



WHOLE FARM AND LANDSCAPE PLANNING

*The original version of this article was written for the Post Graduate Degree in Sustainable Agriculture (by external study from Orange Agricultural College N.S.W.) and was presented to a seminar for South Australian Permaculture Design Course graduates in Feb 1992. It incorporated and refers to work done with Haikai Tané in New Zealand and the research work later published in **Trees On The Treeless Plains**. It reflects my long concern with melding and adapting a range of methodologies appropriate to larger scale farm and landscape planning with the better known permaculture site planning methods.*



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SUMMARY

Permaculture design and development projects have been informed by two very different approaches; site analysis and ecological models. While these have been useful and complementary, they are not adequate to deal with larger scale landscape planning and whole farm redevelopment. A broader range of approaches based on more fundamental ecological and systems theory concepts can contribute to the evolution of more sophisticated permaculture design methods for sustainable landuse.

The land systems concept integrates relevant information about landform, climate and biophysical resources of soil, plants and animals into a pattern language which is both ecological and geographical. It provides a foundation for sustainable land use planning and development which reflect permaculture principles.

The strategic planning process widely used in urban planning can be applied to whole farm planning where complexity and limited power and resources make master planning methods ineffectual or counterproductive. Any whole farm planning processes should address the four fundamental development streams of landscape, homestead, infrastructure and enterprise. This approach provides a framework for the integration of rural residential development and intensive integrated land uses as successional development phases.

Network analysis provides an additional conceptual planning tool which can complement zone and sector analysis in whole farm planning.

ECOSYSTEMS AS MODELS

In seeking to understand nature and applying those lessons to our own use of land and natural resources, permaculture has relied heavily on the ecosystem concept in which plants, animals and the physical environment form a functional and self regulating system. While the ecosystem concept has great value, it is not very good at dealing with the spatial geography of gardening, agriculture and land use planning. Geography, and the site design and land use planning professions, provide a diverse range of concepts and methods to deal with this critical spatial aspect of design.

THE SITE BASED APPROACH

The evolution of permaculture design has relied heavily on the site based approach even though broader geographical concepts¹ have been important elements in the permaculture design toolkit.

1 The permaculture zoning concept was based on larger scale analysis by geographers of landuse distribution around towns and villages on the plains of Germany in the late 19th Century.

Yeomans keyline farm landscape planning concepts were also central to permaculture.

Mollison in *Permaculture: A Designers Manual* goes further to include broad landscape planning and land use allocation issues as "site factors" (pages 55-56)

The concept of 'the site' used in permaculture is similar to the use of the term by the design professions² to mean a limited parcel of land often focused on a central point which is generally a dwelling or building.

The site based approach to permaculture design has several advantages.

- Encourages small scale nucleated cellular development which reflects the natural growth patterns of organisms and human energy efficiency.
- Well suited to residential sites, the primary concern of permaculture designers
- Encourages distinct systems which reflect the particular nature of the site.
- Provides a focal point for applying the permaculture zone and sector planning tools.

Ideally broad landscape planning principles would determine development sites, but this is generally only possible in the design of new villages or homestead developments on larger farms. Elsewhere designers and owners are working within constraints determined by history and limited resources. Although examples of sound landscape planning, especially Yeomans' keyline landscape design concepts, have been highlighted by Mollison in the *Designers Manual*, he provides no integrated framework for large scale landscape planning and design.

THE BIOREGIONAL APPROACH

Another approach to understanding landscape which Mollison has extensively used³ is the general patterns of design solutions which are relevant within broad climatic regions. More local permaculture design refines this process to develop bioregionally distinct assemblages of plants and methods towards a new "indigenous" culture of place. This process is very important and has only just begun.

OTHER APPROACHES

However there is a need for permaculture methodologies which can deal with broad acre farming and rural village at the landscape planning rather than site design level.

In my own development of permaculture design methods over the last two decades I have adapted a range of approaches to see how they complement, reinforce and reflect permaculture principles.

