighting tables to allocate scores to key attributes in the input layers. For complex and multiple attributes the highest score is used for the final weighting.
3. The input “criteria” are merged into a single output layer, creating new polygons from the intersection of polygons in all the input layers. The key attributes and weighting values are transferred to the new intersected polygons.
4. Two fields, “Total Weight” and “Max Weight”, are created in the output layer by adding all the weight scores for each polygon and finding the maximum weight score for each polygon respectively.

Completion

1. The output layer and NEDS Script are copied into the NEDS Geodatabase with the current date included in its name. If an optional layer is used, the name of the optional layer is appended to the NEDS output layer name.
2. The output Geodatabase is archived into a zip file with the NEDS script and the program output log.

Figure 7 shows an example of a “Conservation Value” map produced by the NEDS tool. The output layer has been symbolised using a colour ramp from Green (lowest significance) to Red (highest significance). Note that the Species Input Layer weightings have been set to zero to preclude this from the results.

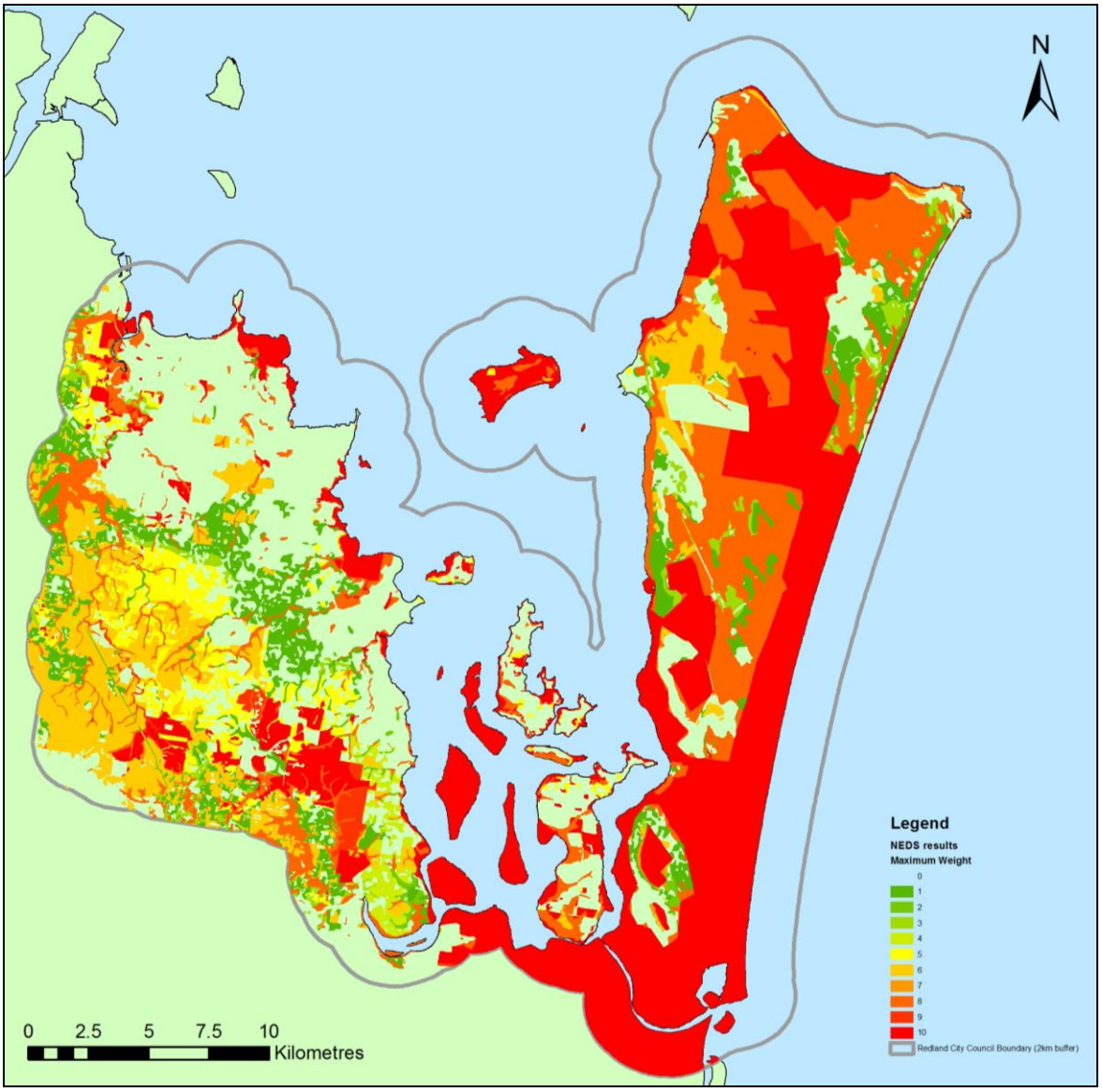

Figure 7 NEDS Conservation Value – Example Output

4.2 Required Technical Environment

NEDS development has been restricted to only the functionality that is available within the current RCC GIS software versions (as opposed to using features or functionality contained in subsequent versions of the ESRI software suite not currently in use by RCC).

Therefore NEDS has been developed and implemented on the ArcGIS 9.2 platform. It has been implemented as a Python script and placed within the Geodatabase (NEDS,gdb) as a toolbox named 'NEDS_Toolbox". This toolbox contains one tool called "NEDS Script". Note that the ArcInfo level of licensing is required to geo-process the data.

The NEDS tool uses lookup tables to rate datasets within the provided Geodatabase. The lookup tables can be modified to some extent to change the rating of components; however keywords should not be altered. To execute the tool locate the toolbox within the NEDS.gdb and double click on the NEDS script in the toolbox.

The tool has been tested and runs on both 9.2 and 9.3 ArcGIS environments, however it will need to be modified to operate within a version 10 ArcGIS environment when RCC make the decision to upgrade.

4.3 Initial Start-up Check

Before any processing can be performed, the tool will establish:

1. The correct license level is available (i.e. ArcInfo).
2. The required database exists (i.e. NEDS.gdb).
3. The required tables exist and required fields are present.

If any of these conditions are not met the tool will report the error and exit.

