

# SOILS OF CO. KILDARE



An Foras Talúntais  
National Soil Survey of Ireland

## PREFACE

The survey of County Kildare is one of a series of county soil surveys being conducted by the National Soil Survey of An Foras Taluntais (The Agricultural Institute) which is charged with the task of surveying, classifying and mapping the soils of Ireland. It was undertaken at the request of the advisory staff of the County Committee of Agriculture who were participating in a general resource survey of Kildare under the auspices of a County Development Committee. It was felt that an appraisal of soil resources was a prerequisite to planning, promoting and developing the county's resources in the most rational and effective manner.

Because of the urgency of the request, this soil survey was brought forward in the time schedule of the National Soil Survey's programme and manpower resources were concentrated in the area to expedite the project. The field mapping was conducted on a scale of 1:10,560 (6 in. = 1 mile) as in the detailed-reconnaissance surveys in the counties already completed. However, the degree of detail and definition of the mapping units is of a lower order because of the time limitation imposed. The entire detail mapped on the field sheets at the 6 inch to 1 mile scale could not be shown on the published soil map due to scale limitation, but copies of the field maps are available in the Soil Survey Office at Johnstown Castle, Wexford. Place names throughout the bulletins and on the maps are not in all cases in accord with local spelling, but it was deemed desirable to adhere to the official spelling used in the Ordnance Survey.

This scientific survey adds another highly important chapter to the records of the land resources of the country. The information provided will be of value to Kildare farmers and to those involved in planning and developing the resources of the county in the years ahead.

The soil survey was carried out by Dr. M. J. Conry, Mr. R. F. Hammond and Mr. T. O'Shea of the National Soil Survey with Dr. Conry as team leader and co-ordinator. The survey was commenced and completed in the 1968 field season. Grateful acknowledgment is made to all who co-operated in the project.

*Pierce Ryan,*  
Head, National Soil Survey

Soils Division,  
An Foras Taluntais,  
Johnstown Castle,  
Wexford.  
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## ACKNOWLEDGEMENTS

Apart from those directly responsible for the soil survey various members of the staff of the National Soil Survey Department and of the Soils Division and other sections of An Foras Taluntais contributed to the work and to this bulletin: Mr. S. Diamond helped with soil correlation; Mr. T. Shanley and the laboratory staff of the National Soil Survey, with some assistance from the Soil Chemistry Department, provided the analytical data; the maps and figures were prepared by Mr. J. Lynch and Mr. V. Staples of the Cartographic Section. The manuscript was edited for publication by Mr. B. Gilsenan and photographs were provided by Mr. C. Godson, Mr. O. V. Mooney and Bord na Mona. The invaluable assistance of Mr. A. J. Cole and the staff of the Peatland Experimental Station at Lullymore is gratefully acknowledged.

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The farmers of the county gave the entire project their wholehearted co-operation.

Mr. O'Meara, Geological Survey of Ireland contributed the information on solid and glacial geology with assistance from Mr. R. Aldwell. Their co-operation is greatly appreciated. Climatic data were provided by the Meteorological Service. The colour printing of the maps was executed by the Ordnance Survey which was also the source of base maps for the field mapping: the printed maps are based on the Ordnance Survey by permission of the Government.

Thanks are due to Commandant P. G. Madden, Assistant Director and to Mr. B. Harding and the mapping staff of the Ordnance Survey for their co-operation and help. The contributions of Mr. W. Brickley, Agricultural Chemistry and Soil Science Department, University College, Dublin on soils and soil suitability from his early studies in the county and that of Dr. J. F. Collins of the same Department, on the soils of the U.C.D. Experimental Farm at Lyons Estate, Celbridge, are gratefully acknowledged. Also deserving of special thanks are Mr. O. V. Mooney, Research Section, Forestry Division, Department of Lands and Messrs. M. Conway, T. A. Barry and G. Fitzsimons of Bord na Mona.

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Dr. T. Walsh, Director of An Foras Taluntais, gave the project his enthusiastic support.

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Plate I *Milled peat bog in Co. Kildare (Boora Complex)*

## CHAPTER 1

### GENERAL DESCRIPTION OF THE AREA

#### **Location and Extent**

Kildare is an inland county situated in the east-central part of Ireland, between 52° 51' and 53° 26' north latitude and 6° 28' and 7° 10' west longitude. It occupies an area of 418,645 acres (654 sq miles or 169,426 hectares).

#### **Topographic Features**

The county may be divided into two main physiographic regions, as follows:

- (a) *Lowlying region*: This region is part of the Central Plain of Ireland and forms a vast area of flattish to undulating topography with elevations ranging from approximately 1£0 to 500 feet (55-152m) O. D., broken only by a few small hills, such as Carbury Hill, Dunmurry Hill, Grange Hill and the Hill of Allen.
- (b) *Hilly region*: This region occurs in the eastern part of the county stretching almost continuously from County Carlow in the south, along the entire Wicklow border to County Dublin in the north-east. Topography is rolling to steeply rolling with elevations ranging from 500 to 1,248 feet O.D. (152-380 metres).

#### **River Systems**

The county is drained by the Rivers Barrow, Liffey and Boyne and their tributaries. The largest of the catchment areas is drained by the Barrow and its tributaries the Figile, Cushina, Slate, Finnery and Greese. This catchment area presents a serious arterial drainage problem, as there is a fall of only about 110 feet in approximately 50 miles. The north-eastern portion of the county is drained by the Liffey and its tributary, the Rye. A small area in the north of the county is drained by the Boyne and its tributaries.

#### **Climate**

Ireland has a typical west maritime climate, with relatively mild, moist winters and cool, cloudy summers. According to Koppen's classification of world climates (Petterson, 1958) it has a warm temperate, rainy climate, with warm summers, without dry season. The prevailing winds are westerly to south-westerly. For the greater part

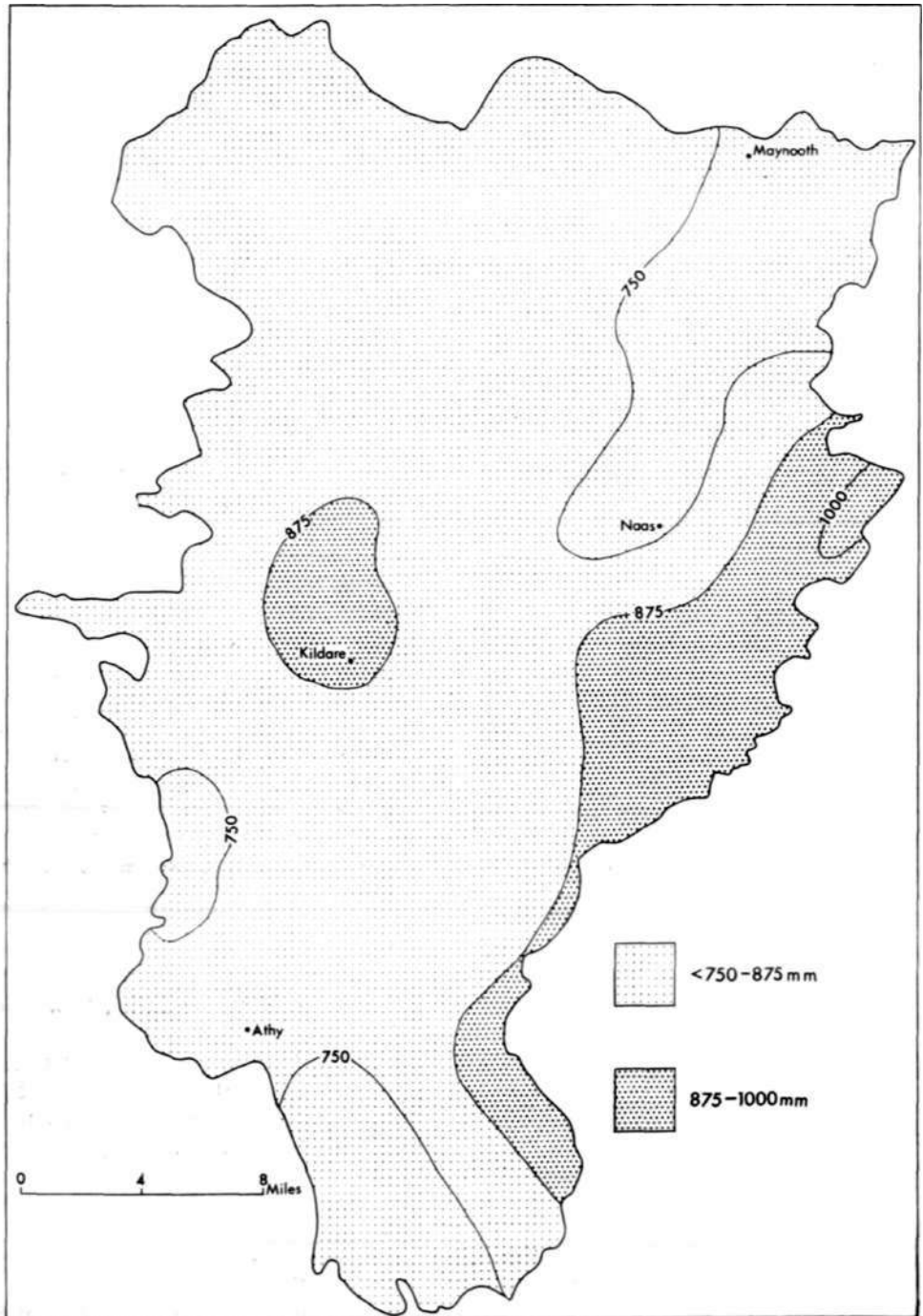


Fig. 1 - Rainfall distribution throughout the county (average annual rainfall 1950-1964)

of the year, warm maritime air associated with the Gulf Stream helps to moderate the climate. The average humidity is high. Annual average precipitation is highest on the west coast and in inland areas of high relief. County Kildare occurs in the drier south-east.

The information presented here is based on the records of the Meteorological Office. The rainfall figures are based on meteorological records for the period 1916-1950. The figures for air temperature, sunshine, relative humidity and ground frost, were recorded at Carlow and Lullymore over the period 1954-1964 and 1963-1967 respectively.

### *Rainfall*

The mean annual rainfall varies within the county from less than 29.5 inches (750 mm) in the lowlying region to over 39.4 inches (1000 mm) in the hilly eastern area. Although there is a certain seasonal fluctuation in rainfall, there is a fairly even distribution of rainfall throughout the year.

The county may be divided broadly into low and relatively high rainfall areas. The "low" region covers the greater part of the county in which the mean annual precipitation varies from less than 29.5 inches (750 mm) to 34.5 inches (875 mm). The "high" rainfall area occurs in the hilly eastern region with mean annual precipitation ranging from 34.5 inches (875 mm) to over 39.4 inches (1000 mm). Thus the hilly eastern area gets an average of 5-10 inches (125-250 mm) more rainfall per year than the larger lowlying region. Furthermore, observations suggest that a greater proportion of the precipitation in the hilly region falls as snow.

### *Temperature*

Temperature records are available for one station within the county and two stations just outside the county boundary. Figures recorded at Lullymore (Hammond, 1968) for the period (1963-67) show that January is the coolest month (3.7°C) and July is the warmest month (14.1°C). The data for the other two stations show a similar trend. Temperature data recorded at Peamount (Collins, 1965) show that July has the highest mean maximum air temperature (15°C) and the lowest mean minimum (4.3°C) occurs in January. Average monthly air temperature figures recorded at Carlow over the period 1954-64 are shown in Table 1 (Conry and Ryan, 1967). January on average is again the coldest month and July the warmest. Recorded temperature extremes over the period 1954-64, not given in Table 1, show a maximum of 23.3°C in July 1955 and a minimum of -3.3°C in January 1963.

