A REVISED LAND AND SOIL CAPABILITY CLASSIFICATION FOR NEW SOUTH WALES

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Abstract
In recent years, New South Wales has seen the development of a number of natural resource management initiatives and reforms. These have created a renewed need for a land classification system to assist the implementation of sustainable land management practices as well as the targeting of public funds. Rural land capability classification (RLC) (Emery 1986) is one system that has been used in the past to achieve these outcomes. However, the rural land capability classification was designed principally to assess the physical characteristics of a site to define limitations on agricultural practices and was intended to meet the needs of farming operations of the time. Such a system therefore has limitations for contemporary use since it does not account adequately for more recent farming practices nor does it account for soil limitations in a sufficiently transparent way. A revised Land and Soil Capability (LSC) classification has therefore been developed to provide a capability assessment based not only on physical land characteristics but also on soil limitations and the management of these to mitigate land degradation and associated off-site environmental impacts. The concepts and development of the revised LSC classification are described and the application of the system to contemporary natural resource management challenges are illustrated.

Introduction
In recent years, NSW has seen the development of a number of natural resource management initiatives and reforms. These have created a renewed need for a consistent land classification framework to assist the implementation of sustainable land management practices as well as the targeting of public funds. The concept of land capability is useful in this respect because it is a composite assessment of land and soil, which incorporates the key physical characteristics that limit sustainable land management. Such an approach is simple and logical in approach, is widely known and accepted in the rural community and has been applied widely (e.g. Klingebiel and Montgomery, 1961; USDA, 2000, CLI, 1965; Bibby *et al*., 1991).

The existing Rural Land Capability Classification system in NSW (Emery 1986) was originally developed to identify and map the environmental factors that may limit agricultural activity in a rural environment and was designed to meet the needs of farming operations of that time. While soil limitations were considered in this original classification, there was no transparent system for including or recording these. The system also has limitations in that it does not fully account for contemporary farming practices nor for all the available information and current knowledge of soil constraints, related off-site environmental impacts and the appropriate management of these.

Here we propose a revised land and soil capability classification system for NSW. The proposed '*Land and Soil Capability Classification*' (LSC) retains the eight class structure of the earlier Rural Land Capability Classification system (designated Class I to Class VIII) because of their logical and transparent nature and their general acceptance in the land resource assessment and the rural community. However, the revised scheme places additional emphasis on soil limitations and their management and explicitly incorporates these into the classification. As we move to progressively higher capability class numbers, an increasing degree of both soil and land limitations then progressively restrict the range of land use practices within these.

The Revised Land and Soil Capability Classification
The aim of the Classification is not to take the place of existing detailed classification systems relating to specific land uses (eg Urban Land Capability Classification, Hannam and Hicks, 1980), but to provide a broad overview for the assessment of the capability of any particular parcel of land. The LSC provides a guide for the assessment of land capability, soil constraints and land management recommendations for use at a range of scales including State,

catchment and the property planning level. The existing NSW DIPNR Land Capability Mapping used in conjunction with other soils information such as soil landscape mapping can be used to provide a broad guide to the soil and land capability class and soil limitations present at the coarse scales. . However, when applying the LSC at the more detailed property scale, a site investigation and assessment by local experts in land resource planning is required.

Operation of the Revised LSC

Although LSC is intended primarily to address land resource issues associated with agricultural activities, it can also be used to provide a general indication of the capability of the land for other land use practices. This is achieved by grouping land use practices on the basis of their potential *impact* on soils and other natural resources, including on-site and off-site environmental effects. Some examples of land uses grouped by their impact on the soil are listed in Table 1.

Table 1. Examples of land uses and land management grouped by their potential impact on the soil.

Impact of Land Uses and Land Management on the soil	Examples of land uses and land management
Very low impact	National parks and wilderness areas,
Low Impact	Very light opportunistic grazing and low intensity logging.
Moderate impact	Occasional tillage of the soil, long term medium intensity grazing, urban and infrastructure development where erosion control and sedimentation practices are adequately implemented.
High impact	Removal of ground cover by tillage, grazing or clearing, frequent tillage of the soil using discs and tines**,** long term intensive grazing; clear felling, irrigation; water use and disposal in urban environments, land uses that can have a high impact on the soil chemical balance (eg soil acidification, exposure of acid sulfate soils);

The identification and appropriate management of soil constraints is an important component of the revised LSC. Table 2 summarises a range of soil limitations used in the classification. This list is intended to be flexible and can be augmented by the addition of other limitations as knowledge of soil degradation and its mitigation improves. The severity of soil limitations present, along with any landscape constraints, determine the capability class of the land being assessed. For example, LSC classes I and II have minor soil limitations which are easy to overcome whilst LSC classes VI to VIII have high to extreme limitations that are difficult to impossible to overcome.

