



Review of land/ground cover monitoring in Victoria

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Introduction

Background

Land and ground cover datasets are collected by government and regional bodies for a range of applications, from monitoring, assessing and reporting on land, soil and vegetation condition, to monitoring greenhouse emissions and water resource modelling (NLWRA 2007). NLWRA (2007) includes a description of the specific “product” requirements for each identified “need” and indicates that the capacity to monitor the impact of land management practices was important from the regional to the national level. Measurement of ground cover is generally a good indicator of land management and becomes increasingly useful when a time series is available (NLWRA 2007).

The NLWRA (2007) report recognised that a land/ground cover data set should ideally be generated once, work up and down scales and be available to all. The Australian Collaborative Land Use and Management Program (ACLUMP) utilises land cover data to map land use and is developing the capacity to spatially locate and map land management practices. ACLUMP thus has a requirement for consistent land cover data across Australia.

ACLUMP has sought support from the State Agency members of the National Committee for Land Use and Management (NCLUM) to establish ground cover reference sites. These sites would be used to calibrate and test satellite derived ground cover datasets in cropping and modified pasture land uses. Data collection would be standardised using the recommendations of a technical working group (TWG). These reference sites would objectively measure land use, land management practice and ground cover. To prevent duplication and reduce costs, sites which currently monitor soil condition (including erosion risk), ground cover and cropping practice, should be utilised and adapted where practical.

Objectives

ACLUMP proposes to establish national protocols for producing a data set of ground cover maintenance. This data set will focus on critical levels of ground cover (the bare to low levels including both photosynthetically and non photosynthetically active vegetation) under cropping and modified pasture land uses. A national network of reference sites will be used to calibrate and validate the estimated ground cover levels and to support the interpretation of likely land management practices from satellite imagery.

With the assistance of 'Caring for our Country' funding, ACLUMP will collate information on existing monitoring sites to:

1. Assess their suitability as ground cover reference sites for calibration and validation of remote sensing products
2. Compare different methods used to collate information on ground cover (i.e. within the rangelands) and/or land management practices (i.e. for erosion risk) to assist in determining national standards
3. Produce a spatial data set for each reference site showing the location, size, land use, purpose and attributes collected.

This data set will be used to assess the suitability of existing monitoring sites for calibrating and validating remote sensing products of ground cover levels and the associated land management practices. From this assessment, a national network of reference sites will be proposed and costed for on-going monitoring of ground cover within cropping and improved pasture grazing systems.

A national workshop entitled "Developing national protocols to map ground cover management practices in cropping and grazing systems" was held in Brisbane on the 14th & 15th of May 2009 (Stewart and Rickards 2009).

To implement a national program that monitors management practices impacting on ground cover levels, the workshop participants recommended:

1. That the following on-ground measurements to calibrate and validate remote sensing products be conducted
 - undertake assessment of paddock sizes to determine where reference sites can be located suitable directly for MODIS (large homogeneous areas) and where Landsat or finer-scale imagery is needed (intensively managed areas)
 - determine sampling strategy for location of reference sites which considers key agricultural land uses and management regimes
 - at an accurately located reference site:
 - Measure fractional cover – photosynthetic (green) vegetation, non-photosynthetic or senesced (yellow) vegetation and bare soil
 - Measure woody and non-woody vegetation – persistent (non-deciduous perennial vegetation types) and recurrent (deciduous, annual and ephemeral vegetation types) fractional green vegetation
 - Measure soil colour (hue, chroma, value for both wet and dry soil)
 - Record calendar of operations for that reference site (paddock)
 - Revisit cropping reference sites 4-6 times per year to measure key management practices that impact on ground cover levels.

2. That field data is collected using the QLD SLATS (Statewide land cover and trees study) modified discrete point sampling method. This method measures green (separating persistent and recurrent) and yellow vegetation fractions and bare soil.
 - Provide a manual on field measurements and training to those undertaking the measurements in each state
 - For pastoral environments, apply the proven star-shaped transect approach of Scarth et al. (2006)
 - For intensive agricultural environments with linearly sowed crops, trial the two, 100 m, 45 degree diagonal across row layout (the cross-transect method of Schmidt et al. (2009).

The following review has been undertaken with the above recommendations and objectives in mind.

Review of land cover monitoring in Victoria

The number of soil monitoring networks currently operating in Victoria is limited. The Mallee wind erosion monitoring network is the only one that has strong similarities to the SLATS method and a detailed assessment has been provided for that network. Several other networks have been documented from a variety of sources and are included below.

