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# Envirolink Project

## Updating the Land Use Capability handbook – a Scoping Report

June 2006



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# **Updating the Land Use Capability Handbook – A Scoping Report**

**Horizons Regional Council**

**June 2006**

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*Abstract:* Horizons Regional Council (HRC) is the lead agency for the Sustainable Land Use Initiative (SLUI), a regional initiative responding to the devastating February 2004 floods. SLUI aims to future-proof communities against extreme events by increasing the resilience of landscapes through a change in land use to minimise erosion on farms and reduce sedimentation off-site. The Land Use Capability (LUC) classification system has been used throughout New Zealand to assess the capacity of land to sustain production permanently. Principles of the system and examples of its use were last published in a LUC handbook in 1974. Since then, there has been a rethink about the classification of hill classes (V to VIII) and significant advances in land management research and practices. HRC regards an updated LUC handbook as an important tool to assist with achieving the objectives of SLUI. It consequently requested AgResearch, as lead agency for a consortium of providers including Landcare Research and HortResearch, through Envirolink funding, to prepare a scoping report to 1) identify gaps in current vs. recommended sustainable land use in HRC's region, 2) identify changes required in the LUC classification, 3) canvass opinions from HRC and neighbouring regional councils on desired components of a new handbook, and 4) recommend an appropriate work programme. Interviews were conducted with lower North Island regional council land managers from March to May 2006. Key recommendations were that 1) a bound, hardcopy LUC handbook be produced, 2) hill country classes V to VIII be redefined and areas of classes, subclasses and units be revised nationally at 1: 50 000 scale, 3) classes and subclasses be standardised nationally and LUC units standardised separately within the North and South Islands, and 4) include in the handbook details of the new definitions and relevant summary data, new photographs, new examples of applications of appropriate management for LUC units in examples, and sections on such issues as stock carrying capacity and tree site indices. A realistic timeframe for an implementation project is likely 18-24 months.

## **1. Introduction**

Horizons Regional Council (HRC) is the lead agency for the Sustainable Land Use Initiative (SLUI), which is a regional initiative born out of the February 2004 floods. SLUI aims to reduce the region's reliance on government relief/recovery assistance in the future, protect hill country and lowland communities and assets from future storm events and the ongoing impacts of the 2004 storm event, and protect the soil asset upon which our rural economy is based. Key components of the initiative include an update of land resource information, development and delivery of whole farm plans (WFPs), capacity building, and monitoring and reporting on progress. The development of individual WFPs incorporating physical, farm management and business plans to achieve

environmental and economic sustainable land use, is a key mechanism for delivering future-proofing assistance to the region's land owners. The target is 1,500 plans over 10 years with 50% of plans on the most 'at risk' biophysical non-sustainable sites and catchments. Whole farm plans requested in priority areas will be given the highest priority.

To ensure a consistent interpretation of the land resource information by the land managers who will be trained as part of the initiative to develop the WFPs, the Land Use Capability (LUC) handbook becomes an important resource. Published last in 1974, the handbook requires significant updating to address some inconsistencies in allocation of units to land class, incorporate advances in land management research and practices, and ensure consistency of interpretation across the region. With this update in place, HRC can then revise its regional land inventory in a consistent and transparent manner.

The LUC and associated multifactor mapping system is an adaptation of the United States Department of Agriculture (USDA) system of LUC mapping and defined LUC classes. It aims to assist with classifying and understanding the distribution of land-use/vegetation changes, and subsequent erosion, and for assessing the suitability of the land to permanently sustain productive use (National Water and Soil Conservation Organisation 1979). From 1970 to the early 1980s, the entire rural (non-urban) landscape of New Zealand was classified at a scale of 1:63 360 (1 inch to 1 mile), which was later enlarged to 1:50 000. This near-national coverage (Stewart Island excluded) comprised independent classifications for ten regions of the North Island, one first edition South Island-wide classification, and a second edition Marlborough regional classification.

This New Zealand wide coverage, called the New Zealand Land Resource Inventory, NZLRI (including an inventory and LUC assessment), was prepared by the Water and Soil Division of Ministry of Works and Development, which provided national technical services to soil and water management. The database in part arising from the NZLRI is now designated as a FRST 'nationally significant database'. Landcare Research as owner/manager of the database has responsibilities for its maintenance and availability. The NZLRI is part of Landcare Research's Land Resource Information System, other components being the national soils database and S-map.

The official LUC handbook was first published in 1969, with a second edition being published in 1971, and reprinted in 1974 (Soil Conservation and Rivers Control Council 1974). The handbook comprises a description of the LUC classification system and attributes used to assess capability - lithology, soil type, slope, erosion type, vegetation, current land use, and climate. Photographs of type LUC classes and examples of LUC classification at different scales are included. The system has been accepted by most regional councils, and many of the more experienced staff in councils are very familiar with its principles and applications. The LUC handbook has not been updated since the early 1970s despite new technologies (e.g. direct drilling, drainage systems), changed land-uses/vegetation (e.g. forestry vs. pastoralism and best practice), revision of views on retirement vs. conservation trees and their management, and riparian management practices. Also, there is discontent by some land managers about the definition and representation of different classes of hill country. Within the territorial area of HRC, there are significant parts of three regional LUC classifications – Taranaki-Manawatu (Fletcher 1987), southern Hawke’s Bay-Wairarapa (Noble 1985), and Wellington (Page 1995) - and fragments of three other regional classifications (Waikato, Bay of Plenty–Volcanic Plateau, and northern Hawke’s Bay), which hinders a consistent, region-wide approach. Page (1985) provides a North Island correlation of units, supplemented by Appendix 4 of Page (1995).