One of the conclusions of this work is that the same planning framework can be applied to make existing broad acre uses more sustainable, as well as fit new, innovative, intensive

² See Lynch, K. *Site Planning* MIT Press 1971 a basic text I used when an Environmental Design student and Alexander, C. *Pattern Language* for a better understanding of the site concept

³ The whole layout and organisation of the *Designers Manual* reflects design solutions grouped by broad climatic regions.

land use and appropriate residential development into the landscape. These land uses can evolve in a successional way without the need to wipe the slate clean and start again with each change of ownership or input of new capital and resources. With the undesirable consequences of existing forms of rural residential development in Australia well documented, new forms based on sound planning and design principles are urgently needed⁴. Without appropriate rural resettlement it is unlikely for the intensive and fully integrated land uses envisaged in permaculture to develop because of shortages of capital, infrastructure, labour and skills.

THE LAND SYSTEMS CONCEPT

The land systems concept integrates information about climate, geology, landform, soils, natural vegetation and wildlife to identify land types which can be read in the field and mapped. At the simplest level it has similarities to vernacular ways of identifying different land types which focus on a dominant tree (eg Red Gum country) or soil and landform (eg black soil plains). It has evolved from principles put forward by Downes and others⁵ and used in a number of countries since the 1950's as a basis for land capability planning, development planning control and land rehabilitation.

Land systems are generally considered to be "large and heterogeneous land units with a distinctive and repeating pattern of more homogeneous units called Land Components". Land Systems are typically mapped at 1:50,000 or 1:100,000 scale while Land Components are generally mapped at 1:10,000 or 1:25,000

The greatest problem with the land systems concept is that the recognition, mapping and use of land systems information seems to depend on knowledge of several different scientific disciplines combined with skills in reading landscape, which are not formally taught in academia. Different land systems surveyors can come to different conclusions about system and component characteristics and boundaries. Different theories about past and present geomorphological, pedological and ecological processes can result in different conclusions about the nature of land systems.

In an attempt to standardise soil and land survey information, description of land and soil features follows agreed procedures and definitions such as outlined by McDonald et al⁶. These approaches do not include any judgments about land, soil or ecosystem formative and evolutionary processes. In my view this attempt to make land and soil surveying a more consistent process capable of being done by anyone with modest training does not achieve the holistic integrated understanding of landscape which is possible when surveyors are highly skilled and attuned to their environment.

4 See **Submission In Response to a Review of Rural Land Use in Victoria** David Holmgren Hepburn. Central Victoria May 1991

5 A more recent account of the principles and techniques is given by Gibbons, F. R and Haans, J.C.F.M **Dutch and Victorian Approaches to Land Appraisal** Soil Survey Papers no.11 Soil Survey Institute: Wageningen, Netherlands [1976]

6 McDonald, R.C. Isell, R.F. Speight, J.G., Walker, J., and Hopkins, M.s. **Australian Soil and Land Survey Field Handbook** Inkata Press Melbourne 1984

Haikai Tané, my teacher on land systems took a much more flexible approach. He defined a land system as;

A heterogeneous land unit with a characteristic pattern of physical terrain, energy regimes and biophysical resources.

- Physical terrain include the bedrock or sediments which make up the landscape (geology) and the land shape (topography).
 - Energetic Regimes (sunshine, heat, wind, rainfall and water movement, frost and fire) act on physical terrain via geomorphological and climatic processes.
 - Biophysical resources (soil, plants and animals) are the results of interaction between physical terrain and energetic regimes over time scales from hundreds of millions of years to annual cycles and events.
- Biophysical resources are renewable resources useful to humanity.

In describing soil as a result rather than a primary determinant, Tané is reinforcing the Keyline and Permaculture concept that the characteristics of soil are amenable to change while the climatic and geomorphological processes are not as amenable to sustained manipulation on any substantial scale.

Native vegetation associations, generally dominant tree are often the simplest indicators of lands systems which can used by anyone able to identify local plants as a way into understanding local land systems. However tree associations are often characteristic of whole bioregions and inconspicuous ground flora or elusive animals may better reflect and characterise system and component units. Frequently key species regarded as totemic for aboriginal peoples will be missing due to land use history. The fact that indigenous ecologies were, at least in part, the result of long standing land management practices, combined with changes brought about by species extinctions and invasions and soil fertility changes, makes native vegetation a still useful but incomplete measure of any land system.