### *Sunshine*

The average daily mean of bright sunshine registered at Lullymore (1963-67) ranged from 1.6 hours in January to 5.8 hours in May, while at Carlow (1954-64) the average daily mean varied from 1.55 hours in December to 6.5 hours in May.

### *Relative humidity*

The relative humidity figures for the county are high being normally between 75 and 85%.

### *Frost*

The average number of days with ground frost recorded at Lullymore (1963-67) was as follows: January 12.0, February 10.0, March 7.8, April 3.8, May 1.4, June 0, July 0, August 0.2, September 0, October 2.2, November 11.4, December 11.2. The

TABLE 1—Average monthly maximum and minimum air temperature, °C (Carlow 1954-1964)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov	Dec.
4- <b>Maximum</b>	7.2	7.7	10.0	13.3	15.5	18.2	19.4	19.4	17.2	14.4	10.5	8.3
<b>Minimum</b>	0.1	1.1	2.8	3.9	6.1	9.5	10.5	10.0	s.s	6.1	3.9	1.7

average number of days with ground frost recorded at Carlow (1954-64) was as follows: January 20.7, February 16.8, March 13.5, April 12.9, May 8.5, June 2.5, July 0.3, August 1.6, September 4.0, October 8.9, November 15.3, December 18.9. Obviously the frost-free period in this region is very limited in most years.

### Solid Geology\*

The broad plains of Co. Kildare have been slowly evolved by atmospheric solution of the Carboniferous Limestone. The few conspicuous hills are mostly of other resistant rock types. The Chair Hills are all of older rocks; Ordovician slates, with an andesite lava flow make up Allen and Grange hills with "reef limestone forming the Chair proper; Ordovician red shales occur in Dunmurry and Red Hills and also some green grits that may be Silurian. The ridges along the south-eastern margin of the county consist of tightly folded Silurian grits and slates. These are highly baked to the south where the main intrusion of the Leinster granite emerges but only a few knobs of this readily rotted rock appear at the surface near Castledermot. Sporadic remnants of red conglomerates and sandstones, supposedly Old Red, survive on many of the hills but are only significant at Lyons and Allen.

Carboniferous rocks occupy the remainder of the county. In the south, there is a fairly full limestone succession consisting of lower bedded limestones, middle oolites and dolomites, and upper pure bedded limestones. Around Clane, several "reef knolls" occur and from here northwards, the pure upper limestones in the south change to black earthy limestone and shales. Finally on Cappagh Hill these earthy beds pass up into black shales assigned to Upper Carboniferous Millstone Grit.

### Glacial Geology

A thick mantle of glacial tills and gravels swathes the rock almost everywhere, thinning only as the rock emerges to form hills or where rivers have recently cut down. This mantle resulted from the grinding of the bedrock by vast sheets of ice that bulldozed across the country during the Ice Age, and from the action of the torrential floods released as the ice melted. The last general ice sheet in Ireland overrode all county Kildare, the crests of the higher ridges on the south-east alone protruding above the sea of ice. On these there is mostly thin local rubble with patches of deeply weathered till, with much limestone and some granite that could only have been carried here by at least two separate earlier glacial episodes.

The last great Irish ice sheet built up in the west central midlands, whence it flowed outwards. Pushing along the north side of the Slieve Bloom mountains, it rasped off great quantities of the Carboniferous limestone bedrock in its path. This it pushed eastwards into north Kildare where it coalesced with ice pushing south from the northern part of the country and the combined flow then pushed south-eastward to the foothills of the Leinster mountain chain, just outside the county. Here it finally halted and terraces of till and outwash were piled against the mountain slopes. As melting set in at first slowly then in torrents, the narrow gaps of the Slaney and the Barrow valleys could only cope with part of the waters released by the decay of the vast pile of ice all along the Leinster chain. The surplus melt waters were forced to accumulate

\*These sections on solid and drift geology were contributed by Mr. M. O'Meara, Geological Survey of Ireland. The description and accompanying map of the glacial deposits are somewhat tentative pending the completion of the drift survey of the county.

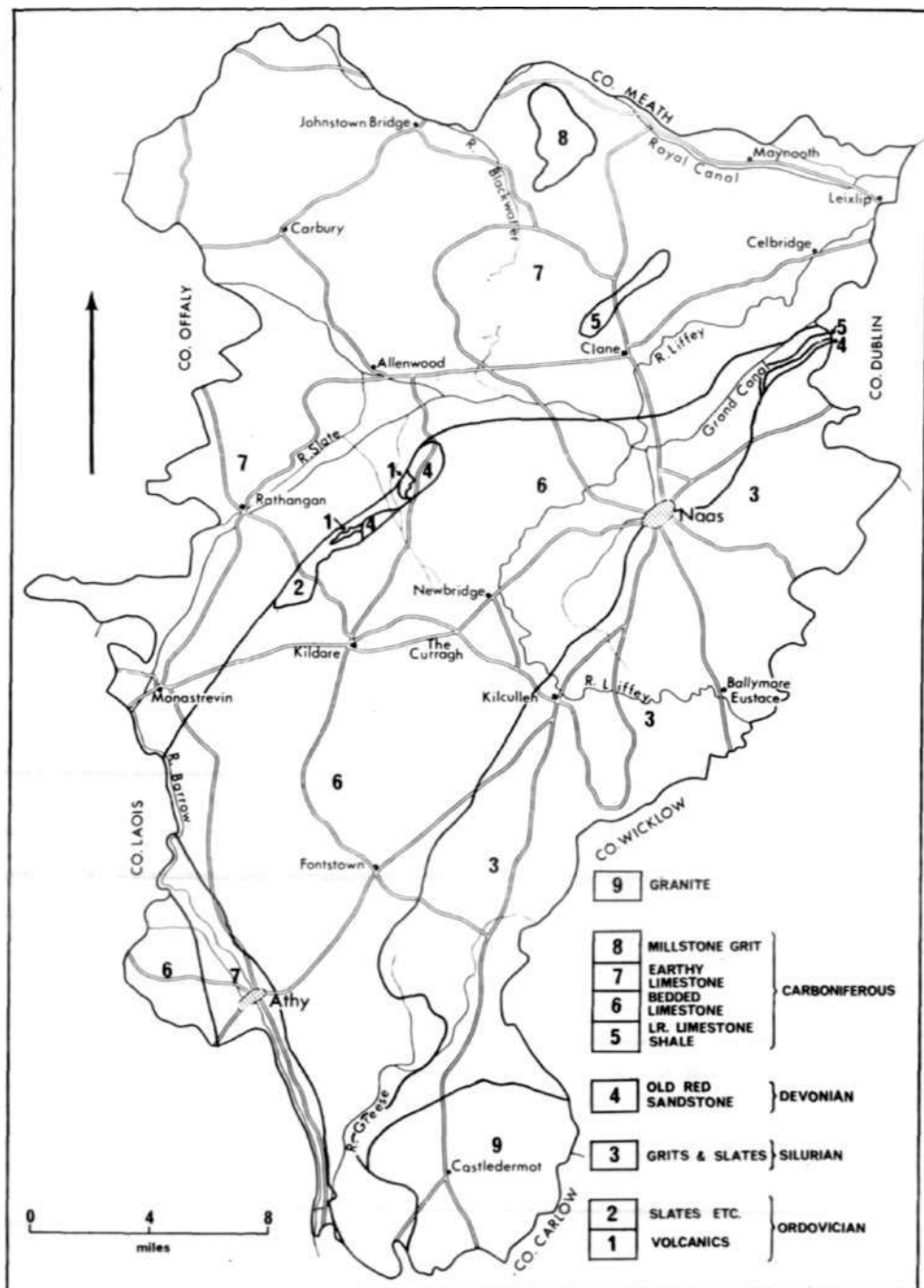


Fig. 2 - Distribution of solid geological formations throughout the county

# Generalised Map of Glacial Drifts of Co. Kildare.

COMPILED BY M. O'MEARA FROM MAPS OF THE GEOLOGICAL SURVEY

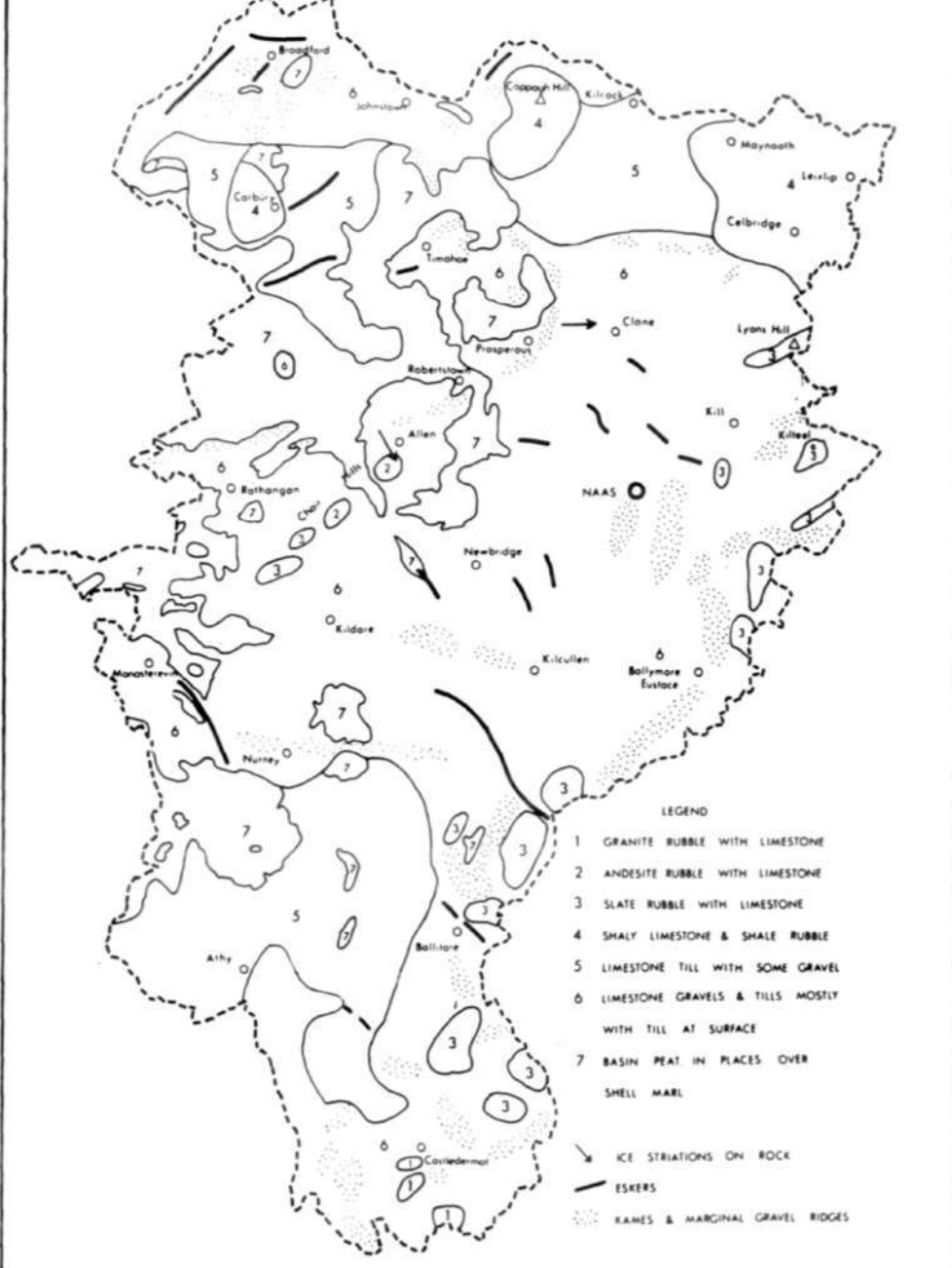


Fig. 3 - Generalised map of glacial drifts of Co. Kildare

under the ice and into this deepening pool the ice above and the melt waters jettisoned their excess loads. So a broad belt of diverse tills and gravels was dumped across the centre of county Kildare, which in most places has an erratic cover of loamy till, deposited when the ice finally melted. After the ice level in county Dublin had fallen sufficiently to allow melt waters to escape in that direction a new outlet opened from Newbridge to Dublin cutting a wide valley through the limestone barrier about Celbridge. Therefore, in this area, except where covered by later river terraces, limestone bedrock comes to the surface.