This scoping report aims to identify gaps in current versus recommended sustainable land use in the region administered by HRC, appraise the merit of revising hill country land classes, identify areas of inconsistency within and between regional councils, and outline a plan of action to update the LUC handbook. It also reports on the strong level of interest by neighbouring regional councils to participate in a project to update the handbook, in a larger, co-ordinated effort.

## **2. Approach**

Interviews were conducted by the senior author from March to May 2006 with staff from HRC (3 staff), Hawke’s Bay Regional Council (HBRC, 2), Greater Wellington Regional Council (GWRC, 1), and LandVision (2). Each interview centred around 1) familiarity with the LUC system and usefulness to staff, 2) improvements needed/desired for an effective and efficient update, 3) examples of significant changes in recommended land uses compared with current/earlier practices, and 4) the extent of updating desired (regional, several regions, or national). In several cases, discussions were wider than the LUC handbook, and included such aspects as issues pertaining to the extended

legends of regional LUC classifications. Some of the small amount of literature on the LUC classification in New Zealand was also reviewed.

### 3. Overview

#### 3.1 Usefulness of LUC system

There was consensus that the LUC classification is robust and appropriate for general classification of rural landscapes at the class (I to VIII), subclass (limitations predominantly because of erosion (e), climate (c), soil (s) or wetness (w)), and unit levels. However one interviewee (and on behalf of some who were not interviewed) expressed concern at the low representation of Class V land at the regional or multi-regional level and felt that this should be increased by widening the definition of Class V land. Currently, this land is defined as “high producing land which has limitations which make it unsuitable for cropping but which has only slight limitations to pastoral or, in general, forestry use” (National Water and Soil Conservation Organisation 1979). The interviewee also felt that some Class VI land should be reclassified as Class V land, and similarly that there should be reclassification of some Class VII land to Classes VI and VIII. The area (ha) and proportion of Class V land in the North and South Islands, based on data extracted from the NZLRI, is shown in Table 1. Two other interviewees defined Class V land as hill country covered in pasture (or forestry) which is too steep for cultivation and which has negligible or no erosion; they were happy to retain this definition and accept that Class V land will continue to be poorly represented. It should be noted that the LUC handbook describes Class V land as also including flat to gently undulating land which has limitations such as wetness, stoniness, rockiness (Soil Conservation and Rivers Control Council 1974).

Table 1.  
% of Class V land recorded in the NZLRI

	<b>Class V</b>	<b>Total area</b>	
<b>North</b>	93532	11455925	0.816%
<b>South</b>	116650	15115808	0.772%
<b>Total</b>	210182	26571733	0.791%
(excludes Stewart Island)			
<b>Horizons</b>	4002	2222030	0.180%

The LUC classification was designed by soil conservators for effective farm management, including identifying areas of potential erosion risk. Some confusion was expressed about the recent development, use and value of Land Management Units

(LMU) and how they compare with LUC units. The basis for the confusion appears to depend mainly on the definition of the management being considered. For example, an LMU comprising areas of pastoralism or sheep and beef grazing could be conducted across several LUC units, and it could cross several classes e.g. Classes V to VII. In contrast, a more restrictive/specific LMU such as areas receiving fertiliser application on sunny, uneroded pastoral hill country could match an LUC unit, or even be a part of an LUC unit. Essentially, LUC units and LMU are two of many different ways of classifying land, and hence the units may have considerable or negligible relationship to each other. LMU were never intended to replace or compete with LUC units. They can change and their use recognises that there are factors other than the landscape's inherent capability to produce, that determines use e.g. provision of shelter, distance from infrastructure.

### **3.2 Landuse changes**

Land use/vegetation cover has changed in a number of parts of regions over the past three decades. Neither of these should directly affect LUC per se because it is based on the permanent physical features of the land (National Water and Soil Conservation Organisation 1979). However, how land has changed in response to land use and vegetation changes may warrant a re-evaluation of capability. Examples of changes include general conversion of pastoral areas to plantation/protection forestry, and vice versa, a general decline in the number and area of native forest fragments, and more productive use of some areas because of effective drainage or irrigation practices. Recent permanent drainage of previously wet areas should not change the original primary limitation because wetness was not regarded as a limitation in areas that were permanently drained or where this was considered a possible practical option. In contrast, recently permanently irrigated areas may change the LUC unit because in the original assessment, the soil moisture limitation was only regarded as removed if permanent irrigation was installed; potential permanent irrigation was not considered. Hence, associated with vegetation changes and landscape modifications, the primary limitation to productive use may have changed which has implications for possible revision of relevant LUC units.

