Chapter 5

Assessment of Future Risks in Victoria

There are social, economic, environmental and technical issues involved in the appropriate management of acidic soils. Approaches to manage acidic soils, including perennial species, plant tolerance, lime application, fertiliser choice and changed land use are likely to be used concurrently on different parts of the landscape.

The challenge is to understand which options should be applied to which part of the landscape and to identify high priority actions where intervention is needed to encourage sustainable, environmentally appropriate land management. If acidification is allowed to continue unabated, the outlook for much of the high to medium rainfall regions of Victoria will be the loss of highly productive land to increasingly acid surface soils. In assessing the risk of acidification across the agroecological zones of Victoria, the following major criteria were used.

- Soil type and surface soil texture (rate of nitrate leaching),
- Annual average rainfall (primarily the 400-500 mm and 500-600 mm rainfall zones),
- Current farming enterprise,
- Current use of fertiliser nitrogen and phosphorus,
- Preferential water flow (surface, subsurface or deep drainage),
- Acidification rates based on farming enterprise and product removal.

In predicting the possible change in surface soil pH into the future several major assumptions were made.

- Assumed that pH decline is evenly distributed across the region according to broad pH layers,
- Ignored the differential acidification rates of different soil types,
- Considered a uniform spread of single major commodity industries within pH bands and regions (eg. broadacre cropping or permanent grazing),
- Assumed that lime is spread to offset the decline in soil pH at a level of 0.1% of acidified soil, which is consistent with current application volumes.

On this basis it is possible to predict the likely changes in surface soil acidity across the state of Victoria. If the current landuse and soil types for each Catchment Management Authority (CMA) in Victoria is examined it is possible to identify regions of greatest risk (Table 7).

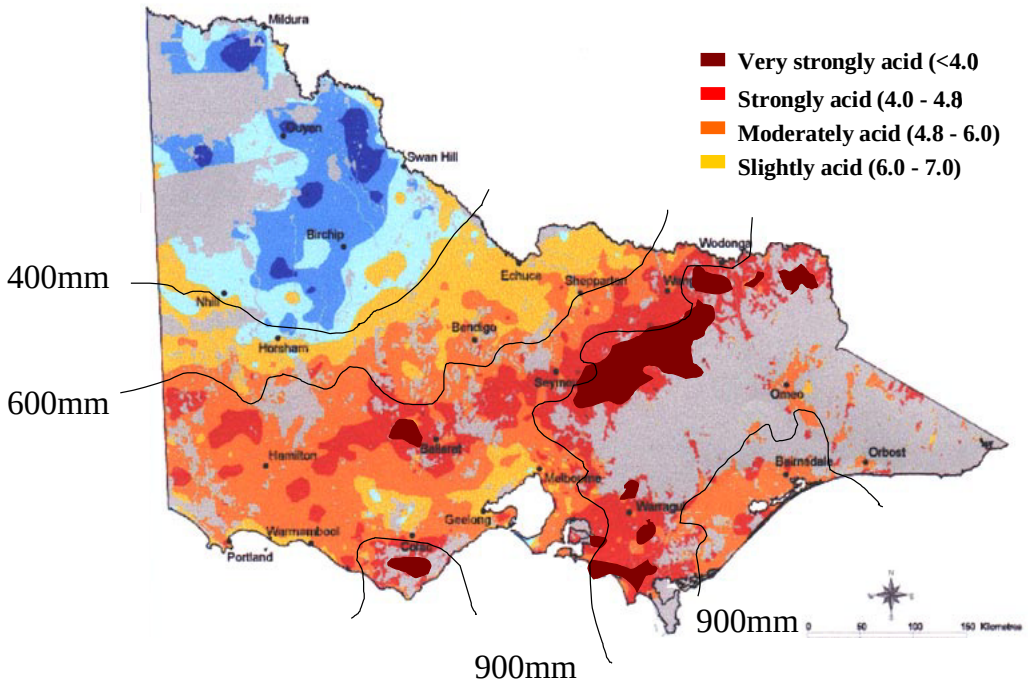
In Victoria there are 10 CMA regions.

