# The Natural Resource Management Planning Portal: perspectives for NRM planning and reporting

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## ABSTRACT

Natural Resource Management (NRM) is often conducted as a partnership between government and citizens. In Australia, government agencies formulate policy and fund implementation that may be delivered on-ground by community groups (such as Landcare). Since the late 1980s, over AUS$8b of Commonwealth investment has been made in NRM. However, quantitative evidence of environmental improvements is lacking. The NRM Planning Portal has been developed to (1) provide an online spatial information system for sharing Landcare and agency data; and (2) to facilitate NRM priority setting at local and regional planning scales. While the project successfully federates Landcare NRM activity data, challenges included (1) unstructured, non-standardised data, meaning that quantitative reporting against strategic objectives is not currently possible, and (2) a lack of common understanding about the value proposition for adopting the portal approach. Demonstrating the benefit of technology adoption is a key lesson for digital NRM planning.



Keywords: community-based NRM, catchment management, data standards, web-GIS, NRM priorities, citizen science, Corangamite, Victoria

## INTRODUCTION

Conservation and sustainable management of natural assets like water, biodiversity, soil and ecosystem processes underpins Natural Resource Management (NRM). NRM frequently has a strong focus on community involvement, resulting in the concept of community-based natural resource management (CBNRM), which is "about managing people – environment relationships" (Curtis et al. 2014). While this philosophy applies globally, CBNRM programs in countries like Australia may operate at larger spatial scales (*c.f.* the German Landcare Association: Prager and Vanclay 2010), or differ by targeting landscapes in predominantly private ownership (*c.f.* a public land focus for CBNRM in Canada: Bork 2016; Dressler et al. 2010). These differences makes the lessons from the Australian experience both unique and valuable for programs in other countries.

In Australia, NRM planning and implementation is conducted by a range of stakeholders, the most involved being regional NRM bodies and community groups (Robins and Dovers 2007; Prager 2010). National and state governments set policy and targets for NRM, and regional NRM bodies provide strategic direction for actions, distribute funding, and monitor, evaluate and report (MER) on regional NRM outcomes (Whittaker et al. 2004). Australia has 56 regional NRM bodies that are often most closely connected to local communities (Lockwood and Harwood 2017; Prager 2010).

In the state of Victoria, Catchment Management Authorities (CMAs) are the statutory regional NRM bodies charged with planning and implementation (Robins and Dovers 2007). They are required by the Victorian Government to develop and implement Regional Catchment Strategies (RCS), intended to guide investment in on-ground activities within the region and reflect State and Commonwealth priorities (Whittaker et al. 2004). CMAs engage with communities to co-develop and implement their RCS and community groups like Landcare are funded, via the CMA, to implement on-ground NRM activities at local scales (although groups are not always engaged in the planning process: Wallington et al. 2008). Landcare groups usually operate at small spatial and social scales, and most are part of a Landcare network (Robins 2018). Presently, Landcare and regional NRM bodies facilitate community engagement to deliver NRM outcomes (Curtis et al. 2014).

The soil conservation movement of the late 1930s heralded the provenance of Landcare, which was formalised by the launching of two Landcare Groups in Victoria in 1988 (Youl et al. 2006). The Decade of Landcare (1990-2000) and the National Landcare Program (NLP)

established Landcare nationwide (Robins 2018). NLP is funded by Commonwealth and State Governments to engage communities and land holders in land stewardship and sustainable resource management, mostly on private land (Curtis and Lockwood 2000; Tennent and Lockie 2013). The extent to which these works are influenced by regional or state strategies is poorly documented however, reflecting variable community involvement in past formulation of strategies and policy (Prager 2010; Prager and Vanclay 2010; Robins and Dovers 2007).

Since 1990, >$8 billion of Commonwealth NRM investment has been channelled through the National Landcare Program, National Heritage Trust, National Action Plan for Salinity and Water Quality, Caring for our Country and the Biodiversity Fund, and the current National Landcare Program 2 (NLP2) (Cresswell and Murphy 2016; Curtis et al. 2014, Robins 2018). However, the value of this public investment in terms of environmental improvements is not clearly demonstrable (Curtis and Lockwood 2000; Pannell and Roberts 2010; Pannell et al. 2012), especially without a unified approach to the collection, recording and reporting of NRM on-ground activities and outcomes. Without the knowledge base from previous funded works, combined with decision support tools, formulation for future priorities for NRM investment is hampered (Curtis and Lockwood 2000).