When the new-born Liffey had drained, the sole of the ice sheet split into its component lobes, the northern one shrinking back to county Meath and the western one into county Offaly. The new dry-shot ice left till with occasional gravel in its path as it washed away in north county Kildare. The splitting of the ice is marked by a chain of marginal gravel moulds running from Rathangan to Prosperous and thence swinging back to Broadford and the feeding eskers veer round, so as to be normal to this new direction of the ice front.

When the ice had gone, chara muds developed freely in the lime-rich waters, impounded in the hollows in the uneven drift surface. As the climate became more genial, plants developed rapidly and fen peats grew over the chara marls. At the optimum of the oceanic climatic cycle, peats grew rapidly upwards and outwards across the low ground, swamping the then flourishing forests. The growth of peat and forest, was finally checked by a fairly recent chilling of the climate.

## CHAPTER II

### THE SOILS

Nineteen Soil Series\* have been recognised and mapped within County Kildare. Six soil complexes, including two peat complexes, have also been recognised and described.

In mapping their distribution in any area, the soils can be classified, on a broad scale, into Major or Great Soil Groups, each consisting of a collection of closely related Soil Series. Each Great Soil Group then is comprised of soils having a number of important profile characteristics in common. A certain latitude in profile variation is permissible at this level of classification, but the degree of similarity, nevertheless, is of quite a high order.

Descriptions and discussions of the various soils mapped in the county arranged according to Great Soil Groups are given in the following pages. Analyses and descriptions of modal profiles are given in Appendix 3.

#### **Grey-Brown Podzolic Group**

The development of these soils is associated primarily with a leaching process; the principal constituent accumulated in the B horizon is the finely divided clay fraction. To qualify as a Grey-Brown Podzolic, a soil must have a B horizon significantly higher in clay content than either the A or C horizons; such an horizon is termed a textural B or Bt horizon. The occurrence of clay skins on the structural ped surfaces is a further characteristic of the Bt horizon.

In general, the Grey-Brown Podzolics are some of the most inherently fertile soils in the county; they are well drained to moderately well drained, possess a moderately well or well-developed structure and are usually moderately acid to neutral in reaction. The organic matter content in the surface is within the normal range for mineral agricultural soils and the humus is of the desirable mull type.

Under Irish climatic conditions, the "lighter" textured members of the Grey-Brown Podzolics are good all-purpose soils and, when adequately manured and managed, are very productive for most agricultural enterprises. The "heavier" textured members are good grassland soils, responding well to good manurial and management practices. The Grey-Brown Podzolic soils are not generally available for afforestation but should be highly productive for this purpose.

\*For series and profile definitions see Appendix 1.

*Donaghcwnper Series*

*Soil character:* The soils of this series occur in a small area near Celbridge and occupy an area of 1,460 acres (591 hectares or 0.35%). They occur on flattish to undulating topography at an elevation of around 200 feet (61 metres). The soils appear to be derived from the underlying carboniferous limestone but may possibly contain some drift material.

These are moderately deep, moderately well-drained soils, of high base status. The profile consists of a dark brown surface horizon overlying a thin lighter-coloured subsurface horizon, which in turn overlies a well developed textural B horizon. The A horizon is 9 to 11 inches (23-28 cm) deep, has a loam to clay loam texture (26 % clay) and moderately good structure while the B horizon shows a significant increase in percentage of clay. The profile varies in depth from 15 to 22 inches (38-56 cm) and

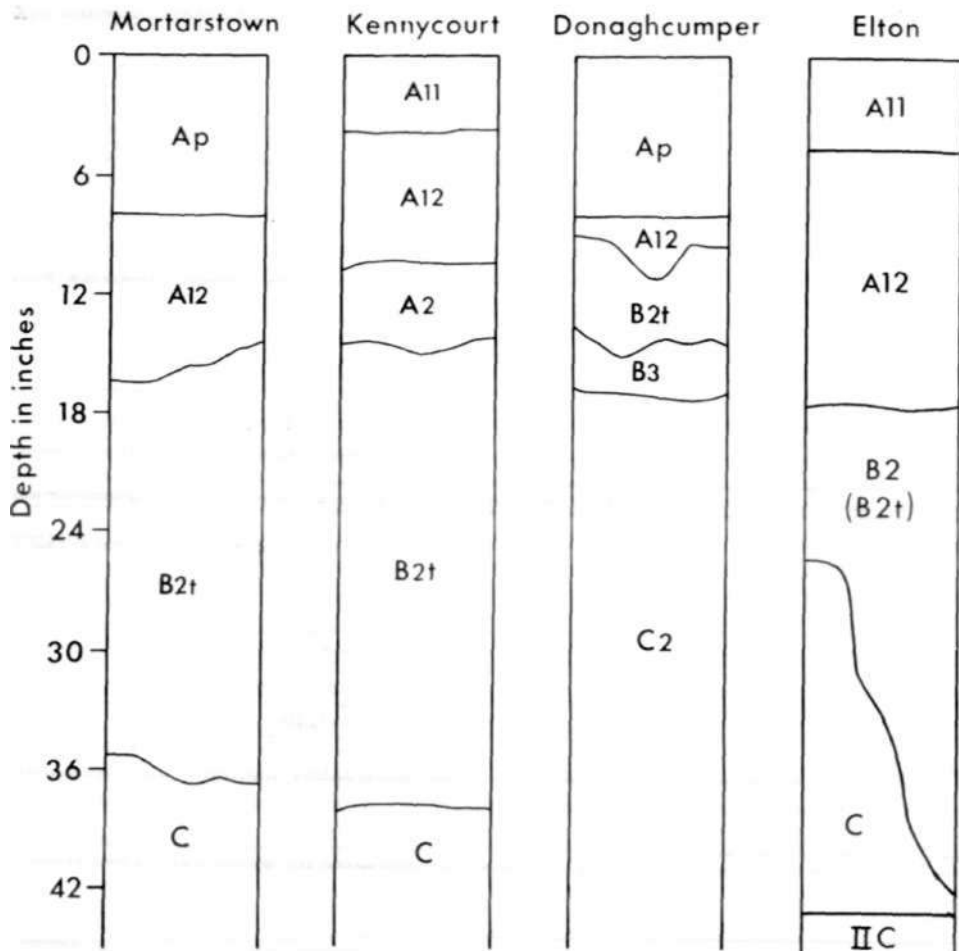


Fig. 4 - Horizon sequence in some grey-brown podzolic profiles

although there is some evidence of drainage impedance (mottling) roots can penetrate freely down to the base of the profile. Moisture holding capacity is moderately good but in very dry seasons there can be a moisture deficit.

Profile descriptions and analyses are given in Appendix 3.

*Soil suitability:* These soils have a wide use-range. They are good tillage soils, being well suited to the production of a wide range of farm, fruit and vegetable crops. Good yields of wheat and barley can be obtained. Oats, potatoes, swedes, sugar beet and other root crops give good returns but are not normally grown as the farming pattern consists mainly of summer grazing and silage conservation for winter feed. Owing to their medium heavy texture and slight drainage impedance, cultivation and harvesting are difficult in unfavourable seasons. The soils respond well to fertilisers but liming is not necessary. The soils are ideally suited to grass production. With proper manuring and management, a very high output can be attained and, although there is a poaching hazard in wet periods, pastures can be grazed over a relatively long season.

#### *Elton Series\**

*Soil character:* This series occurs most extensively in the northern and eastern portions of the county. It occupies 20.42% (85,493 acres or 34,599 hectares) and is therefore one of the largest and most widely distributed series in the county. These soils occur normally at elevations of less than 500 feet (150 metres), usually on undulating relief with slopes of 2 to 6<sup>c</sup>. They are derived from dominantly limestone drift with a small admixture of shale and sandstone.



Plate 2 - Park landscape, Elton Series, Brannockstown, Co. Kildar

•First mapped in County Limerick.

The soils of this series are deep, well-drained, of loam texture and high base status. The profile has a dark brown to brown loamy surface All horizon over a lighter coloured sub-surface A12 horizon. The structure of the A horizon is good; depth varies from 10 to 17 inches (25-43 cm). The surface horizon of the Elton Series south of Naas contains 18 to 20% clay and 35 to 45% silt while that portion of the series in the northern part of the county, which appears to be more strongly influenced by the occurrence of Lower Avonian shales in the glacial till, contains up to 25% clay and 38 to 45% silt. Organic carbon content varies from 1.8 to 4.2%, but is usually between 2.3 and 3.2%. In many fields which have been under permanent pasture for generations, the A1 is A\ to 5 inches (11-13 cm) deep and is stone free; its formation can be attributed to worm activity. The A2 horizon is generally very weakly developed and the B horizon normally shows little or no clay increase. Because only small portions of the B horizon show a significant increase in clay content the soils have been classified as minimal Grey Brown Podzolics. The soil profile varies from 25 to 48 inches (63.5-127 cm) but is generally over 33 inches deep. Roots are plentiful in the surface horizon and penetrate freely to a considerable depth. Moisture-holding capacity is high.

Profile description and analyses are given in Appendix 3.

*Soil suitability:* These soils have a wide use-range, being suitable for the production of a wide range of farm and vegetable crops. A large portion of the soils carry permanent pasture and a high concentration of stud farms are found particularly in the central and eastern part of the area. Owing to their depth, free drainage, medium texture and good moisture holding capacity, these are first-class grassland soils. When adequately limed, fertilised and managed, very high levels of production can be obtained. The grassland can be grazed over a long season but controlled grazing is necessary to prevent poaching and to obtain maximum utilisation.

Although these soils are more noted for grass production, they are also very good tillage soils. Less than 10% of the soils are cultivated annually. Cultivation and harvesting can be difficult in wet seasons, but nevertheless, good yields of wheat, oats, feeding barley, potatoes, sugar beet, swedes and mangels can be obtained.

#### *Fontstown Series*

*Soil character:* These soils occur mainly in the southern half of the county. Although the elevation varies from less than 200 to over 500 feet, the flattish to undulating nature of the topography is a feature of this area. The soils occupy 16.89% (70,731 acres or 28,624 hectares) of the county. Parent material consists of calcareous, non-tenaceous, compact stony till, composed almost entirely of limestone. Small pockets of loose gravelly material are commonly observed in profile section.

