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Introduction

The one inch to one mile soil map Sheet 56 (Blairgowrie) represents 1120 square kilometres within the former counties of Perthshire and Angus, but now comprising part of Tayside Region.

The three main settlements of Blairgowrie, Alyth and Kirriemuir are located at the mouths of Glen Shee, Glen Isla and Glens Clova and Prosen respectively. They developed originally as market towns for the glens but only Kirriemuir has an operative livestock mart today. Many of the population commute to Perth and Dundee, although small industries often associated with agriculture and tourism are locally important.

The nature of the soils and favourable climate make Strathmore one of the most important agricultural areas in Scotland growing a wide range of crops.

Agriculture remains the main economy of the area although afforestation of the higher ground is increasing.

Geology and Physiographic Regions

The Highland Boundary Fault is the most significant structural element of the area, running across it from south-west to north-east. To the north of the Fault lie the ancient metamorphic rocks of the hill and upland area and to the south the younger sedimentary rocks of the lowlands.

Fig. 1 Physiographic regions
The area can be divided into four main physiographic regions (Fig. 1):

i. The Grampian foothills and glens

ii. The Fault zone

iii. The Vale of Strathmore

iv. The Sidlaw Hills

i. The Grampian foothills and glens

Lying to the north of the Highland Boundary Fault, this region contains the oldest rocks of the area. The dominant rocks are schistose grits and mica-schists of the Dalradian. A belt of metamorphosed granite occurs to the north of the sheet and extends from Lamh Dhearg in a north-easterly direction through Loch Beanie to Broom Hill and forms the watershed between Glen Shee and Glen Isla.

Other rock types of limited occurrence, but with an influence on soil properties and map units, include andesite, epidiorite, quartzite serpentine, calcareous schist and limestone.

The land rises gradually in a series of hill summits from approximately 30 m at the Fault to a maximum of 868 m on Meall a’Choire Bhuidh in the north-west. The area has been greatly dissected by agencies of erosion and is probably the southernmost limit of a dissected peneplain. The sharpness of present features reflects inherent lithological and structural differences.

The major glens (Shee, Isla, Clova and Prosen) run in a north-west to south-east direction towards Strathmore and in so doing they transect the varied structures of the Highland rocks.

Deposits of glacial drift are widespread, being normally thickest in the valleys and thinning out upslope. On the hilltops, locally derived coarse-textured drift often overlies shattered rock. Moundy morainic deposits are often present in the glens, contiguous with fluvioglacial sands and gravels and recent alluvium.

ii. The Fault Zone

The Fault zone lies between the Highland Boundary Fault and the Vale of Strathmore. The geology to the south of the Fault is dominated by sedimentary rocks of Lower Old Red Sandstone age. Igneous rocks, generally andesitic in nature, occur locally throughout the area. Lintrathen Porphyry occurs around the Loch of Lintrathen and north-eastwards to the Highland Boundary Fault. It is an acid rock with strong affinities to rhyolite.

A feature of the region is a series of low, but prominent, rounded hills e.g. Hill of Alyth (279 m), Culhawk Hill (300 m) underlain by coarse conglomerates. The hills are the product of differential erosion between the resistant conglomerate and the less-resistant surrounding rock.

Deposits of glacial till are widespread throughout the region. The till reflects strongly the lithology of the underlying rocks, principally schists, sandstones and lavas.
iii. The Vale of Strathmore

The vale of Strathmore, occupying the lower ground between the Fault zone and the Sidlaw Hills, is underlain by Lower Old Red Sandstone sediments comprising a succession of dull-red sandstones, which are coarse-grained and massive, conglomerates, flagstones and occasional limestones, marls and mudstones.

The region can be divided into three subregions:

a. alluvial flats along the Dean Water and River Isla, lying below 30 m.
b. terrace or beach deposits at approximately 30-45 cm.
c. gently undulating land over 45 m much influenced by glacial and meltwater action.

The recent alluvial deposits are extensive with a wide range of textures and drainage, reflecting changes in river courses, rates of deposition and flooding events.

The terrace or beach deposits rise above the alluvial flats, sometimes very steeply, and represent older alluvia laid down in Late-Glacial times.

Deposits of glacial till are widespread throughout the region. As the ice retreated, water from the melting ice cut distinct meltwater channels and river gorges and deposited extensive tracts of sand and gravel. In some places the action of meltwater has also modified the upper layers of some of the till deposits giving a depth of coarser textured material above the unaltered till.

Further glacial features are the series of kettlehole lakes to the west of Blairgowrie (Loch of the Lowes, Butterstone Loch, Clunie Loch, Marlee Loch) and the kame terrace along which the Alyth to Blairgowrie road runs.

iv. The Sidlaw Hills

The Sidlaw Hills are represented by a limited area in the extreme south-east of the sheet. The hills are composed of andesitic and basaltic igneous rocks and sedimentary rocks of Lower Old Red Sandstone age. Differential erosion has produced a characteristic landscape of hill masses, often with steep rocky slopes and intervening valleys containing till deposits.