### **3.3 Scale of assessment**

LUC surveys in the regions were applied originally at a range of scales. In 1973 a national survey of physical resources was commenced at a 1:63 360 (1 inch to 1 mile) scale which has been updated to a 1:50 000 scale, and for which LUC units have been developed. A 1:50 000 scale is satisfactory for use at regional and district levels and has



relevance for planning and other purposes at national level. Its appropriateness at the farm scale depends very much on farm size, intensity of land use, and how complicated the landscape is. For many farms in the North Island and a number in the South Island, a 1:50 000 scale would be too coarse for practical use, but this scale is conceivably quite appropriate for some high country runs. However generally a scale of about 1:50000 is probably most appropriate for understanding and interpreting farm attributes, and for planning, but farm maps at scales of 1:10 000 to 1:20 000 are also very useful. Most interviewees agreed that any updating of the LUC classifications should be assessed using relevant data presented at 1:50 000 scale. However one interviewee commented that assessments at 1:50 000 are now of marginal usefulness for many catchments, and that an updating of the LUC classification at 1:20 000 would be much more informative and useful than at 1:50 000. A national update at 1:20 000 scale could only be achieved with a huge amount of ground truthing and associated interpretation and revision. Individual regional councils could consider classifying all or part of their land at this scale should their resources permit. Another interviewee felt that a 1: 20 000 scale is too small for farm mapping and too large for planning, and that farms need to be mapped at 1:8 000 to 1: 10 000 scale depending on topography and objectives/proposed use of the information.

The LUC classification can be used at any scale, but at the farm level, almost invariably an expanded classification will be required because of the concealment or masking of units at smaller scales. Classification at the farm level e.g. > 1:25 000 may be achieved by subdivision of units such as V1e11a for sunny aspect and V1e11b for shady aspect. In a number of its farm plans, GWRC has classified land using the LUC classification or modifications of it e.g. landforms (stable, inactive, and actively eroding). However GWRC will be using the LUC classification increasingly for farm plans because land managers understand it and can explain it easily to farmers.

### **3.4 Number of LUC units**

These vary considerably between LUC regional classifications mainly because of administrative decisions at the time about the number of units that could be used. In some of the earlier LUC regional classifications, there were insufficient LUC units to adequately accommodate the variability in the landscapes. An example is the Gisborne-East Coast region where there were 54 LUC units in the first-edition classification. This was addressed with the release of the second-edition LUC classification of the region where 104 LUC units were defined (Jessen et al. 1999), which enabled a much more thorough understanding of the variability in the resources and capabilities of the region.

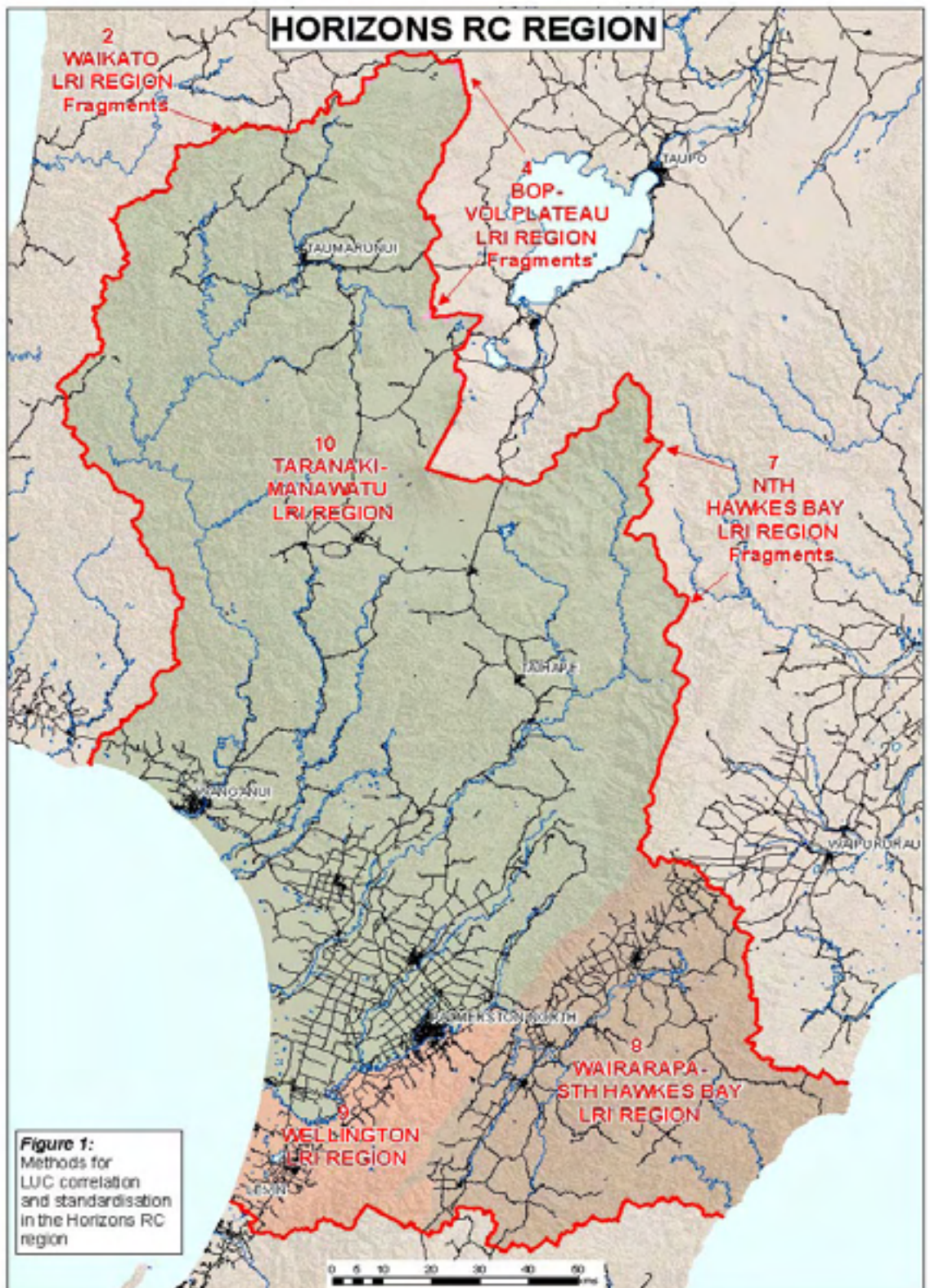
Similarly for the first-edition South Island legend, there were 220 units compared with the second-edition Marlborough legend which comprised 154 units, with inter-edition correlations provided. The area administered by HRC comprises significant parts of three LUC regional classifications and fragments of another three regional classifications. The former three classifications vary in the number of LUC units from 70 for the Wellington region (Page 1995) to 150 for the Taranaki-Manawatu region (Fletcher 1987).