These are moderately deep to shallow, well-drained soils, of sandy loam to loam texture (Fig. 5). The profile normally shows a wide variation in depth; in extreme cases the profile varies from 7 to 30 inches (17.5 to 76 cm) but is generally 15 to 18 inches (38-46 cm) deep. The profile normally consists of a brown to dark brown Ap horizon with a moderately strong structure and friable consistence. This A horizon is generally 10 inches deep but varies from 7 to 12 inches; it usually contains 16 to 18% clay and 35% silt but the clay percentage varies from 14 to 21% and generally tends to increase from west to east. Organic carbon content of the surface horizon varies from 1.2 to 2.3%. Beneath this horizon a leached, sometimes indurated, pale brown A2 overlies a dark yellowish-brown B horizon which shows a strong textural increase. There is an abrupt transition from the textural B horizon to stony parent material.

In the shallow parts of the profile the A2 and B horizons are absent and the Ap horizon rests directly on the parent material (C horizon).

These soils generally have a very high base status with free carbonates occurring throughout the profile. These show their lowest concentration in the A2 and B horizons (Brickley, 1942). The free carbonates in the A horizon are probably due to the large scale use of the underlying "corn gravel" and burned lime as liming agents, particularly in the 19th century. However, some lime-deficient patches occur throughout this series. Small areas of the Athy Complex (gravels) occur within this series but they could not be separated from the Fontstown Series at the scale of mapping employed.

Profile descriptions and analyses are given in Appendix 3.

*Soil suitability:* These soils have a wide use range. Together with the soils of the Athy Complex, they are largely responsible for South Kildare's reputation as a tillage area. With their light to medium texture, good structure and friability they are easily

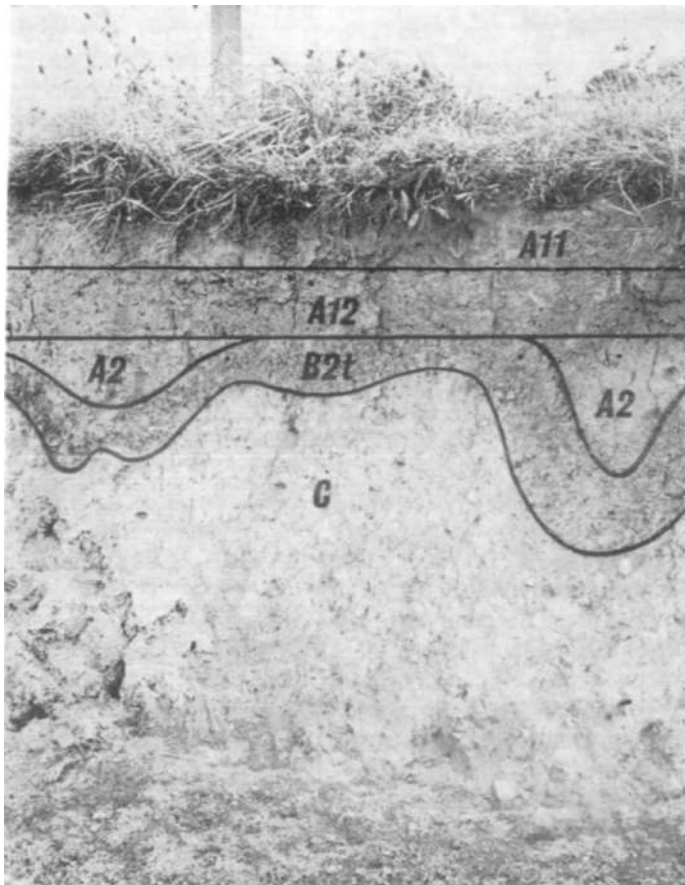


Plate 3 - Soil horizons in the Fontstown Series

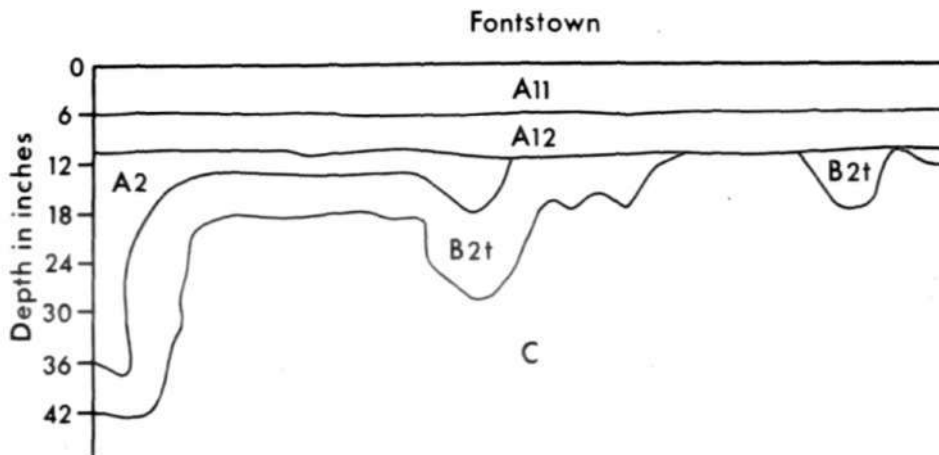


Fig. 5 - Horizon sequence in Fontstown Series

tilled. Where properly manured especially with potash, excellent yields of malting barley, wheat, sugar beet, swedes and other root crops can be obtained. Boron deficiency in swedes is a common problem. Peas, French beans, carrots and cabbage are grown extensively for food processing. Raspberries and strawberries give good returns. Blackcurrants give good returns despite the fact that frost is a serious hazard and the soils are only considered moderately suitable for blackcurrants because they show a moisture deficit in dry periods.

Traditionally, these soils were not supposed to require lime but in most recent years where lime-sensitive crops, such as swedes, sugar beet or peas are grown, irregular patches showing severe lime deficiency symptoms have been observed. As a direct result toxic levels of manganese generally reduce yields considerably and often result in complete crop failures.

These soils are highly suitable for grass production. With proper manuring, and particular attention to potash and nitrogen, a very high output can be attained especially on new leys. Due to the relatively light texture of the soil, free drainage and shallow depth a moisture deficit can severely limit production in dry seasons.

#### *Grange Series\**

*Soil character:* The Grange Series covers a small area of 1,380 acres (558 hectares) or 0.33 % in the extreme north-east of the county. It occurs on undulating topography between 200 and 250 feet O.D. The soils are derived from non-tenaceous, calcareous drift composed mainly of limestone.

These are moderately deep to deep, well-drained soils of high base status. The profile consists of a clay loam surface A horizon about 12 inches (20.5 cm) deep overlying a Bt horizon which shows a small clay increase. The Bt horizon merges with the parent material at a depth of 28 to 33 inches (71-83.8 cm). Where the soils have not been cultivated for generations a stone-free surface A1 1 horizon has developed as a result of earthworm activity. Roots penetrate freely to the base of the profile and moisture holding capacity is good.

Profile description and analyses are given in Appendix 3.

\*This soil occurs more extensively in County Meath.

*Soil suitability:* These soils have a wide use-range. They are suitable for the production of a wide range of farm crops including wheat and barley. Swedes and other root crops are not normally grown in this area although there is no reason why good yields should not be obtained.

These deep, medium to heavy textured, well-drained soils have a high potential for grass production provided they are adequately manured and well managed.

#### *Kellistoun Series\**

*Soil character:* These soils occur on undulating to rolling topography at elevations of 200 to 400 feet O.D. in the extreme south-east corner adjoining county Carlow. They occupy only 1.59% (6,640 acres or 2,687 hectares) of the county. Parent material consists of calcareous, non-tenaceous glacial till of Weichsel Age, composed mainly of limestone with an admixture (less than 20%) of granite and sandstone.

These are deep, well-drained soils, of sandy loam texture and of medium base status. The profile has a deep, friable, dark greyish-brown to brown sandy loam surface horizon with a moderately strong granular structure. This A horizon is normally 14 inches (36 cm) deep but varies from 12 to 18 inches (30.0-46.0 cm) ;it contains 13 to 15% clay and 4 to 7% organic matter. Beneath this horizon a leached, sometimes indurated yellowish-brown A2 horizon varying in thickness from 2 to 8 inches (5 to 20 cm), overlies a thick dark yellowish-brown textural B horizon with a clay content of 18 to 24% and in which clay skins are prominent. There is an abrupt transition from the textural B horizon to the parent material. The soil profile varies in depth from 36 to 54 inches. Roots penetrate to a considerable depth and moisture-holding capacity is good.

Profile description and analyses are given in Appendix 1 (p. 94), *Soils of County Carlow* (Conry and Ryan, 1967).

*Soil suitability:* These soils have a wide use-range, being well suited to the production of farm, fruit and vegetable crops. With their medium to light texture and their good structure and friability, they are easily tilled. Where properly manured, including the regular application of lime, good yields of wheat, malting and feeding barley, oats, sugar-beet, swedes and other root crops can be obtained. Peas, French beans, carrots and cabbage are also grown successfully.

Due to their depth, desirable physical properties and good conditions for root penetration, these soils have also a high potential for grass production which can be utilised over a long grazing season.

Sporadic occurrences of molybdenum deficiency have been recorded locally in *Brassica* crops, but generally higher than normal levels of this element are found in these soils.

#### *Kennycourt Series*

*Soil character:* These soils occupy 3.83% (16,050 acres or 6,495 hectares) of the county and occur on rolling topography in the eastern part of the county bordering counties Wicklow and Dublin. The elevation varies from 400 to 900 feet but the majority of the soils occur between 500 and 800 feet. The parent material consists of limestone with a strong admixture of the underlying shale bedrock and some sand-

\*First mapped in County Carlow.

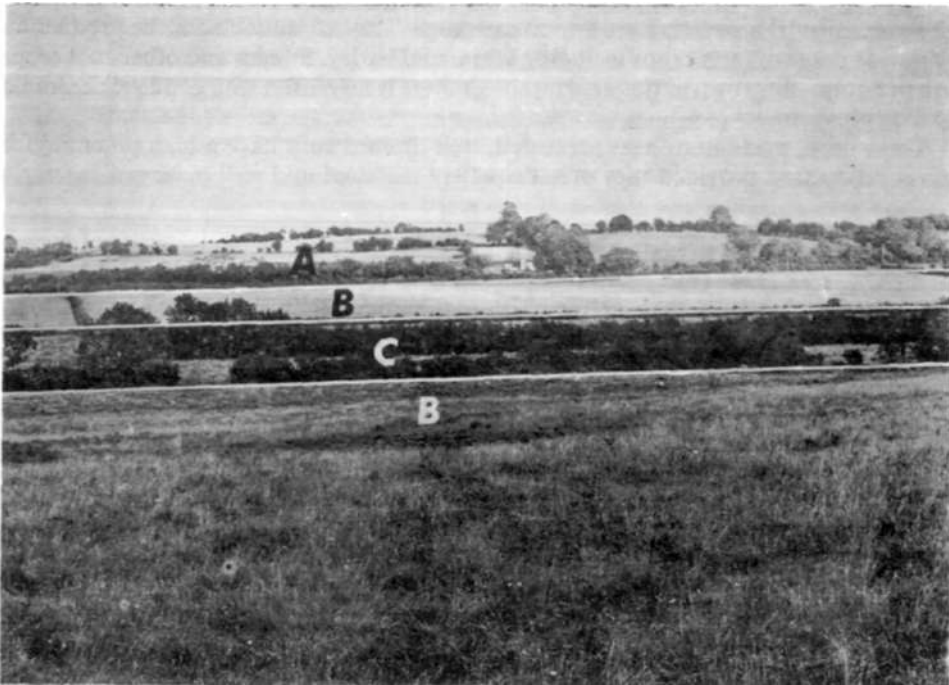


Plate 4 - Landscape in East Kildare showing Kenny court Series (A) on hilly background with Dunnstown (C) in the depressions and Elton (B) on the gently undulating topography in the foreground

stone. In many places, particularly on steeper slopes at higher elevations, the Kenny-court Series rests directly on the underlying shale bedrock. In other places, in similar situations small enclaves of the Hughstown Series occur. In many cases these enclaves are too small to be separated at the scale of mapping employed.