A simplified geological succession is shown in Figure 2.

Climate

The contrast in the topography and altitude in this area is reflected in the climate and correspondingly on the agriculture practised.

The principal areas of arable agriculture (The Vale of Strathmore, the Fault zone and glens) have a warm or fairly warm and moist climate. With increasing altitude, the temperatures are lower and rainfall higher, giving a cool and rather wet climate in the foothills and a cold and wet climate on the highest ground.
Fig 2. Geological succession

<table>
<thead>
<tr>
<th>Era</th>
<th>Epoch</th>
<th>Deposits/Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary</td>
<td>Recent</td>
<td>Peat, alluvium</td>
</tr>
<tr>
<td></td>
<td>Pleistocene</td>
<td>Fluvio-glacial sand and gravel, solifluction deposits, moraine deposits and till</td>
</tr>
<tr>
<td>Upper Palaeozoic</td>
<td>Lower Old Red Sandstone</td>
<td>Sandstones, conglomerates and marls. Basaltic and andesitic lavas with tuffs and felsites</td>
</tr>
<tr>
<td></td>
<td>Cambro-Ordovician</td>
<td>Serpentine and granite</td>
</tr>
<tr>
<td></td>
<td>Dalradian</td>
<td>Schistose grits, mica-schists, graphite-schists, calcareous schists, chloritic schists, quartzite</td>
</tr>
</tbody>
</table>

Arable agriculture is generally restricted to areas with less than 1000 mm average annual rainfall. Strathmore has rainfall figures of 750–850 mm per annum, rising to 900–1000 mm in the Sidlaw Hills and the Fault zone. August and December are generally the wettest months. Within the Grampian foothill region, arable agriculture is restricted to the sheltered glens. Rainfall figures increase from 1000 mm at the Fault to over 1600 mm on the highest ground.

Monthly mean air temperatures of the arable land rise from 1.8°C in January to a maximum of 13.9°C in July. In sheltered areas of Strathmore (e.g. along the River Isla flood plain), temperatures are often slightly higher. May and June are the sunniest months with 170 sunshine hours. The growing season is approximately 215 days, extending from around 10th April to around 10th November, increasing to 220 days in the sheltered areas of Strathmore. The soils are generally at field capacity from mid-October to early March, limiting winter cultivations.

Microclimatic features can modify the climate in localized areas. For example, south-facing slopes receive more incident sunlight than north-facing slopes, giving longer growing seasons.

On the hill land the combination of lower temperatures, higher rainfall and shorter growing seasons preclude arable agriculture, restricting the land to permanent grassland or rough grazing.

Parent Material

The soil parent materials in the area can be divided into six types:

1. Glacial till and partially water-modified glacial tills occurring on flat or gently undulating ground. The thickness of the water-modified material does not exceed 60 cm.
2. strongly water-modified glacial till. The water-modified material exceeds a thickness of 60 cm and is underlain by the unaltered till. Such tills occur on flat or gently undulating ground.

3. locally derived stony drift often developed on weathering rock and occurring on hillsides and summits.

4. fluvioglacial and raised beach or terrace deposits occurring on moundy topography or flat terrace sites.

5. recent alluvial deposits associated with major streams and rivers.

6. organic deposits found as basin and valley peats or as blanket peat.

Soil Mapping Units

The soils are separated into soil series, soil complexes and soil associations. The soil series is a group of soils with similar type and arrangement of horizons developed on similar parent material. The series is given a name, generally that of the locality in which it was originally observed.

Where the pattern of soils is too intricate for the individual soil series to be shown separately, soil complexes are mapped. The complexes are determined on the basis of component soils, landform and degree of rockiness.

The soil association is a grouping of map units (series or complexes) in which the soils are developed on similar parent materials. Most associations are described on the basis of the rocks from which the soil-forming materials have been derived.

Alluvial soils are separated on the basis of topsoil texture and subsoil drainage and where areas of land are of sufficient extent for delineation, the soils are mapped at series level. Where texture and drainage are so variable that differentiation into series is impractical, the soils are mapped as undifferentiated alluvium.

Organic soils occur either as separate mapping units or as a component soil in a complex. The individual mapping units are:

- Basin and valley peat 50-100 cm
- Basin and valley peat >100 cm
- Blanket peat >50 cm

Sixty-eight soil series and thirty-three soil complexes have been mapped and are grouped into the following nineteen soil associations:

<table>
<thead>
<tr>
<th>Association</th>
<th>Parent Material</th>
</tr>
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</table>
| Balrownie    | a. Till and water-sorted till derived from Lower Old Red Sandstone sediments, mainly sandstones with some Dalradian schist erratics.  
               | b. Weathering sandstone. |
| Bemersyde    | Drifts derived from rhyolite, trachyte and allied rocks. |
Fluvioglacial sands, very fine sands and silty fine sands derived from acid rocks.