4.4 Executing the Geoprocessing Tool

The following requirements are mandatory when running the geoprocessing tool:

- The tool must be executed from within the NEDS.gdb, and it is suggested to run from ArcCatalog.
- All required feature classes and weighting tables should be within the database and feature classes should be projected as GDA94 MGA Zone 56.
- No modification is performed on the source datasets directly; all processing is performed in a temporary database to which the source data is extracted. This scratch database is created in the folder stated in the users' TEMP environment variable.
- In the directory in which the tool is executed (i.e. location of the NEDS.gdb), a log file will be written in plain text. If for any reason the tool fails to produce an output, the log file will provide valuable debugging information.
- All feature classes must be in a feature dataset to ensure the same coordinate information and spatial reference. Feature classes 'standalone' or at the root level will not be detected by this tool.
- All reference fields are predefined. If a feature class is updated it is the users' responsibility to ensure that key fields are present and populated accordingly.
- The NEDS.gdb may be copied but cannot be renamed as the tool will not be able to locate the required files.
- Environment settings such as 'Extent', 'Config Keyword', 'Spatial grids' and 'Output XY domain' may affect the operation of this tool.

One optional layer can be provided for the tool to include in the results provided it meets the following stringent criteria:

- The optional feature class must be within one of the feature datasets contained in the NEDS.gdb to ensure the same spatial reference and coordinate precision.
- The feature class must have an integer field named 'Weight'.
- Weighting on these features is not performed by the tool and must be populated prior to execution of the tool.
- The feature class must only be polygon data.
- The feature class must be prefixed with “NEDS_”, which will be removed in the output (for example NEDS_catchments becomes catchments).
- If more than one data layer is prefixed with “NEDS_”, the tool will only use the first layer it comes across.

4.5 Look-up (Weighting) Tables

In preparation for processing, the tool will load the values from the lookup tables into variables. These tables are configurable, i.e. categories and ratings can be amended by RCC as desired. The tables are accessed by whole name match and therefore these table names should not be changed. All instances of 'Value' are integer. Tables are assumed to be unsorted and therefore the values are arranged accordingly by the tool.

Refer to Appendix A (Data Dictionary) for metadata relating to these tables.

