Wimmera CMA

NRMPCC Modelling

Waterway Datasets

State Wide

Natural Resource Management Plan for Climate Change

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Introduction

The WCMA NRMPCC aims to assess future projects in terms of their value by taking into account biodiversity, agriculture and carbon. In order to be a robust and informed plan, these three factors need to be balanced within the plan's modelling framework.

This modelling framework aims to address terrestrial and wetland activities. In order to understand and prioritise waterway ecosystems, it is important to gain an understanding of the capacity of different wetlands types to sequester and store carbon. Similarly, it is important to understand the potential for a waterway to be restored to a functioning state.

A report produced by the Danone Fund for Nature (DFN) discussing carbon offsets through wetland ecosystems provides a framework for defining carbon sequestration and restoration potential for 26 distinct wetland types (Danone Fund for Nature, 2009).The first stage of this project was to reclassify Victoria's wetlands into the categories referenced in the Danone Report. Once reclassified, the waterway were be assessed using a multi-criteria decision analysis to determine their potential for carbon sequestration and restoration.

Defining Wetland Categories

Waterway were classified as per the recommendations set out in the Danone Report, using a range of input datasets. There are three primary datasets used in classifying waterway, each used to classify different ecosystems:

- **Wetlands 2013**
  http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803004912
  The wetlands 2013 layer is used to define wetland classes from state government recognised wetlands.
- **ISC Streamed**
  http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803005125
  The ISC streambed layer is used to define riverine wetland classes.
- **EVC 1750**
  http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803003496
  The EVC1750 layer is primarily used to define riparian classes, however it does also contribute to estuarine and other water dependant ecosystems not included in Wetlands 2013. EVC groups 8, 14, 18 and 19 were deemed suitable for inclusion in this process.

Two secondary datasets were also used to determine waterway class:

- **NaturePrint Vegetation Extent**
  http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803005186
- **Victorian Digital Soil Map**
  http://services.land.vic.gov.au/catalogue/metadata?anzlicId=ANZVI0803005246

Secondary datasets were used to complete waterway attributes not present in the primary datasets. The following sections outline the approach for using these datasets:

Functional vs Non Functional Waterways

Functioning and non-functioning waterway are treated separately within the recommendations of the Danone Report. Typically non-functioning waterways have a lower ability to sequester carbon. In the absence of a dedicated waterway condition dataset for the

state of Victoria, a non-functional waterway layer was derived from the NaturePrint Vegetation Extent.

- Where a waterway was classed as native within NaturePrint Vegetation Extent, it is assumed to be functioning.
- Where a waterway was not classed as native within NaturePrint Vegetation Extent, it is assumed to be non-functioning.

Waterway Organic Content

Waterway organic content was classed as either mineral or organic using the Victorian Digital Soil Map organic carbon dataset. Organic matter was calculated by multiplying the percent of organic carbon provided in the dataset by a factor of 1.72, as recommended by a range of sources (Pluske, et al., 2015). In Australia, most soils are deemed to be influenced by organic matter contents of greater than 7% (DEPI, 2015).

- Waterways with soils containing 1-7% organic matter were classed as mineral.
- Waterways with greater than 7% organic matter were classed as organic.