These are deep, well-drained soils, of loam texture and of medium base status. The profile has a moderately deep to deep (9 to 16 inches), brown to dark brown surface horizon with a moderately strong subangular blocky structure; it has 18 to 20% clay, 35 to 46% silt and 2.5 to 4.1% organic carbon. Beneath this horizon a leached, sometimes indurated but intermittent yellowish-brown A2 horizon overlies a thick dark yellowish-brown B horizon. There is an abrupt transition from the B horizon to the parent material (glacial till) or underlying bedrock. The soil profile varies in depth from 24 to 44 inches (61 to 112 cm) but is generally over 36 inches (92 cm) deep. This series like the Elton Series is considered a minimal Grey Erown *Todzolic* because the B horizon normally shows only slight clay increase.

Erofile description and analyses are given in Appendix 3.

*Soil suitability:* These soils have a wide use-range, being well suited to the production of a fairly wide range of crops. With their medium texture and moderately good structure and friability they are relatively easily tilled. When properly limed and manured good yields of barley, oats, sugar beet, swedes and other root crops can be obtained. However, the colder climatic conditions associated with the higher elevation causes great difficulty in cereal growing, particularly as a result of late sowing and

ripening. Sugar beet is usually not grown.

Due to their depth and desirable physical properties these soils have a high potential for grass production which can be utilised over a long growing season. Unless adequately limed, fertilised and managed sown species are replaced by poor quality indigenous species and furze.

#### *Mortarstown Series\**

*Soil character:* This soil occurs in isolated pockets among the Fontstown and Elton Series mainly in the western part of the county. Topography is flattish and elevation varies from 150 to 400 feet. The series occupies 2.79% (12,400 acres or 5,018 hectares) of the county. The soils are derived from relatively fine-textured, non-tenaceous, calcareous, glacial till composed mainly of limestone.

These are deep, well-drained soils of loam to clay loam texture and of medium to high base status. The soil consists of a brown to dark brown surface Ap horizon 8 to 11 inches (20-28.4cm) deep, overlying a lighter coloured A12 horizon which in turn overlies a heavy textured B horizon. The surface horizon contains 20 to 24% clay and 35 to 40% silt and has an organic carbon content which varies from 2.3 to 3.5 and is as low as 1.1 % under almost continuous tillage. Occasionally the clay content may be up to 27%. The A12 (or A2) is thin or absent in places but in all cases the Bt horizon, which is usually 20 inches (51 cm) thick, normally contains 40 to 45% of both clay and silt. The B horizon has a very good structure and shows a very high proportion of both micro- and macropores as well as large worm holes thus ensuring easy penetration of air and water. There is an abrupt transition from the textural B horizon to the parent material at a depth of 30 to 38 inches (76 to 96 cm). Roots penetrate freely to a considerable depth and moisture holding capacity is high.

The heavy textured condition of this soil is attributed to the moderately heavy, rather stone-free nature and relatively low CaCO<sub>3</sub> content of the glacial till from which the soil is derived. Many of these soils particularly in the Churchtown area north-west of Athy, have been formerly used for brick making, the surface horizons are often replaced after the thick heavy carbonate-free B2t horizon has been used for brickmaking.

Profile description and analyses are given in Appendix 3.

*Soil suitability:* These soils are suitable for the production of a wide range of farm, fruit and vegetable crops and are capable of supporting high-class grassland. Response to fertilisers, particularly potassium, is good. Due to the heavy texture and rather weak structure of the soils, tilling and harvesting can be difficult in unfavourable seasons, resulting in reduced crop yields and poor quality. This is especially true when the soils are frequently tilled. For the same reason, poaching by grazing stock in wet periods is a hazard. Wheat gives good returns but frequent cropping is often the reason for reduced yields. Although heavy textured soils are considered unsuitable for malting barley, these soils are used extensively for this enterprise in the Churchtown area, near Athy. Swedes, sugar beet and other root crops grow satisfactorily. Peas, French beans, cabbage and carrots are successfully grown for the processing industry.

\*First mapped in County Carlow.

## Brown Earth Group

The Brown Earths are relatively mature, well drained, mineral soils possessing a rather uniform profile, with little differentiation into horizons. It follows, therefore, that these soils have not been too extensively leached or degraded; there are no obvious signs in the profile of removal and deposition of materials such as iron oxides, humus or clay. However, in many cases, some leaching has occurred, resulting in the translocation of soluble constituents, notably carbonates of calcium and magnesium. In other cases, there is a substantial release of iron and aluminium constituents in the subsoil as a result of weathering *in situ* giving rise to the development of a yellowish (B) horizon so that the profile closely resembles the more strongly leached Brown Podzolic soils.

Some Brown Earths are derived from parent materials poor in lime or base-rich components and are, therefore, inherently acid; these are called Acid Brown Earths or Brown Earths of low base status. Others have developed on more lime-rich parent materials, are less acid or may even be alkaline, and are described as Brown Earths of high base status. An intermediate sub-group classified as Brown Earths of medium base status can also be distinguished. These and the Brown Earths of low base status can develop also on base-rich parent materials under conditions conducive to excessive depletion of bases.

Brown Earths normally possess medium textures, desirable structure and drainage characteristics, and a high degree of friability. They are generally good arable soils. Although normally of rather low nutrient status in their natural state, they respond well to manurial amendments. With good management, they constitute high-quality grassland soils and are also suitable for a wide range of forest trees.

### *Hughstown Series*

*Soil character:* The series occupies 1.30% (5,480 acres) of the county and occurs in the more elevated areas in the eastern part of the county along the Wicklow border stretching from Hughstown Hill in the south to the County Dublin boundary in the north east. Topography is steeply rolling to rolling and elevations range between 450 and 1,150 feet (137-350 metres) O.D. The greater proportion of the area occurs above 800 feet. Because of the elevation and steep slopes, the area does not carry a mantle of glacial drift. The soils, therefore, are derived mainly from the underlying shale materials.

These are moderately shallow, well-drained Acid Brown Earths. The profile is characterised by a friable, brown loamy surface horizon overlying a weak B horizon which merges with the parent material (shattered shale) at a depth of 15 to 20 inches (38 to 51 cm). The surface horizon varies in depth from 7 to 12 inches (18-30 cm) and has a well developed crumb structure and 18 to 22% clay. The soil contains a high proportion of small shaly stones. Root development throughout the soil profile is very good.

These soils are very similar to the Ballindaggan series previously mapped in County Carlow (Conry & Ryan, 1967), and to the Deerpark variety on the Lyons Estate (Collins, 1965).

*Soil suitability:* On the less steeply sloping landscape at lower elevations, these soils have a moderately wide to wide use-range. They are suited to the production of a wide variety of tillage crops, including feeding barley, oats, wheat, potatoes, swedes, sugar beet, rape, kale and cabbage. Their physical properties render cultivation easy,

but their natural lime and nutrient status, particularly phosphorus, is low, and for best results, constant attention must be given to liming and manuring. Adequate liming is especially important for barley and sugar beet. On the steeper slopes mechanical operations are very difficult. These soils can support satisfactory pasture and meadow. If manuring and management are neglected, however, the sward rapidly degenerates. Moisture-holding capacity of these soils is moderately good, but a moisture deficit is a serious problem in dry seasons.

At higher elevations (above 700 feet approximately) degeneration of pasture often reaches an advanced stage; without rotation, cultivation and the application of lime and fertilisers, furze, bracken and even heather become dominant. At these elevations the range of tillage crops is rather limited; wheat and barley give unsatisfactory returns due to late sowing and ripening and the yields of sugar beet are uneconomic. Steep slopes, which render mechanical operations extremely difficult, are a further limiting factor in many places.

### **Podzol Group**

These soils are intensely leached. They display well-defined horizons of depletion and accumulation within the profile and are considered to be degraded soils. They develop from parent materials of very low base reserves or under conditions which deplete the base reserves to a low level. The hilly eastern region for instance provides a situation in which both of these factors operate; with the acid nature of the geological parent material together with the higher rainfall, considerable leaching of soil constituents, principally bases, iron and aluminium oxides and humus takes place. In more advanced deterioration, the surface becomes very acid, the environment for decomposition by micro-organisms becomes unfavourable, and a peat-like layer accumulates on the surface, on which heath-type vegetation develops.

Podzols are generally poor soils with high lime and fertiliser requirements. In their unreclaimed state they usually have a cover of semi-natural vegetation. In lowland areas, they have been successfully reclaimed for cultivated cropping and other purposes, but unless management is good they revert easily. Considerable improvement in stock-carrying capacity is possible by surface regeneration of the rough grazing, through manuring and improved management.

Where an ironpan occurs within the profile, it hinders root penetration (an important factor in forestry and in the agricultural use of these soils) and water percolation. For the latter reason drainage in the surface horizons may be very poor—a further unfavourable feature of many Podzols. Besides having a low level of major nutrients, these soils are usually very deficient in trace elements.

Podzols are the most widely available mineral soils for afforestation in the country and are usually planted with pines (*Pinus spp.*). However, with deep ploughing and the application of phosphorus fertiliser in particular, they can support other species with relative success.

#### *Cupidstownhill Series*

*Soil character:* This series occupies only 0.26% (1,080 acres or 437 hectares) of the county, mainly on the higher reaches of the hilly eastern area, particularly on Cupidstownhill and Hughstown Hill. The soils occur on moderate slopes and at elevations ranging from 825 to 1,250 feet O.D. in areas which are not covered by a mantle of glacial till. Like the Hughstown Series the soils are derived, therefore, from

the underlying bedrock. The high altitude, with attendant higher rainfall and lower temperature, has contributed to the strongly leached nature of these soils and to the surface accumulation of raw humus.

The series consists of a Peaty Ironpan Podzol and its reclaimed phase. In the natural state, the profile is characterised by a peaty surface horizon, a strongly leached A2 horizon, a thin, continuous, tonguing ironpan (B21) and a strong brown B22 horizon overlying the shattered shale bedrock. Root and water penetration are impeded by the ironpan; root development is confined to the horizons above the ironpan. The vegetation is heather dominant but has been altered by close grazing.

A large proportion of this complex has been improved considerably by human activity. Cultivation with the addition of lime, fertiliser, scrapings and marl has altered the physical, chemical and biological properties of the soil. The peaty surface horizon has been mixed with the greater part of the greyish leached A2 horizon, thereby lowering the surface organic matter content; the remainder of the A2 horizon has been almost obliterated by increased worm activity following the amelioration process. Portion of the ironpan has been destroyed by cultivating implements, consequently both internal drainage and rooting depth have been greatly improved. Cultivation and mixing of the surface horizons together with the addition of scrapings and carted soil material has given a dark brown colour to the surface horizon. The application of marl, lime and fertiliser has decreased acidity and raised the nutrient status of the soil while the use of farmyard manure, in particular, is considered to have increased the earthworm activity.

