SOIL CONSERVATION AUTHORITY

MOUNT KORONG LAND SURVEY
REPORT SUBMITTED TO THE AUTHORITY

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This report has been prepared to acquaint the Authority with the various types of land around Mt. Korong where Group Conservation Areas are being set up. It contains enough data on which to base pasture trials in 1965, but much of the soil analytical work has not yet been done.

The area surveyed covers 112 square miles, embracing parts of the parishes of Korong, Kurting, Powlett and Kinypanial (see map). The field work was done in December, 1964.

Climate. The average annual rainfall is 18 inches in the south decreasing to about 16 inches in the north. About 60 per cent of the rain falls during the six cooler months May-October. The period when moisture is continuously available for plant growth (the growing season) is May-November on the average. Rains outside this period are sporadic and ensuing growth is shortlived because of high temperatures.

Physiography and Geology. Mt. Korong forms part of the rising ground flanking the cast riverine plain of northern Victoria and southern New South Wales. In Victoria most of this rising ground is composed of Ordovician sandstones and mudstones, but Mt. Korong consists of granite.

Most of the area has been geologically mapped (see 40 chain per inch maps of Mines Dept. for Parishes of Kurting and Korong, and quarter sheet 63 d SW). Outcropping granite occurs in a large belt extending from Mt. Korong to Little Mount and also in small adjacent patches. The highest and steepest granite outcrop is Mt. Korong which rises to 1, 400 feet. Little Mount is 780 feet above sea level.

Surrounding the granite outcrops is a larger area of undulating land where the rocks are cemented grit formed in Pliocene times by lateritisation of granite detritus. The grit is mainly white but it contains coarse yellow and sometimes red mottles, representing the mottled and pallid zones of the laterite formation. There are occasional remnants of lateritic ironstone.

Recent alluvium covers the grit in the drainage lines of undulating land and also on the surrounding plains. The level of the plains falls from 505 feet at Glenalbyn in the south to about 400 feet to in the north.

The landscape appears to have been blanketed by dust (parna) in Recent times. Evidence for this is occasional pockets in subsoils of lime which could not have been derived from the underlying acid rocks. The proportion of dust in soils appears to increase on moving away from the granite outcrops because the soils become heavier in this direction.

Soils. All soils contain significant quantities of grit and coarse sand derived from the granite and granitic grit except the red soils of the plains in the extreme north and the grey clay flood plains of the Loddon River. The lightest soils are podzols between boulders. These sands have only a weak clay B horizon. On the undulating land surrounding the outcrops of granite, there are sandy A horizons usually between 10 and 15 inches deep, and clay subsoils (minimal solonetz on rising ground and solonetz in the drainage lines). The gentle undulations furthest from the granite and the plains have shallow sandy clay loam A horizons and clay subsoils (red brown earths).

Samples were taken from the four main soils to a depth of 3 feet but the analytical results are not available.

Replicated surface samples were taken on road easements from the main soils in each land unit and the results are available for pH and available potassium which are particularly significant for setting up pasture trials (Table 1). Organic carbon has also been determined.

In the samples analysed, the surface pH was mainly slightly acid, between 6.0 and 6.6. However some of the lighter soils had values between 5.5 and 5.8. The critical pH below which lime is needed for clover establishment is about 5.5.

The critical value for available potassium (about 100 parts per million) was exceeded in all samples. In general the values increased as the soils became heavier. However, the sands were variable, as expected because of their variable distances from drainage lines.

The percentage carbon ranged between 1.4 and 2.6 except in the sands which again were more variable.

Replicated surface samples were also taken from three paddocks beside samples easements to estimate the effects of cultivation on chemical values (Table 2.). There was little effect on pH or available potassium. However organic matter has declined under cultivation as shown by the lowering of the carbon, by more than half in one sample.

Table 1. Laboratory analyses of replicated surface samples taken from easements and other uncultivated sites.

	Sample	pH	Avail. K p.p.m	C%
Sand	65/37	5.8	160	1.3
(podzol)	42	5.7	360	2.4
	47	6.4	680	4.3
Sandy loam	35	6.0	140	2.2
Rising ground minimal	38	5.5	180	1.8
(solonetz)	48(a)	5.7	240	2.4
Sandy loam drainage line	34	6.5	200	1.4
(solonetz)	39	5.8	180	1.6
Sandy clay loam plain	32	6.0	220	1.9
(red brown earth)	40	5.8	360	2.2
	48	6.3	260	1.9
Sandy clay loam	41	6.2	280	1.6
undulating (red brown	43	6.6	240	1.9
earth)	45	6.1	440	2.6

Table 2 Laboratory analyses of replicated surface samples. Comparison of easements versus adjacent cultivated paddocks.