Lacustrine red silts and clays.

Upper terrace deposits, mainly fine sands and silts.

Fluvioglacial sands and gravels derived mainly from acid schists and granites.

Drifts derived from granite and granitic gneiss.

Drifts derived from basalt and allied igneous rocks.

Drifts derived from limestones and calc-silicate schists of the Dalradian.

Fluvioglacial sands and gravels derived mainly from acid schists and Lower Old Red Sandstone sediments and lavas.

Water-sorted material generally more than 60 cm thick overlying till derived from Lower Old Red Sandstone sediments.

Drifts derived from slates and argillaceous schists of the Dalradian.

Till derived from acid schists and Lower Old Red Sandstone sediments and lavas.

Drifts derived from ultrabasic igneous rocks.

Drifts derived from Old Red Sandstone lavas and sediments.

Drifts derived from andesitic lavas.

Drifts derived from Lower Old Red Sandstone conglomerates.

Drifts derived from acid schists and schistose grits of the Dalradian.

Drifts derived from acid and basic rocks or from intermediate rocks.

In addition, sixteen mineral alluvial soils, three peaty alluvial soils and three organic soils have been mapped.

The soils are described as they occur within each physiographic region.
i. Soils of the Grampian foothills and glens

Soils of the Strichen Association dominate the area north of the Highland Boundary Fault, with eleven soil series and nine soil complexes mapped. Derived from acid schists and schistose grits of the Dalradian, the parent material is a compact yellowish brown or brown sandy loam or sandy silt loam. On the upper slopes, the parent material is more stony, coarser textured and shallower, with rock often occurring within 100 cm.

The principal soils are freely draining humus-iron podzols (Strichen Series) and imperfectly draining humus-iron podzols (Obney Series), but brown forest soils of the Fungarth Series occur on the steeper slopes. A typical non-cultivated humus-iron podzol has up to 10 cm of black humus overlying a bleached grey sandy loam horizon and a dark brown humus-enriched horizon. Below this a strong brown horizon enriched in iron and aluminium and usually of sandy loam texture, overlies a yellowish brown subsoil which is often indurated and is underlain by the yellowish brown or brown parent material. Where cultivated the upper horizons are destroyed and a dark brown sandy loam or sandy silt loam plough horizon rests directly on the strong brown subsoil.

Above altitudes of about 400 m, the humus-iron podzols are replaced by peaty podzols of the Gaerlie Series (freely draining) and Smyrna Series (imperfectly draining). A typical Gaerlie Series profile has up to 50 cm of peaty humus overlying a grey sandy loam on a dark grey humus-enriched horizon. A discontinuous iron pan may occur above a brightly coloured sandy loam subsoil. Where present, the iron pan holds up the downward movement of water and causes gleying in the upper horizons. Below the brightly coloured horizon enriched in iron and aluminium, the material is often indurated and characteristically yellowish brown or brown in colour.

The imperfectly draining peaty podzol exhibits similar horizon morphology but greater evidence of gleying and mottling is found throughout the profile.

Peaty gleys (Hythie Series) and humic gleys (Kilry Series), poorly and very poorly draining, are found in depressions or associated with spring lines along hillslopes.

Beneath an organic top these soils have characteristically much duller and greyer matrix colours and ochreous mottling associated with intermittent periods of waterlogging.

Above about 650 m, subalpine podzols (Finbracks Series) occur, often with peat deposits.

Pitcarmick and Kilbo Complexes are mapped on moundy moraine. The former has humus-iron podzols and brown forest soils on the mounds with peaty and noncalcareous gleys and peat in the hollows. Where the soils are predominantly peaty, the Kilbo Complex is mapped.

The Buzzart Complex is found in the area around Buzzart Dykes (5 km to the north-west of Blairgowrie). This complex has a distinctive landform of nearly parallel, steep-sided till ridges with humus-iron podzols and brown forest soils, and noncalcareous or peaty gleys in narrow inter-ridge channels and flats.
The Fhithich Complex comprises brown rankers and lithosols with some brown forest soils on colluvial slopes and restricted areas of humus-iron podzols. The complex occurs on rocky and very rocky steep hillsides, often scree covered, e.g. Creag an Fhithich and Nether Crag between Glen Isla and Glen Shee.

The most extensive complexes of the Strichen Association are the Loch Ordie Complex and the Straloch Complex. The former has humus-iron podzols, peaty podzols and rankers with peaty and humic gleys and peat in the wetter sites on slightly rocky to rocky hills. Straloch Complex is mapped on summits and steep hillsides which are rocky and very rocky, often with scree. The component soils reflect the increased rockiness and are predominately podzolic and peaty rankers and lithosols with restricted areas of humus-iron podzols and peaty podzols.