Forested vs Non Forested Waterways

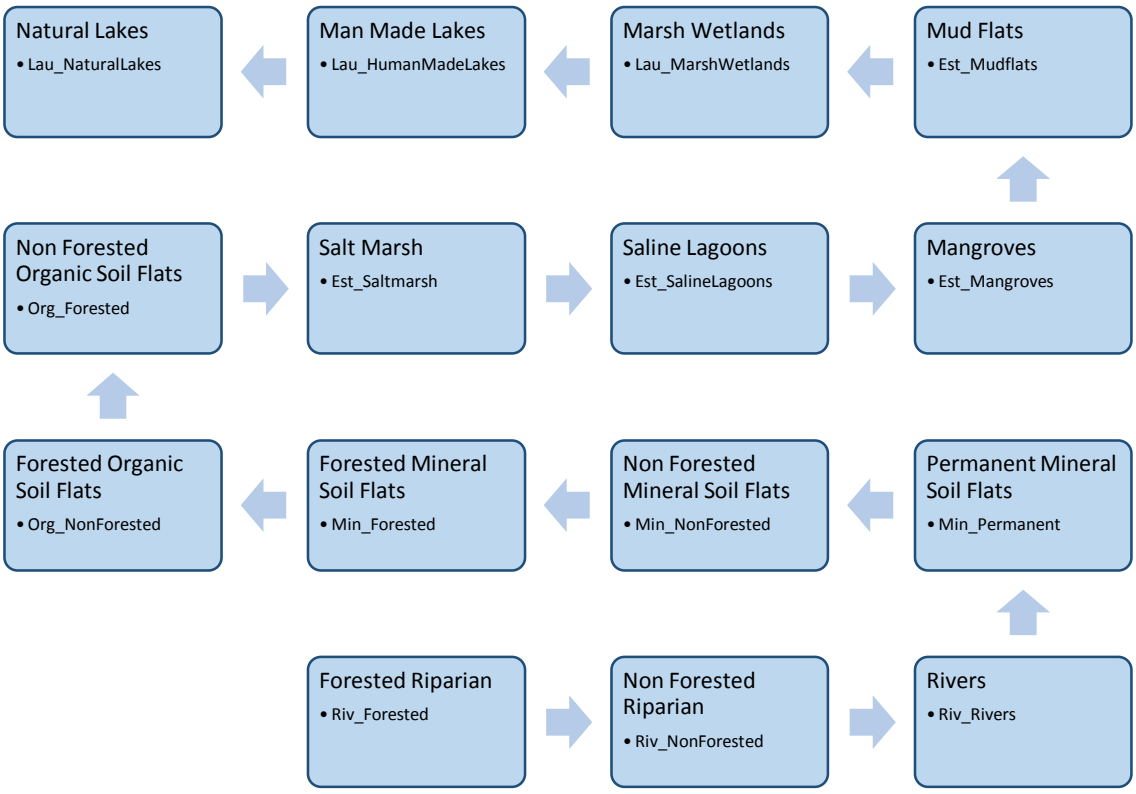
Forested waterways have been defined using attributes of Wetland 2013 and EVC1750. A waterway has been classified as forested then the dominant vegetation is listed as 'Forest/Woodland'. In areas not covered by Wetland 2013, the large tree count and tree canopy cover attributes of EVC1750 were examined.

Waterway classes were assigned using the information above as well as data embedded within Wetlands 2013. The final list of EVC and Wetland definitions for classification has been included in Appendix 1: Defined Waterway Classes.

In some cases, classified waterway datasets overlap. This is due the use of three non-exclusive primary datasets as input to this modelling process. Overlaps can occur both within and between classes. Each of these overlap types are handled differently:

Within classes, functional datasets will always override those that are degraded.

Between classes, the hierarchy outlined in the below indicates the dataset join order.



Key

Wetland Classification

A → B Where feature A overlaps feature B, feature B takes preference

Carbon Capture Potential

A multi-criteria decision analysis has been used to determine carbon capture potential as per the Danone Report. The carbon capture potential score ranges from 0 to 100, with 0 indicating a low and 100 indicating a high potential for carbon requestion. The carbon capture potential score is derived by obtaining the sum of carbon storage and sequestration rates, as a percentage of the total possible score.

$$\frac{Carbon\ Storage + Sequestration\ Rate}{max(Carbon\ Storage + Sequestration\ Rate)}$$

The input values for this calculation differs for functioning and non-functioning ecosystems. The tables in Appendix 2: Carbon Capture Potential indicate values used in calculations and are summarised from the Danone Report.

Restoration Potential

A multi-criteria decision analysis has been used to determine restoration potential as per the Danone Report. The restoration potential score ranges from 0 to 100, with 0 indicating a low and 100 indicating a high potential for restoration. The restoration potential score is derived by obtaining the sum of degradation risk and degradation mitigation priority, multiplied by the permanence score as a percentage of the total possible score.

$$\frac{(Degradation\ Risk + Mitigation\ Importance) * Permanence}{\max((Degradation\ Risk + Mitigation\ Importance) * Permanence)}$$

The tables in Appendix 3: Restoration Potential indicate values used in calculations and are summarised from the Danone Report.

References

Danone Fund for Nature, 2009. *Achieving Carbon Offsets through Mangroves and Other Wetlands.* [Online]
Available at: http://wetcarbon.earthmind.net/files/DFN-Expert-Workshop-Nov-2009-Final.pdf

DEPI, 2015. *How do the properties of soils affect plant growth.* [Online]
Available at: http://www.depi.vic.gov.au/agriculture-and-food/dairy/pastures-management/fertilising-dairy-pastures/how-do-the-properties-of-soils-affect-plant-growth
[Accessed 25 April 2015].

Pluske, W., Murphy, D. & Sheppard, J., 2015. *Total Organic Carbon Factsheet.* [Online]
Available at: http://www.soilquality.org.au/factsheets/organic-carbon
[Accessed 25 April 2015].