### **3.5 Standardisation/correlations**

Within each of the ten North Island regional assessments and one South Island assessment (and one later assessment of a single region in the South Island), the LUC classification was applied uniformly, but separately for each region/island, resulting in LUC units in any one region being numbered independently of those in other regions. In the North Island there are 706 regional LUC units and Page (1985) correlated similar LUC units in the different regions to derive 443 units for the whole of the North Island. This was a significant enhancement because it enabled an overview of the North Island's land resource information on a standardised basis. The distribution of land resources between former catchment boards at the time was not presented.

In the HRC region, standardising was conducted by Landcare Research in 2005/06 (in prep.) for the LUC units across the relevant parts of the regional NZLRI/LUC classifications for Wellington, southern Hawke's Bay-Wairarapa, and Taranaki-Manawatu regions, and three adjacent NZLRI regions (Figure 1). There was agreement by interviewees that standardising LUC units across the entire area administered by HRC be undertaken, including field checking, before proceeding to update other aspects of the LUC extended legend. Standardisation of LUC units throughout the North Island was conducted (Page (1985) with additions in Page (1995) Appendix 4) before regional councils were formed, so that a procedure is available (see below). If hill country classes V to VIII (without revising the inventory database) were redefined, this procedure could be applied to the revised class data at the regional council (e.g. HRC) or national level.

Most interviewees recommended that a wider standardisation process be conducted, some suggesting across several lower North Island regional council areas, some suggesting across the North Island, and two people suggesting a national standardisation. One of these people recommended standardising LUC classes (I to IV and the revised V to VIII) and subclasses throughout New Zealand, but standardising



LUC units separately within the North and South Islands. In all cases, it was considered essential to be able to identify all LUC units in the regions administered by each regional authority.

Methods have been developed for LUC correlation by Landcare Research and a correlation report published for the North Island in 1985 (Page 1985) was mentioned previously. Since that time other LUC correlation projects have been conducted. Most notable was the work for Environment Bay of Plenty for the regional council administration area (Harmsworth 1991, 1993, 2002; EBOP 1998). Five NZLRI regions were recognised for the Bay of Plenty area, and LUC units from the five regions needed to be correlated and then reclassified into one single Bay of Plenty classification using Geographic Information Systems (GIS) and office compilation. The LUC unit descriptions and new single regional LUC unit description was presented in an extended legend (Harmsworth 1991, 1993) and methods were documented at the start of the project. LUC correlation at the regional level therefore has a number of steps, these are:

- In GIS use regional and catchment boundary data supplied by the regional council at a scale of 1:50 000 to 'clip' out the administrative region. Clip out all NZLRI data within this larger administrative region.
- Identify NZLRI regional boundaries within the Manawatu-Wanganui Horizons Regional Council region. Check NZLRI LUC units against NZLRI boundary arcs and clean.
- Check all NZLRI and LUC data for accuracy before commencement of LUC correlation.
- Generate GIS LUC unit tables for all polygons in each NZLRI region, and physical NZLRI attribute information on rock type, soils, slope and erosion.
- Group LUC units into LUC suites and sub-suites with common attributes.
- List all LUC units across extended legend tables, with NZLRI regions headings in each extended legend column and common LUC units for each row.
- Use physical attribute data to correlate LUC units and complete draft.
- Split LUC units where necessary based on attribute information, and reassign to best fit LUC units from other NZLRI regions and add to draft document.
- Complete LUC correlation and document in extended legend tables.

- For all correlated LUC units provide new detailed land management recommendations.
- If necessary provide a new single number LUC classification for the regional council area.

## **4. Specific Issues**

A number of issues were raised during the interviews which pertained to the LUC handbook and wider parts of the NZLRI / LUC classifications, as follows.

### **4.1 Presentation/content of rewritten LUC handbook**

The consensus from interviewees was that a hardcopy be produced for practitioners in the field. It was stated that land managers rarely, if ever, use a computer in the field (many don't own them!), and therefore a bound hardcopy is essential. Two interviewees commented that some type of web-based system may be useful to complement the hardcopy handbook, for use in the office. However it was uncertain how this might be managed and what functions it would perform. It was recognised that Landcare Research is the custodian of the NZLRI (including inventory and LUC classification) and there needs to be a central repository of the database. The opportunities of web-based technologies and how they might assist to meet any additional needs of the regional council staff interviewed, should be discussed with Landcare Research.