	Sample	pH	Avail. K p.p.m	C%	Treatment
Sandy loam rising	65/35	6.0	140	2.2	easement
	36	6.0	160	0.8	cultivated
Sandy clay loam,	32	6.0	220	1.9	easement
plain	33	6.6	240	1.2	cultivated
Sandy clay loam,	45	6.1	440	2.6	easement
undulating	46	6.3	340	2.2	cultivated

Native Vegetation. Except on the stony land, little timber remains in the paddocks. Grey box (*E. hemipholia*) predominates everywhere but on the steep slopes of Mt. Korong. Other species are yellow gum (*E. leucoxylon*), buloke (*Casuarina leuhanii*), long leaf box (*E. elaeophora*), yellow box (*E. melliodora*), drooping sheoke (*Casuarina stricta*), black box (*E. largiflorens*), and in the drainage lines red gum (*E. camaldulensis*). On the plains in the far north there are relatively few trees along the roads. It is not clear whether this has followed excessive clearing or whether the timber was originally sparse.

On the steep slopes of Mt. Korong long leaf box predominates as scattered, small trees. Wattles are conspicuous (e.g. *Acacia Pauciflora* and *A. implexa*) but many are dead.

Land Units. Four types of land have been recognised by changes in soils and topography – boulders and sand, sandy undulating land, loamy undulating land and loamy plains (see map). The features of each and their relationship are shown in Figure 1.

Boulders and Sand

On the highest parts of the landscape there are boulder-stream areas frequently too steep for access with tractors. The steepest parts are on Mt. Korong where overall slopes from the crest to the break of slope are 16 degrees and more. Spurs are often very steep, up to 30 degrees and more.

The depth of soil varies erratically from nil to 2 or 3 feet except towards the base of major rises where colluvial deposits are deep, up to several feet.

The surfaces are mainly light brown gritty loamy coarse sands. However in the drainage lines they are brown gritty coarse sandy loams several inches deep. In the occasional soaks the surfaces are dark brown to dark grey brown loams or clay loams with little grit. The subsurfaces are less variable, being light brown gritty coarse sands. When the soils are deeper than about 18 inches there is a sharp break to a red gritty light clay. When deeper than about 36 inches the clay is underlain by a zone of organic matter accumulation. Thus, when deep enough, the soils look like maximal podzols because of the accumulation in subsoils of clay, iron and organic matter. However the horizons are less acid than in maximal podzols which are not expected to occur under a rainfall as low as 18 inches per annum.

The following description applies to a soil samples just below the break in slope on the southern foot of Mt. Korong. The structure is weak throughout.

A_1	0-6"	Brown gritty coarse sandy loam, gradually merging into
A_2	6-24"	Reddish light brown gritty coarse sand, sharply defined from
B_1	24-36"	Red gritty coarse sandy clay, porous though less than above and below, sharply defined but irregular boundary
B_2	36-54"	Yellowish rd with brown mottles gritty coarse sandy loam, sharply defined from
B_{om}	54-64+	Brown gritty clayey coarse sand, passing eventually into granite.

Land use is mainly grazing but crops are grown on occasional areas where boulders are sparse. Timber has frequently been left standing.

Away from the drainage lines fertility is low. The water holding capacity is also low because not only is the average soil depth shallow but also the coarse sand would need about 12 inches to store 1 inches of rain. In the lower reaches of the drainage lines the soils are fertile and, being deep, could store several inches of rain.

The effective rainfall on soils would be increased by the presence of boulders which frequently occupy more than half of the landscape. Much of the rain would pass through the porous soils and enter the granite, some to emerge as springs and some to pass to the underground. The percolation of water to the granite may not be greatly hindered where clay B horizons are present. Even though this clay is less porous than he horizons above and below, it is still porous and thus permeable.

The present pasture is mainly silver grass (*Vulpia* spp.). It is interesting to note that several acres on the southern slope of Mt. Korong are covered by a vigorous stand of bracken (*Pteridum esculentum*). Although there is little run-off from the boulders and sand, the drainage lines may well carry considerable subsurface flow which would emerge as run-off in the land unit lower down. Thus increased water usage by improved pastures may help to reduce erosion further downslope.