Appendix 1: Defined Waterway Classes

1. Riv_Rivers	
Dataset	ISC 2010 Streambed
Query:	*
Description:	All streambed features were included in the modelling and classified as *Riverinene> River, waterfalls, wadi*
2. Riv_Forested	
Dataset	EVC 1750 Wetlands 2013
Query:	**EVC1750** 17, 40, 53, 59, 185, 191, 212, 233, 269, 272, 280, 318, 430, 431, 432, 434, 449, 509, 510, 512, 522, 553, 585, 588, 596, 607, 637, 638, 639, 666, 707, 937, 56, 68, 198, 250, 256, 514, 515, 516, 640, 659, 662, 674, 679, 808, 811, 812, 813, 814, 816, 817, 822, 823, 942, 943, 945, 946, 1021, 1022, 1023, 1024, 1025, 1031, 1032, 1033, 1034, 1035, 1036, 1037, 1039, 1067, 1068, 1069, 1070, 1071, 1072, 1075, 1076, 1077, 1078, 1079, 1080 **Wetlands 2013** AQ_SYS = 'Palustrine' AND CORR_CLASS = '1 - Flooded river flats' AND DOM_VEG = 'Forest/woodland'
Description:	All features matching the queries above were included in the modelling and classified as *Riverinene> Forested riparian/alluvial*
3. Riv_NonForested	
Dataset	EVC 1750 Wetlands 2013
Query:	**EVC1750** 19,41,83,126,141,687,688,695,701,720,733,775,776,798,799,851,168,690,774,863,869 **Wetlands 2013** AQ_SYS = 'Palustrine' AND CORR_CLASS = '1 - Flooded river flats' AND NOT DOM_VEG = 'Forest/woodland'
Description:	All features matching the queries above were included in the modelling and classified as *Riverinene:Non forested marshes/deltas*
4. Min_Permanent	
Dataset	Wetlands 2013
Query:	AQ_SYS = 'Palustrine or Lacustrine (unknown specifics)' AND WTRREG='Permanent') *OR* AQ_SYS = 'Marine' AND CORR_CLASS = '5 - Permanent open freshwater'
Description:	All features matching the queries above were included in the modelling and classified as *Mineral soil flats and Depressional> Permanent: depressional wetland, oases, ponds, karst, marshes, prairie, pothole*
5. Min_NonForested	
Dataset	EVC 1750 Wetlands 2013 and Soil Class

Query:	**EVC1750** 11, 12, 74, 104, 107, 125, 136, 172, 647, 653, 655, 680, 681, 691, 700, 718, 830, 831, 832, 833, 834, 875 **Soil Class and Wetlands 2013** NOT DOM_VEG = 'Forest/woodland' AND SOILTYPE = 'Mineral'
Description:	All features matching the queries above were included in the modelling and classified as *Mineral soil flats and Depressional> Seasonal wet non-forested: meadows, salt pans, dambos*
6. Min_Forested	
Dataset	EVC 1750 Wetlands 2013 and Soil Class
Query:	**EVC1750** 200, 284, 288, 291, 292, 297, 300, 333, 334, 458, 519, 521, 804, 807, 809, 810, 819, 821, 886, 899, 915, 932, 939, 975, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1081, 1082, 1083, 1084, 1087, 1090 **Soil Class and Wetlands 2013** DOM_VEG = 'Forest/woodland' AND SOILTYPE = 'Mineral'
Description:	All features matching the queries above were included in the modelling and classified as *Mineral soil flats and Depressional> Seasonal wet forested: meadows, salt pans, dambos*
7. Org_Forested	
Dataset	EVC 1750 Wetlands 2013 and Soil Class
Query:	**EVC1750** 103, 106, 255, 295, 321, 663, 815, 1015, 1016, 1017, 1019, 1020, 1027, 1028, 1029, 1030, 1040, 18, 84, 1041, 1042, 1061, 1062, 1063, 1065, 1073, 1074, 1099, 641, 668, 818, 928, 1085 **Soil Class and Wetlands 2013** DOM_VEG = 'Forest/woodland' AND SOILTYPE = 'Organic'
Description:	All features matching the queries above were included in the modelling and classified as *Organic soil flats> Temperate, alpine and boreal forested wetlands*
8. Org_NonForested	
Dataset	EVC 1750 Wetlands 2013 and Soil Class
Query:	**EVC1750** 110, 658, 870, 871, 872, 873, 123, 237, 293, 506 **Soil Class and Wetlands 2013** NOT DOM_VEG = 'Forest/woodland' AND SOILTYPE = 'Organic'
Description:	All features matching the queries above were included in the modelling and classified as *Organic soil flats> Temperate, alpine and boreal non forested wetlands*
11. Lau_NaturalLakes	
Dataset	EVC 1750 Wetlands 2013
Query:	**EVC1750** 992 **Wetlands 2013** AQ_SYS = 'Lacustrine' AND CORR_CLASS = '5 - Permanent open freshwater' AND Origin = 'Naturally occuring'