Soil descriptions do provide a more fundamental indicator of land systems but soil surveying and taxonomic identification is a highly technical field which few can understand, let alone interpret.

The land systems concept allowed us to describe and evaluate land independently of current land use priorities, values and economics to see the land more akin to how aboriginal people's understood it⁷. This understanding of underlying biological potential of land goes beyond simple notions of land capability defined by the absence of noticeable land degradation.

⁷ Ecologists in central and northern Australian have found aboriginal descriptions of land types closely match land systems descriptions

Where land uses do not make full use of the landscape potential and its resources, degradation in some form can be expected (reflecting the permaculture principle that unused resources become pollutants).

The failure of more simplistic land capability methods focused on more obvious erosion hazards to recognise the slowing emerging problems of dry land salinity and acidification is a powerful example of the need to better understand the underlying nature of landscapes and their patterns of variation.

An indication of the strength of the land systems approach is provided by the early studies done of Kangaroo Island in South Australia prior to clearing much of the island for agriculture. As a result of those studies in the 1950's, the leading Australian soil scientist Northcote warned the government of the day that salinity would emerge following the clearing of specific land systems as a result of hydrological changes in the landscape even though there was little direct evidence of salinity in the natural landscape. That advice was ignored and today landholders and the taxpayer are having to pay for remedial revegetation work.

Land systems provide a framework within which a deeper more context rich understanding of permaculture sites can be considered and a basis for broad acre whole farm planning and more intensive, including village, development. In particular, mapping of System and Component boundaries is recognition of the more subtle and unseen edges within landscapes beyond the more obvious ones depicted in the generalised descriptions in the *Designer's Manual* and other permaculture texts. If the creation of edges by farm development follow land system and component boundaries they are more likely to be efficient and sustainable while reinforcing an underlying landscape harmony.

Further permaculture design and development proposals would be less likely to include inappropriate or unworkable systems⁸. While the land system concept does not of itself define sustainable land use it does provide a sound foundation for their design.

Examples of my own mapping and interpretation of land systems is documented in *Permaculture in the Bush*⁹, and *Hepburn Permaculture Gardens*. In the first case, the development site is all within one land component. In the second the site straddles the boundary between two land systems. A casual survey of the surrounding district can identify other gardens or relevant land uses which are sited on similar land and can provide examples of what grows well and other land management hazards and opportunities.

It is interesting the degree to which people expect the land in a particular district to have the same characteristics and the surprise when they grasp the mosaic pattern of soils

⁸ For example; Very few high value fodder and food trees thrive on ancient, infertile, waterlogged or shallow soils. High density plantings cannot be expected to thrive in low rainfall areas without irrigation.

⁹ Holmgren, D. *Permaculture In The Bush: The design and development of a homestead on the far south coast of N.S.W.* Nascimanere 1992

and land systems which is the norm across almost all landscapes. Where government Land Systems studies are available I use these as a base from which to more specifically interpret and map land units at a scale relevant to property planning.

WHOLE FARM PLANNING

While land systems provide an excellent foundation for permaculture landscape, farm and community planning and design, they are only one element in the planning, design and development process.

In the *Designers Manual*, Mollison explores several different methods of design, indicating some of their strengths and weaknesses. More broadly permaculture designers have drawn heavily on site design methodologies of the architecture and landscape architecture professions. For larger scale projects, the master plan which outlines all the physical elements for later detailed design and specification has been used.

The trouble with master plans is that they almost invariably need radical modification due to unforeseen problems and opportunities which emerge during the process of development. This is especially the case when dealing with complex and evolving systems.

Long ago the urban planning profession abandoned master planning as too rigid and inflexible for dealing with the complex nature of cities where the planners could not control all factors or even fully understand their influence.

To deal with complexity of cities urban planners adopted strategic planning¹⁰. Today strategic planning (in name at least) is everywhere because rapid rates of change and complexity have made it a mandatory minimum.

In dealing with novel and evolving living complexity, permaculture planning and design must use methods with maximum flexibility.