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On slightly rocky, steep hillsides with peaty gleys, peaty rankers and peaty podzols, Logie Complex is separated.

Dundurn Complex is limited in extent but often forms a distinctive topographic unit where brown forest soils and brown rankers occur on slightly and moderately rocky hillsides, often with steep, bracken-covered slopes, e.g. south slopes of The Crandart.

At higher elevations where subalpine podzols and rankers predominate on slightly rocky hill summits and ridges (e.g. Mount Blair, Crag of Runavey), the Vanoch Complex is mapped. Some subalpine gleys and peat occur in this complex but in restricted areas. The peat is usually shallow and eroding.

The till of the Strichen Association has, in places, been carried south of the Highland Boundary Fault, for example in the Drimmie area, north-west of Alyth, where the underlying rocks are andesites and conglomerates. The till contains a minor andesitic or conglomeratic component.

Further variation occurs at Riechip to the west of Blairgowrie. There the till has a distinct reddish brown colour, possibly due to the influence of underlying Lower Old Red Sandstone sediments.

Soils of the Countesswells Association are restricted to the belt of metamorphosed granite which extends from Lamh Dhearg to Broom Hill. The soils usually have a coarse sandy loam texture and are often stony. Soils separated as series are humus-iron podzols (Countesswells Series), peaty podzols (Charr Series), peaty gleys (Drumlasie Series) and subalpine podzols (Saighdeir Series) and alpine podzols (Rinnes Series). Alpine soils are very local and restricted to broad summits over 750 m, e.g. Monameanach.

Six soil complexes are mapped. The three most extensive are the Ariundle Complex developed on moundy moraine around Loch Beanie, and the Rait and Moymore complexes on rocky hillslopes.

The component soils of the Ariundle Complex are humus-iron podzols and brown forest soils on the mounds, with peaty gleys, noncalcareous gleys and peat in the hollows; this complex is similar to the Pitcarmick Complex of the Strichen Association.
The Sanda Complex, of minor extent, is also developed on moundy moraine but the soils are peaty with peaty podzols on the mounds and peaty gleys and peat in the intervening hollows.

The Rait and Moymore Complexes have component soils and topography similar to the previously described Loch Ordie and Straloch Complexes respectively, of the Strichen Association.

The Crandart Complex, of limited extent, occurs on slightly rocky or bouldery hillsides with brown forest soils, brown rankers and humic and noncalcareous gleys.

At elevations greater than approximately 650 m the Duchray Complex is mapped on slightly rocky or rocky hill summits and ridges. The component soils are subalpine podzols, rankers, subalpine gleys and peat.

Soils of the Tarves Association are developed on mixed drifts derived from acid and basic rocks, epidiorites, hornblende-schists and other rocks of intermediate basicity. Mapped only to the north of the Highland Boundary Fault, the most extensive areas of the Tarves Association occur in Glen Prosen and Glen Fearnate. The parent material is generally a brown or yellowish brown stony sandy loam.

The enhanced base status of these soils is illustrated by the occurrence of brown forest soils (Tarves Series) in situations where humus-iron podzols would be expected with soils developed on parent materials derived from acid rocks. The humus-iron podzols (Tillypronie and Fenzie Series) are replaced by peaty podzols (Pressendye Series) at elevations of approximately 440 m. Small areas of subalpine podzols (Fiactach Series) are found above 650 m on Bodnasparet Hill.

Four soil complexes are mapped. The Auchintaple Complex is restricted to moundy moraine and has similar component soils and topography to the previously described Pitcarmick Complex of the Strichen Association and the Ariundle Complex of the Countesswells Association.

Both the Prosen and Isla Complexes are found on slightly rocky hills with a wide range of slopes. The Prosen Complex has brown forest soils, humus-iron podzols and rankers. The soils of the Isla Complex are generally podzols and rankers with some humic gleys.

The Runavey Complex occurs on steep, rocky and very rocky hillsides often with scree. Soils are brown rankers and lithosols reflecting the rock presence, with limited areas of brown forest soils where there is a greater depth of soil material.

Soils of the Foudland Association are mapped on fine-grained graphite-schists in Upper Glenshee and on the slopes of Ben Gulapin. Five soil series and three complexes are separated, although all are limited in extent.

The freely draining brown forest soil (Ettenbreck Series) occurs on the lower slopes or on steep colluvial slopes. Humus-iron podzols (Foudland Series) and peaty podzols (Suie Series) occur with increasing altitude. Small areas of peaty gleys (Shanquhar Series) and subalpine podzols (Ladylea Series) are found in localized areas.
The Spittal Complex is mapped on slightly rocky or rocky hills with a wide range of slopes. Component soils are humus-iron podzols and podzolic rankers.