	OR AQ_SYS = 'Lacustrine' AND WTRREG='Permanent' AND ORIGIN='Naturally occuring'
Description:	All features matching the queries above were included in the modelling and classified as *Lacustrine> Natural: lakes, glacier lakes*
12. Lau_HumanMadeLakes	
Dataset	Wetlands 2013
Query:	AQ_SYS = 'Lacustrine' AND CORR_CLASS = '5 - Permanent open freshwater' AND Origin In ('Dam / Storage =>8ha', 'Dam / Storage <8ha', 'Artificial (type unknown)', 'Excavation ponds', 'Unknown') *OR* AQ_SYS = 'Lacustrine' AND WTRREG='Permanent' AND ORIGIN IN ('Dam / Storage <8ha', 'Dam / Storage =>8ha', 'Artificial (type unknown)', 'Excavation ponds', 'Unknown')) *OR* ORIGIN IN ('Sewage treatment ponds', 'Stormwater treatment ponds', 'Salt works','Aquaculture ponds') OR CORR_CLASS IN ('20 - Sewage oxidation basin','21 - Salt evaporation basin')
Description:	All features matching the queries above were included in the modelling and classified as *Lacustrine> Human made: reservoirs and dams, post mineral extraction sites (gravel, mine), aquaculture ponds, treatment ponds*
13. Lau_MarshWetlands	
Dataset	Wetlands 2013
Query:	AQ_SYS = 'Lacustrine' AND CORR_CLASS IN ('2 - Freshwater meadow','3 - Shallow freshwater marsh','4 - Deep freshwater marsh') *OR* AQ_SYS = 'Lacustrine' AND CORR_CLASS = '99 - No Category'
Description:	All features matching the queries above were included in the modelling and classified as *Lacustrine> Marsh Wetlands*
14. Est_SaltMarsh	
Dataset	EVC 1750 Wetlands 2013
Query:	**EVC1750** 9, 101, 196, 636, 648, 676, 677, 717, 741, 820, 888, 940,991 **Soil Class and Wetlands 2013** AQ_SYS = 'Estuarine' AND CORR_CLASS = '6 - Semi-permanent saline') OR (AQ_SYS = 'Estuarine' AND CORR_CLASS = '99 - No Category' *OR* AQ_SYS = 'Marine' AND CORR_CLASS = '6 - Semi-permanent saline' AND DOM_VEG = 'Coastal saltmarsh'
Description:	All features matching the queries above were included in the modelling and classified as *Estuarine & coastal fringe> Salt marsh*
15. Est_SalineLagoons	
Dataset	EVC 1750 Wetlands 2013

Query:	**EVC1750** 10, 13, 643, 656, 891, 906, 914, 934, 935, 941,,1107 **Soil Class and Wetlands 2013** AQ_SYS = 'Estuarine' AND CORR_CLASS = '7 - Permanent saline' *OR* (AQ_SYS = 'Lacustrine' AND CORR_CLASS = '5 - Permanent open freshwater' AND Origin In ('Dam / Storage =>8ha', 'Dam / Storage <8ha', 'Artificial (type unknown)', 'Excavation ponds', 'Unknown') *OR* AQ_SYS = 'Lacustrine' AND CORR_CLASS IN ('6 - Semi-permanent saline','7 - Permanent saline') *OR* AQ_SYS = 'Marine' AND CORR_CLASS = '7 - Permanent saline')
Description:	All features matching the queries above were included in the modelling and classified as *Estuarine & coastal fringe> Saline/Coastal lagoons*
16. Est_Mangroves	
Dataset	EVC 1750 Wetlands 2013
Query:	**EVC1750** 140, 302, 692, 903 **Soil Class and Wetlands 2013** AQ_SYS = 'Marine' AND DOM_VEG = 'Mangrove'
Description:	All features matching the queries above were included in the modelling and classified as *Estuarine & coastal fringe> Mangroves*
20. Est_Mudflats	
Dataset	Wetlands 2013 and Soil Class
Query:	**Soil Class and Wetlands 2013** AQ_SYS = 'Marine' AND CORR_CLASS = '6 - Semi-permanent saline' AND DOM_VEG IN ('No emergent vegetation', 'No dominant class', 'Unknown') *OR* AQ_SYS = 'Marine' AND CORR_CLASS = '7 - Permanent saline'
Description:	All features matching the queries above were included in the modelling and classified as *Estuarine & coastal fringe> Mudflats, tidal flats, beaches*

Please Note: Some classes in the Danone Report have been excluded from this modelling process due to their absence from the study area.