Several interviewees requested new definitions of hill country classes (V to VIII), new photographs of examples of classes, subclasses and units, revision and/or new examples of applications of the classifications, revision of Glossary of Terms (e.g. "Catchment authorities", conversion of units from imperial to metric, new descriptions of soil types and soil profiles), and updating of references. A list of links to relevant websites e.g. soil and landcover databases, individual regional councils, were also deemed worthwhile.

### **4.2 Soil Conservation & Water Management Measures**

There was unanimous agreement that this column in the extended legend associated with the LUC classifications (National Water and Soil Conservation Organisation 1979)

needs updating because of significant changes in land use recommendations and practices since the 1970s. However this task would need to be conducted as part of another project, as it is outside the scope of producing a 2006-style LUC handbook. Management measures are not embedded in the definition of LUC classes, and therefore they can be revised at any scale at any time. Nevertheless, some of the key changes and developments should be described in relevant sections of a rewritten handbook because they will provide a modern context.

In HRC's region, much Class VII land was recommended for forestation or pole planting in the 1970s/1980s whereas partial or complete retirement (do nothing option) of such areas to encourage natural forest regeneration, is now recommended more widely. However there are a number of factors influencing the decision to retire land, and therefore there cannot be a universal rule for a specific LUC class. There is increasing awareness that many exotic tree species planted for soil conservation, regardless of species, need to be managed throughout their lifetime. It is now recognised that large trees can be a liability to infrastructure, livestock and farmers, and this is a key consideration in planting programmes. Form pruning was not recommended in the 1970s but managers now encourage pruning trees from an early age. If there is not a willingness by farmers to manage trees over their lifetime, it is now sometimes recommended that areas not be planted. There is much more vision in planting recommendations such as the implications of mature trees in 20-30 years. Vegetation function for multiple uses e.g. for soil conservation, timber, shade, shelter is of much greater consideration now than previously.

Pine trees are now used in some cases as nurse crops for understorey native restoration. Harvesting of them is recommended in U-shaped gullies because harvest debris can be retained on land and therefore not block waterways. In contrast, harvesting adjacent to V-shaped gullies is not recommended in some areas of HRC's area because tree debris can easily accumulate in waterways and hinder water flow, as found in recent flood events. However this may not be relevant in all situations e.g. where bank erosion is not a problem, slash in waterways may be beneficial through providing habitat for native fauna. There is a strong realisation that pines are not the panacea for all problems, and that there is a range of other useful species available e.g. poplar, willow, cypress, eucalypt, wattle.

The measures recommended for some LUC units in extended legends are single words such as "drainage" and "windbreak", or just a few words, and several interviewees felt

that a little information on these could be provided in a new handbook. For example, the type of drainage e.g. mole drain, tile drain, could be specified, and some key species for use as windbreaks could be listed. However interviewees cautioned about providing too much detail to the extent that the handbook becomes too cumbersome and not practically useful. Direct-drilling was mentioned by several interviewees as a significant technological development for assisting with managing cultivable, fragile landscapes. Options for addressing particular types of erosion, and guidelines on various plant and engineering practices for different landscapes, are described comprehensively in two recent manuals (Ministry for the Environment 2001a, b), so that only brief reference to these would be required in the new handbook.

Other technologies/developments over the last two or three decades which could be mentioned include 1) an increased understanding of soil structure, how it is damaged (compaction, deformation etc.) by various landuses, and management practices to minimise damage, 2) riparian management through fencing and other strategies, and 3) differential fertiliser placements and rates/precision agriculture strategies. The shifting in thinking from conservation trees to indigenous biodiversity (reversion) as a driver for land use change (biodiversity + soil conservation benefits) is also a major shift in thinking on pastoral hill country. Reverting scrub has become a respectable land use/cover, and with carbon credits and niche products may become an economic land use. This does not affect versatility and hence LUC, but it may have an economic advantage.

### **4.3 Grazing/Carrying capacity and Exotic forest growth potential**

Grazing/carrying capacity is presented in extended legends and is based on stock units (SU). Several interviewees favoured a revision away from a SU system because of such issues as a SU being defined in terms of a variable standard (an “average” ewe), variation in livestock systems and livestock inventory dates, and seasonal issues. It was suggested that a system based on dry matter yield (DMY), or possibly metabolisable energy (ME), would be better and subject to less interpretational difficulties. It would also enable the user to estimate stock numbers/carrying capacity more tailored to their specific circumstances (e.g. stock type, breed, age). Perhaps DMY estimates across New Zealand could be generated using relationships between DMY and slope class, or appropriately interpreted remote sensing data. One interviewee considered that even if the three carrying capacity estimates based on SU (present average, top farmer, and attainable physical potential) varied 10-30% from “real” figures, including any updating to the present, this was probably not of great concern. Increasing use of nitrogen fertiliser on a range of topographies and the availability of new fodder crops are much more



important contributors to DMY on various farm types than they were in the 1970s. There should be a section on stock carrying capacity on farms in the revised handbook.

The potential for exotic forestry growth is based on the site index (SI) for *Pinus radiata* which is the mean height at age 20 years (National Water and Soil Conservation Organisation 1979). One interviewee queried the relevance of the SI to those farmers who have negligible knowledge of trees and/or no intention of growing them on any part of their farm e.g. because of personal preference, or higher economic returns from alternative enterprises. Also, farmers who wish to grow a plantation of exotic trees other than *Pinus radiata* may have difficulty relating an index for *Pinus radiata* to their selected species. There has been considerable recent genetic improvement in *Pinus radiata* and it is uncertain how this might change SI estimates used in the original classifications. Although acknowledging limitations to the applicability of the SI for *Pinus radiata*, another interviewee commented that the SI has been estimated throughout the country, which is a significant strength for comparisons e.g. within and between regions; standardisation is important. Issues around applicability of the SI could be mentioned in an appropriate section of the handbook.