*Soil suitability:* In the unimproved state these soils have a very limited use-range and are only suitable for extensive grazing or forestry. At the present time, they are mainly used as extensive grazing for livestock and sheep. Their nutrient status and lime content are very low but their stock carrying capacity can be improved considerably by the application of lime, fertilisers, and where feasible, by overseeding.

The soils reclaimed by human endeavour have a wider but, nevertheless, limited use-range. As a result of extreme podzolization, natural lime and nutrient status is extremely low. However, generations of cultivation with addition of lime and manures have tended to improve the fertility and general nutrient status.

Even with lime, manures and good management, serious limitations still exist for cereal production. Oats is the most suitable grain crop. Owing to the poor natural fertility and high elevation, wheat and barley give poor returns. Similarly, sugar beet growing is uneconomical. With good management satisfactory yields of potatoes, cabbage, rape, kale and swedes can be obtained. New leys, when adequately limed, manured and managed give moderately good returns; unless properly limed and fertilised the pastures easily revert to heather, furze and poverty-tolerant grass species.

## **Gley Group**

Gleys are soils in which the effects of drainage impedance dominate and which have developed under conditions of permanent or intermittent waterlogging. The impeded conditions may be caused by a high water-table or by a "perched" water-table due to the relatively impervious nature of the soils and their parent materials and, in many cases, by both of these factors, together with excess run-off from higher slopes. For this reason, gley soils can occur both in depressions and on elevated sites.

Where the gley conditions result from a high water-table, the soils are referred to as ground-water Gleys. Where they are due to the impermeable nature of the soils or of their parent material, or to run-off from higher slopes, the soils are usually referred to as surface-water Gleys.

The mineral horizons of Gleys are usually grey (or bluish-grey in more extreme cases) with distinct ochreous mottling much in evidence. Relative to the podzolic soil group, depletion of bases and other constituents is not so pronounced. However, rooting area is limited, aeration poor, rate of decomposition of organic matter slow, and many other unfavourable features prevail.

Podzolised Gleys are soils in which there is evidence of a soil formation process similar to that described for Podzols associated with the Gleys, whilst Podzolic Gleys refer to soils displaying evidence of Grey Brown Podzolic characteristics associated with the Gley.

The majority of gley soils have weak structure, are not very friable and, in the wet state, tend to become very sticky. Due to their poor physical properties, these soils, except in favourable seasons, present difficulties in cultivation, especially in the development of a desirable tilth. Poor drainage conditions retard growth in the spring. Even for pasture production, this is a decided disadvantage. Besides poor drainage, the characteristic weak structure renders these soils susceptible to poaching damage by grazing stock, a factor which curtails the length of grazing season and the proportion of fodder utilised. Despite their physical shortcomings, however, the potential of these soils for pasture production is high in many cases, provided management and manuring are satisfactory.

Gleys are generally considered to be relatively productive forest soils especially for softwoods. However, wind throw caused by poor root penetration is a common hazard.

#### *Dunns town Series*

*Soil character:* The soils of this series cover 5.40% (22,600 acres or 9,146 hectares) of the county. This is a poorly drained gley soil, found in the lowlying areas associated with the Elton Series. Topography is flat and the elevation varies between 200 to 350 feet O.D. (60-106 metres).

These poorly drained soils have a high base status and, in some areas, have a slightly peaty surface horizon. The poor drainage is caused by a high water table. The profile consists of a dark greyish brown surface horizon overlaying strongly gleyed and mottled, compact subsoil horizons. Rooting depth is almost confined to the surface horizons. Vegetation consists of *Juncus* (rush) infested wet grassland.

*Soil suitability:* These soils have a very limited use-range. They are unsuitable for tillage. In their present condition they are only suitable for rough grazing. With drainage and adequate fertilising good levels of grass production can be obtained. A very high level of management is required to prevent poaching, to control rush infestation and to utilise the sward fully.

About 30% of these soils have been improved by artificial drainage so that a wider range of farm crops can be grown. Improvement is contingent on securing a suitable outfall.

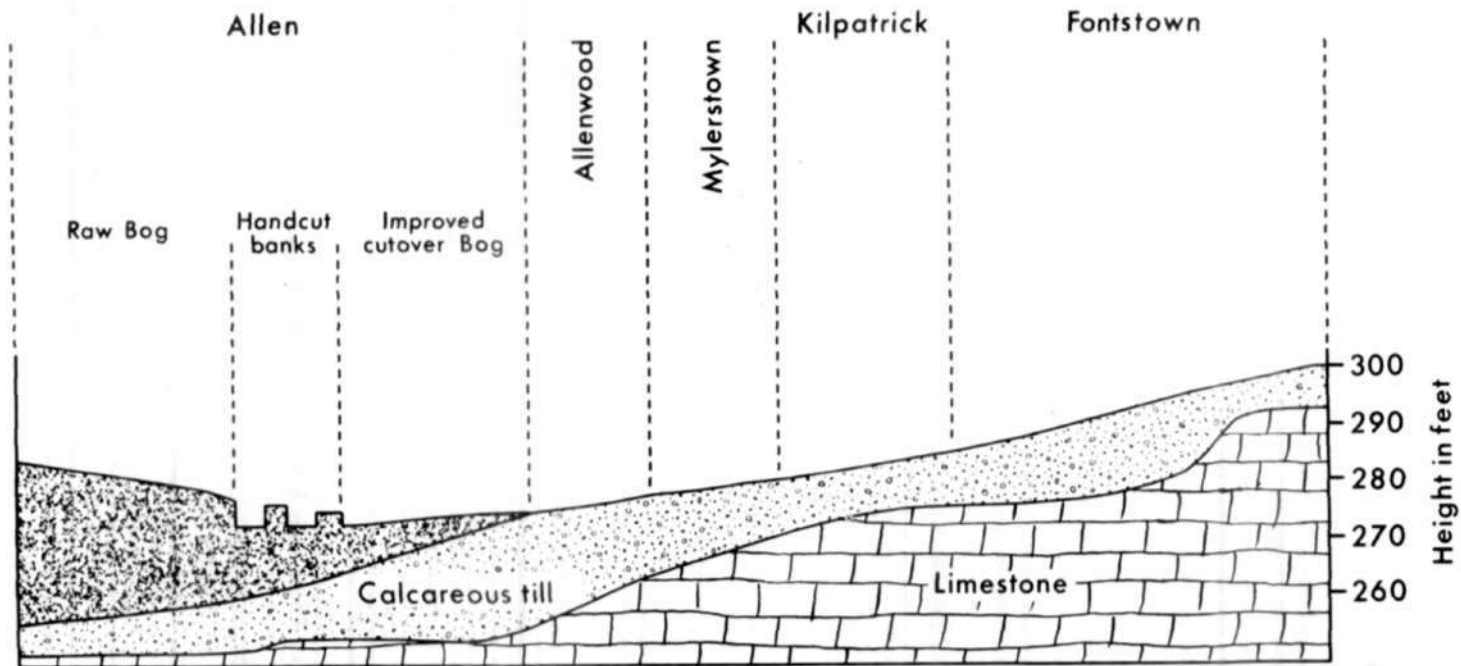


Fig. 6 – Diagrammatic representation of soil series in relation to landscape features and geology

### *Garristoun Series\**

*Soil character:* These soils occupy a small area of 920 acres (372 hectares) on rolling topography in the north of the county, adjacent to the Meath border. They are derived from dense glacial till composed of a mixture of shale of the Upper Carboniferous Millstone Series, sandstone and limestone. The soils are imperfectly drained. The dense, impermeable nature of the parent material, the heavy texture, and poor structure of the soils cause the drainage impedance in the soil profile: consequently they have been classified as surface-water Gleys.

The profile consists of a very dark greyish brown surface horizon with a clay loam texture (30% clay and 30% silt), weak structure and poor consistence. The subsoil horizons are grey and mottled; the subsoil shows a clay increase at a depth of 20 to 30 inches (50 to 70 cm) and hence the soils can be further classified as Podzolic Gleys. Moisture holding capacity is good but root development is largely restricted to the surface horizons.

Profile description and analyses are given in Appendix 3.

*Soil suitability:* These soils have a somewhat limited use-range. Owing to their adverse physical properties they are generally unsuitable or only moderately suitable for tillage crops, especially in wet seasons. However, in favourable weather conditions, they can produce a wide range of arable crops. The soils are best suited to grass production. With liberal use of lime and fertiliser very high output from grassland can be attained. Controlled grazing is necessary to prevent serious poaching damage and to attain maximum utilisation; stocking must be restricted when ground conditions are soft and surplus growth should be conserved for indoor feeding over the relatively long "winter" period.

### *Kilpatrick Series*

*Soil character:* This imperfectly drained podzolic Gley occupies an area of 9,320 acres (3,772 hectares or 2.23%). It occurs on undulating to flattish topography at a more lowlying position in the landscape than its well drained counterpart the Fontstown Series, and at slightly more elevated position than the poorly drained Mylertown Series (Fig. 6).

The soil profile consists of a dark greyish brown surface horizon, with moderately good structure and consistence and is approximately 7 to 12 inches (17.5 to 30 cm) deep. This horizon overlies a thin, bleached and mottled A2 horizon which in turn overlies a thin, undulating strongly mottled textural B horizon. The soil was formerly imperfectly drained as a direct result of a high water-table during the winter period. Artificial drainage has improved the internal drainage properties to such an extent that the soils are now free-draining but they still retain the characteristics associated with impeded drainage, namely, gleying and mottling.

The artificial drainage was commenced centuries ago but it received a great impetus in the nineteenth century by the encouragement and financial assistance given by the Duke of Leinster, while large areas have been improved within the last 20 years under the Land Project Schemes. There are still fairly considerable areas which require artificial drainage.

Profile description and analyses are given in Appendix 3.

\*This series occurs more extensively in Counties Meath and Dublin.

*Soil suitability:* These improved soils have a fairly wide use-range. As a result of improvement in drainage properties they have the same wide use-range as the well drained Fontstown Series. However, some salient differences still exist between the two soils. In favourable seasons the Kilpatrick Series has no disadvantages when compared with the Fontstown soils, but in unfavourable seasons it is much more difficult to produce a desirable tilth so that spring sowing is often delayed and as a direct consequence harvesting is also delayed. This increases the risk of obtaining both reduced yields and poorer quality. Similarly, there is also a greater risk of poaching damage by grazing stock in wet periods so that a greater proportion of the grass produced should be conserved for winter feeding off the land.

#### *My lets town Series*

*Soil character:* This series occupies an area of approximately 12,500 acres (2.99% of the county) and occurs mainly in the central part of the county as part of the catenary sequence (Fig 6) which includes the Allen, Kilpatrick and Fontstown Series. The topography is flattish to undulating with the Mylerstown Series occupying an intermediate position between the edge of the bog and the more elevated better drained soils. Like the Kilpatrick and Fontstown Series these soils are derived from stony calcareous glacial till composed almost exclusively of limestone.

The soil profile consists of a very dark greyish brown, loamy surface horizon with a moderately strong to weak structure and friable consistence. This horizon overlies a mottled grey A2 horizon which in turn overlies the mottled yellowish-brown and grey textural B horizon. The soils are usually calcareous within 6 inches (15 cm) of the surface; in many cases the surface horizon is calcareous. The soil was formerly poorly drained as a direct result of the prevailing high water-table during the winter period. However, the vast majority of these soils have been improved by deepening the artificial drainage system and installing field drains, thus lowering the water-table to such an extent that the soils are now free-draining. Like the Kilpatrick Series they still retain their grey and mottled colours which are ample testimony of their former poor internal drainage properties. In some places where the arterial drainage has been neglected these soils have reverted to their original poorly drained state. There are also considerable areas which still require artificial drainage.