Appendix 2: Carbon Capture Potential

Functioning Ecosystems

Dataset Name	Carbon Storage	Sequestration Rate	Score
Rivers (Riv_Rivers)	0	0	**0**
Forested Riparian & Alluvial (Riv_Forested)	2.5	2	**75**
Non-forested Marshes (Riv_NonForested)	1.5	1	**42**
Permanent (Min_Permanent)	1.5	1.5	**50**
Seasonal non forested (Min_NonForested)	1	1	**33**
Seasonal forested (Min_Forested)	2.5	1	**58**
Temperate, alpine and boreal forested wetlands (Org_Forested)	3	1	**67**
Temperate, alpine and boreal nonforested wetlands (Org_NonForested)	3	1	**67**
Natural: Lakes (Lau_NaturalLakes)	1.5	1.5	**50**
Human Made (Lau_HumanMadeLakes)	1.5	2	**58**
Salt marsh (Est_SaltMarsh)	2.5	3	**92**
Saline Lagoons (Est_SalineLagoons)	1.5	2	**58**
Mangroves (Est_Mangroves)	2.5	3	**92**
Mudflats, Beaches, Tidal flats (Est_Mudflats)	1.5	1	**42**
Marsh Wetlands (Lau_MarshWetlands)	1.5	2.5	**67**

Non-Functioning Ecosystems

Dataset Name	Carbon Storage	Sequestration Rate	Score
Rivers (Riv_Rivers)	0	0	**0**
Forested Riparian & Alluvial (Riv_Forested)	1.5	0.5	**33**
Non-forested Marshes (Riv_NonForested)	1	0.5	**25**
Permanent (Min_Permanent)	1	0.5	**25**
Seasonal non forested (Min_NonForested)	0.5	0.5	**17**
Seasonal forested (Min_Forested)	1.5	0.5	**33**
Temperate, alpine and boreal forested wetlands (Org_Forested)	2	0	**33**
Temperate, alpine and boreal nonforested wetlands (Org_NonForested)	2	0	**33**
Natural: Lakes (Lau_NaturalLakes)	1	1	**33**
Human Made (Lau_HumanMadeLakes)	1	1	**33**
Salt marsh (Est_SaltMarsh)	2	0.5	**42**
Saline Lagoons (Est_SalineLagoons)	2	1	**50**
Mangroves (Est_Mangroves)	2	0.5	**42**
Mudflats, Beaches, Tidal flats (Est_Mudflats)	1.5	1	**42**
Marsh Wetlands (Lau_MarshWetlands)	1	0	**17**

Appendix 3: Restoration Potential

Restoration Potential

Dataset Name	Degradation Risk	Mitigation Importance	Restoration Permanence	Score
Rivers (Riv_Rivers)	3	0	2	**33**
Forested Riparian & Alluvial (Riv_Forested)	3	2	2	**56**
Non-forested Marshes (Riv_NonForested)	3	1.5	2	**50**
Permanent (Min_Permanent)	3	1	1	**22**
Seasonal non forested (Min_NonForested)	3	1	2	**44**
Seasonal forested (Min_Forested)	3	3	2	**67**
Temperate, alpine and boreal forested wetlands (Org_Forested)	2.5	3	2.5	**76**
Temperate, alpine and boreal nonforested wetlands (Org_NonForested)	2.5	3	2.5	**76**
Natural: Lakes (Lau_NaturalLakes)	3	1	2	**44**
Human Made (Lau_HumanMadeLakes)	1	1	3	**33**
Salt marsh (Est_SaltMarsh)	3	1.5	1.5	**38**
Saline Lagoons (Est_SalineLagoons)	3	1	1.5	**33**
Mangroves (Est_Mangroves)	3	1.5	1.5	**38**
Mudflats, Beaches, Tidal flats (Est_Mudflats)	3	1	1.5	**33**
Marsh Wetlands (Lau_MarshWetlands)	3	1.5	2	**50**