The present time period provides unprecedented opportunities for monitoring and recording NRM activities, through the use of digital technologies. Globally, the volume of community-based monitoring and citizen science data is growing exponentially as technologies empower citizens with the means to easily record spatial data (Sui et al. 2013; e.g. Conrad and Hilchey 2011), adding to an increasing amount of digital NRM data available to practitioners (Dahlhaus et al. 2018). In addition, data availability has vastly improved as governments in many countries adopt open data policies (Zuiderwijk and Janssen 2014). Thus, the use of spatial digital technologies for a more holistic understanding of NRM is an emerging area of eResearch.

This paper describes the development of an eResearch initiative called the NRM Planning Portal (NRMPP) and reflections from the authors, along with recommendations for future social research. The NRMPP was created to support NRM planning in the Corangamite catchment region of Victoria (Figure 1). The NRMPP (www.ccmaknowledgebase.vic.gov.au/nrmpp) has been developed to allow eleven Landcare networks and the Corangamite CMA to view and spatially match their NRM priorities and

explore the potential for co-investment in activities (Figure 2). Combining data sources, including legacy data, into an online spatial information system that visualises NRM activity and priorities, has helped facilitate engagement between NRM stakeholders. The outcomes of this project provide insights into the challenges and lessons for environmental accounting and future NRM planning.

## DEVELOPMENT OF THE NRMPP

The NRMPP was conceived and implemented through an iterative co-design and co-development process involving university researchers and technicians, Corangamite CMA staff and Landcare network coordinators. This usually involved CMA-hosted workshops with 1-3 coordinators for each network (average one session per network), at which the optimum for each network was designed.

The NRMPP is a web-based interactive viewing and mapping application built on open source software and open data standards to enable users to view interoperably federated data in a standard web browser. In using the NRMPP, stakeholders are cycled through key stages (Figure 3), which include online mapping of NRM spatial data and NRM priorities (e.g. weed control) at regional (CMA) and local (Landcare) scales, data standardisation and identification of locations where CMA and network priorities overlap in order co-develop new NRM projects that address the objectives of those joint priority areas.

Data may be provisioned from disparate custodians and viewed in a web mapping application alongside a suite of simple tools for viewing, querying and downloading these NRM data. Via a login, Landcare network users can draw point, line or polygon features, and describe them using agreed attributes for a project activity (e.g. revegetation works), an asset (e.g. remnant vegetation) or a priority (e.g. erosion control). The standard descriptions were co-developed with consideration of standard protocols developed by the Victorian Government to enable consistent classification and description of the submitted data. Any other digital content, such as images or documents, can also be attached to the mapped feature.

Data for the NRMPP are acquired from three main sources: Corangamite CMA, government web services or data repositories, and the participating Landcare networks. CMA spatial data is provisioned in standard desktop GIS formats, pre-processed where necessary to standardise map projections, then uploaded to the NRMPP database and published online. Relevant contextual information in standard document, image or video formats is linked to spatial features through dynamic queries.

Government data layers (e.g. native vegetation maps) are provisioned to the NRMPP through web services where available, or via scheduled updates from online repositories (e.g. Victoria's open data directory: data.vic.gov.au).

Polygons representing NRM activity data (e.g. tree planting, erosion control works, pest plant or animal control) recorded and held by Landcare networks are supplied in a range of GIS formats, digitised from hard copy maps, or mapped directly into the NRMPP using the 'contribute tool'. In other instances, unrecorded data has been field mapped with the person(s) having the knowledge of past works and activities.

Supplied spatial layers are often pre-processed to correct discernible data anomalies, standardise spatial file formats and map projections, delete duplicate features, and merge multiple spatial elements that share the same geometry. Field names or attribute data are not altered, and are retained in merged tables. The processed data layers are published to the NRMPP and can be accessed and downloaded by members through their network login.