Both grazing/carrying capacity and site indices are not part of LUC per se, but rather are growth indices attached to LUC units. They can be revised at any time without adding to or subtracting from the LUC classification.

#### **4.4 Present and potential land use**

There was a general view that columns specifying land use in the LUC extended legends should be checked and revised where appropriate. In some cases, it is possible that new land uses/enterprises might be considered for specific LUC units. Several interviewees stated that they discuss optimum and potential land uses for LUC units with farmers and at least two interviewees also specify land uses which are inappropriate. One interviewee commented that it would be unwise to recommend a land use(s) for a particular LUC unit because recommendations may vary depending on a number of factors. It would be preferable for each LUC unit to restrict a revision to specifying a range of appropriate land uses (land manager/farmer to choose during consultation), but identify those land uses which should not be practised. These could be listed in a separate column in the LUC extended legend, or included in the current column titled "Additional comments". Revision of any of the land use categories in extended legends would need to be conducted in another project, as it would be outside the focus of



revising the LUC handbook. However several interviewees considered that a section on current attitudes to present and potential land use would be useful in the new handbook.

#### **4.5 Related issues**

*Spatial association of LUC units:* One interviewee commented that in theory, LUC units are standalone but they can markedly influence neighbouring units in various ways. For example, land use options for using a plateau (perhaps class II to 1V) surrounded by erodible steep slopes (class VI or VII) may be restricted because of access options, and similarly for fertile valley plains adjacent to steep hill country. This could be commented on where there are vastly disparate LUC units adjacent to each other. However this is relevant to specific local situations only. Also, the location of land does not determine its versatility or limitation to use, but it can influence its practicality for use.

*Resource limitations:* It was highlighted by several interviewees that a rationalisation will be required in a rewrite of the LUC handbook, and wider issues such as revision of parts of extended legends. The immediate need is for a new handbook, and as one interviewee stated, "We will have to wait for the rest to be progressed."

*Other thoughts/initiatives:* Since interviews were conducted, views have been expressed by other people to the senior author. These include: 1) that another hardcopy handbook is not required, but a flexible web version is required (which would require expertise in informatics); 2) there is an immediate need for new subclasses by northern councils; and 3) give attention to design of LUC so that it can in the longer term be supported by S-map (a digital soil spatial information system developed by Landcare Research). These issues, together with those obtained through interviews of staff from regional councils in the lower North Island (which was the required approach for the current scoping report), will need to be discussed and debated by all interested parties to determine consensus needs by regional councils - the main end users. The additional views are not considered in the recommendations presented in this report.

### **5. Conclusions and Recommendations**

- There was unanimous support from lower North Island regional councils that the LUC handbook be rewritten, and be produced as a hardcopy. It should include redefinition of hill country classes V to VIII, and hence has wider relevance than

the region administered by HRC. Some interviewees want new photographs of classes (particularly important if redefined), subclasses, and units, an update of information on geology and soils, a revision and/or new examples of applications of the classifications, a general revision of definitions, and an update of references (including appropriate websites).

**Recommendation 1:** Produce a new hardcopy LUC handbook.

- Redefining hill country classes should be accompanied by a reclassification of land in the database held by Landcare Research, and at least two interviewees recommended a national coverage. It is proposed that the LUC reclassification be conducted at the 1:50 000 scale, which is the current scale of the national land inventory database. As part of this revision, subclasses within classes would require checking and revising if necessary, and new LUC units produced. A standardisation of LUC units was advocated unanimously, whether for the area administered by HRC, or more widely.

**Recommendation 2:** Standardise revised LUC classes and subclasses across New Zealand; standardise LUC units separately within the North and South Islands.

- Land uses have changed in some parts of regions for economic and other reasons. It is desired that current and potential land uses in the LUC extended legends be revised, and it would be useful to identify inappropriate land uses for specific LUC units. These tasks would be beyond the focus of a new handbook, although they could be presented in appropriate examples of applications of the LUC classification.

**Recommendation 3:** Define appropriate (recommended and potential) land uses for LUC units in examples of applications of the classification in the new LUC handbook.

- Soil conservation and water management practices have changed or developed considerably since the 1970s/1980s, particularly in relation to vegetation function and systems for establishment and management, and philosophy. Some of the key changes/developments should be included as a section(s) in the rewritten handbook, and highlighted in specific examples.

**Recommendation 4:** Present changed/new soil and water management practices in the LUC handbook, and specify relevant practices in examples.

- An assessment of grazing/carrying capacity based on stock units (SU) has limitations. The feasibility of using dry matter yield (DMY) data for this purpose

could be evaluated, although recommendations above are of higher priority. Site indices for *Pinus radiata* across New Zealand are satisfactory for broadly assessing exotic forest growth potential, but they may benefit from updating because of improved genetic stocks.

**Recommendation 5:** Include a section(s) in the handbook comparing and contrasting SU and DMY for quantifying productivity of LUC units, and the applicability of Site Index and alternative indices for appraising *Pinus radiata* productivity of LUC units.