1 Mallee
2 Wimmera
3 Glenelg-Hopkins
4 Corangamite
5 North Central
6 Goulburn-Broken
7 Port Phillip
8 North East
9 West Gippsland
10 East Gippsland

These regions are shown on Figure 3b

(a)

Surface soil pH_{Ca} - present



An estimation of the surface soil pH_{Ca} in the year 2050

(b)

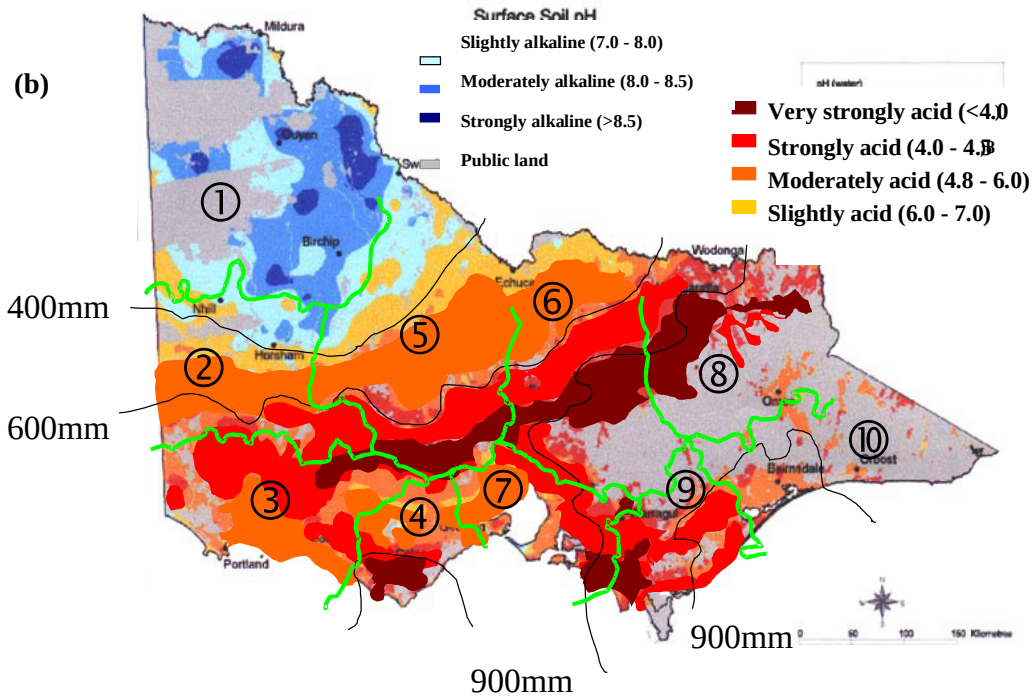


Figure 3. Current (a) and predicted 2050 (b) surface soil acidity in Victoria, with Victorian Catchments indicated on 3b.

These broadscale maps were generated by NRE's State Chemistry Laboratory who applied geo-statistical techniques ('kriging') to the mean pH (+/- 0.5 of a pH unit) of the locations. It indicates the geographic trends in the acidity and alkalinity of surface soils across Victoria's agricultural land. These maps cannot indicate soil pH at the paddock scale and it should only be used as an indicator of likely pH at a regional scale. Considerable variations in soil pH will occur within a region. These maps are published on the *Victorian Resources Online* website (www.nre.vic.gov.au/vro).

Assessment of specific Victorian catchments

Table 7 lists the Victorian catchments at greatest risk from the effects of soil acidification and the potential flow on impacts. These are:

North East

Goulburn-Broken

Glenelg-Hopkins

West Gippsland

southern region of the North Central and

southern region of the Wimmera.

Table 7. Acidification rating, impacts and remedial actions for each CMA catchment in Victoria.

Risk rating	CMA Catchment	Possible Future Impacts	Remediation and monitoring activities
High	**North East** **Goulburn-Broken** **Glenelg-Hopkins** **West Gippsland** ***Southern* North Central** ***Southern* Wimmera**	Production loss, Decreasing ground cover, Increasing salinity as a result of poor ground cover, Declining biodiversity.	Education, liming, increase perennial pastures, and monitor soil pH and Al. Research required to maintain productive soils.
Medium	**Corangamite** **Port Phillip** ***Northern* North Central** ***Northern* Wimmera**	Production loss, Decreasing ground cover, Increasing salinity as a result of poor ground cover,	Education, lime, increase perennial pastures, and monitor soil pH and Al
Low	**Mallee** **East Gippsland**	Decreasing production if soils allowed to become strongly acidic. Unlikely for some time.	Monitor soil pH.