Where podzolic rankers, lithosols and some humus-iron podzols occur on rocky and very rocky summits and steep hillsides (e.g. Bad an loin), the Cambs Complex is mapped.

At higher elevations, the Eich Complex has subalpine podzols, rankers, subalpine gleys and peat on slightly rocky hill summits and ridges, e.g. Carn an Daimh, but is of only limited occurrence.

The Durnhill Association is not extensive and only occurs as two soil complexes. Rankers, lithosols and subalpine and alpine podzols, developed on quartzite, with some peat deposits, cap the summit of Ben Gulapin (Iutharn Complex) and a rock-dominated complex (Leacach Complex) with peaty rankers and lithosols is found on the slopes of Carn an Daimh.

Soils of the Deecastle Association are developed on parent material derived from calcareous schists and limestones. The most extensive area is at Wester Bleaton, to the east of Kirkmichael. The soils are freely draining brown forest soils (Deecastle Series) and brown rankers. Minor areas are mapped as series, but the major mapping unit is the Soilzarie Complex, a complex of brown forest soils and brown rankers with flushed gleys, occurring on slightly rocky, steep hillsides.

Fluvioglacial deposits of sand and gravel occur throughout the valleys and glens north of the Highland Boundary Fault, either as moundy topography, flat terraces or gently undulating land. Two soil associations are mapped within the Grampian foothills and glens region.

Boyndie Association soils are developed on brown or yellowish brown sand and very fine sand or silt, derived mainly from acid rocks. These deposits can be fluvioglacial in origin or else form remnants of former river terraces.

The freely draining humus-iron podzol (Boyndie Series) is the most common soil of the association and is developed on sand deposits. Where the parent material is very fine sand or silt, the freely draining Inchewan Series and the imperfectly draining Blackcastle Series, (both humus-iron podzols), are mapped. These finer textured soils usually occur on terrace sites such as in Glen Clova and Glen Prosen and bear a close similarity to Carey Series of the Carpow Association mapped in Strathmore.

The parent material of the Corby Association is either fluvioglacial, morainic or river terrace gravel deposits. The gravel varies in size and geological composition. The rocks from which most of the gravel is derived are mainly acid igneous and acid metamorphic, such as granites, quartzies or Dalradian schists. Both freely draining humus-iron podzols (Corby Series) and imperfectly draining humus-iron podzols (Leys Series) are mapped.
Moundy topography in Glen Shee with humus-iron podzols and brown forest soils on the mounds and gleyes and peat in the intervening hollows is mapped as the Kildrummie Complex.

Alluvial soils occur as ribbon-like tracts of land in the glens and valleys, where they form an intricate pattern with the fluvioglacial sands and gravels. Textures vary greatly, but generally the freely draining and imperfectly draining soils have sandy, sandy loam or sandy silt loam textures and are intensively cropped. In lower lying sites or where silt and clay textures predominate, poorly and very poorly draining soils are found. Undifferentiated alluvium is commonly mapped where the variability and drainage precludes separation.

Organic soils occur throughout the region, either as separate mapping units or as a component soil in a complex. Basin and valley peats are of small extent but do have a widespread distribution. The major deposits occur in the Forest of Alyth, just to the north of the Fault.

Blanket peat is more extensive, occurring on the upper, less steep slopes and summits, often above 500 m. The main areas are in the hills above Glens Prosen and Clova. At altitudes greater than 650 m, the peat is associated with subalpine soils. Areas of hagged peat are present but not of sufficient extent to warrant separation on the soil map.

ii. Soils of the Fault zone

To the south of the Highland Boundary Fault, a till derived from Dalradian schists and Lower Old Red Sandstone andesites and sandstones forms the parent material for the soils of the Gourdie Association. The mixed nature of the parent material was formed when ice moving south-eastwards from the Highlands into Strathmore was deflected south-south-west by the Scandinavian ice-sheet. The resultant glacial till was derived, in part, from the schistose rocks of the Highlands and in part from the underlying sandstones and lavas of the Lowlands. The sandy silt loam or sandy clay loam till ranges in colour from reddish brown to light yellowish brown depending on the location and the proximity of a particular rock type.

Soils of the Gourdie Association are widespread and dominate the Fault zone. The most extensive soils are the imperfectly draining brown forest soil (Gourdie Series) and the freely draining brown forest soil (Snaigow Series).

A typical Gourdie Series profile has a dark brown sandy loam or sandy silt loam topsoil overlying a brown, sometimes water-sorted, sandy loam or sandy silt loam subsoil with some ochreous mottling above the till. The Snaigow Series exhibits similar colours and horizons without any evidence of mottling.
Podzols have also been mapped, usually on uncultivated moorland sites. The imperfectly draining Peel Series and freely draining Beithe Series show the characteristic podzol profile previously described for the Strichen Association. Textures are similar to the brown forest soils, the main criteria for the differing soil types being past and present land use and vegetation cover.