Mallee wind erosion monitoring network

Overview

Wind erosion in the Mallee has been recognised as an environmental/ land management issue since 1945 and in 1978 the Mallee fallow survey was established to assess actual erosion and land use practices across the Mallee. The survey has continued up until this time although the survey methodology has changed a number of times since it was established. In 2005-2006 the survey and the accumulated data was reviewed. This led to the survey being redesigned with the current format being adopted in 2007 (Gordon, 2008).

Program intent

To monitor changes in land cover type and wind erosion severity across the Mallee Catchment Management Authority area in north-west Victoria.

Data storage

Data is recorded in the field on paper and transferred to an Excel ® spreadsheet for analysis and storage.

Extent

The Mallee Catchment Management Authority area in north-west Victoria is shown in (Figure 1).

Number of sites

Approximately 160 sites were selected randomly after stratification based on land system. The proportion of sites from within each land system was equivalent to the representation of the land system within the major agricultural regions of the Mallee (Gordon, 2008).

Current monitoring

All sites are visited 3 times each year. However, discussions are currently underway as to whether the current sites adequately represent the variation in wind erosion and land use practices across the whole Mallee. This may lead to some changes in the number and location of sites in the future.

Site reassessment schedule

In-paddock assessments occur three times a year; late summer (February/March), post cropping (June/July) and spring (October).

At each site

Sites are restricted to agricultural paddocks i.e. paddocks that are cropped at one time or another, although the paddock may have been in a pasture phase at the time the site was established. At each site a one hectare area (100 m x 100 m) was used for collecting data. This was located 100 m along the roadside fence line from the start of the paddock and 50 m into the paddock (away from the roadside). The following attributes are recorded at each site:

- a visual estimate of erosion
- vegetation cover measurements using the levy point sampler (Levy & Madden, 1933). The sampler was placed randomly within a 1 hectare area 20 times (200 points). At each sampling point the number of times the levy point sampler touches vegetation was recorded. These results were then used to calculate a percentage vegetation cover.
- the current management phase (i.e. conventional fallow, chemical fallow, stubble, crop, pasture)
- the presence of livestock
- the presence of standing stubble (summer and post cropping survey).

Where it was necessary to establish a new site (due to a farmer no longer wanting to participate or difficulties gaining access to the site), the following was also collected:

- a GPS reference point at the roadside and within the paddock to enable the site to be accurately located for future evaluation
- the approximate slope (percentage) of the landform (Figure 2 was used as a guide to estimate slope)
- soil surface roughness
- soil texture and Munsell colour
- vegetation counts are made but the location of each set of 10 observations is selected and oriented within the 1 ha plot at random by the observer. Counts are only made at 200 sites (300 for SLATS) and only the presence of vegetation at each of the 200 points is noted.

Comparison with SLATS

This monitoring network records a range of attributes that compare with SLATS, these are listed below (as well as the SLATS attributes that are not recorded),

- landform is recorded
- slope is recorded but not aspect
- only a moist soil colour is recorded
- cryptogam percentage and colour not recorded
- rock// Lag colour not recorded
- biomass estimate is not recorded
- grass height is not recorded
- no overstorey observations are recorded
- evidence of burning is not recorded
- faunal activity and type is recorded
- crust brokenness not recorded
- erosion features not recorded
- deposited material not recorded

- soil micro topography not recorded
- surface nature not recorded
- there is no distinction between green and brown vegetation
- only counts at 200 sites are made (compared to 300 for SLATS)
- location of the count points is subjective.

Potential use within proposed national ground cover monitoring program

The Mallee wind erosion monitoring sites record a similar but cut down version of the SLATS sites, but these Mallee sites provide no estimate of overstorey cover. In their current format they are probably not adequate for calibration and validation purposes. It may be possible to expand the monitoring at several of the sites. There is some advantage in using an established site where contact has been established with the landholder. The distribution of the sites is limited to the Mallee and it may be desirable to locate several sites outside the Mallee.