## 6. The Team

A multidisciplinary team comprising researchers, land managers, and consultants is required to produce a relevant and practically useful rewrite of the LUC handbook. The team will need a range of skills and knowledge in the areas of LUC classification and application at various scales, database management and interpretation, soil conservation and water management practices, and land uses and applicability to sites.

It is suggested that the following be involved in an implementation project.

Crown Research Institute scientists: Landcare Research is the custodian of the NZLRI/LUC database, which will require editing and validation if hill country classes V to VIII are redefined. The institute has expertise in LUC classification and interpretation e.g. Garth Harmsworth, Grant Hunter, Mike Page (now Institute of Geological and Nuclear Sciences, who could be subcontracted), mapping at various scales, photogrammetry, and strong links with regional councils. AgResearch staff e.g. Alec Mackay, Andrew Manderson, Grant Douglas, have expertise in one or more of land and vegetation management, land classification systems particularly at the farm scale, farm systems, and have strong links with regional councils especially in the lower North Island. Staff in other CRIs such as HortResearch (e.g. those with exotic tree management expertise) could contribute to sections in the LUC handbook as required.

Regional Council/consultant land managers: Relevant staff are needed to advise on landscapes/land uses and soil conservation and water management practices in their respective regions, assist with ground verification of draft LUC units, and to ensure that the project produces a handbook that they consider is of practical relevance to them, and their immediate successors. As it is proposed that the project has a national focus, it is essential that representatives from as many interested regional councils/authorities from throughout the country be invited to participate.

## 7. Workplan/Budget

It is possible with effective co-ordination and ample availability of relevant expertise that the implementation project could be completed within 12 months. However this is a very ambitious timeframe and an 18-24 month period would be more realistic e.g. first draft of handbook by June 2007, and published hardcopy of handbook by June 2008.

For the purpose of illustration only, a suggested programme and cost over 12 months follows. The final programme (content and timeframe) and costs can be determined more accurately following the workshop in July 2006. It is envisaged that the workshop be attended by a much wider cross-section of regional council personnel, and a few more scientists, than those who contributed to the preparation of this report. The workshop would clarify regional council needs, nationally, and the ability of the relevant CRIs to meet them. If the programme was spread to 24 months, it is likely that the guide of \$360K (incl. GST) over 12 months would be spread over the longer period, rather than seeking significantly more money.

### 7.1 Workshop (July 06)

1 day at AgResearch Grasslands Palmerston North, confirm needs/objectives, identify tasks/responsibilities, assume regional council (RC) staff time covered by employer (in kind).

	\$K
Travel	6
Facilitator	1
Scientists/consultants	6
Total	<u>\$13K</u>

## 7.2 Review LUC Class/Sub-class (Aug - Nov 06)

National coverage – standardisation, scientists working with regional council staff and farmers, field testing/validation of revision, reporting (workshop, and interim written report)

Iterative runs/NZLRI	2
Field checks	10
Staff time	
Scientists/tech	30
RC staff	15
Workshop	13
Report	20
Total	<u>\$90K</u>

## 7.3 LUC Units (Nov 06 - Mar 07)

Unlike 7.2, there would be 2 standardisations - across NI and across SI - using existing correlations/matchings where possible and updating as required; extensive interactions between RC staff (and perhaps farmers) and scientists.

### a) North Island

Correlation	15	
Visit RCs	10	
Database mgt	5	
Workshop	13	
Update LUC	25	
extended legend		
IT development	20	Sub-total 88

### b) South Island

Visit RCs	10	
Database mgt	5	
Workshop	13	
Update LUC e.legend	10	
IT development	20	Sub-total 58

Interim report (N&S Islands) 10; Total \$156K

## 7.4 Publication – rewritten Handbook (Mar 06 - Jun 07)

Including all previous work in project, final report

\$45K

## **7.5 Project management/administration (July 06 - June 07)**

\$15K

Total project: \$319K + GST = \$360K

## **8. Acknowledgements**

Interviewed staff from a range of organisations: HRC (Grant Cooper, Dave Harrison, Kevin Rooke), Hawke's Bay Regional Council (Garth Eyles, Neil Faulknor), Greater Wellington Regional Council (Dave Cameron), and LandVision Ltd. (Lachie Grant, Sarah Dudin); comments on report drafts by Allan Hewitt, Grant Hunter, and Ian Lynn, all of Landcare Research, and Andrew Manderson and Alec Mackay of AgResearch. Landcare Research provided an outline of methodology for standardising LUC units, Figure 1, and Appendix 1. Funding was provided by FRST through its Envirolink scheme (Application HZLC8).

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## **APPENDIX 1. LUC/NZLRI IN NEW ZEALAND.**

### **Introduction**

Land Use Capability (LUC) mapping commenced in New Zealand in the 1960s and the system was based on the United States Department of Agriculture (USDA) system of LUC mapping and defined LUC classes. It was very different from other forms of mapping at the time because it was multi-factor, and drew on existing bio-physical single factor knowledge (e.g. soils, rock type, vegetation, land-use history) supported by land management knowledge. It was adapted for New Zealand conditions and institutional frameworks in the 1960s, and in 1969 a New Zealand LUC methods handbook was published (SCRCC 1971). The goal of the LUC mapping was to form a sustainable agricultural mapping base for New Zealand at various scales at first (e.g., farm, catchment, regional, national). It was used to describe land versatility and capability at different scales, record actual and potential erosion under agricultural land use, identify and target key erosion prone areas (through planning, policy, and practice), seek remediation through some form of management intervention for targeted areas, and use the LUC and physical attribute information to make recommendations on land use management and practice. Although at different scales, national consistency in the approach and classification of land was a key priority. In essence the LUC approach provided information to encourage sustainable land stewardship or guardianship.