The impact on regional Victoria in the year 2050 if no on ground remedial action takes place will potentially be significant infrastructure degradation, water quality decline and a downturn in community viability in affected regions. . A detailed synopsis of each CMA catchment, the major soil types and their potential to acidify is provided in the following pages.

The following maps were produced by mapping soil pH across Victoria using NRE's State Chemistry Laboratory's statewide soil chemistry data set which is based on samples submitted from farms, vineyards and orchards between 1973 and 1994. Each sample was a composite of 20 to 30 cores representing the 0-10, 0-15 or 0-30 cm depth of soil taken from the main soil type in each paddock. Samples from national parks, urban land and sport and recreational turf were excluded from the data. Collated data included nearest location and pH as measured in $CaCl_2$.

North East CMA

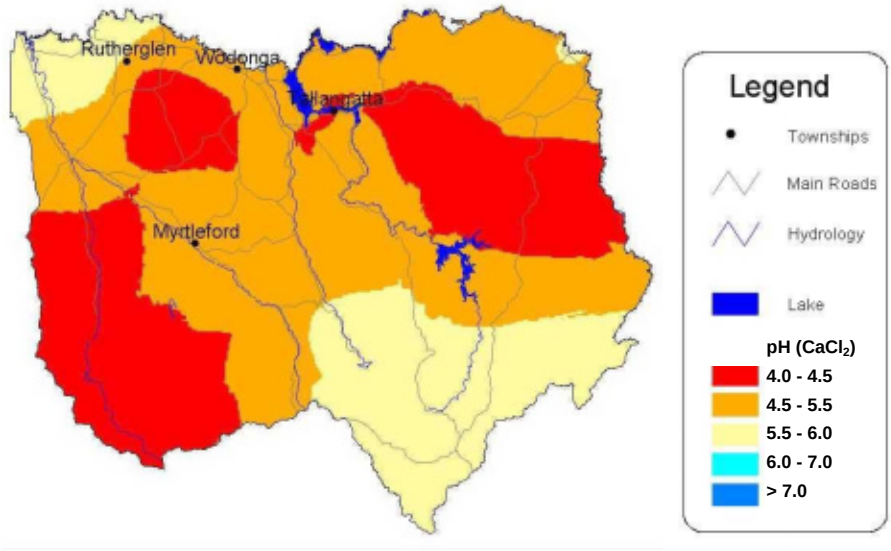


Figure 4. North East CMA, present surface soil pH

Table 8. North East CMA soil type, land use and threat to acidity.

Soil Types	Current Land Use	Acidity Threats
Red duplex soils 40%	Dry land cropping and pasture, uncleared, horticulture, forestry	-Medium rates of acidification under annual pasture and crops well documented. Increasing risk of subsoil acidification may be difficult to rectify if left too long. High risk of soil degradation and soil loss on upland soils, leading to high sediment loads in waterways and reduced water quality.
Yellow duplex and friable leached earths 50%	Dry land cropping and pasture, uncleared	-Acidification through annual pasture and crops around Rutherglen has led to medium to high rates of acidification. The rate of acidification will be dependent on the proportion of legumes used in the farming system or length of cropping. -The high potential for leaching in these soils represents a risk to subsoil acidification. -Many of these soils are granitic in origin, are highly acidic and in high rainfall environments represent a high risk of subsoil acidification. -Some of these soils are already strongly acid to depth and will require significant landuse change to halt current rates of acidification.