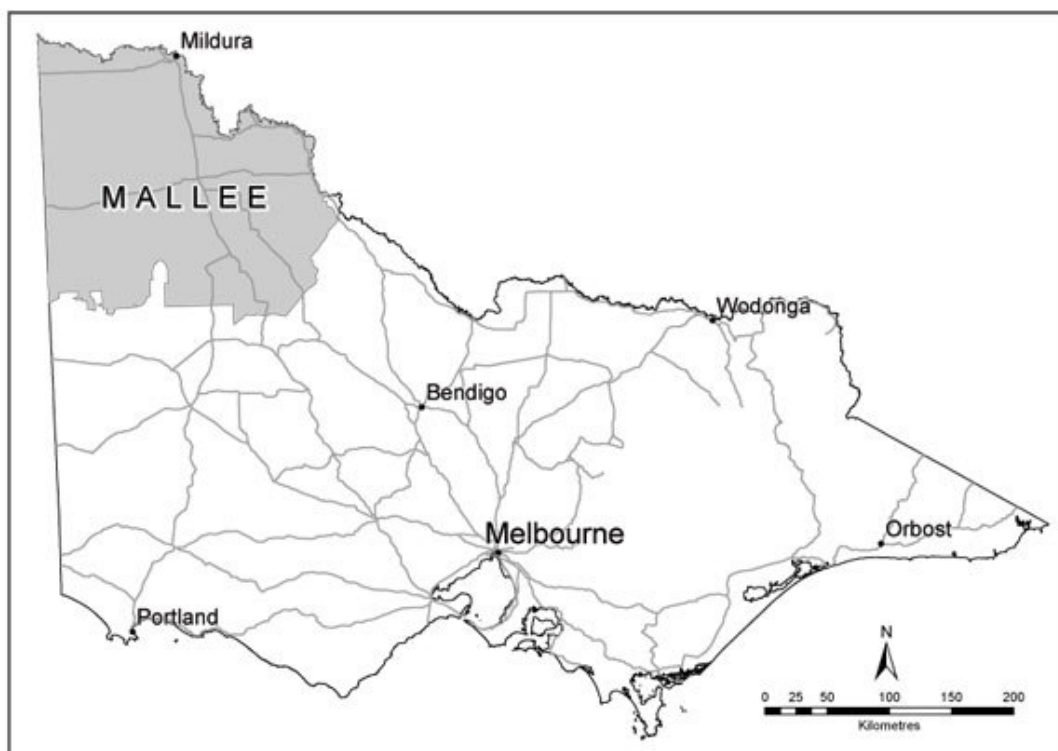


Figure 1 Area covered by the Mallee Catchment Management Authority.

Wimmera cropland management transect

Overview

The Wimmera Cropland Management Transect (the Transect) was developed in 1996 from a need to benchmark the long term trends in dry land agricultural cropping systems. The Transect captures visual data and reflects practices and trends in the management of cropping paddocks as a way of measuring the adoption of conservation farming practices.

Conservation farming includes stubble/crop residue retention in continuous cropping as well as in phase cropping. This means no burning of stubbles. The retained stubble can be managed and utilised in a number of ways; simply left standing or mulched, slashed and/or incorporated into the soil. Each of these paddock management practices leads to reduced mechanical (conventional) fallow, allowing the farmer to adopt a reduced tillage or direct drill and perhaps no-till cropping system. All of these help with improving soil health.

Program intent

The program has 2 intentions. Firstly the need to benchmark the long term trends in dry land agricultural cropping systems and secondly as a tool for identifying and addressing areas of high risk soil management.

Data storage

Data is recorded directly into a digital database along with GPS coordinates.

Extent

The Wimmera is located in western Victoria. The transect is depicted in Figure 2.

Number of sites

The Transect covers approximately 1000 paddocks across a representative selection of the highest wind erosion risk soils, those being broadly north of Horsham and east of Jeparit (Gordon, 2008).

Current monitoring

Sites are visited 2-3 times each year in Autumn and Spring.

Site reassessment schedule

In-paddock assessments occur 2 times a year; Autumn (March/April), Spring (October/November).

At each site

The Transect uses a drive-by visual observation and recording method. It begins at Horsham and follows a prescribed route (Figure 2) to Dimboola, Nhill, Broughton, and Kaniva back near Nhill to Netherby, Yanac, Jeparit, and Brim then close to Warracknabeal, Sheep Hills then back toward Dimboola. The transect has collected data for approximately 1000 paddocks over the last 12 years.

The following attributes are recorded at each site:

- crop type
- the current management phase (i.e. conventional fallow, chemical fallow, summer cultivation, stubble, crop, pasture)
- the presence of livestock
- the presence of standing stubble (summer and post cropping survey).

