# The Land Use Impact Model (LUIM)

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# 1 Introduction

This report describes the evolution and capability of a land use impact model (LUIM) used in the Department of Primary Industries, Victoria. We use the LUIM to rate and map the risks to soil, land, water, and vegetation under different land uses and practices. It can be used to rate the present risks of current land use. It can also be used to evaluate scenarios of changed land use and practices. The LUIM's primary benefit is in environmental reporting and planning. It is available through DPI to any person or authority wishing to use it for research or planning purposes.

## 1.1 Context

The condition or health of land depends on how it is used and managed. Land capability assessments combine knowledge of the soil and land requirements for particular land uses with knowledge of degradation processes such as soil erosion. Throughout the world there are examples of land capability assessments being used to guide agricultural, forestry and urban development and to inform planning decisions. However, land use and the associated management practices in Australia are largely uncontrolled and left to the discretion and risk of the investor. Poor decisions can result in land degradation, loss of natural resources and wasted investment.

Government investment in regional catchment authorities and boards has been one major response to concerns over unsustainable land management, declining condition of soil, water and native ecosystems. These boards are responsible for the development of natural resource management strategies at the catchment or regional scale. This devolution of responsibility has resulted in considerable effort directed to assessment of natural resource condition and subsequent investment in protection, rehabilitation and restoration. The decisions made by the boards rely strongly on community consultation and on scientific analyses provided by outside agencies (other government departments, universities and consultants).

## 1.2 Landscape design and decision making

Land resource assessment (mapping of soil, land, hydrology, vegetation, degradation, land use), models of landscape processes, and predictive tools are all necessary to support good decisions. The framework of Steinitz (1993) provides a good illustration of the data, information and cultural knowledge that is needed to support landscape planning or investment decisions. Steinitz proposed the following levels and questions that have to be addressed:

1. Representation of the landscape. How should the landscape be described, what attributes need to be mapped?
2. Processes in the landscape. What are the processes that are occurring or need to be understood?
3. Evaluation of the landscape. How well is the landscape working and how can we evaluate this?
4. Change in the landscape. What aspects of the landscape are changing or might change?
5. Impacts on the landscape. What impacts are likely to occur given different scenarios for change?
6. Decision for the landscape. What decision can be or needs to be made?

Answering these questions requires an understanding of complex processes and good data for models. However, our process understanding is often only rudimentary and our data incomplete or at insufficient scale. A simple approach is needed that can use available data at any scale and also integrate expert knowledge of the inter-relationships between land management practices, land qualities and threatening processes. The LUIM is one tool that can fulfil this need.

The LUIM provides a way of integrating the first five levels of Steinitz's framework and can therefore inform the sixth level, the decision process. The data, information and knowledge requirements for the LUIM are

dictated by the type of decision that needs to be made. For example, if decisions need to be made regarding investment in soil protection then this dictates specific needs with respect to soil erodibility, land use practices and land capability, etc.

## 1.3 LUIM applications

We have used the LUIM in seven significant projects since 2000, each of which has contributed to the development of the modelling process.

1. Development of land use impact indicators to support statewide catchment condition reporting,
2. Development of a decision support system for irrigation practices and wetland protection (Kerang).
3. Analysis of land use impacts on biodiversity (Goulburn Broken CMA region).
4. Contribution to the development of the Corangamite Regional Soil Health Strategy.
5. Analysis of risks to remnant vegetation posed by adjacent land use and land management in the Lower Murray dryland region (Lower Murray Landscape Futures project).
6. Contribution to the development of the West Gippsland Soil Erosion Management Plan.
7. Wind erosion risk assessment in the Mallee Region.

## 1.4 Report structure

In this report we briefly describe:

- the risk framework that is now part of the LUIM,
- dealing with data uncertainty using a Bayesian approach,
- the development of the LUIM through cases studies that illustrate different applications,
- the data and knowledge inputs, and
- the principal outputs.

In the final section we discuss future improvements and data needs for the LUIM.