Goulburn-Broken CMA

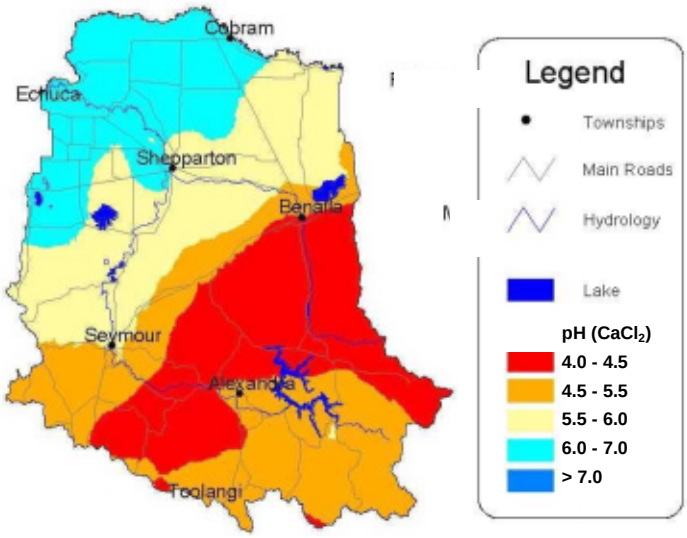


Figure 5. Goulburn-Broken CMA, present surface soil pH

Table 9. Goulburn-Broken CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Red duplex soils 55%	Dry land cropping and pasture, irrigated pasture, horticulture, uncleared, forestry	-The red brown earths encompass the north of this region and cover varying rainfall zones. The susceptibility of this soil type to medium acidification is well documented under all forms of dry land agriculture. Soils in the north and east of the catchment and the central area are more acid to begin with and surface soils have acidified rapidly. -Irrigated fruit production has been highly acidifying in the rows where fertiliser practices have been sub-optimal, -There is significant risk of subsoil acidification.
Yellow duplex soils 30%	Dry land pasture and cropping, uncleared, forestry	-The majority of these soils are granitic in origin and are highly acidic. Leaching potential is high, and sub surface as well as topsoil acidification is a reality. -Under annual pasture and crops, acidification is high. -With perennial pasture species the potential is low/medium. -Uncleared areas are acidifying very slowly but under forestry the poor buffering capacity of these soils is cause for alarm.
Friable leached earth 15%	Uncleared, forestry, dry land pasture and cropping	-In the Dookie area annual pastures and crops have caused medium acidification in the topsoil and will continue to do so.

Glenelg-Hopkins CMA

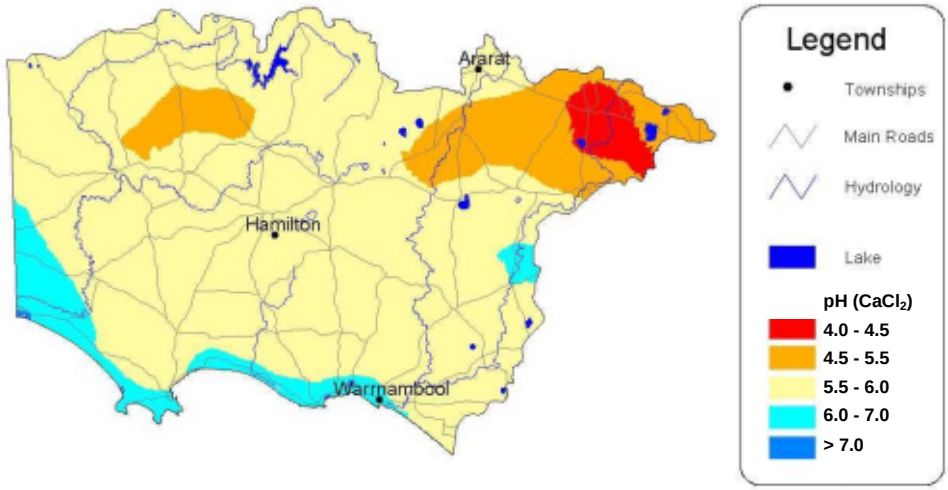


Figure 6. Glenelg-Hopkins CMA, present surface soil pH

Table 10. Glenelg-Hopkins CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Yellow duplex 60%	Dry land pasture, uncleared, dry land cropping, forestry	-Most soil moderately to strongly acid (pH 5-6). Poor quality perennial/annual pastures contributing to medium acidification but mediated by high organic matter contents. -Change in landuse to broadacre cropping is a major threat on these soils and will accelerate the rate of acidification, and possible nutrient losses.
Leached sands 15%	Uncleared, forestry	- Rate of acidification will be hastened by forestry activities in this area. The ensuing subsoil acidification through tree regrowth will be difficult to ameliorate.
Friable leached earth 5%	Dry land pasture, horticulture	-Horticulture with high N fertiliser usage could hasten acidification on these soils.
Loam 5%	Dry land pasture, horticulture	-High fertiliser usage in horticultural areas will more rapidly acidify soil on these soil types if unlimed.