Extensive areas of poorly draining noncalcareous gleys (Cairnleith Series) and poorly and very poorly draining peaty gleys (Blairmore Series) occur to the north-west of Alyth. These soils exhibit the characteristic dull-grey matrix colours and ochreous mottling of poorly draining soils. Textures are sometimes slightly heavier than other soils of the association.

A topographic feature to the north of Blairgowrie and west of Alyth, comprising non-rocky ridges and mounds with brown forest soils and podzols with humic and peaty gleys and peat in the hollows, has been mapped as the Rannagulzion Complex.

The soils of the Stonehaven Association are developed on drifts derived from Lower Old Red Sandstone conglomerates and are confined to the rounded hill masses running parallel to the Highland Boundary Fault, e.g. Hill of Alyth, Kaimes of Airlie, Culhawk Hill.

The till, a reddish brown sandy loam or sandy clay loam, is patchily distributed. More commonly the soils are shallow and stony on the hill tops with variable thickness of colluvial material on the slopes.

The freely draining brown forest soil (Cuiltballoch Series) is found on the steeper slopes. A typical profile has a dark brown sandy loam or sandy silt loam topsoil over a brown, often stony, sandy silt loam which may overlie rock or till. The stone content can be high and the stones are characteristically round cobbles or broken cobbles from the conglomerate rock. The imperfectly draining brown forest soil (Stonehaven Series) is usually found on gentler slopes or where rock or induration inhibits water movement down the profile.

The humus-iron podzol (Shields Series) is present on heather-covered hills.

Very small areas of the poorly draining noncalcareous gley (Balhagarty Series) usually occur in channels into which water from the surrounding land drains.

Formal Complex has been mapped, e.g. Hill of Alyth, Culhawk Hill, where humus-iron podzols, brown forest soils and brown podolic rankers and peaty gleys occur on slightly or moderately rocky hillslopes.

Occurring in the Fault zone and also in the Sidlaw Hills soils of the Sourhope Association are developed on parent material derived from intermediate lavas of Lower Old Red Sandstone age and range from a brown, residual, stony sandy loam on hills to fine-textured, brown or reddish brown till on lower ground.

The brown forest soil (Sourhope Series) and the humus-iron podzol (Frandy Series), both freely draining, are mapped generally on slightly higher ground where the andesitic rock is relatively close to the surface and contamination from other rock types is minimal.
A typical Sourhope Series profile has a dark greyish brown sandy silt loam topsoil overlying a strong brown sandy silt loam which is often stony. On the deeper soils, the parent material is usually reddish brown or brown and can range in texture from sandy silt loam or silt loam to sandy clay loam. Where rock is close to the surface the parent material usually comprises rock rubble with brown interstitial material of sandy silt loam texture.

The freely draining humus-iron podzol (Frandy Series) occurs on moorland sites. An organic top is underlain by a grey sandy loam or sandy silt loam and a dark brown humus-enriched sandy silt loam subsoil. Below this a strong brown horizon enriched with iron and aluminium overlies the parent material which is as variable as that found with the brown forest soils.

Carlunie Complex is mapped throughout the Fault zone region and on Carlunie Hill in the Sidlaw Hills. The component soils are brown forest soils, humus-iron podzols, gleys and rankers occurring on slightly rocky undulating land and hills.

Bemersyde Association is confined to localized areas where Lintrathen Porphyry rock is found, e.g. around Loch of Lintrathen and Kinclune. Soils are mainly freely draining brown forest soils (Bemersyde Series), often stony and occurring on steep slopes. Much of the association is mapped as Lintrathen Complex which has brown forest soils and brown and podzolic rankers on non-rocky and slightly rocky, undulating lowlands.

Soils of the Darleith Association are very limited in extent within the Fault zone, only occurring around Clunie Loch in the extreme south. Soils are developed on drifts derived from basalt and allied igneous rocks. Most of the association is mapped as Kilmalcolm Complex with brown forest soils, brown rankers and some noncalcareous gleys on slightly rocky undulating lowlands. A small area of the freely draining brown forest soil (Darleith Series) occurs where the rock component is less or absent.

Leslie Association is limited to a very small area to the north of Alyth where drifts from serpentine rock give rise to freely draining brown magnesian soils of the Leslie Series.

Fluvioglacial deposits of the Doune Association derived mainly from acid schists and Lower Old Red Sandstone sediments and lavas, occur throughout the east of the region on moundy or gently undulating land. Stones of andesite and Old Red Sandstone sediments are more evident in the gravel deposits than found in the previously described Corby Association. Both freely draining brown forest soils (Doune Series) and humus-iron podzols (Gart Series) are mapped. Small localized areas of the imperfectly draining brown forest soils (Cossans Series) are found.