4.5.1 Biodiversity Planning Assessment (BPA)

Table Name: ***BPA_Weighting***

BPA Data key field used: ***C_TRACT_HA.***

Initial values as agreed by workshop:

Category	Value
10000	8
1000	6
100	4

Table 1 BPA_Weighting

Table 1 BPA_Weighting contains two fields, 'category' and 'value'. In the category field values are ranked by C_TRACT_HA with the numeric categories. The listed values are minimum values, i.e. values greater than or equal to the stated (numeric) category will receive the value. The numeric categories can be changed but should retain a numeric value greater than or equal to 0.

The table above can be read as follows:

- Tract sizes greater than or equal to 100 and less than 1,000 will be given a weighting of 4.
- Tract sizes greater than or equal to 1000 and less than 10,000 will be given a weighting of 6.
- Tract sizes greater than or equal to 10,000 will be given a weighting of 8.

4.5.2 High Value Regrowth (HVR)

Table Name: ***HVR_Weighting***

HVR Data key field used: ***BD_STATUS***

Initial values as agreed by workshop:

Category	Value
Endangered - Dominant	5
Endangered - Sub-Dominant	4
Of Concern - Dominant	3
Of Concern - Sub-Dominant	2
Not of concern	1

Table 2 HVR_Weighting

Table 2 HVR_Weighting contains two fields, 'category' and 'value'. The values of the 'category' are keywords utilised by the tool and should not be changed; the associated values may be changed if required. In order of processing, the tool searches for endangered dominant, endangered sub-dominant, of concern dominant, of concern sub-dominant and finally not of concern.

The required values for regrowth are not present in the table. To obtain the values required to rank the regrowth the features are intersected with the pre-clearing vegetation data

4.5.3 Regional Ecosystems (RE)

Table Name: ***RE_Weighting***

RE Data key field used: ***BD_STATUS***

Initial values as agreed by workshop:

Category	Value
Endangered - Dominant	10
Endangered - Sub-Dominant	9
Of Concern - Dominant	8
Of Concern - Sub-Dominant	7
Not of concern	6

Table 3 RE_Weighting

Table 3 RE_Weighting contains two fields 'category' and 'value'. The values of the 'category' are keywords utilised by the tool and should not be changed; the associated values may be changed if required. In order of processing, the tool searches (gives precedence) to endangered dominant, endangered sub-dominant, of concern dominant, of concern sub-dominant and finally not of concern.

4.5.4 Species

Table Name: ***Species_Weighting***

Species Data key field used: ***FIRST_SUM_***

Initial values as agreed by workshop:

Category	Value
88	10
66	8
44	6
22	4
0	2

Table 4 Species_Weighting

Table 4 Species_Weightingcontains two fields 'category' and 'value'. The values of the 'category' are keywords utilised by the tool and should not be changed; the associated values may be changed if required. The stated values are minimum values, i.e. values greater than or equal to the stated (numeric) category will receive the value. The numeric categories can be changed but should retain a numeric value greater than or equal to 0.

The table above can be read as follows:

- Sum greater than or equal to 0 and less than 2 will be given a weighting of 2.
- Sum greater than or equal to 22 and less than 44 will be given a weighting of 4.
- Sum greater than or equal to 44 and less than 66 will be given a weighting of 6.
- Sum greater than or equal to 66 and less than 88 will be given a weighting of 8.
- Sum greater than or equal to 88 will be given a weighting of 10.

Note that the current synthesis of Species data is for demonstration purposes primarily, and requires further work invested to bring this to a standard whereby it can be practical used. The dataset at present contains overlapping polygons which would create problems in the results; hence to alleviate potential problems, the species information is planarised with the higher values taking precedence over the lower values.

4.5.5 Wetlands (Combined)

Table Name: ***Wetlands_Weighting***

Wetlands Data key field used: ***none***. Data is ranked from data source.

Initial values as agreed by workshop:

DataSource	Value
RAMSAR	10
WMA_Wetlands	8
DIWA_Wetlands	0

Table 5 Wetlands_Weighting

Table 5 Wetlands_Weighting contains two fields, 'datasource' and 'value'. The values of the 'datasource' are keywords utilised by the tool and should not be changed; the associated values may be changed if required. Wetlands data is rated by its contributing source, the tool searches for features (gives precedence) that are present in RAMSAR then WMA and finally the DIWA dataset.