West Gippsland CMA

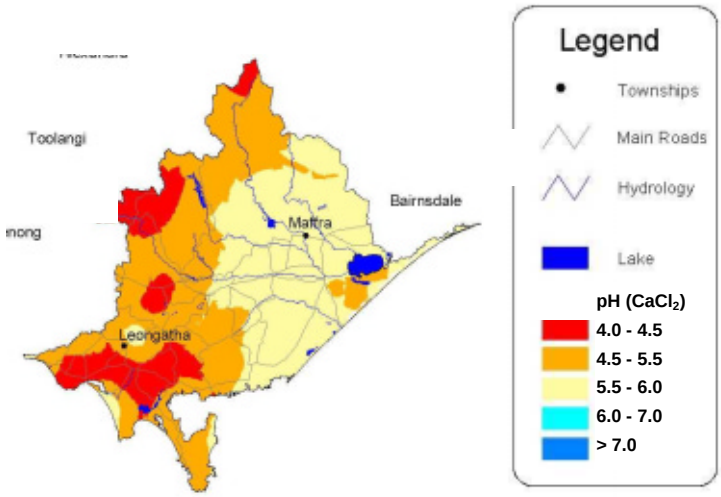


Figure 7. West Gippsland CMA, present surface soil pH

Table 11. West Gippsland CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Yellow duplex soils 35%	Dry land pasture and cropping, uncleared, irrigated pasture, forestry,	-Naturally moderately acid, with perennial pasture acidifying slowly due to high organic matter contents. Annual cropping will acidify the soil at a faster rate. -Uncleared forest acidifying very slowly. -Irrigated pasture surrounding the river valleys will lead to increased leaching of nutrients, especially if fertilised with nitrogen. High organic matter contents however will mediate pH change. -Forestry likely to slightly acidify surface soils due to well buffered subsoils.
Friable leached earth 35%	Dry land pasture, uncleared, forestry, horticulture	-Well drained soils that have high organic matter contents and very low pH. Main use is dairy grazing. High usage of both N and P fertiliser, but pH change is slight and lime response on highly acidic soils is poor due to high buffering. -Uncleared areas acidifying very slowly. -Timber production both existing and recent planting unlikely to cause severe acidification, but slight change in the topsoil. -Potato production has led to declines in organic matter, initial pH was acidic, however soil C levels are still generally high and further acidification is slow.
Sands 10%	Uncleared, dry land pasture	-Very acidic surface soils and to depth that perennial pasture is causing to acidify slowly due to poor buffering. -Acid sulphate soil potential at Loch Sport. -Pollution of waterways and man made structural degeneration is a risk if urban development disturbs pyrite sediments.

