

HAG Harrogate Land System

Undulating to rolling low hills in the Harrogate area

Area: 75.8 km²

Annual rainfall: 410 – 705 mm average

Geology: The land is formed on schists, metasandstones and metasilstones of the Tappanappa Formation. There are limited quartzitic beds and minor pyrite bands. Basement rocks are within a metre of the surface over about 90% of the area. On lower slopes and in valley floors and drainage depressions, locally derived outwash sediments have accumulated. These are sands, clayey sands and sandy clays. Most are micaceous. Windblown calcareous materials have leached into the soils over time, and depending on leaching conditions, may occur as minor or abundant soft or rubbly segregations in the subsoil. Often, all traces of carbonates have disappeared.

Topography: The system comprises mostly undulating to rolling low hills with slopes ranging from 4% to 30% and occasionally more on some dissection slopes. Relatively flat topped crests and summit surfaces are typical. Rocky outcrops are a feature in places, but distribution is erratic. The land is dissected by water courses which flow in a general south westerly direction. The watercourses, which occupy narrow drainage depressions, are commonly eroded.

Elevation: 110 m in the south east to 370 m in the north-west

Relief: Up to 80 m

Soils: Soil variation is determined by the nature of underlying material (i.e. rock or outwash sediment), and presence or absence and type of subsoil clay or carbonate. Soils on hillslopes usually have sandy loam surfaces, with or without clayey subsoils over weathering rock. Clays are both dispersive and non dispersive. Texture contrast soils predominate on flats, but coarse textured uniform and gradational soils are common. All are deep over alluvium.

Main soils

Soils without clayey subsoils formed over basement rock

L1 Shallow stony loamy sand over hard rock (**L1a**) or soft weathering rock (**L1b**)

Soils with clayey subsoils formed on basement rocks

D1 Sandy loam over red clay, weakly (**D1a**) to strongly (**D1b**) calcareous with depth

K3a Sandy loam over dispersive micaceous red clay

K3b Loamy sand over dispersive blocky red sandy clay

Minor soils

Soils with clayey subsoils formed on basement rocks

K4 Sandy loam over brown clay

K3c Pyritic sandy loam over red clay

Soils formed on outwash sediments

D2 Sandy loam over red clay

D3 Loamy sand over sodic red clay

M4 Gradational loamy sand

M1 Deep alluvial sand

F2 Sandy loam over brown (**F2a**) or dark (**F2b**) dispersive clay



Main features: The Harrogate Land System is characterized by mostly rolling low hills with shallow stony soils, or moderately deep texture contrast soils over basement rock. Although many soils are moderately fertile, only a small proportion of the land is arable due to the extent of surface rock and stone, the high erodibility of the soils, and moderate to steep slopes. Hard setting surfaces are widespread, and many soils have dispersive clayey subsoils as well. Creek flats have deep but variably fertile soils which are susceptible to waterlogging. There is minor salinization on lower slopes and flats.

Soil Landscape Unit summary: 15 Soil Landscape Units (SLUs) mapped in the Harrogate Land System:

SLU	% of area	Main features #
AKB AKC AKD	3.2 20.5 4.6	<p>Very rocky moderately inclined to steep slopes, formed on weakly calcified schists, metasediments and metasilts of the Tappanappa Formation. Water courses are very well defined and are often eroded. Rock outcrop is very extensive, particularly on steeper slopes.</p> <p>AKB Moderately inclined slopes with relief to 40 m, slopes of 10-20% and up to 20% surface stone and rock outcrop.</p> <p>AKC Rolling low hills and moderate slopes with relief of 30-90 m, slopes of 16-30% and up to 20% surface stone and rock outcrop.</p> <p>AKD Steep hillslopes and ridges with relief of 50-100 m, slopes of 30-100% and up to 50% surface stone and rock outcrop.</p> <p>Soils are stony and usually overlie rock at shallow depth. These soils are <u>shallow stony loamy sand - L1a</u> (E) and <u>sandy loam over calcified rock - L1b</u> (C). Less common are deeper profiles with a clay layer forming in weathering rock. These are <u>sandy loam to loamy sand over dispersive red clay - K3a / K3b</u> (L), <u>sandy loam over red clay, calcareous with depth - D1a / D1b</u> (L), and <u>sandy loam over brown clay - K4</u> (L). The rocks are variably calcified, with carbonate contents ranging from nil to 50% or more. These slopes are extremely rocky, with substantial areas inaccessible to conventional equipment. Soils are generally very shallow, so water availability is a major limitation. The land is well suited to rough grazing.</p>
ALB ALC ALY	14.2 28.6 4.6	<p>Undulating to rolling rises and low hills with rounded crests formed on schists, metasediments and metasediments of the Tappanappa Formation, partially calcified with soft carbonate segregations. Slopes range from 4% to 30% and relief ranges from 20 to 80 metres. Rock outcrop is sporadic, but locally extensive. Watercourses are well defined and often eroded.</p> <p>ALB Gently rolling low hills and moderate slopes with relief to 60 m, slopes of 8-16% and up to 10% surface stone and rock outcrop.</p> <p>ALC Rolling low hills and moderate slopes with relief to 80 m, slopes of 16-30% and up to 20% surface stone and rock outcrop.</p> <p>ALY Gently undulating summit surfaces, steeper on margins with slopes of 5-20% and up to 5% surface stone and rock outcrop.</p> <p>Soils are mostly shallow with stony sandy to loamy surfaces grading directly to rock. These are <u>sandy loam over calcified rock - L1b</u> (C) and <u>shallow stony loamy sand - L1a</u> (C). Sub-dominant soils have clayey subsoils which grade to weathering rock. These are <u>sandy loam over red clay, calcareous with depth - D1a / D1b</u> (C) with well structured subsoils, and <u>sandy loam to loamy sand over dispersive red clay - K3a / K3b</u> (C) with poorly structured subsoils. Subsoil carbonate contents vary according to leaching conditions from none to abundant. This land is essentially non arable due to the extent of stone and rock outcrop and moderately steep slopes. The soils, although often shallow, are moderately fertile and well drained with generally well structured clayey subsoils (exceptions are K3 soils) although usually with hard setting surfaces. Pasture productivity is limited mainly by lack of soil moisture storage capacity, particularly a problem in dry finishes.</p>
ApC	0.1	<p>Low discontinuous ridges up to 20 m high formed on pyritic rocks. Slopes are variable up to 20%. There is up to 25% ferruginized sandstone on the surface.</p> <p>Main soils: <u>pyritic sandy loam over red clay - K3c</u> (E), and <u>shallow stony loamy sand - L1a</u> (E). These small areas are non arable but have good grazing potential. However, the significance of the pyritic rocks is their association with acid sulfate soils, which become a problem when the pyrite is oxidized.</p>