Strategic planning can be applied in many ways but the core concept is the development of a strategy which embodies your objectives without being specific about the precise forms of designs which will express that strategy.

The strategy planning process can be seen a series of steps with feedback at each to refine the previous steps. Thus in practise the process can be closer to the apparently chaotic processing of informal decision making where we start out with some information and ideas which are refined in the light of experience.

¹⁰ Strategic planning was developed by military planners who accept uncertainty, complexity and uncontrollability as the normal decision making environment. General Eisenhower once said, plans are useless but planning is essential.

I see the steps in the strategic planning process as follows:

- **Inventory:** collection of relevant data
- **Evaluation:** organisation of data into comprehensible patterns
- **Strategy:** general directions and frameworks for development
- **Design:** particular forms which express the strategy
- **Management:** process of physical creation and management

The following chart¹¹ illustrates the application of this process to permaculture (whole) farm planning. Any farm consists of an interweaving of the four development streams of Lands, Infrastructure, Homestead and Enterprise.

THE FOUR DEVELOPMENT STREAMS OF PERMACULTURE FARM PLANNING FOR INTENSIVE LAND USES

THE STRATEGIC PLANNING PROCESS

INVENTORY ► EVALUATION ► PLANNING ► DEVELOPMENT ► MANAGEMENT

← *feedback and refinement*

← increasing complexity of planning and management

LANDSCAPE (the natural environment and wild nature)	EARTH FACTORS (geology, land form, hydrology) CLIMATIC FACTORS (rainfall, sunlight, heat, frost, wind, fire patterns) BIOPHYSICAL RESOURCES (soils, plant and animal biodiversity including naturalised)	LAND SYSTEMS and COMPONENTS (the underlying patterns of biological potential)	LAND USE SYSTEMS (the mix and broad patterns of vegetation type, water management and use)	LAND USE DYNAMICS (succession processes for soil, vegetation and animals)
INFRASTRUCTURE (built improvements)	EXISTING INFRASTRUCTURE (Improvements of buildings, access, fencing, water supply and drainage, power and telephone)	POTENTIALS and LIMITATIONS of existing systems for future development and maintenance	NETWORKS and NODES (eg water supply)	DESIGN AND SPECIFICATIONS (eg earthworks for dams, plumbing and pumping for water reticulation)
HOMESTEAD (permaculture zone 1 & 2)	DETAILED SITE SURVEY (contour and feature survey, microclimate, soil profiles, flora and wildlife)	LAND SYSTEMS CONTEXT AND DETAILS (including changes due to land use history)	ZONE, SECTOR AND NETWORK ANALYSIS for each dwelling and major building	DESIGN AND SPECIFICATION (eg buildings, soil improvement, planting design, water reticulation, fencing etc)
ENTERPRISE (activities which generate surplus capital to sustain other development streams)	SURVEYS OF TECHNOLOGIES & METHODS (development, management, harvesting, processing, marketing & finance) DETAILED SURVEYS OF LAND FOR INTENSIVE LAND USES (contour and feature surveys, microclimate, soil profiles and tests, flora & fauna)	SWOT ANALYSIS (strengths, weaknesses, opportunities, threats) REQUIREMENTS for capital, information, infrastructure, labour and skill	STRATEGIC PLANS (for enterprise development, management, harvesting, processing and marketing)	DESIGN AND SPECIFICATIONS (eg orchard layout, tree stock, irrigation, soil mineral balancing, design, processing shed design, advertising and packaging)

11 Adapted from *Developing A Tree Crop Farm* by Tané, H & Holmgren, D. paper to the 1984 New Zealand Tree Crops Conference. These ideas were further developed and applied in Holmgren, D *Trees On The Treeless Plains: A Revegetation Manual for the Volcanic Landscapes of Central Victoria* 1987 Report to Project Branchout and published in 1994 by Holmgren Design Services.

Landscape is the natural foundation which can be best described using the land systems methodology. Land use degrades and/or evolves the landscape and its biophysical resources. Sustainable land use focuses the natural forces towards providing for human need while continuing to perform the landscape's essential functions.