On the cultivable areas away from the drainage lines the shallow-rooted sub clover and ryegrass could tap moisture from all or most of the soils because the average soil depth is shallow. Summer-growing species may not persist. On the non-cultivable areas the native vegetation reduces moisture loss. Regeneration of the native trees would be enhanced by the control of rabbits which are particularly thick in the Crown reserve.

Sandy Undulating Land

Surrounding the granitic outcrops there is a large area where the slopes are gentle (maximum about 2 degrees) but where the surfaces are sandy. The subsoils are heavy and encountered at an average depth of about 12 inches, ranging from about 9 to 15 inches. The soils are underlain by cemented whittish grit, most commonly at about 2 1/2 feet. On occasional rises there is virtually no soil and here ironstone has been noted in addition to the cemented frit. The following profile is typical of the rising ground.

A_1	0-1"	Brown gritty coarse sandy loam, clearly defined from
A	1-8"	Light brown gritty loamy coarse sand, clearly defined from
A_2	8-10"	Very pale brown gritty loam coarse sand, sharply defined from
B	10-36'	Mottled red an slight grey heavy clay with grit, low porosity, containing stones of cemented frit below 24"

The soils of the drainage lines are similar but with more surface organic matter, greyish subsoils and a columnar top to the B horizon.

Land use is cropping and grazing, and the area is as badly gullied as the worst land I the Eppalock Catchment (3 miles of gullies per square mile). The light A horizons have low fertility reserves and a low water holding capacity but high permeability. The clay subsoils have a low porosity and much moisture would move downslope as subsurface flow, discharging in the drainage lines. Pasture improvement was seen on only one farm by this showed that sub clover and ryegrass thrive. For soil conservation a deep-rooted species is also needed.

Loamy Undulating Land

Still further from the granitic outcrops but before the undulating land merges into the plains, the soils are heavier. Maximum slopes are about 1 degree instead of the 2 degrees of the sandy undulating land. The separation of the two land units has been shown on the map as a discontinuous lines because, without a definite topographic break, the boundary cannot be found accurately within reasonable time. The soils are similar to those of the loamy plains with shallow gritty coarse sandy clay loam surfaces sharply defined from reddish clay subsoils. Whittish cemented frit underlies the soils, typically at a depth of 2 to 21/2 feet. On occasional rises it reaches the surface.

Land use is cropping and grazing. Gullying is less severe than on the sandy undulating land. Again the subsoils are relatively impermeable and improved pastures for soil conservation would need to include a vigorous, deep-rooted perennial. Because the A horizons are shallow more run-off can be expected than from the sandy undulating land but because of the gentle slopes sheet erosion is not serious.

Loamy Plains

Except in the west the undulating land merges into plains where, apart from occasional sandy surfaces and grey clays the soil is a brown to red brown gritty coarse sandy clay loam about 4 to 9 inches deep sharply defined from a reddish clay (red-brown earth). A typical profile is

A_1	0-3”	Reddish brown gritty coarse sandy clay loam, clearly defined from
A_2	3-4”	Reddish light brown gritty coarse sandy loam, sharply defined from
B	4-15’	Yellowish red gritty coarse sandy heavy clay, low porosity, clearly defined from
D	15-36	Mottled red and pale brown gritty coarse sandy clay, low porosity.

Colours are browner and greyer that this in the gentle drainage lines. The depth to cemented grit is a serious problem. Yields could be improved by longer rotations which include improved pastures. Waterlogging is a problem and run-off would be considerable. However the gradients are low and the gullies present have originated from the higher land units.

Although gilgais occur on many parts of the plains they are prominent only in the north est, reaching their strongest development within a mile or so of the weir on the Loddon. Most uneveness is of the “mushroom” type where the mounds are set on more or less level ground. The latter has the normal red-brown earth profile but the mounds are brown, calcareous, self-mulching clays. Grit and coarse sand derived from the granite is absent in the far north where the soils are also redder than those further south. Another variation o the plains is the cluster of small depressions and associated lunettes just north of Fiery Flat. The atypical grey clay Loddon River floodplain has also been included within the plains mapping area.

Conclusions. The amount of soil lost by water erosion depends on the rate of run-off and the susceptibility of the soil to detachment by run-off. Both of these are affected by the amount and type of plant cover.

As in other granitic areas run-off is small on rising ground away from the drainage lines because the coarse A horizons are permeable and reasonably deep. Rain readily penetrated the surface and thus sheet erosion is not a serious problem.