DbC DbD DbI	3.7 6.7 3.8	<p>Undulating to rolling rises and low hills formed on schists, metasiltstones and metasandstones of the Tappanappa Formation, partially calcified with soft carbonate segregations. Rock outcrop is sporadic, but locally extensive. Watercourses are well defined and sometimes eroded.</p> <p>DbC Undulating rises and gently inclined slopes with relief to 20 m, slopes of 4-8% and up to 5% surface stone with little rock outcrop.</p> <p>DbD Gently rolling low hills and moderate slopes with relief to 60 m, slopes of 8-16%, up to 10% surface stone and minor rock outcrop.</p> <p>DbI As for DbD but with eroded water courses.</p> <p>Soils are mainly texture contrast types. They are <u>sandy loam over red clay, calcareous with depth</u> - D1a / D1b (E), and <u>sandy loam to loamy sand over dispersive red clay</u> - K3a / K3b (E), with or without subsoil carbonate. Shallow soils without subsoil clays, <u>sandy loam over calcified rock</u> - L1b (L) and <u>shallow stony loamy sand</u> - L1a (L) occur in rockier areas. These soils have moderate natural fertility, but tend to have poorly structured surface soils and some have hard dispersive subsoil clays. These conditions lead to excessive runoff and some waterlogging. Consequently much of the land, although arable, has high erosion potential.</p>
JUJ	0.3	<p>Broad, shallow drainage depressions, alluvial flats and gently inclined outwash fans formed on weakly calcified sandy to silty clay alluvium. Slopes are up to 10%. Water courses are well defined and are often severely eroded. The predominant soils have sandy to loamy surfaces and reddish clay subsoils. These are <u>sandy loam over red clay</u> - D2 (E), and a sodic variant, <u>loamy sand over sodic red clay</u> - D3 (E). Less common are soils with minimal profile development, <u>gradational loamy sand</u> - M4 (C). These soils are deep and moderately fertile, but generally poorly structured, with hard setting surfaces, and commonly dispersive subsoils. Consequently runoff and erosion potential are high, although the land is fully arable. Water courses, eroded in the past, are fragile areas in need of protection.</p>
LZC	1.7	<p>Gently inclined outwash fans with slopes of 3-10%. The land is underlain by outwash sediments lying between basement rock rises. These small areas have properties in common with DbC and LkE.</p>
LkE LkJ	0.5 5.4	<p>Narrow creek flats and drainage depressions formed on alluvial silty sands, clayey sands and sandy clays. Water courses are well defined and often eroded. Slopes range from 2% in broader flats to 10% on lower slopes of adjacent rising ground.</p> <p>LkE Flats and depressions with minor water course erosion.</p> <p>LkJ Flats and depressions with moderate water course erosion.</p> <p>The diversity of parent sediments results in a variety of soils. Most have duplex profiles with sandy to loamy surfaces. Subsoils range from brown or dark coloured mottled clays - <u>sandy loam over brown dispersive clay</u> - F2a (C) and <u>loam over dark clay</u> - F2b (L), to red sandy clays - <u>sandy loam over red clay</u> - D2 (L) and <u>loamy sand over sodic red clay</u> - D3 (L). Some are calcareous with depth. Poorly differentiated coarse grained alluvial soils, <u>deep alluvial sand</u> - M1 (C) and <u>gradational loamy sand</u> - M4 (L) occur throughout. Soils of these flats are deep and of variable fertility, depending on clay content and organic matter. Many are poorly structured with hard setting surfaces and tight subsoil clays. Waterlogging is common and there is minor saline seepage. Erosion of water courses has been severe in places in the past, and all creeks are at risk. Most of the land is not arable, although relatively flat, due to the presence of water courses and the potential for erosion.</p>
XHJ	0.1	<p>Small flat formed on sediments of the Bremer River. Main soils are <u>deep alluvial sand</u> - M1 (E) and <u>gradational loamy sand</u> - M4 (E). Soils are deep, but of low fertility and relatively low moisture holding capacity.</p>
-Q-	2.0	<p>Kanmantoo mines.</p>