4.6 Tool Output

The results of the tool are placed into the NEDS.gdb at the root level and will be date stamped e.g.: ResultsWed_29_Feb_2012. Should the tool be executed on the same database on the same day, the previous results will be overwritten.

If the option to include an optional feature class is utilised, the results will be named to indicate the inclusion of the feature class e.g. Results_Including_NatureRefuges_Wed_29_Feb_2012 when NEDS_NatureRefuges is included in the database.

After successful execution, the log file and database will also be archived into a ZIP file.

4.7 Additional Configurability

Process variables have been introduced to allow modification of the process without having to change multiple instances of code. No programming experience is necessary to make these changes however care must be exercised if making changes. It is recommended that AECOM be consulted before any configuration changes are made.

Please note that python is a 'case sensitive' programming language therefore 'True' is not the same as 'true'. String delimiters should be matched, i.e. for each open quote (") there should also be a closing quote (").

Only two types are used by the process variables: String and Boolean. Strings must be quoted and Booleans may only be True or False; if a variable is a string it must remain a string and likewise a Boolean must remain a Boolean.

```
COINCIDENCE         = "10"
USING_CLIP          = True
DELETE_TEMP         = True
DO_ZIP_RESULTS      = True
```

COINCIDENCE: This is the measure (in metres) between two or more datasets where boundaries are considered to be the same and are made to coalesce. Values can be any positive number expressed as a string by using double quotes.

USING_CLIP: Instructs the tool to clip the source data (and trim the edges), to the 2km buffer of the local government area. A value of False will cause the tool to extract the data that intersects the 2km buffer without trimming the edges. Values may only be True or False.

DELETE_TEMP: Instructs the tool to clean up the temporary feature classes when they are no longer needed. Values may only be True or False.

DO_ZIP_RESULTS: When set to True the tool will archive the database and log file in a ZIP file. Values may only be True or False.

A number of additional variables exist within the Python code, used to aid in ongoing maintenance, however are not discussed within this report.

5.0 Assumptions and Limitations

5.1 Species Data

As indicated in section 3.1.3, Species is an amalgamation and synthesis of data from the Queensland Herbarium, Museum and RCC observations, with variable quality and spatial accuracy.

The current synthesis of Species data is therefore for demonstration purposes only, and requires further work invested to bring this to a standard whereby it can be practically used with NEDS.

Current employment of the Species Layer assumes that for any given record for a species, that species is potentially still present within that location. This may not always be correct, for example where the record is very old (refer section 6.1.3) or where there has been a recent land use change. This point emphasises the utility of the secondary datasets when querying NEDS; for example the vegetation mask could be used to ascertain whether the area still contains forest habitat. It may also emphasise the role of ground survey to verify conservation significance results obtained for NEDS.

Further, the Species Layer has the limitation that some records in the dataset are not particularly accurate. This means that the polygons created from the data may be large and incorporate areas unsuitable for the species recorded. Refer to section 6.1.3for potential refinements to the accuracy of the records in this layer.

5.2 Policy Development

The output of NEDS, namely the expression of “Conservation Value” in conjunction with supplementary overlay layers DOES NOT represent final policy, rather it is to be used to inform the policy making process, which will be based on a human decision-making process, i.e. NEDS will NOT determine policy, it will provide information to decision makers in order to make informed decisions and policy.

A final spatial expression of policy will then be created by RCC and used to disseminate information internally and externally.

5.3 NEDS Technical Environment

As requested by RCC, NEDS has been developed to operate within RCC’s current GIS software platform, specifically ESRI ArcGIS version 9.2. Due to the nature and extent of changes ESRI have incorporated in version ArcGIS 10 (the current software version available at the time of writing this report), NEDS will not operate within version 10, i.e. it will need to be ported/upgraded to work with version 10. NEDS however will operate on version 9.3 without change.

5.4 NEDS Training

This report is not intended for use as a training tool or manual. Training material will be a deliverable of Stage 4 – Training.

6.0 Potential Future Amendments and Recommendations

6.1 Spatial Data

6.1.1 Habitat/Bioregional Corridors

It may be of benefit to undertake a habitat/bioregional corridors mapping and assessment project to assess the importance of individual patches in maintaining habitat connectivity and identification of critical gaps that would be priorities for rehabilitation.