Small areas of the poorly drained component (Peaty Gley) of the Allenwood Complex occur within this series but could not be separated at scale of mapping employed.

*Soil suitability:* These soils have a moderately wide use-range. Like the Kilpatrick Series they can produce the same wide range of crops as the Fontstown Series but the "risk hazard" is still greater. Although most of the soils are now free-draining, it is difficult to produce a good tilth in unfavourable seasons. Consequently, both sowing date and harvesting are often delayed thus increasing the risk of obtaining poor quality, low yielding crops. This is especially true for cereal production. The soils are best suited to grass production but here again some salient differences exist even after maximum improvement has been carried out; the grazing season must be curtailed in order to reduce the risk of poaching damage particularly in spring and late autumn. For these reasons, although they can grow a wide range of crops these soils have a more limited use-potential than the Yontstown or even the Kilpatrick Series. The portions of this series which have not been artificially drained have a limited use range at present.

#### *Newtown Series\**

*Soil character:* The soils of this series are found on concave slopes, flattish topography and local depressions associated in the landscape with the well-drained soils of the Kellistown Series. They are derived from calcareous till composed mainly of limestone with granite, sandstone and shale and occupy 0.52% of the county (2,160 acres or 874 hectares).

The soils are poorly drained, of organic sandy loam texture, and high base status. The poor drainage is due to the presence of a high water-table, and in most areas springs and water seepage are contributing factors. The profile consists of dark greyish-brown surface A horizon overlying horizons which are grey and mottled. Root development is largely confined to the surface horizon.

Profile description and analyses are given in Appendix I of *Soils of County Carlow* (Conry and Ryan, 1967).

*Soil suitability:* In the unimproved state these soils have a limited use-range. Due to poor drainage and other adverse physical conditions, they are generally unsuitable for tillage. Their optimum agricultural use is grassland production.

Very little permanent improvement can be obtained without artificial drainage and reclamation. This is difficult in many places without first improving the arterial drainage. About 25 % of these soils have been drained and reclaimed in the last 15 years. Drainage is most successful when the drains are at least 36 inches deep. Large granite boulders, at or near the surface render reclamation more difficult.

With liberal use of fertilisers, particularly phosphorus and potassium, and with lime as required, the improved soils can grow cereals and root crops. The yields, however, can be disappointing especially in unfavourable seasons. With manuring and a high standard of management, grassland gives good returns. For full utilisation of the grass, grazing must be properly controlled to prevent poaching damage, rush (*Juncus*) infestation, and general deterioration of the sward.

#### *Sawyerswood Series*

*Soil character:* The soils of this series occur on flattish topography between 200 and 240 feet approximately. They occupy 0.35 % (1,460 acres or 591 hectares) of the county. Parent material consists of dense, calcareous till composed mainly of limestone.

These are poorly drained soils, of clay loam texture, and of high base status. The poor drainage is due largely to their lowlying position in the landscape together with the heavy dense nature of the parent material with its attendant poor structure and permeability giving rise to low moisture penetration.

The profile consists of a greyish brown, mottled surface horizon over horizons which are also grey and mottled. The surface horizons contain over 30% of both silt and clay. The soil profile varies in depth from 19 inches to 44 inches (48-112 cm).

Structure is poor throughout the profile and roots are largely confined to the surface 10 inches. In the unimproved state the vegetation contains a high proportion of rush (*Juncus*).

Profile description and analyses are given in Appendix 3.

*Soil suitability:* These soils have a rather limited use-range. Due to their poor physical properties, they are generally unsuitable for tillage. Nevertheless, with

•First mapped in County Carlow.

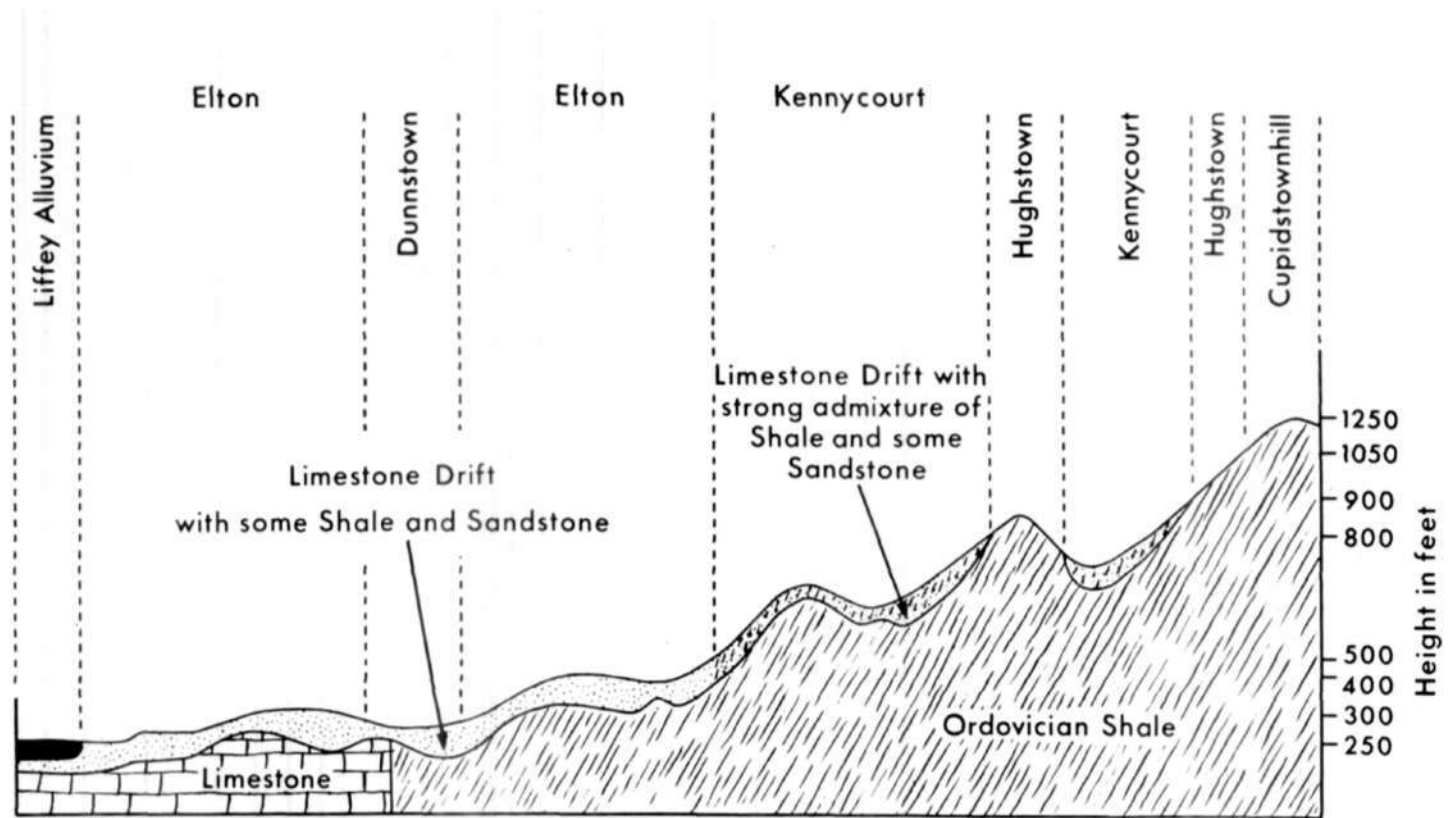


Fig. 7 – Diagrammatic representation of soil series in relation to landscape features and geology

artificial drainage and the application of fertilisers they can be used for arable cropping, but success or failure depends largely on weather conditions. Harvesting operations are often particularly difficult. Wheat and barley can give good returns in favourable seasons but yields of root crops are often disappointing.

These soils are more suitable for grass production. With adequate manuring and artificial drainage higher levels of production can be attained. The grazing season is curtailed and controlled grazing is necessary to prevent poaching and to attain maximum production; stocking must be restricted when ground conditions are soft and surplus growth should be conserved for winter feeding off the land.

### Alluvial Soils

These soils are derived from alluvial deposits, which can be divided broadly into two major types, fresh-water and marine. The latter do not occur within the survey area. The only fresh-water type mapped in County Kildare is river alluvium. The material laid down by rivers is usually found in the vicinity of existing stream and river courses. The river alluviums are related in composition to the geological formations in their vicinity.

Most alluvial soils are very immature and, therefore, show little or no profile development; as such they are classified as Regosols. They are usually differentiated on the basis of such factors as, origin and composition of parent material, texture, drainage and base status.

#### *Liffey Series*

*Soil character:* This series occurs along the basin of the River Liffey (Fig. 7). Topography is always flat, but elevation ranges from 400 feet at Pollaphuca on the Wicklow border to under 100 feet where the river enters Co. Dublin at Leixlip. The soils are derived from non-calcareous river alluvium of mixed granite, shale and limestone origin. They occupy 2.16% of the county (9,060 acres or 3,666 hectares).

The soils of this series are deep, well drained and of loam texture. The profile has a relatively uniform dark brown colour down to a depth of 48 inches. Small areas of more poorly drained alluvial soils occur within this series but separation was not possible at the scale of mapping employed.

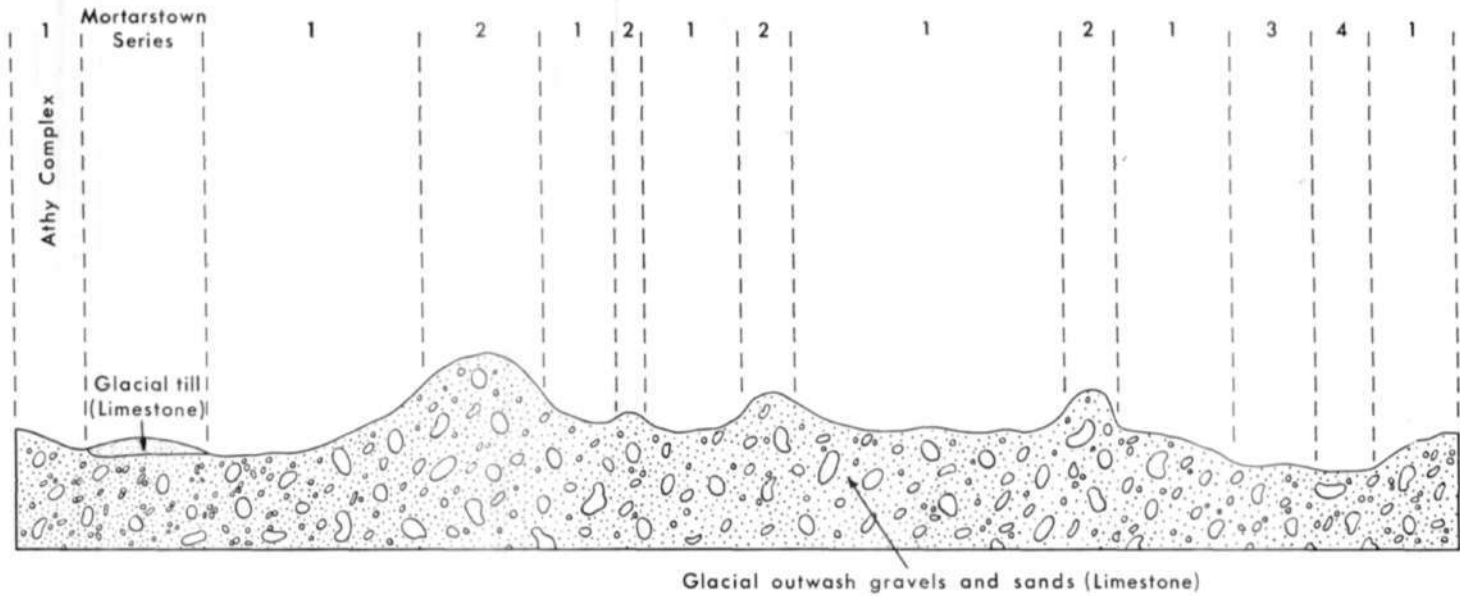
Profile description and analyses are given in Appendix 3.