Historically, few Landcare networks produced digital spatial layers representing local priorities for NRM investment and activity. Therefore, spatial layers are either newly created by the network, or constructed by transposing priorities identified in local strategies or plans into a digital format. In rare cases, existing digital priority mapping was simply loaded to the NRMPP in the same manner as activity data. This process was often facilitated through informal training sessions, aimed at providing guidance in GIS and portal use, and seeking feedback from users on portal improvements and new features. Previously recorded spatial NRM activity data were also retrieved from the archived Catchment Activity Management System (CAMS) database (1997-2013) managed by the Department of Environment, Land, Water and Planning, to increase representation of past works undertaken within the catchment. Spatial layers representing regional priorities for "natural assets" e.g. soils, waterways and wetlands, native vegetation and threatened species (CCMA 2013), are provisioned by the CMA and uploaded to the NRMPP.

## IMPLEMENTATION OF THE NRMPP

From the outset of the project it was apparent that very few networks had complete and structured spatial data sets, that is, GIS files with comprehensive attribute information, and consistent vocabularies and nomenclature (e.g. erosion works versus revegetation versus stream fencing). Only two networks had a complete record of their own historical spatial data in structured, electronic format (e.g. shapefiles with attribute information) and all lacked formal metadata records for the spatial elements.

Network coordinators and volunteer members involved in data management have variable levels of technical expertise and capacity, hence storage, retrieval, interpretation and standardisation of digital spatial data is often problematic. Lack of continuity of volunteers and co-ordinators, and ageing technology also posed challenges for networks, as data are sometimes lost on obsolete hardware and file formats, without accessible backups. These limitations resulted in some networks choosing to discard all previous works data and remap it from anew, with the inevitable delays in publishing their data to the NRMPP. Despite these issues, NRM activity data and its visualisation in the NRMPP are now available for all networks in the Corangamite region, although much of the legacy data remains incomplete and is still being entered as it is rediscovered.

As each network joined the project, information and training sessions were run by the project researchers to provide background on the NRMPP, advice in relation to provisioning of data and guidance on using the portal's tools. User training sessions were usually successful in conveying an understanding to networks about data management and sharing using the NRMPP. The sessions also enlightened the researchers on network needs and the challenges they face in compiling and providing their data. Hence feedback from these sessions guide(d) enhancements to the NRMPP, providing benefits for all networks by increasing the availability of bespoke tools to meet their needs. The intention is to make it intuitive, seamless and as easy as possible to add their data to the portal.

Priority setting has been less successful than NRM activity data acquisition. Networks struggled to undertake or supply local priority mapping, since in most cases they have never actually mapped their local NRM priorities. Nevertheless two networks have since used the NRMPP's contribute tool to map local priorities and another three networks communicated their local priorities to the project researchers, who mapped them on the network's behalf. One network had two local priority types mapped in advance, and both these are published in their original form to the NRMPP.

At the time of writing, only one network has used the NRMPP to develop joint priorities, which occurred in an informal workshop environment facilitated by the project researchers. In consultation with their broader membership, the network and the Corangamite CMA agreed to 'joint priorities' where both organisations are willing to co-invest resources (Figure 4). This network is currently developing funding expressions of interest for on-ground activities at specific sites, based upon these joint priorities, and supported by the Corangamite

CMA. However, no other network has produced joint priorities with the CMA suggesting that none could see the benefit of completing the full priority setting process ahead of other demands.

## BARRIERS TO SUCCESS AND LESSONS LEARNED

The NRMPP has been successful in sharing existing Landcare network data in an open access, online platform. It has refocused the approach of participating networks, in some cases allowing them to see for the first time, the spatial extents of their achievements and those of their neighbouring networks. And it has demonstrated a novel process for planning and prioritisation of activities, with potential for co-investment from the government or other sources.