Alluvial soils are not extensive within this region but do occur either as narrow strips of land along the major streams or as small alluvial flats, e.g. north of Kingoldrum. Textures and drainage are variable.
Organic soils occur as both shallow and deep basin and valley peat. The most extensive area is on Cochrage Moor but small basin peats or mosses are found throughout the region, e.g. Balloch Moss.

iii. Soils of the Vale of Strathmore

The soils of the Balrownie Association are extensive throughout Strathmore and also in the Sidlaw Hills. The soils are developed on glacial till, often with a water-modified upper layer, derived from Lower Old Red Sandstone sediments, or in localized areas, on weathering sandstone rock.

The till is a reddish brown sandy loam, sandy silt loam or sandy clay loam, massive, often compact and an impedance to root development and water movement down the profile. The water-modified material has a variable thickness and generally a sandy loam or loamy sand texture. The till, however, always occurs within 60 cm depth.

The most extensive soil is the Balrownie Series, a brown forest soil with gleying. A typical profile has a dark brown sandy loam or sandy silt loam topsoil overlying a mottled, brown sandy loam subsoil. The mottling in the subsoil is due to the compact till below, impeding drainage down the profile. The till is characterized by its distinct reddish brown colour and is usually mottled.

The Reedie Series is a freely draining brown forest soil, occurring in localized areas throughout Strathmore. The soil is usually found on slightly higher ground on shedding sites surrounded by Balrownie Series. A typical profile has a dark brown sandy loam or sandy silt loam topsoil over a water-modified sandy loam subsoil with no mottles. The till retains its reddish brown colour but has few or no mottles. The free drainage is often associated with topographic position rather than any textural differences between Reedie Series and Balrownie Series.

The freely draining (Aldbar Series) and imperfectly draining (Muirhead Series) humus-iron podzols are limited in extent within Strathmore and are usually found on moorland sites. Some Aldbar Series is cultivated and has been mapped where evidence of podzolization has not been destroyed by cultivation.

The Buchanyhill Series is extensive to the west of Kirriemuir. It is a freely draining brown forest soil developed on rock in situ. Abundant angular stones are present throughout the profile. Solid rock is generally found at depths ranging from 20 cm to 70 cm depending on the topographic position of the site.

The Hayston Series is a freely draining humus-iron podzol developed on rock in situ. Very limited in extent, it is found on Hayston Hill near to Glamis.

The poorly draining noncalcareous gley (Lour Series) is found in depressions or at the foot of slopes. Colours are duller and greyer and the textures often slightly heavier than other soils of the association.
Till similar to that described for the Balrownie Association, but with a greater thickness of water-modified material, such that the till occurs at depths greater than 60 cm, is the parent material of the soils of the Forfar Association. These soils are important agriculturally, having a much deeper rooting medium than most other soils of the area whilst retaining water at depth.

Vinny and Forfar Series are freely draining and imperfectly draining podzols respectively and usually found contiguous with Balrownie or alluvial soils. In the natural state Vinny and Forfar Series are humus-iron podzols but cultivation has destroyed the podzolic upper horizons. Profiles differ from Balrownie soils in that there is a greater thickness of coarser textured subsoil material. A typical Vinny profile has a dark brown sandy loam or sandy silt loam topsoil over a water-modified sandy loam or loamy sand subsoil to depths greater than 60 cm. Where contiguous with alluvium the upper horizons are often difficult to differentiate from alluvium. The reddish brown till underlies both variants. The imperfectly draining Forfar Series shows similar profiles to Vinny Series but does have mottling in the subsoil and parent material which can be due to induration restricting water movement or to topographic position.

Although both Forfar and Balrownie soils are intensively cropped, they are prone to capping. The production of fine seed-beds enhances the possibility of capping, increasing surface-water run-off and the potential for erosion. The greater thickness of topsoil often found in Forfar soils may have resulted from movement of material downslope through years of cultivation.

Poorly draining noncalcareous gleys (Vigean Series) and very poorly draining humic gleys (Slaughs Series) are found in small localized areas associated with depressions.

The soils of the Carpow and Carbrook Associations occur at altitudes of approximately 30-40 m along the Dean Water and River Isla and represent older alluvium or raised beach deposits.

The Carpow Association is represented by the Carey Series, an imperfectly draining brown forest soil developed on very fine sands and silts. The textures are variable but generally a fine sandy loam or sandy silt loam topsoil overlies silty fine sand, often with bands of silt loam. At depth the material is usually of silt loam texture. The profile is normally stone-free.

Contiguous with the Carey Series are freely draining sand and gravel soils which have been assigned to the Doune Association.

