GUIDING PRINCIPLES FOR SOIL HEALTH

The terms 'soil health' and 'soil quality' are becoming increasingly familiar worldwide. A modern consensus definition of soil health is **"the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans"** (Natural Resources Conservation Service –USDA-NRCS, 20122; Soil Renaissance, 2014). Doran and Parkin, in 1994, defined soil quality as **"the capacity of a soil to function, within ecosystem and land use boundaries, to sustain productivity, maintain environmental quality, and promote plant and animal health."**

Healthy soils:

- Supplies nutrients, water and oxygen for healthy plant growth
- Allow infiltration, and facilitate storage and filtration of water
- Retaining and cycling nutrients and supporting plant growth
- Suppresses pests, disease and weeds
- Large and diverse population of soil biota
- Resistant to degradation
- Resilient to impact of environmental stresses

Management objectives for soil health:

- Minimise soil loss
- Reduce acidification and salinity
- Improve soil physical properties
- Manage wet soils
- Prevent contamination
- Maintain and enhance soil biota
- Maintain nutritional fertility
- Maintain/improve groundcover and organic carbon

Principles for soil health:

1. Adoption of sustainable practices for productivity outcomes (dryland and irrigation).

a) Implement farming practices which maintain soil structure, improve water use efficiency, and nutrient use efficiency, minimise soil loss, nutrient losses, run-off and conserve limited water supplies (for both dryland and irrigation).

b) Specifically, for irrigation, manage deep drainage to prevent off-site impacts.

c) Adoption of grazing practices that maximise groundcover all year – monitoring and matching stock numbers to seasonal pasture availability, allow pastures to recover to set seed and maintain groundcover.

d) Adoption of sustainable cropping practices – reduced tillage, stubble retention, legume incorporation into rotations, maintain stubble for groundcover, soil-testing and nutrient matching.

e) Minimise compaction and excessive tillage.

f) Build levels of organic matter / carbon in soils.

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2. **Property planning, including a Soil Health Management Plan – involves a long-term vision which considers the whole of the property and its place in the catchment.**
   a) Prevention of soil degradation is nearly always substantially cheaper than the cost of restoration.
   b) Understand the landscape; its geology, geomorphology, hydrology, soils and climate
   c) Manage property according to the capability and the limitations of the land.
   d) Protect and rehabilitate areas that are degraded or at risk from degradation.
   e) Ensure the appropriate placement of infrastructure to minimise the soil impacts.
   f) Work with communities - soil health is not an individual issue but a landscape issue.

3. **Preserve and protect natural features.**
   a) Manage and protect native vegetation, including native grasslands, as part of whole of property management.
   b) Protect waterways and drainage lines with fencing, vegetation and appropriate land management strategies.
   c) Adoption of a strategic and coordinated approach to sustainable weed and pest control.

More information

Contamination

Usually correlated with the degree of industrialization and intensity of chemical usage.

This type of contamination typically arises from rupture of underground storage tanks, application of pesticides and herbicides, percolation of contaminated surface water to subsurface strata, leaching of wastes from landfills or direct discharge of industrial wastes to the soil.

Protecting a dam water supply from contamination may be a top priority after a bushfire. Heavy rainfall can generate run off that may carry with soil, organic matter and debris.

In Victoria the primary source of contaminated soils is redevelopment of former industrial sites for urban renewal, both property and infrastructure development. There is some rehabilitation of industrial land.

Groundcover

Different levels of minimum groundcover (and herbage/plant mass can also be important) are needed for different soil types and regions. Minimum levels for pastures in south-eastern Australia are suggested to be:

- 70% for pastures on flat and slightly sloping (<3%) land and on non-erosion prone soils (moderate-good soils generally). Herbage mass should be a minimum of 800-1200kg dry matter (DM)/ha.
- 80-90% groundcover for lighter, more erosion prone soils and Minimum herbage mass should also be 1000-1500kg DM/ha - where land is undulating.

Carbon (C) - What is its optimum level?

Organic matter (OM) is the total of all organic materials contained within and on soils.

Organic carbon (OC) is the measurement used for calculating OM.

- To do this the equation "OM (g/kg soil) = OC (g C/kg soil) x 1.72" is used. It is preferable to just use OC as the figure of 1.72 can vary from 1.72 - 2.00.
- Typically, OC varies with depth and the magnitude of such changes differs between soil types. Typically, OC contents are greatest at the soil surface and decrease exponentially with depth.
- OC is a dynamic soil fraction that has many functions. Therefore, it is difficult to define a single level of OC in a soil at which all functions are optimised.
- Low OC generally means the soil has "poor" structure, holds less water and nutrients Soils with high OC generally have "good" structure, good water holding capacity and reduced erosion and nutrient leaching. OC levels will vary according to pasture or crop type, as well as the original soil type.
- 90-100% groundcover for steep hill country on light and erosion prone soils (e.g. slopes of greater than 10%, granite or light sedimentary soils with low fertility and often high acidity). Herbage mass should be a minimum of 1500kg DM/ha.

Soil carbon levels under pasture and cropping regimes in low and high rainfall regions in Victoria

	Low rainfall (<500 mm)		Higher rainfall (>500 mm)	
	Crop	**Pasture**	**Crop**	**Pasture**
	Percentage By Weight			
Low Soil Carbon Level Range	**0.9**	**1.7**	**1.45**	**<2.9**
Normal Soil Carbon Level Range	**0.9 – 1.4**	**1.7 – 2.6**	**1.45 – 2.9**	**2.9 – 5.8**
High Soil Carbon Level Range	**>1.45**	**>2.6**	**>2.9**	**>5.8**

(Source: Department of Primary Industries, briefing to the Environment and Natural Resources Committee – Melbourne,14/12/2009)

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