The main problem is gullying in and below those land units which have clay subsoils of low permeability (Table 3). These clays act as a bottleneck to the penetration of moisture which moves downslope as subsurface flow and emerges as run-off in the drainage lines.

Table 3. Extent of gullying in each land unit. N.B Greeks are included because they are eroding.

	Area (sq. miles)	Gullies Length miles	Gullies Miles/sq. mile
Boulders and sand	7	0.5	0.1
Sandy undulating land	28	86	3.0
Loamy undulating land	18	29	1.6
Loamy plains	59	68	1.1
Total	112	184	

The corollary of reducing this run-off is to use the moisture where it falls – in the catchments. The solution is to increase transpiration and permeability so that the soil can take up moisture like a dry sponge.

The vigorous growth needed to dry out the soils cannot be obtained at all times of the year. A build-up of moisture cannot be avoided during the winter when rainfall exceeds potential evapo-transpiration by about 4 inches on the average. However if the soils were dry at the beginning of winter most of this 4 inches could be absorbed on the problem soils instead of being lost by run-off and subsurface flow. Absorption could be achieved if spring-summer growth of deep-rooted perennial, e.g phalaris were to remove subsoil moisture. At present pastures are almost entirely silver grass which dries off in spring leaving subsoils charged with moisture which remains during summer and autumn. The shallow-rooted species such as sub clover and ryegrass likewise die off in spring leaving the subsoils charged with water but these species are useful in transpiring relatively vigorously during winter-spring. The sub clover is also needed to improve nitrogen levels for a species such as phalaris.

If soils are to absorb all of the prolonged heavy rains the subsoils must be not only dry but also permeable. Here again vigorous deep-rooting species are needed to improve subsoil porosity.

If deep-rooted perennials were uses, crops could only be grown on long rotation. This is desirable at present on the hazardous rising ground where low soil fertility is reducing crop yields. Short-term pastures of sub clover and ryegrass are less effective for soil conservation. However they would transpire more moisture than the spindly stands of silver grass. They would also five a better protection against soil detachment in the drainage lines.

Long fallowing conflicts with soil conservation, its object to keep subsoils moist instead of dry. On the rising ground fallowing should be restricted to a couple of months in autumn. This would reduce the moisture supply to crops. However nitrogen also limits crop yields severely on the lighter soils and under autumn fallow it may be possible to obtain the present moderate yields by including sub clover in the rotation.

Cropping is not detrimental to soil conservation in all reports. The deep, vigorous roots of cereals have increased subsoil porosity and this would have increased the rate at which prolonged heavy rains can penetrate the soils to great depth in the spring so that, until the following winter, there would be relatively little loss of moisture downslope.

Because cropping has improved deep penetration of moisture, subsurface slow and run-off per acre are likely to be greatest from the rising ground which has not been broken up. This is found mainly on the sandy undulating land.

Table 4. Effect of cropping on porosity of subsoils (18 observations)

	Depth into clay	**No. of pore larger than 0.1 mm per sq. inch.**	
		Uncropped	**Cropped**
Sandy loams on rising ground	6” 12-18”	8, 18 5, 5, 4	25, 45, 32, 47 20, 24, 7
Sandy clay loam on plain	6” 14-18” 20-24”	9 12 7	67 38 26

Recommendations

Long fallowing should be discouraged on all rising ground.

The pastures most suitable fro soil conservation need to be found immediately.

Ideally sites for pasture trials would be chosen in each landunit but this is not likely to be practicable. First priority should go to the sandy undulating land which is the worst gullied area and which contributes most to gullying downslope. An effort should also be made to place trials in the drainage lines among the boulders and sand.

The main type of species to test is one which will root vigorously at depth and phalaris is the obvious choice. Lucerne should also be tested and it may be particularly suited to the drainage lines between the boulders and sand. There is little doubt that sub clovers and Wimmera ryegrass will thrive where there are heavy clay subsoils. According to Mr. Crouch (District Agricultural Officer) perennial ryegrass may be more acceptable on cropping land, being easier to control by cultivation. The ryegrasses may not have a place in long rotations. Two summer growing perennials native to the area may be worth testing provided seed of suitable strains could be got. These are windmill grass (Chloride truncata) and common love grass (Eraorostis brownii).

The main fertiliser needed would be superphosphate. Molybdenum could be tested and also lime for clover establishment because some of the lighter soils are as acid as pH 5.5. Potassium need not be applied

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