Infrastructure is all the built "improvements" added to landscape which facilitate or enable the land use but are not its purpose such as fencing, water supply, access, maintenance facilities, power supply and even shelter. Sustainable planning of infrastructure reflects and reinforces the natural landscape and its boundaries rather than ignoring or masking them. Landform fencing is a common example.

The **homestead** is the domestic environment of the farm, which tends to be ignored in more conventional approaches to farm planning. The domestic (non commercial) aspects of the farm correlate roughly to the permaculture zones one and two. It is a microcosm of the farm which can;

- provide some household needs more efficiently than the monetary economy
- be a refuge during environmental or economic catastrophe from which farming can reestablish.
- provide a testing ground for new ideas, processes and species before they are applied on the broad scale.

The **enterprise** is the economic engine of the farm, linked to the wider society and economy. Husbandry, hard work and management have traditionally been seen as the keys to making a living from farming. Today it requires consideration of design at one end of the business, especially where tree crops and other new land uses are involved, and marketing and finance at the other end where the customer and partners have become critical players.

Each development stream has its own dynamic and critical factors, all are important but there is an increasing complexity of planning and management as we move from landscape to enterprise, especially in the case of intensive land uses. However the landscape and its free ecosystem services always remain the foundation and reference point for sustainable agriculture. Experience with land degradation shows that the complexity of planning, and the management to rehabilitate landscapes, are great.

INFRASTRUCTURE NETWORK DESIGN

The concept of the site is central (literally) to permaculture design but site selection for rural homesteads depends on understanding the opportunities and constraints created by landscape and infrastructure. Analysis of farm landscapes will often show many sites with good homestead potential (eg good drainage, gentle slopes, favourable aspects etc) for development. Consideration of access, water supply and power will often determine

if and how that potential might be realised. Where several activity centres or nodes are planned, the networks which link the nodes (eg access and water supply) become critical to the effectiveness of the total design. Using a scoring card to sum multiple factors can often be useful in making a decision between alternatives¹². Once a site is selected there are considerable savings in energy and resource use from close clustering of farm facilities and intensive land uses around the homestead site using the zoning concept. A farm with a house on a hilltop, sheds at the front gate and garden on the river flat may appear to reflect good individual site selection but difficulties in transport and communication between these separated activity nodes results in wasted time and energy as well as impeding integration between functions.

On the other hand the homestead as a focal point for clustering of all activities using zones and sector analysis has its limitations.

- Firstly the size of a site may not be large enough to accommodate all functions without excessively compact development or spreading across unsuitable land. This is often the case in steeper landscapes and on commercial farms where processing facilities, animal yards and other facilities require more space than all of the domestic (non-commercial) homestead facilities.
- Secondly physical separation can sometimes be an advantage to reduce adverse impacts or create new opportunities. For example large scale farm business facilities may involve noise or smell not compatible with a homestead. While permaculture design should aim to both integrate the living environment with its means of support and keep enterprise activities small scale and environmentally benign, some degree of segregation may be necessary. A farm retreat cottage is generally more attractive when at a remote location.
- Thirdly integration between functions can require physical separation. For example a high barn on a ridge top access entrance to the homestead providing gravity supply tank water to a homestead on the lower slopes creates a bi-nodal development pattern¹³ where use of slope (gravity) becomes more important determinants of location than zones and sectors.

Taking this idea further it can be seen that the location of infrastructure serving any activity node becomes a powerful factor changing the location and relationship between the permaculture zones. For example the easily accessed and monitored edge of a long driveway becomes a natural place to extend homestead plantings (the traditional driveway avenue). A water main from a distant supply dam provides opportunities for linear extension of irrigated plantings close to the water main. Perhaps most importantly

¹² See both *Permaculture In The Bush* and *Hepburn Permaculture Gardens* for examples of this design tool.

¹³ See Mollison *Permaculture: A Designers Manual* (figure 3.11 and figure 7.2)

landform fencing which constrains and directs vehicle, animal and pedestrian access will extend and constrain zones.

In the design of rural villages and hamlets, and more complex farms characterised by

- multiple integrated land use enterprises
- more than one residence
- significant on farm processing facilities or farm tourism,

network analysis of landscape and infrastructure with multiple nodes of activity become critical to practical and sustainable design.