6.1.2 Local RE Map

As the state RE data is mapped at a broad scale (1:50,000 for South East Qld), it is recommended to create a localised version of the RE using the vegetation mask that has been produced as a bi-product of this project. This can be used to improve the accuracy of external remnant vegetation boundaries and potentially internal RE boundaries using canopy height and vertical structure. The ability would therefore exist to feed this data back to DEHP to incorporate into the state dataset.

6.1.3 Species

As indicated, the Species data requires further work and therefore an investment of time in order to make it a viable layer for use in decision making within NEDS. Should RCC not desire to utilise the current data layer within NEDS, the ratings can be set to zero.

The following issues are recommended for further investigation.

Spatial Accuracy

- Purging of records deemed to be too inaccurate.
- Using specific buffers based on the accuracy values for individual records.
- Incorporating new, more accurate records that may be collected in the future by RCC, BAAM and/or other entities.
- Removing areas of non-remnant vegetation, using the RE layer or other suitable vegetation mapping.

Age of Records

- Purging records older than a certain age from the dataset.
- Requires discussion how old records can be to still be included.

Taxonomy

- Check dataset to ensure species names are up-to-date and there is appropriate use of the subspecies epithet.
- Check species and common names are standard across the different datasets and consistent.
- Discussion on the incorporation of other datasets/species e.g. koala records into the dataset, and if so, what records to be used.

Geospatial Data check

- Ensure that all geoprocessing steps are logically consistent and appropriate for the desired output.
- Check geoprocessing steps have generated the desired output with no spatial errors, e.g. overlapping polygons.

GIS Table Structure

- Determine which fields need to be retained in the table structure of the final species layer output

Data Content Check

- Ensure there are no duplicates with the same polycentre and that the data is otherwise consistent with regards to the above points.

6.2 NEDS Geoprocessing Tool

The following considerations are presented as potential enhancements to NEDS.

- Enhancement Potential Model – Review data sources, appropriateness and required process/methodology for the development of a model to provide an expression of “Enhancement Potential”
- Allow a variable number of optional layers.
- Migrate tool to operate within an ArcGIS 10 environment.

Appendix A – Data Dictionary

This dictionary details environmental datasets and NEDS user configurable weighting tables that have been synthesised as a result of this project, namely Species and weighting configuration tables.

1. BAAM NEDS Species Layer

Description

The Species layer is an amalgamation and synthesis of data from the Herbarium, Museum and RCC observations for the purpose of an input into the RCC Natural Environment Decision Support model. It provides a score for a given area, based on the number of different conservation significant species recorded and the legislative status of those species. The shape of the polygons in the dataset is the result of two factors:

1. Spatial accuracy of the original records.
2. Topology of resultant areas with a record for a species or combination of species. The dataset provides an indication of the number of conservation significant species potentially occurring within a given area, and can thus contribute this information to the NEDS model to integrate conservation significance of species records into the model.

Custodian

Principal Ecologist (Botany)
Biodiversity Assessment and Management
Suite 11 (Basement Level), 2-20 Shore Street West, Cleveland Q 4163
PO Box 1376 Cleveland Q 4163

Version History

Version 1.0 – Demonstrative version.

ANZLIC Search Words

ECOLOGY Habitat
ECOLOGY Biodiversity
ECOLOGY Classification
ECOLOGY Conservation
ECOLOGY Mapping
ECOLOGY Planning
ECOLOGY Inventory
VEGETATION Mapping
VEGETATION Planning
VEGETATION Inventory
FLORA Native
FAUNA Native

Dataset Status

Progress: Draft—Demonstrative only.
Release Date: 4 May 2012
Maintenance and Update Frequency: as required

Spatial Domain

Datum: GDA94
Spheroid: GRS1980
Stored Data Format: Digital ArcGIS

Positional Accuracy:

<10m

Attributes

Name	Definition	Type	Domain Values
SCI_All	A concatenation of scientific names from records in the component datasets within the spatial extent of a given polygon.	Text	Species scientific names, delimited by a comma.
Score	The total score for that polygon, calculated by summing the score for each species within a given polygon.	Integer	Numeric value greater than or equal to 1

2. NEDS Configuration Tables

2.1 BPA_Weighting

Description

This user-configuration table is used by the NEDS tool to define the relative weightings of each defined category within the Biodiversity Planning Assessment dataset. For the purposes of NEDS, the category chosen to represent environmental significance is Tract Size, with this table defining categories based on ranges.