Soils of the Carbook Association are heavier in texture with sandy clay loam topsoils and silty clay loam or clay loam subsoils. Imperfectly draining brown forest soils (Harviestoun Series) and poorly draining noncalcareous gleys (Carbook Series) have been mapped. A characteristic feature of these soils is the cloddy nature of the topsoil found after ploughing and subsequent drying.
Soils of the Doune Association are developed on fluvio-glacial sands and gravels derived mainly from acid schists and Lower Old Red Sandstone sediments and lavas. These soils occur throughout Strathmore either as moundy topography or terrace sites contiguous with Carey Series of the Carpow Association. Both the freely draining brown forest soils (Doune Series) and the freely draining humus-iron podzols (Gart Series) are mapped. The imperfectly draining brown forest soils (Cossans Series) are most extensive around Glamis but do occur in small areas throughout the region, the imperfect drainage resulting from induration of the subsoil or the nature of the site.

Alluvial soils are extensive throughout Strathmore, particularly along the River Isla and Dean Water. The soils are generally freely or imperfectly draining with sandy, sandy loam or sandy silt loam textures. They are intensively cultivated and represent some of the best land of the area.

Poorly or very poorly draining soils are found in the lower lying sites or where silt or clay textures predominate. The development of a peaty topsoil is common in the wetter sites, e.g. around lochs and in the extreme east of the area along the Dean Water.

Basin peats although not extensive throughout Strathmore do occur mainly in the east of the area, e.g. north of Glamis. Smaller localized areas are often associated with wet sumps in fields.

iv. Soils of the Sidlaw Hills

Several previously described soils occur in the Sidlaw Hills region. Soils of the Balrownie Association are extensive in the extreme south-east. The imperfectly draining brown forest soils (Balrownie Series) occur generally in the valleys and glens, e.g. Glen Ogilvy. Noticeable is the greater extent of podzols compared to Strathmore. Both the freely draining humus-iron podzols (Aldbar Series) and the imperfectly draining humus-iron podzols (Muirhead Series) are mapped, usually on the lower hills to the south of Glamis. Areas of cultivated podzols have been mapped where evidence of podzolization is still apparent.

Buchanyhill Series and Hayston Series are mapped on hillsides and summits where sandstone rock is close to the surface.

Areas of the poorly draining noncalcareous gleys (Lour Series) occur on lower-lying land or channels associated with streams.

Castleward Complex is mapped only on Castleward Hill. The component soils are humus-iron podzols, brown forest soils, rankers and gleys occurring on slightly rocky hillslopes.

Soils of the Forfar Association are found in the valleys often contiguous with alluvium.
Soils of the Sourhope Association are described under the Fault zone. Within the Sidlaw Hills region, the freely draining brown forest soils (Sourhope Series) are generally mapped on colluvial slopes. The freely draining podzols (Frandy Series) occur on uncultivated land on Ark Hill and an extensive area of Carlunie Complex is mapped on Carlunie Hill.

Of small extent, the Mountboy Association occurs only in the Sidlaw Hills region. The parent materials are derived from lavas and sandstones of Old Red Sandstone age with some igneous rocks from local intrusions. One type is a reddish brown sandy loam or sandy clay loam till similar to that of the Balrownie Association. Another type is a coarse textured drift deposit derived from sandstones and lavas.

Only two soil series, both brown forest soils, are mapped, the freely draining Garvock Series, often found on the steeper slopes, and the imperfectly draining Mountboy Series.

The Darleith Association is limited in extent within the Sidlaw Hills region. Soils are developed on drifts derived from basalt and allied igneous rocks. Outcropping rock is common and all the association is mapped as the Tourgill Complex, comprising brown forest soils and brown rankers on moderately rocky hills with strong and steep slopes.

Alluvial soils are very limited in extent, being restricted to small linear tracts of land along the major streams.

Land Use

The wide range of land use found in the area can be attributed to the diverse climate, gradient and the variability of the soils. The Vale of Strathmore is one of the most important arable areas of Scotland growing a wide range of crops (cereals, potatoes, oilseed rape, root crops, grass and bulbs). Blairgowrie remains the centre of soft fruit production. Animal production in Strathmore, although limited in occurrence, is often concerned with pedigree beef cattle enterprises.

In the hill areas sheep and cattle production is extensive. Arable cultivation of the valley floors is mainly cereals and root crops, often winter feed for the stock. Although climate and gradient limit land use on the highest ground to rough grazing or improved grassland, this land is a very important component of the hill farm.

An increase in afforestation of the hills and glens is a response to market trends and represents a change in land use.

The area covered by this report gives an almost complete perspective of land use in Scotland - from the forests and grouse-moors to the stock-rearing and marginal land to the intensively cultivated arable land.

The agricultural industry is basic to the economy of the area and has often been innovative in many aspects of crop and livestock production throughout the years.