Comparison with SLATS

This data collection program is fundamentally different from the SLATS program.

Potential use within proposed national ground cover monitoring program

While the Wimmera cropland management transect does not compare with the SLATS method for collection of site data for satellite calibration it may provide a basis on which to select sites for a more detailed calibration exercise. An on-the-ground survey calibration and verification to support satellite monitoring is currently under consideration.

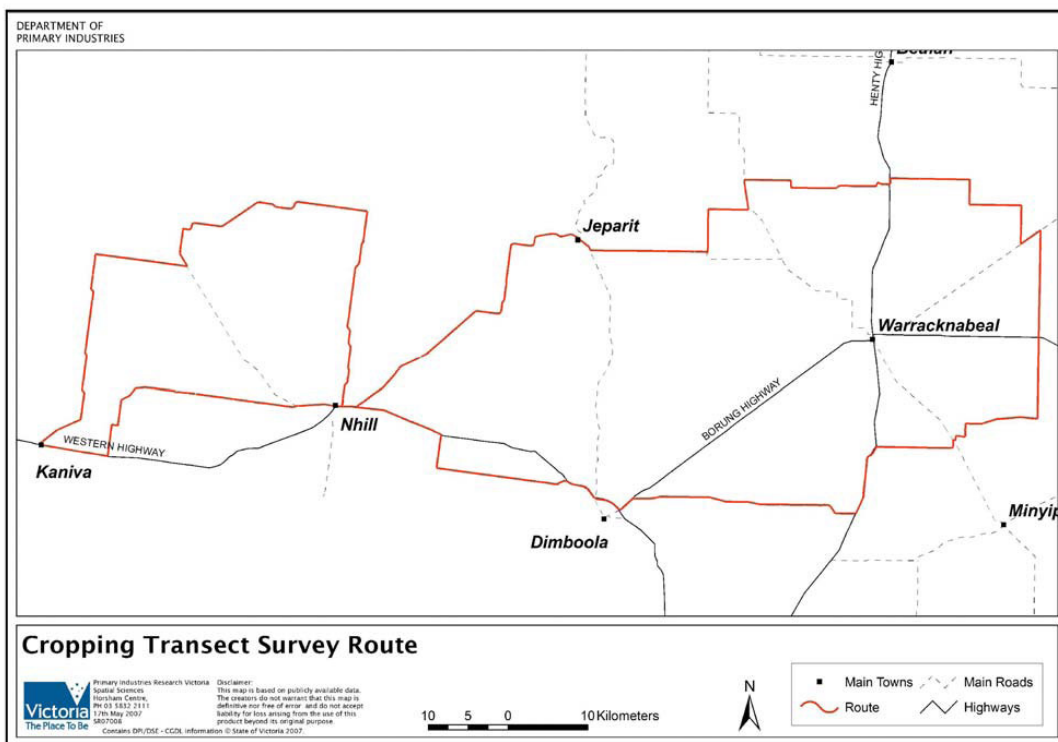


Figure 2. Route of the Wimmera cropland management transect

Victorian Land Use Information Systems (VLUIS) – ground truth and calibration

Overview

The ability of the current range of information sources and tools to support policy development and program monitoring is dependent on access to up-to-date, comprehensive land use and land management information. However, one of the major problems with these tools and frameworks is a lack of access to current sources of land use and land management information that are both reliable and repeatable.

The objectives of this project are:

- development of a dynamic information system that can describe what, where and when of land tenure, land use and land cover is present on a regular basis
- development of a system that allows access by a range of users and stakeholders including modelling, reporting, monitoring, planning and policy groups
- integration of this system within DPI and DSE spatial data investment plans.

The ground truth and satellite calibration components of this project involve the random selection of 1,500 primarily agricultural sites across 7 representative shires within Victoria. The aim of this survey is to validate the land tenure, land use and land cover at each site and provide land cover calibration data for MODIS land cover classification algorithms.

Program intent

The survey program has 2 intentions. Firstly to validate the land tenure, land use and land cover at each site and secondly provide land cover calibration data for MODIS land cover classification algorithms.

Data storage

Data is recorded directly into a digital database along with GPS coordinates.

Extent

The survey covers 7 shires – Wellington, Wangaratta, Swan Hill, Nillumbik, Northern Grampians and Colac-Otway as shown in Figure 3.