The table does not need to be ordered by Tract Size (as the tool will do this), however for readability and ease of maintenance it is suggested that the table be ordered by decreasing Tract Size.

Attributes

Name	Definition	Type	Domain Values
Category	Minimum Tract Size of this range	Integer	Numeric value greater than or equal to 0
Value	Weighting (Score) representing environmental significance of this category relevant to other categories within this layer and externally, i.e. relative to other NEDS primary data layer weightings.	Integer	Numeric value greater than or equal to 0

2.2 HVR_Weighting

Description

This user-configuration table is used by the NEDS tool to define the relative weightings of each defined category within the High Value Regrowth dataset. For the purposes of NEDS, the category chosen to represent environmental significance is "BD_Status, with this table defining categories based on individual BD_Status values.

Attributes

Name	Definition	Type	Domain Values
Category	BD Status from source data.	Text	• Endangered - Dominant • Endangered - Sub-Dominant • Of Concern - Dominant • Of Concern - Sub-Dominant • Not of concern
Value	Weighting (Score) representing environmental significance of this category relevant to other categories within this layer and externally, i.e. relative to other NEDS primary data layer weightings.	Integer	Numeric value greater than or equal to 0

2.3 RE_Weighting

Description

This user-configuration table is used by the NEDS tool to define the relative weightings of each defined category within the Regional Ecosystems (RE) dataset. For the purposes of NEDS, the category chosen to represent environmental significance is "BD_Status, with this table defining categories based on individual BD_Status values.

Attributes

Name	Definition	Type	Domain Values
Category	BD Status from source data.	Text	• Endangered - Dominant • Endangered - Sub-Dominant • Of Concern - Dominant • Of Concern - Sub-Dominant • Not of concern
Value	Weighting (Score) representing environmental significance of this category relevant to other categories within this layer and externally, i.e. relative to other NEDS primary data layer weightings.	Integer	Numeric value greater than or equal to 0

2.4 Species_Weighting

Description

This user-configuration table is used by the NEDS tool to define the relative weightings of each defined category within the synthesised species dataset. For the purposes of NEDS, the category chosen to represent environmental significance is "First_sum, with this table defining categories based on ranges.

Attributes

Name	Definition	Type	Domain Values
Category	Minimum Sum of this range	Integer	Numeric value greater than or equal to 0
Value	Weighting (Score) representing environmental significance of this category relevant to other categories within this layer and externally, i.e. relative to other NEDS primary data layer weightings.	Integer	Numeric value greater than or equal to 0

2.5 Wetlands_Weighting

Description

This user-configuration table is used by the NEDS tool to define the relative weightings of each input data layer that is used to represent Wetlands as a whole. Currently, three data layers are utilised. Note that weightings for wetlands are based on the input data layer as opposed to a specific attribute.

Attributes

Name	Definition	Type	Domain Values
DataSource	Data Source Layer Name	Text	• RAMSAR • WMA_Wetlands • DIWA_Wetlands
Value	Weighting (Score) representing environmental significance of this layer relevant to other categories within this layer and externally, i.e. relative to other NEDS primary data layer weightings.	Integer	Numeric value greater than or equal to 0

Appendix B – Species Data Synthesis

Species is an amalgamation and synthesis of data from the Herbarium, Museum and RCC observations, with variable quality and spatial accuracy.

The following steps describe how this data has been synthesised form the three source datasets, and is provided here for transparency of process only .

Remove Unrequired Fields

1. Museum data – removed all columns except “Taxon_Fa”, “Taxon_Ge”, “Taxon_Sp”, “Taxon_Su”, “Taxon_Co”, “Latitude_E”, “Longitude” and “Field_Co_2”. Columns “Taxon_Ge”, “Taxon_Sp” and “Taxon_Su” were then combined into one field. The fields “AQ_number” and “Precision” were added to correspond with other datasets. The column “Source” was added and filled with “QM”.
2. Herbrecs data - removed all columns except “Aq_Nr”, “Family_nam”, “Botanical_”, “Precision”, “Lat_decima”, “Long_Decim” and “Collect_Da”. The column “Source” was added and filled with text “Herb”.
3. RCC flora data - removed all columns except “Collected”, “Commonname”, “Genus”, “Species”, “lat” and “long”. “Genus” and “Species” columns were then combined. The fields “AQ_number” and “Precision” were added to correspond with other datasets. The column “Source” was added and filled with text “RCC”.