Table 2. Summary of soil limitation categories

Soil Limitation	Risk Categories
Soil acidification	ac0 = no acidification risk; ac1 = low acidification risk; ac2 = moderate acidification risk; ac3 = high acidification risk; ac4 = extreme acidification risk.
Wind erosion	ze0 = no wind erosion risk; ze1 = low wind erosion risk; ze2 = moderate wind erosion risk; ze3 = high wind erosion risk; ze4 = extreme wind erosion risk.
Water erosion	we0 = no water erosion risk; we1 = low water erosion risk; we2 = moderate water erosion risk; we3 = high water erosion risk; we4 = extreme water erosion risk.
Soil structure decline (sodic surface soils)	ssd0 = no soil structure decline risk; ssd1 = low soil structure decline risk risk; ssd2 = moderate soil structure decline risk; ssd3 = high soil structure decline risk; ssd4 = extreme soil structure decline risk.
Mass movement	mm0 = no mass movement risk; mm1 = low mass movement risk; mm2 = moderate mass movement risk; mm3 = high mass movement risk; mm4 = extreme mass movement risk.
Soil carbon loss	Relevant for greenhouse issues and especially for peat and alpine soils.
Soil contamination	con0 = no soil contamination risk; con1 = low soil contamination risk; con2 = moderate soil contamination risk; con3 = high soil contamination risk; con4 = extreme soil contamination risk. Often relevant in man-made lands associated with mining or in areas of industrial waste disposal.
Soil fertility decline	Related to acidification but also considers losses of nitrogen, phosphorus, sulfur and micronutrients
Acid sulfate soil	as0 = no acid sulfate risk; as1 = low acid sulfate risk; as2 = moderate acid sulfate risk; as3 = high acid sulfate risk; as4 = extreme acid sulfate risk.
Dryland salinity	dsal0 = no dryland salinity risk; dsal1 = low dryland salinity risk; dsal2 = moderate dryland salinity risk; dsal3 = high dryland salinity risk; dsal4 = extreme dryland salinity risk.

Having assessed the site characteristics and soil limitations, land is then grouped within the classes detailed in Table 3. Although these class definitions are similar to those of the original Rural Land Capability Classification System (Emery 1986) they incorporate more information relating to land management intensity and soil limitations. For this reason, the revised Land and Soil Capability Classification can, in some circumstances, substantially alter the original classification under RLC. An example of such a change includes riparian zones adjacent to stream channels, which are assigned a relatively high class number in an area of otherwise low class number. Another example might be Class II or Class III land (RLC) in which a clear salinity or sodicity soil limitation exists, in which case this land would be assigned to Class VI.

Table 3. Summary of the land and soil capability classes.

Class	Definition	Description	Land-Use
I	Land with no major limitation for use and suitable for a wide range of land uses	Generally found on level alluvial flats of major rivers with stable fertile soils. Considered to be prime agricultural land and contain some of the best cropping soils in the State.	Suitable for both high and low impact land uses. The exception urban development as much of this land is flood prone. Includes the best cropping land in the State. Few limitations.
II	Land with minor constraints to land use	Generally on very gently sloping to undulating slopes and footslopes where limitations can be controlled by simple soil management.	Suitable for a wide variety of land uses with very low to high impact on the soils. The exception is urban development as much of this land is flood prone
III	Land with slight to moderate constraints to use	Includes gently sloping to undulating areas prone to soil erosion that can cause significant off-site impacts	Generally suitable for very low to moderate impact land uses but also some high impact land uses if suitable soil management practices implemented
IV	Lands with moderate limitations for land use	Not capable of regular cultivation cropping owing to limitations of slope gradient, shallowness of soil, climate or a combination of these.	Generally suitable for very low to moderate impact land uses. Includes some of the best grazing lands in the State.
V	Lands with moderate to high limitation to use	Land not capability for regular cultivation owing to limitations of soil erodibility, slope gradient, shallowness of soil, climate or a combination of these.	Land is generally suitable for moderate to low intensity grazing. Significant limitations for high impact land uses.. Suitable for very low to moderate (with appropriate management) impact land uses such as direct drill cropping and grazing.
VI	Lands with a high degree of limitation to use	Includes rolling to steep hills with slopes up to 33 % with high erosion risk and areas where climate severely limits the potential for plant growth	Not capable of supporting high or medium impact land uses due to extreme difficulty in removing or reversing degradation and associated off-site impacts. Low productivity agricultural land capable of light grazing or nature conservation.
VII	Land should remain under native vegetation due to high soil erosion hazard and extreme site limitations	Includes very steep lands and all eroded lands where the best method to control soil erosion is by retention or re-establishment of native vegetation.	The extreme degree of limitations present preclude the use of all land use practices except for those with very low impacts on the soil (e.g. native vegetation and maintenance for nature conservation)
VIII	Other lands not suitable for any type of land use apart from native timber and nature conservation due to severe limitations.	Includes: beds and banks of streams; swamps; lagoons; wetlands; lakes; tidal flats and estuaries; land with steep to precipitous slopes (> 50%); and sand dunes and beaches which are bare or prone to extreme wind erosion	Suitable for only very low impact land uses such as native vegetation conservation. Includes the beds and streambanks of streams of fifth order or greater.

Although the land capability framework was not specifically designed with the drier western parts of the State in mind, it can be adapted to these areas. These areas are currently covered by Land Systems Mapping (NSW Soil Conservation Service) and this can provide the basis on which to apply the land capability system to these areas and this element of the land and soil capability system is currently being developed.

Although the revised land and soil capability scheme requires detailed on-ground testing, it seems to offer much potential for use in natural resource management at regional, catchment and property scales. It provides a common framework by which targets for soil management can be placed and applications of this type are currently being developed by staff in the NSW Government agencies.

Conclusion

The proposed LSC provides a convenient framework for assessing the impact of various land use and land management options on natural resources and particularly catchment health. It provides a convenient checklist of the natural resource limitations that need to be considered when natural resource planning is undertaken from the broad scale, to the catchment, sub-catchment and local property scales. It also provides a mechanism to assess these natural resource limitations, but also allows for the incorporation into the scheme of more detailed and comprehensive techniques based on the modelling of natural resource processes.

The revised LSC is intended to support land use planning. It is intended to be simple and logical, transparent to users and community, be applied at a variety of spatial scales and is designed in such a way that it can incorporate assessment of National indicators of soil quality if necessary. The scheme does need to be tested on-ground, and that is an objective for the further development of this scheme.

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