North Central CMA

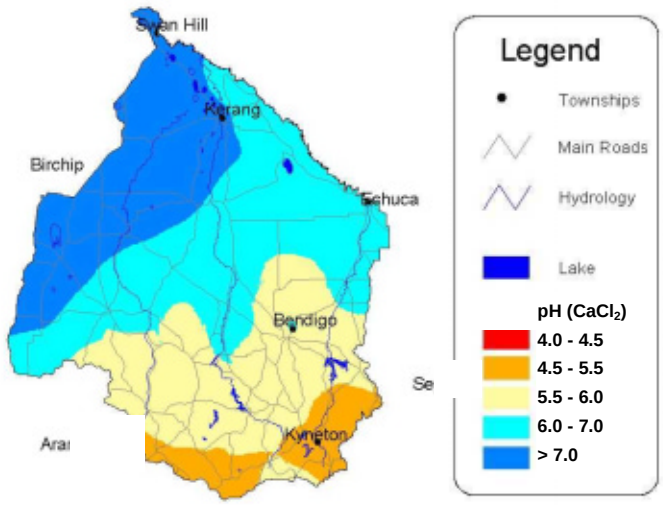


Figure 8. North Central CMA, present surface soil pH

Table 12. North Central CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Red duplex soils 35%	Dry land cropping and pasture, irrigated pasture	-These soils vary from slightly neutral to moderately acidic in their current state. In the higher rainfall areas the acidification rate under annual species is moderate and surface soil acidity is fast becoming an issue in areas such as Elmore. Increased use of nitrogenous fertiliser will accelerate acidification. -Pasture irrigation on slightly acidic soils will be promoting leaching and further acidification.
Yellow duplex soils 30%	Dry land pasture, uncleared	-Poor quality annual pasture persists on these acidic soils with poor structure. -Acidification is moderate on these low organic matter soils. -Uncleared, these areas are acidifying very slowly but because of poor buffering capacity they are fragile and prone to subsoil acidity as well.

Wimmera CMA

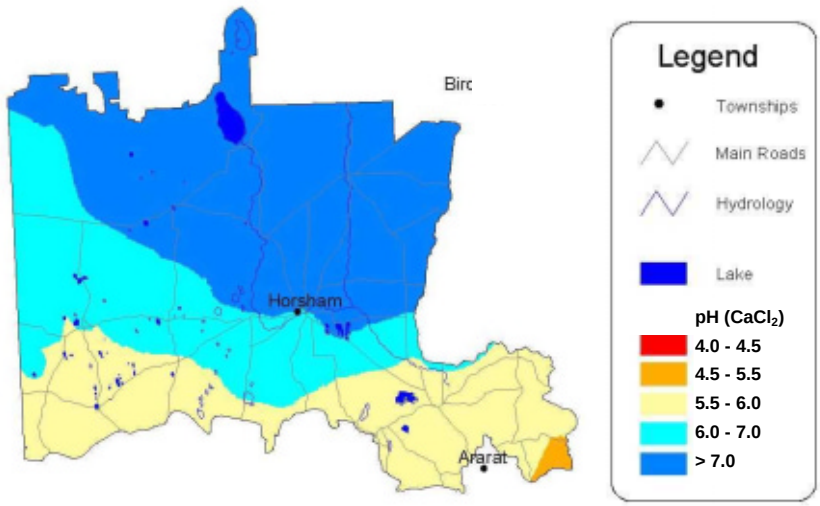


Figure 9. Wimmera CMA, present surface soil pH

Table 13. Wimmera CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Yellow duplex 40%	Dry land cropping and pasture, uncleared	-More heavily textured soils south of Horsham are moderately acidic and surface soils are acidifying further at a slow rate under annual pasture grazing systems.
Red/brown duplex (cracking clays) 35%	Dry land cropping and pasture	-SE corner highly acidic and slow rates of surface soil acidification with high rainfall.