Number of sites

The survey will visit 1,500 sites across 7 shires.

Current monitoring

Sites are visited randomly selected and visited once as part of an annual survey

Site reassessment schedule

This program of land use/cover survey is subject to funding beyond its current year.

At each site

The following attributes are visually assessed and recorded at each site:

- land use according to the Australian Valuation Property Classification Code
- land cover according to the Food and Agriculture Organisation Land Cover Classification System (Di Gregoria and Jansen 2005)
- ground cover %/dry cover %/green cover %
- GPS location
- paddock identification
- site photo.

Comparison with SLATS

This data collection program is fundamentally different from the SLATS program.

Potential use within proposed national ground cover monitoring program

While the VLUIS ground survey does not compare with the SLATS method for collection of site data for satellite calibration it is a program designed to support MODIS classification of land cover and as such may provide some basis for a statewide network that supports the national program.

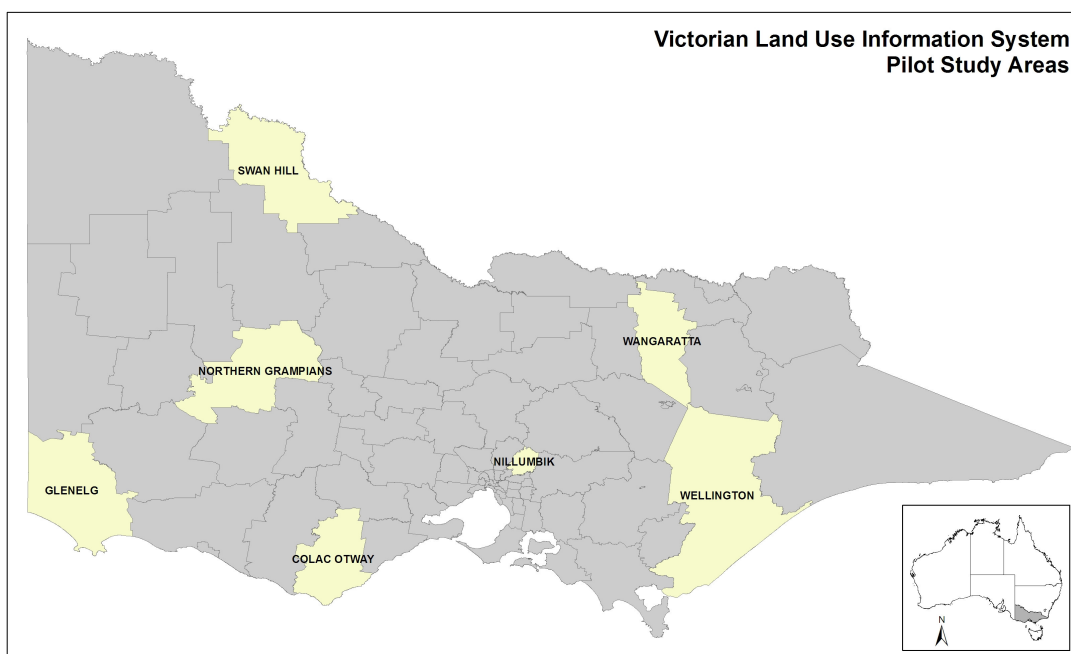


Figure 3. Shires participating in the pilot VLUIS ground survey

Long term agro-ecological experiments (LTAE)

Overview

The long-term agronomic-ecological research sites (LTAE) represent a research network across the agro-ecological zones where cropping occurs in Victoria. The network currently includes locations at Horsham, Rutherglen and Walpeup. The long term agronomic experimental sites (LTAE's) across Victoria represent a valuable early warning system of the ecological impacts of farming management practices that may threaten food security, sustainability of soil and water resources and potential impacts on biodiversity (VRO 2009).

The LTAE sites established in the Mallee include two agronomic experiments conducted at the Walpeup Research Station. These sites known as MC14, MM1 and DDL have generated extensive data outputs from numerous years (MM1 since 1940) of collected and collated crop yield and soil observation data.

Program intent

To monitor the affect of agronomic practices on soil health.

Data storage

Not known.

Extent

Sites are located at Horsham, Rutherglen and Walpeup in northern Victoria. Sites are limited to plot scale e.g. 2 m x 7 m, 40 m x 8 m and 20 m x 21 m for the three experiments at Walpeup.