Combine into One DataSet

1. Species datasets from Museum, Herbrecs, and RCC were then combined into one table with the following column headings: “Aq_Number”, “Family”, “Scientific”, “Common_Nam”, “Date_Colle”, “Precision”, “Latitidue”, “Longitude” and “Source”.

Add Fields to Describe Scoring and EPBC Status

1. The following columns were then added to the combined dataset: “EPBC_Status”, “EPBC_Score”, “NC_Status”, “NC_Score”, “Backon_Tra”, “BoT_Score” and “Score_tota”.

Filter Undesired Records

1. Records for all species not listed under Qld Nature Conservation Act, the federal EPBC Act and the south east Qld Back on Track priority species were then removed from the table.

Populate Scoring and EPBC Status

1. The Qld Nature Conservation Act, the federal EPBC Act and the south east Qld Back on Track priority species score columns were filled using allocations specified in the following table.

NC Act	EPBC Act	Regional values	Score
–	Critically endangered	–	5
Endangered	Endangered	–	4
Vulnerable	Vulnerable	–	3
Near Threatened	Conservation Dependent	–	2
–	–	Back on Track	1

2. The scores from these three columns were then added together to fill the “Score_tota” field.

Develop Spatial Model using Buffer Approach

1. Points were then spatially registered using the latitude & longitude fields.
2. Entries from the fields “Latitude” and “Longitude” were concatenated into a single field “Lat_Long”, delimited by a space—“ ” using the field calculator.
3. Entries from the fields “Scientific” and “Lat_Long”, were concatenated into a single field “Sci_L_L” delimited by an underscore—“_” using the field calculator.

4. All but one of the records that had duplicate entries in the field “Sci_L_L” were deleted using the “delete duplicates” feature.
5. The least accurate records in the dataset are rounded to arc minutes (e.g. 27 38' 0" South, 153 10' 0" East). At the equator, an arcsecond is 30.9 metres. So 59 arcseconds equals 1823.1 m. As a minimum distance for accuracy of all points, a buffer was carried out at 1823.1 m. For future refinement of the dataset, more accurate buffers for entries rounded to arcminutes could be calculated using the specific latitudes of the points (multiplying by cos(lat)). Specific buffers could also be applied for records from the HERBRECS using the accuracy field in that database.

Refine Data through Union, Concatenation and Dissolve

1. A union was carried out on the resulting polygon dataset.
2. Two new double fields were created—“Ply_Lat” and “Ply_Long”, and the geometry calculator was used to derive X and Y in decimal degrees.
3. A new text field was created called polycentre and the field calculator was used to join X and Y together, delimited by a comma (","). This in effect created a new ID for the polygon based on the centroid of the newly unioned polygons.
4. A concatenation of the “Scientific” field was carried, but based on the polycentre field. This was done using the Concatenate Row Values tool added to ArcToolbox, with the script modified to only concatenate unique values, not duplicates. This allowed the desired concatenation in cases where coincident polygons contained the same species.
5. Another text field was added, called “Ply_Sci” as a concatenation of the polycentre (x,y) & “Scientific” (the original, not concatenated using the field calculator)
6. A dissolve was carried out, based on the “Ply_Sci” field. But including the numeric field “Score_tota” in the output, as well as the fields “Ply_Sci”, “Polycentre”, “Ply_Sci” (using FIRST as the statistic for all).
7. A new text field was created “Sci_all”.
8. A concatenate was carried out on polycentre using the Concatenate Row Values Tool in order to combine all species in each polygon. These concatenated entries were populated in the “Sci_all” field.
9. A dissolve was carried out just on the “polycentre” (x,y) this time with the tool being told to sum the numeric field “Score_tota” using the SUM statistic. The concatenated species field (“Sci_all”) and other relevant fields were included in the output as well, using FIRST as the statistic.
10. A final dissolve was carried out based on the concatenated species field (“Sci_all”).

Appendix C – Metadata of State Government and RCC Datasets