Detailed soil profile descriptions:

Soils with clayey subsoils formed on basement rocks

K3a Sandy loam over dispersive clay (Eutrophic, Red Sodosol)

Medium thickness reddish brown sandy loam with abundant quartz and schist gravel, overlying a dark reddish brown micaceous clay loam to clay with many rock fragments, grading to soft schist by 100 cm.



- K3b** Loamy sand over dispersive clay (Eutrophic, Red Sodosol)
Medium thickness brown massive loamy sand to sandy loam, with a paler coloured, sandier and quartz gravelly A2 horizon, overlying a red coarse blocky sandy clay with parent rock and quartz fragments, grading to weathered quartzitic metasandstone between 50 and 100 cm.
- K4** Sandy loam over brown clay (Sodic, Eutrophic, Brown Chromosol)
Medium thickness stony sandy loam, overlying a red or brown well structured clay grading to weathering non-calcified sandy schist or metasandstone.
- D1a** Sandy loam over red clay, weakly calcareous (Hypocalcic, Red Chromosol)
Medium thickness reddish brown loamy sand to loam, overlying a reddish brown well structured clay with abundant rock fragments, grading to weathering metamorphosed sandstone or greywacke with carbonate coatings on fracture planes.
- D1b** Sandy loam over red clay, strongly calcareous (Hypercalcic, Red Chromosol / Sodosol)
Medium thickness reddish brown loamy sand to sandy clay loam, overlying a reddish brown well structured clay with abundant soft carbonate at shallow depth. Strongly calcified weathering metamorphosed sandstone or greywacke occurs between 50 and 100 cm.
- K3c** Pyritic sandy loam over red clay (Eutrophic, Red Chromosol)
Medium thickness reddish brown fine sandy loam with a paler coloured A2 horizon, sometimes with ironstone gravel, overlying a red clay up to a metre thick, with blocky structure and ferruginous rock fragments throughout.

Soils without clayey subsoils formed over basement rock

- L1a** Shallow stony loamy sand (Lithic, Leptic Rudosol)
Medium thickness reddish brown massive loamy sand to sandy loam with abundant rock fragments, overlying hard metamorphosed sandstone.
- L1b** Sandy loam over calcified rock (Calcareous, Paralithic, Brown-Orthic Tenosol)
Thick brown sandy loam to loam with schist fragments throughout, overlying weakly calcified soft schist, continuing below 100 cm.

Soils formed on outwash sediments

- D2** Sandy loam over red clay (Calcic, Red Chromosol)
Medium thickness loamy sand to fine sandy loam with a paler coloured A2 horizon, overlying a dark reddish brown well structured clay, highly calcareous with depth, grading to yellow, red and brown mottled micaceous sandy clay loam to clay alluvium.
- D3** Loamy sand over sodic red clay (Hypocalcic, Red Sodosol)
Thick reddish brown loamy sand to sandy loam with a pink and sandier A2 horizon, overlying a red firm sandy clay loam to sandy clay with coarse prismatic structure and minor soft carbonate segregations at depth. The profile is formed in red clayey sand to sandy clay alluvium.
- M4** Gradational loamy sand (Hypocalcic, Red Kandosol)
Thick reddish brown sand to sandy loam, over a reddish brown massive light sandy clay loam to sandy clay with occasional carbonate nodules, grading to variable silty, sandy and clayey, layered alluvial sediments.
- M1** Deep alluvial sand (Calcareous/Basic, Regolithic, Brown-Orthic Tenosol)
Thick brown loamy sand to sandy loam, overlying a brown massive fine sandy to silty loam with limited soft calcareous segregations, grading to very fine brown micaceous sand from 100 cm.
- F2a** Sandy loam over brown dispersive clay (Eutrophic, Brown Sodosol)
Thick massive grey loamy sand to loam with a bleached and gravelly A2 horizon, overlying a grey brown, red and yellow brown mottled clay with prismatic structure, grading to silty alluvium or deeply weathered soft schist.
- F2b** Loam over dark clay (Calcic, Black / Grey Sodosol)
Thick grey massive loamy sand to sandy clay loam with a bleached A2 horizon, overlying a dark grey and yellow brown prismatic structured clay with soft calcareous segregations at depth, grading to alluvium.

Further information: [DEWNR Soil and Land Program](#)