Indicative evaluation of traffic and material flows along access routes, pipes and wires is often required to see how the generators and receivers of flows can be arranged in clusters, daisy chains and parallel circuits. The design of informational network and industrial processes offer insights, patterns and models which could be adapted to whole farm and landscape planning.

KEYLINE PLANNING

On many farms in sub-humid landscapes keyline planning¹⁴ will reflect and reinforce a lands systems analysis and provides a sound basis for such network planning. Dams can be considered as the nodes where runoff is directed by contour diversion channels and pattern plowing. Flood channels, pumps and pipelines distribute the water from dam which are themselves potential activity centres for wildlife, aquaculture and recreation. Sensible location of roads and tracks along ridges and beside collection channels and crossing dam walls can then be determined which provide vehicle access to the whole landscape and reinforce the water harvesting and distribution systems as the dominant feature of the landscape.

A network of vehicle access routes with intersections and loops which will offer the greatest flexibility in land use will then become evident. Intersections of access routes on generally sloping or flat well drained sites will generally have appropriate relationships to the water harvesting network for development as houses or other activity centres. Thus development sites can be seen as the nodes or activity centres of the access network which are almost diametrically opposed to the dams in the landscape on gentle slopes of ridges with good water and cold air (frost) drainage, water supply options, microclimate modification, fire protection, recreation and other benefits.

The advantage of this method is that it reveals all the potential dam and development sites and allows for current land use without precluding future intensification of landuse and settlement patterns. For example, appropriate uses of a prime dam site may include grazing and cropping but generally not orchards or timber plantations and certainly not house sites.

¹⁴ see Chapter 7 of the Mollison *Permaculture: A Designers Manual* and Yeomans *Water For Every Farm*

In a similar way potential road locations can be used as vehicle access routes across open paddocks with upgrading dependent on future development so long as new fencing or tree plantations across or along the route are avoided. Where short term uses are incompatible with long term optimum potential, the use should ideally have achieved its purpose, paid for real cost of establishment and use infrastructure which can be salvaged before the need for the long term potential is likely to be realised. This example of strategic planning provides a context for the application of the options approach described by Mollison¹⁵.

VOLCANIC LANDSCAPE PLANNING

The classic keyline analysis may not always be appropriate but the principles of network analysis can still be used. For example in the cool temperate volcanic landscapes of southern Australia¹⁶ with deep free draining red soils, dams are restricted to drainage lines with springs and/or water holding soils. The shape of the land does not follow the classic keyline form of primary and secondary ridges and valleys and the absorbent soils shed little in the way of runoff to dams. Moisture holding soils and good quality ground water mean keyline analysis and water harvesting and distribution strategies have more limited application. On the other hand, the elevated, flat and relatively treeless nature of these landscapes makes wind exposure, and shelter to ameliorate it perhaps the most critical landscape planning issue. In these landscapes, a network analysis of existing and possible shelterbelts and other plantings, can identify nodes where shelterbelts intersect wood lots and other treed and naturally sheltered areas, which become the activity centres or development sites for homesteads, animal yards and barns, orchards and other intensive land uses etc.

If planning and design of farms is to be sustainable then it must be flexible enough to provide for existing occupants and land uses while allowing future occupants and land uses to be accommodated by building on and complementing existing developments. Keeping land use options as open as possible is most important in a rapidly changing world. Of even greater importance is the need to move away from the slate being wiped clean each time there are changes of ownership, land use and subdivision. The decay of farm homesteads and infrastructure when land is subdivided for houses, the loss of paddock trees when new vineyards are planted or the wholesale replacement of farms by pulpwood timber plantations all waste existing assets and values, in the same way that urban redevelopment generally starts with demolition of existing buildings. When each phase of settlement of more people in the landscape or addition of new and more intensive land uses can be accommodated in a way which build on and reinforces good existing design we are closer to the essence of sustainable development.

¹⁵ section 3.5 Mollison *Permaculture: A Designers Manual*

¹⁶ See Holmgren, D. *Trees On The Treeless Plains: A Revegetation Manual for the Volcanic Landscapes of Central Victoria* Holmgren Design Services 1994