However, the NRMPP has not yet achieved its stated aims in involving community in the full NRM planning cycle, and no network has progressed to the final NRMPP stage, i.e. new investment arising from joint priority mapping (Figure 3). Networks are comprised largely of volunteers, with very few people in paid (coordinator) roles. As a consequence, apparent barriers to adoption of this technology-based approach were observed during interactions with networks. These were:

- Constraints arising from volunteerism (time, motivations, resourcing, skills, turnover);
- Lack of understanding about priority setting (how, why, where, what);
- Mismatched perceptions about the objectives of the NRMPP;
- Poor data standards, data management and a lack of technical capability (hindering harmonisation of catchment-wide outputs by theme);
- Communication and network dynamics (both within and outside of the networks).

These barriers could be addressed through three main processes: changes to technology design, capacity building and demonstrating benefit.

Technology can be co-designed to improve uptake of citizen-based web mapping applications like the NRMPP, which is constantly evolving to improve the user experience. While it is possible that the NRMPP design was not well matched to community needs, the technology was co-designed with the networks, suggesting that the technology tools were generally fit-for-purpose (despite the variable level of digital literacy across networks). Nevertheless, requests for improvements were common, for example, a web-based project management system that easily addresses the basic reporting needs of networks (e.g. calculates statistics), preferably with seamless links to external requirements (e.g. MERIT: Commonwealth of Australia 2014). Another suggestion was to develop crowd-sourcing tools that allow community members to contribute suggestions for projects activities in their local area, which

has the dual benefit of acknowledging their contribution and visualising it in a publicly-accessible platform.

Successful implementation of digital systems for community-based NRM requires building capacity and skills in end users (Curtis et al. 2014), achievable through training and ongoing support to establish and maintain community participation. Increasing network technical capacity and improving dialogue between networks and other stakeholders (Wyborn et al. 2012) can be achieved by GIS training workshops, spatial data management and use of technology tools. In this project, training sessions tended to be informal and largely unstructured, which appeared to work well for information exchange, but were infrequent and often postponed. Structured training workshops with clear objectives and incentives for attendance help encourage participation, for example, access to a tutor / guide, catering, and workshop outcomes specifically tailored to each participant (e.g. helping users compile their data into reusable, structured formats). The use of facilitators has been recommended (Alem et al. 2005; Tennent and Lockie 2013) for successful uptake of knowledge sharing technology projects in engagement activities like workshops (and follow-up communications and meetings).

The failure to complete the full NRMPP process with the networks suggests that the benefits for using this planning tool are not clear to end users. Through interactions with Landcare network members, it appeared that volunteers were more motivated by active on-ground environmental improvement, rather than mapping, recording and prioritising works, which is consistent with existing research about volunteer motivations (Hagger et al. 2017). Surveys of Landcare network member motivations would be useful to test this. Thus, the NRMPP may be perceived as an unwelcome bureaucratic and administrative burden. While the benefits of showcasing achievements to date and building community pride are readily acknowledged, the rewards of additional investment into Landcare projects through using the NRMPP remain a promise. The NRMPP is still untested in its full cycle (Figure 3) and the demonstrated benefit for Landcare networks is yet to be realised.

## CONCLUSIONS

The NRMPP eResearch project has provided insight into the state of Landcare (and community group) data (generally unstructured and inconsistent), future NRM pitfalls to avoid (demonstrating the benefits of technology adoption) and strategies to manage and use community-generated data (facilitation and greater training support). It has also revealed that

the current level of digital literacy and technical capacity amongst community NRM groups is variable but generally low. These insights shed light on past failures to quantify change in the state of the environment, as a result of Commonwealth and other NRM investment. They also highlight the challenges facing the new NLP2 program, which explicitly focuses on improved monitoring, evaluation and reporting of NRM outcomes (Australian Government 2018).

A vision for CBNRM planning in the future will ideally include the online capture and dynamic reporting of community and agency activities in a manner that is structured, quantitative, and fully interoperable with complementary systems (e.g. MERIT). Future research should focus on how platforms like the NRMPP can increase recognition of volunteer effort and supports them in a way that is consistent with their motivations. Ultimately, it must also be rewarding and beneficial for the community groups involved.

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**Figure 1.** Location of the Landcare network regions (landscape zones) in the NRMPP.