Corangamite CMA

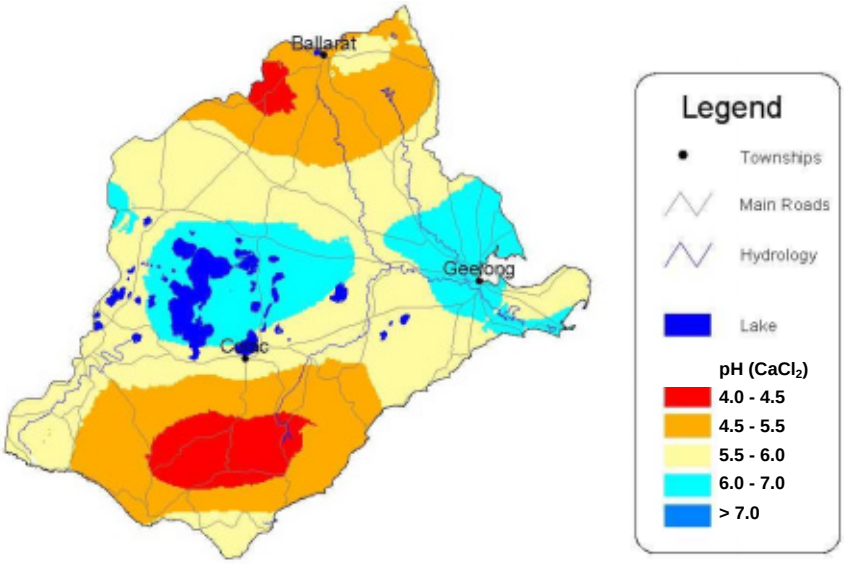


Figure 10. Corangamite CMA, present surface soil pH

Table 14. Corangamite CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Yellow duplex soils 60%	Dry land pasture, uncleared, forestry, dry land cropping	-Significant areas of poor pasture is being converted to raised bed cropping. This will increase acidification rates due to greater product removal and increased water movement through the soil profile. With higher profits though, the ability to spread lime will also increase.
Friable leached earth 15%	Dry land pasture, uncleared, dry land cropping	-Cropping on these soils can occur without raised beds; increased productivity on these soils will result in higher acidification rates.
Dark duplex soils 10%	Dry land pasture, horticulture, dry land cropping	-Raised bed cropping is increasing in this area and will be moderately acidifying if lime is not applied
Loam 5%	Dry land pasture, uncleared	-These soils are strongly acidic and their acidification potential under current pasture practice is high. Changing landuse to cropping or horticulture is the greatest threat to acidification. -Uncleared areas are acidifying naturally and slowly under native vegetation.
Sand 5%	Uncleared, dry land pasture, forestry	-Forestry is cause for concern on this soil type given the poor buffering capacity of this soil and will probably cause subsoil acidity due to cation removal. -Acid sulphate soil potential at Anglesea. -Risk of pollution of waterways if urban and industrial development disturbs pyrite sediments.

Port Phillip CMA

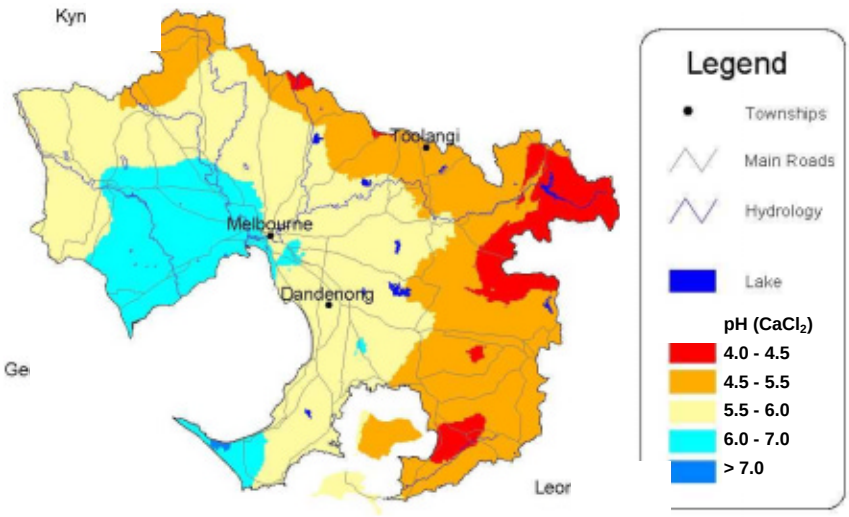


Figure 11. Port Phillip CMA, present surface soil pH

Table 15. Port Phillip CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Yellow duplex soils 25%	Urban development, dry land pasture, uncleared	-Well buffered clays with medium acidification potential in the topsoil. -High leaching losses possible through watering of gardens, leading to localised acidification and threat of infrastructure decline.
Red duplex soils 20%	dry land pasture, urban development, uncleared, horticulture	-Irrigated and dry land horticulture will lead to higher acidification due to increased fertiliser usage, increased crop removal and the potential for higher nutrient leaching. High threat to acidification on these soils due to horticulture expansion in this area.
Friable leached earths 15%	Uncleared, dry land pasture, horticulture	-Horticulture on these soil types will lead to higher acidification rates due to leaching of nitrogen fertilisers and increased product removal. Perennial row crops such as grapes could lead to higher acidification, but are usually well limed to begin with.
Sands 10%	Urban development, dry land pasture, uncleared	-High leaching potential under gardening will lead to high rates of acidification and the threat of infrastructure decline. -Perennial pasture will be unable to halt acidification of this soil type due to poor buffering capacity to depth. -Acid sulphate soil potential at Carrum. -There is a risk of pollution of waterways if development disturbs pyrite sediments.