From 1970 to the early 1980s national land resource mapping, using the LUC system, was carried out throughout New Zealand at a scale of 1:63 360 (NWASCO 1975-79, 79; NWASCA 1986). National mapping consistency was a key priority in this survey. The mapping was carried out in regions, these mainly corresponding to regional catchment authority administration, and regional physiographic and catchment boundaries. The final regional boundaries also took into account political advice from Government headquarters at the time, which was Ministry of Works and directives from Government ministers. In the early 1970s, 11 regions were identified, 10 in the North Island and 1 in the South Island. This mapping made up the New Zealand Land Resource Inventory (NZLRI – NWASCO 1975–1979), a national land resource database. The mapping involved: extensive literature review of a region; use of all single factor maps for a region; aerial photo interpretation of landforms (typically at 1:25 000 for 1:63 360 and later 1:50 000 mapping); extensive fieldwork and assessment; and office compilation onto a stable map base. All the 1:63 360 map unit boundaries and land resource data for New Zealand were published onto maps called worksheets and all data and map boundaries were entered into an ARC/INFO Geographic Information Systems (GIS) in the mid 1980s and early 1990s.



In the database and on the worksheets the NZLRI comprises two core sets of information:

- An inventory of classified data describing five physical factors (rock type, soil unit, slope angle, erosion type and degree, and vegetative cover)
- A Land Use Capability (LUC) assessment for each map unit (polygon)

### LUC system of classification

The LUC system of land classification used in the NZLRI is a hierarchical form of assessment, with LUC class (Table 1), LUC subclass, and LUC unit (SCRCC 1971; NWASCO 1979; Jessen 2001). At the highest level, the LUC class and subclass are nationally consistent and the same across New Zealand. At a lower level, the LUC unit is developed specifically and in number order for each NZLRI region.

**Table A1.** Land Use Capability (LUC) system of mapping and definitions used in the New Zealand Land Resource Inventory (NZLRI).

Land Use Capability class (NZLRI)	Description of land versatility/sustainability
1 (I)	Arable -Most versatile multiple-use land, virtually no limitations to arable use
2 (II)	Arable - Good land with slight limitations to arable use
3 (III)	Arable - Moderate limitations to arable use restricting crops able to be grown
4 (IV)	Arable - Severe limitations to arable use – cultivation, and requires care, more suited to permanent pasture and forestry
5 (V)	Non-arable, Unsuitable for cropping – negligible erosion under pasture and forestry
6 (VI)	Non-arable land. Productive pastoral hill country, slight to severe limitations and hazards
7 (VII)	Non-arable land, moderate to very severe limitations
8 (VIII)	Non-arable land, very severe to extreme limitations requires permanent vegetative cover and protection

Each NZLRI region in New Zealand therefore has a distinct LUC classification list but mapping follows documented nationally consistent physical attribute classifications (Eyles 1985; Hunter and Blaschke 1986; Lynn and Crippen 1991). The actual land resource mapping uses a geomorphic approach to developing land polygons based on landform, which through integration with management knowledge and refinement of mapping boundaries, forms land management units. Over 100 000 polygons (map units) were produced in the NZLRI nationally. Each polygon comprises five key inventory attributes: primary attributes on the top row: rock, soil and slope and secondary attributes on the bottom row: erosion and vegetation. Secondary attributes were seen as

'changing' attributes through time. All regional information and national classifications (Eyles 1985; Hunter and Blaschke 1986; Lynn and Crippen 1991) have been documented in a large number of reports (e.g. Harmsworth 1996; Jessen et al. 1999).

### **New Zealand Land Resource Inventory**

As the new NZMS topographic base series at 1:50 000 became available for New Zealand in the early 1990s, all the 1:63 360 NZLRI mapping was converted over to 1:50 000 in the GIS and systematic checking was carried out (NZLRI GIS 2006). A number of new surveys were also carried out at the 1:50 000 scale and referred to as 2nd edition NZLRI surveys and these were carried out in Northland, Wellington, and Gisborne-East Coast and the Marlborough region (12th NZLRI region) of the South Island. Because of a lack of 1:50 000 topographic base maps at the time, part of the Waikato region was resurveyed at the 1:63 360 scale but called 2nd edition. Any resurvey of the NZLRI was justified on the basis that the previous NZLRI data was out of date or sub-standard in some way. To bring all the NZLRI to a consistent high standard across the country, a number of regions were identified as requiring a re-map. In terms of priority these included Gisborne-East Coast (which was completed in 1999 – Jessen et al. 1999), Northland (completed 1996 – Harmsworth 1996), while the regions, eastern Bay of Plenty, Coromandel, and the whole of the South Island all remain untouched and sub-standard to the present day.

The NZLRI is at present (2006) a national spatial land resource database at a uniform scale of 1:50 000 (Jessen et al. 1999; Jessen 2001) based on mapping from 12 NZLRI regions. The database has become an integral part of regional and district policy/plan development in New Zealand, underpins sustainable land management planning, and is a central source of land resource information (Eyles 1977; Jessen 2001).

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