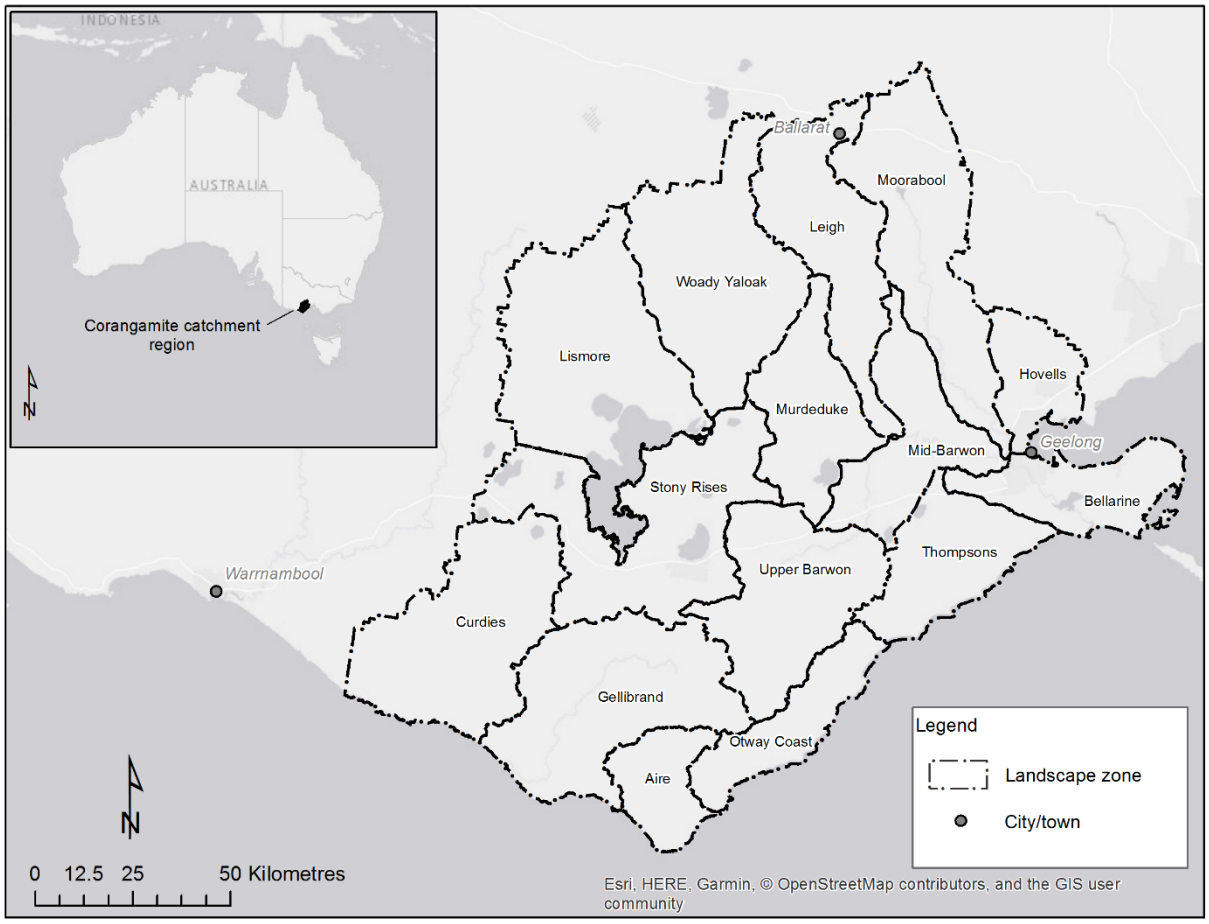


**Figure 2.** Conceptual model for the NRMPP.

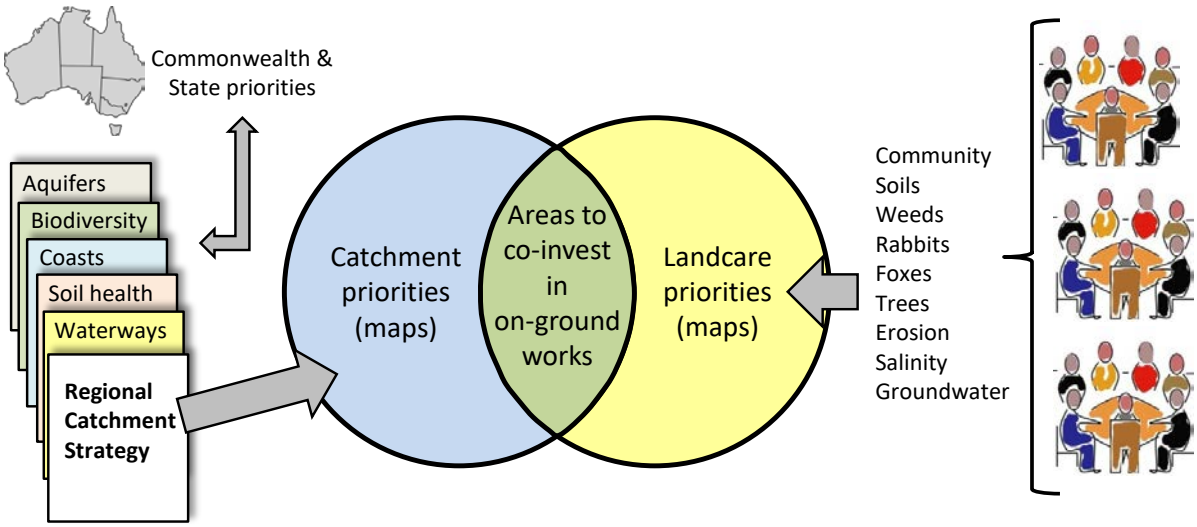

**Figure 3.** Key stages of the NRMPP cycle. CMA = Catchment Management Authority.