Number of sites

There are two sets of experimental plots at Horsham, three sets of experimental plots at Rutherglen and three sets of experimental plots at Walpeup.

Current monitoring

The future of some sites is uncertain due to funding and DPI site rationalisation.

Site reassessment schedule

Site assessments for various attributes e.g. yield at harvest time, tiller counts through the growing season are carried out at appropriate times throughout the year.

At each site

The attributes collected at each site for this program are:

- soil chemistry
- crop yields
- physical and morphological descriptions
- biology
- pest and disease
- soil hydrology.

Comparison with SLATS

These sites have little similarity with the SLATS method and would not be suitable for use as a groundcover monitoring site. Given the small size of the sites and their complex nature (many varied treatments) they would not even be suitable for establishing a SLATS style site.

Healthy soils program – ESAS/ LWA leaving a legacy for South East Australia

Overview

As part of the Environmental Sustainability Action Statement (ESAS) Healthy Soils Initiative and Land and Water Australia (LWA) project, a number of paired sites were established to train and demonstrate approaches to soil assessment that are adaptable to industry or landscape needs in answering the question “how do I know if my soil health is improving?”. Here these demonstration sites were extremely valuable in encouraging information transfer between farmers and farmer groups, agribusiness and research/extension advisers. As part of this work, the Birchip Cropping Group established 4 sites while Mallee Sustainable Farming conducted 4 sites in Victoria also. These sites typically included fully characterised soil pit descriptions and soil analysis for paired paddocks.

Program intent

To provide demonstration sites to help train extension staff and landholders determine if their soil health is improving.

Data storage

Not known.

Extent

Sites are located in the Mallee CMA area but these locations have not been mapped.

Number of sites

Four sites were established by the Birchip Cropping Group and four sites were established by the Mallee Sustainable Farming Group.

Current monitoring

Not known.

Site reassessment schedule.

Not known.

At each site

The following attributes were collected at each site:

- soil chemistry
- physical and morphological descriptions
- biology
- soil hydrology

Comparison with SLATS

Little of the information currently collected at these sites is compatible with the SLATS methodology. However, these may be ideal locations to establish SLATS monitoring sites, given the extent of ancillary soil data that has been collected at the sites and that relationships have already been established with the landholders.

Mallee Landcare delivery sites

Overview

Seven landcare delivery sites, each around 100 ha in size, were established to demonstrate management practices that are sustainable for the Mallee. The delivery sites focus on issues such as dryland salinity management, soil health, soil erosion, weed control in production, education and the identification of knowledge gaps.

Program intent

To provide demonstration sites to make landholders aware of sustainable management practices.

Data storage

Not known.

Extent

Mallee CMA area (Figure 1) .

Number of sites

Only four sites remain in the program. Sites at Carwarp and Cowangie are managed by the Department of Primary Industries and the Sea Lake and Chinkapook sites are managed by the Birchip Cropping Group.

Current monitoring

It is likely that monitoring will continue at the four remaining sites.

Site reassessment schedule.

Various parameters are measured at each site throughout the year.

At each site

The following attributes were collected at each site:

- soil chemistry
- crop yields
- physical and morphological descriptions
- pest and disease
- soil hydrology.

Comparison with SLATS

While little information is currently collected at these sites that are compatible with the SLATS methodology, they may be useful as sites to establish SLATS monitoring sites given the extent of ancillary soil data that has been collected at the sites and that relationships have already been established with the landholders. The scale of the sites is appropriate for both Landsat and MODIS imagery.

Conclusion

Existing monitoring programs within Victoria do not collect data that are entirely compatible with the modified SLATS methodology recommended by BRS (Stewart & Rickards, 2009).

There are several programs that do collect basic land cover, ground cover and land management practices on a regular basis within the agricultural zones of interest. These are:

- Mallee wind erosion monitoring network
- Wimmera cropland management transect
- Victorian land use information systems (VLUIS) – ground truth and calibration.

Of these programs, only the Mallee wind erosion monitoring network collects information comparable with the SLATS program. It should be noted also that the VLUIS ground survey program is the only data collection occurring with the MODIS platform as its basis.

Recommendations

Based on the above review and conclusions the following recommendations are made.

- That the Mallee Wind erosion monitoring network will provide the basis for any adaptation of a national ground cover monitoring approach to the State of Victoria.
- That the Wimmera Cropland management transect and VLUIS program provide the basis for extension of ground cover sites outside of the mallee.

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