Mallee CMA

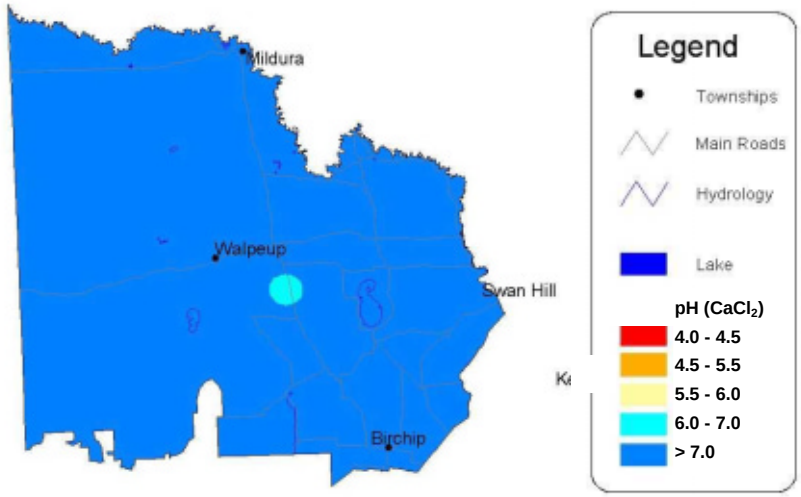


Figure 12. Mallee CMA, present surface soil pH

Table 16. Mallee CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Dominated by calcareous earths 73% and deep sands 20%.	Pasture, cropping, horticulture and uncleared land.	- Soils are very alkaline and only surface soils are at risk of acidification. - Irrigated horticulture has a slight acidification risk but other uses pose very slight to nil risk.

East Gippsland CMA

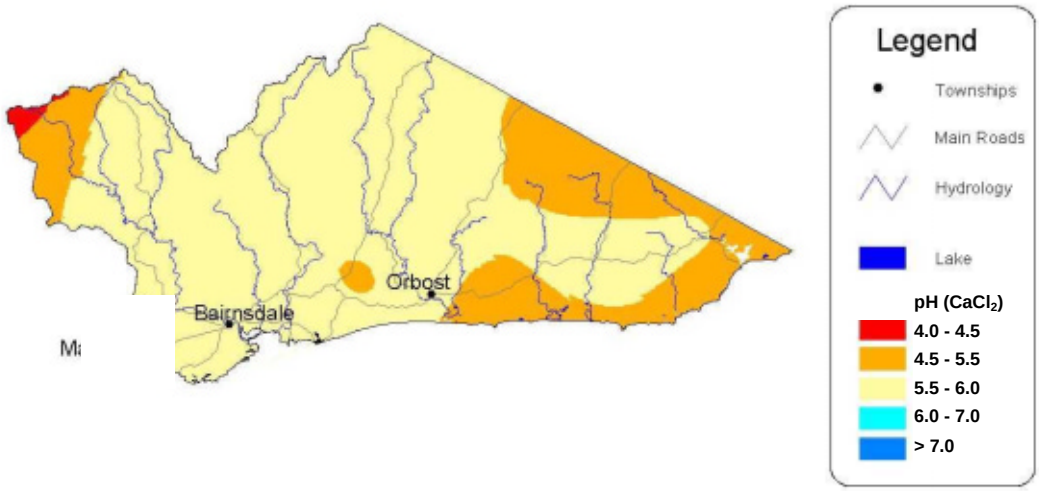


Figure 13. East Gippsland CMA, present surface soil pH

Table 17. East Gippsland CMA soil type, land use and threat of acidity

Soil Types	Current Land Use	Acidity Threats
Red duplex soils 40%	Uncleared, dry land pasture	-Native vegetation is acidifying at a very slow rate. -Perennial pasture is acidifying very slowly from soils that are moderately acidic.
Friable leached earths 30%	Uncleared, dry land pasture	-Native vegetation is acidifying at a very slow rate. -Perennial pasture is acidifying at a low rate or unaltered because high organic matter is mediating pH decline.
Yellow duplex soils 25%	Uncleared, dry land pasture	-Native vegetation is acidifying at a very slow rate. -Perennial pasture is having some acidifying affect on sandy surface soils due to higher leaching and lower organic matter levels.