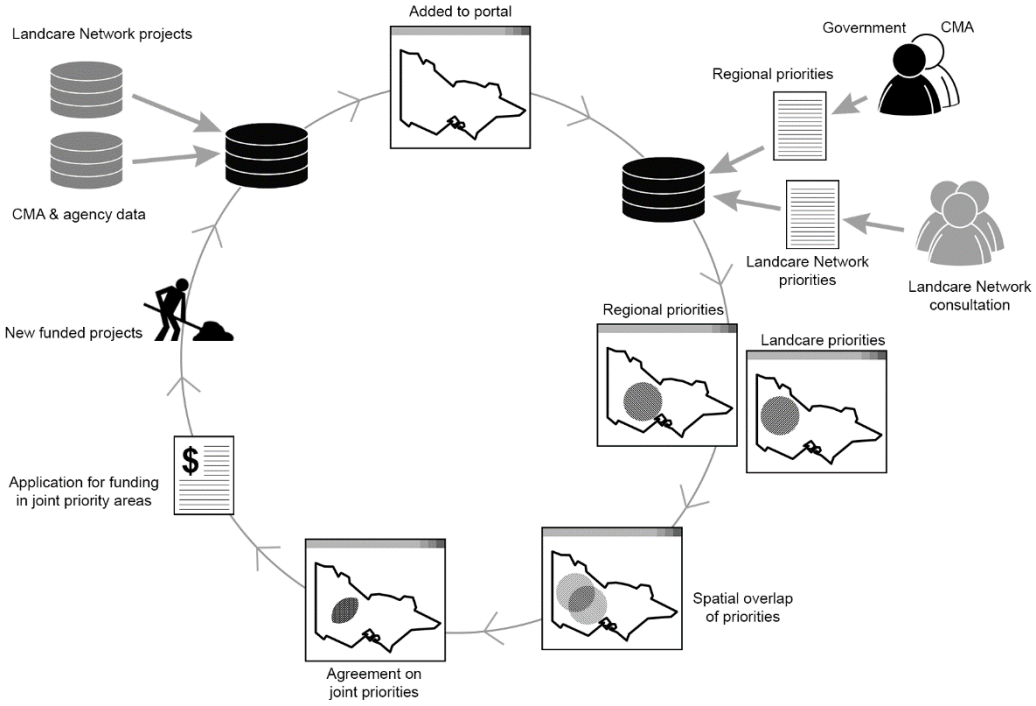

**Figure 4.** Example of mapped joint priorities, agreed upon by the Landcare network and the Catchment Management Authority. Background is VicMap aerial image 2017.