*Soil suitability:* These soils exhibit many of the desirable physical characteristics, which constitute high quality soils. These inherently fertile alluvial soils respond well to lime and fertiliser applications. Thus, they could be devoted successfully to pasture, or a wide range of corn, root and vegetable crops. Good yields of wheat and barley have been obtained from this soil. However, at present, about 90% of the series is under permanent pasture.

### Complexes

#### *Allenwood Complex*

*Soil character:* These soils are associated with the margins of the Allen and Banagher Series (Fig. 6). The soils which comprise this complex are Gleys (Mylerstown Series), Peaty Gleys and shallow organic soils (< 100 cm) although deeper phases of the organic component may also be found.



- |              |   |                              |  |
|--------------|---|------------------------------|--|
| Athy Complex | { | 1. Moderately deep component | 3. Imperfectly drained component                   |
|              |   | 2. Shallow component         | 4. Poorly drained component and Mortarstown Series |

Fig 8 – Diagrammatic representation of soils of Athy Complex in relation to landscape features

The complex occupies 3,820 acres or 1,546 hectares (0.91 % of the county). The Mylerstown Series has been described previously. The Peaty Gley also occurs as an inclusion with the Mylerstown Series. It consists of a peaty surface horizon less than 12 inches (30 cm) deep, overlying a strong mottled B horizon which rests on the strongly gleyed calcareous parent material.

The organic component of this complex varies in depth from 30 to 100 cm approximately. The shallower organic layers are black to dark greyish brown in colour with weak to moderate structure and are well decomposed down to the underlying gleyed mineral substratum. The deeper organic layers have a surface horizon which is black in colour and well decomposed with weak to moderate structure with a sub-surface horizon which shows black to dark reddish brown coloration with some recognisable plant remains in a well humified matrix. Owing to the fluctuating water table within the shallower organic layers the presence of sulphides is not always detectable.

*Land use:* The present land use is usually poor permanent pasture but where artificial drainage has been carried out and maintained, improved arable cropping and substantial increases in grass production and meadowing are obtained. In some areas forest trees have been planted with some success depending on species planted. The most serious limitation is the drainage regime which could be improved by the provision of major outfalls. Even without artificial drainage good management and adequate fertiliser use could result in a substantial increase in summer grass production.

#### *Athy Complex\**

*Soil character:* The soils of this complex occupy 6.57% (27,520 acres or 11,137 hectares) of the county. They are scattered throughout the county, but occur predominantly in the southern part.

The parent material of these soils consists of calcareous, fluvio-glacial coarse gravels and sands of Weichsel Age composed mainly of limestone with a small proportion of sandstone, schist, shale and even conglomerate. Elevation varies from over 150 (46 m) to over 900 feet (275 m) near the Wicklow border. The topography is flattish to undulating, but many areas are hummocky with sharp slope changes ranging from 0°-12° and occasionally up to 20°. These sharp changes in landscape features are mainly responsible for the variability of soils and the intricate pattern of distribution within the complex (Fig. 8). Because of the latter it was not feasible to segregate the different soil components on the scale of mapping employed. Consequently, the soils have been mapped as the Athy Complex.

Four major soils have been recognised within the complex:

- 1) *Moderately deep component:* On the flattish to undulating topography and on the lower slopes of the hummocky hills and eskers, moderately deep soils have been developed. These are naturally well-drained, friable gravelly sandy loams of high base status; they have been classified as Grey Brown Podzolics. This soil accounts for approximately 60 % of the total area of the complex.

The profile is characterised by a dark greyish-brown to dark-brown surface horizon which varies in depth from 10 to 15 inches (25 to 38 cm) and overlies

\*First mapped in County Carlow. Profile descriptions and analyses are given in Appendix 1 of *Soils of Co. Carlow* (Conry and Ryan, 1967).



Plate 5 - *Mechanised harvesting on the light-textured Athy Complex, South Kil.larc*

a brown to yellowish-brown, leached A2 horizon. This in turn overlies an undulating, dark greyish-brown B horizon of distinct clay accumulation; clay skins are prominent on the ped surfaces. The surface horizon contains 12 to 18 % clay and 6 to 12 % organic matter; the B2t horizon has 20 to 30 % clay. Diagnostic features of this soil are the high content of gravels throughout the profile, the distinct tonguing A2 horizon, the well-developed textural B horizon, the high pH and high base status throughout the profile. Structure is moderately well developed. Roots are plentiful in the surface horizon and penetrate freely to the upper portion of the calcareous gravels. Moisture-holding capacity is moderately good, but in prolonged dry periods a moisture deficit develops.

- 2) *Shallow component*: On the crests of the hummocks and higher portions of the eskers, the soils are very shallow, excessively drained, of stony or gravelly coarse sandy loam texture and of high base status. These have been classified as Brown Earths. They occupy about 30% of the complex.

The profile is characterised by a dark-coloured A horizon which passes directly into the coarse-textured, calcareous parent material. The A horizon varies in depth from 7 to 14 inches (18-35 cm), has a friable consistence and a well

developed crumb structure with abundant roots. Deep ploughing brings the gravel subsoil to the surface in many cases. Moisture-holding capacity is poor and a deficit develops in most years.

- 3) *Imperfectly drained component*: On flatfish, lowlying areas the soils are imperfectly drained, of sandy loam texture and of high base status; they have been classified as Brown Earths with gleying. Due to their lowlying position, a high water-table affects the lower portions of the profile for the greater part of the winter period causing gleying in this zone. The dark-greyish brown, friable, calcareous A horizon varies in depth from 10 to 16 inches and contains approximately 15% clay and 8 to 10% organic matter. Although root development is largely confined to this horizon, these soils are not subject to drought due to the proximity of the water-table even in dry periods. This component comprises about 5 % of the complex.
- 4) *Poorly drained component*: On the lowest portions of the topography where the water-table is permanently high, the soils are poorly drained, of sandy loam texture and of high base status; they have been classified as Gleys.

The profile is characterised by a very dark-brown, calcareous surface horizon over an intensely gleyed calcareous parent material. Root development is confined to the surface horizon.

*Soil suitability*: With the exception of the poorly drained component (Gleys) which comprises approximately 5% of the total area of the complex and is only suitable for summer grazing and meadowing, the Athy soils generally have a wide use-range. They are suited to the production of a range of farm, fruit and vegetable crops. Due to their coarse texture and very friable consistency, they are easily tilled. Together with the Fontstown Series they are largely responsible for South Kildare's reputation as a tillage area.

Liming is necessary to a limited extent only on the moderately deep well-drained soils of the complex. Good responses to fertiliser application are obtained. Potassium "fixation" is high in the Athy soils and applications of this element must be regular and generous for optimum crop growth. Farmyard manure, apart from being a nutrient source, also enhances the moisture-holding capacity of these light-textured soils.

The shallow component of the complex is subject to drought almost every year, while the deeper well-drained component is prone to a moisture deficit only in very dry periods. Due to the intricate pattern of soil distribution, even within the same field, certain crops mature unevenly; peas, French beans and cereals mature 2 to 3 weeks earlier on the shallow excessively drained soils of the complex.

With the exception of the poorly drained component, these Athy soils are suitable for cereal crops and are particularly noted for the production of high-quality malting barley. Potatoes, swedes, mangels and sugar beet give excellent yields; sugar content of the beet is usually well above the average. These light textured and friable soils are especially suitable for growing carrots, onions, French beans, peas, white turnips, spinach and asparagus; cabbage gives less satisfactory returns. However, the gritty nature of the soils causes some damage to soft peas during harvesting operations. Molybdenum deficiency symptoms (whiptail) in brassica crops, particularly cauliflowers, have been recorded locally. High levels of selenium have been found in leeks and in certain other vegetable crops grown on the imperfectly drained soils of the complex.

There is not much permanent pasture on the Athy soils. Short-term leys when adequately fertilised, are highly productive and the sward can be utilised fully. The only serious limitation to output is a moisture deficit in dry seasons.

#### *Finnery Complex*

*Soil character:* This complex occupies 10,460 acres (2.50%) of the county. The soils within the complex occur in the flood plains of the Barrow River and its tributaries (Finnery, Cushaling, Black, Figile, Slate and Greese Rivers). The soil type which occurs in any one location is dependent on the river action within the post-glacial period. They consist principally of poorly to very poorly drained organic and mineral materials either as separate entities or in a random inter-layered manner.

The organic component has a variable thickness of peat (12 to over 36 inches) formed under relatively base-rich conditions, and can be underlain by shell marl (chara marl matrix permeated with shell residues) up to 24 inches in thickness with a further layer of calcareous silty clay beneath the marl.

Recent alluvium of variable texture and depth has been deposited over glacial drift, or even over peat formations. In association with shallow alluvial deposits over peat a layer of ferro-manganiferous concretionary material can also be found—this is evidence of a fluctuating water-table close to the surface.

In the eastern environs of the Black River (near Monasterevin) a deposit of stiff calcareous silty clay (up to 3 metres in thickness) has given rise to a poorly drained soil of clay loam to silty clay loam surface texture with weak structure. The sub-surface horizon is calcareous, heavy textured, uniformly grey in colour with massive structure. This material is probably of late glacial origin.

In all these soils which are subject to intermittent, regular or even prolonged water-logging root development is confined to the surface horizons. Sulphides are present at lower depths within organic profiles.

*Land use:* The present land use is restricted mainly to rough summer grazing and meadowing. The vegetation cover is mainly sedges, rushes and poor pasture species with meadow sweet. The major limitation is the high water-table in winter and spring, but with provision of major outfalls in many places, contingent on pumping, such soils would be eminently suitable for grassland production. Forestry potential seems good in these areas of peat soils but would be dubious on shallow peats over shell marl. Improvement in arterial drainage would also render the deeper organic soils more suitable for arable cropping.

#### *St raffan Complex*

*Soil character:* The soils of this complex occupy 13.42% (56,211 acres or 22,749 hectares) of the county. They occur in the north-east of the county stretching from Naas to Kilcock. All the components of the complex are derived from compact, but non-tenaceous, calcareous glacial till composed of limestone with some shale and sandstone. Topography is flattish to undulating and the elevation ranges from 200 to 300 feet O.D. (60-91 metres). These differences in landscape features give rise to differences in drainage properties of the soils with the better drained soils occupying the higher portions of the landscape and the very poorly drained soils occurring in concave depressional areas. The soils with intermediate drainage properties occupy intermediate positions in the landscape (Fig. 9). Because the different landscape features merged gradually into one another it was not feasible to segregate the different

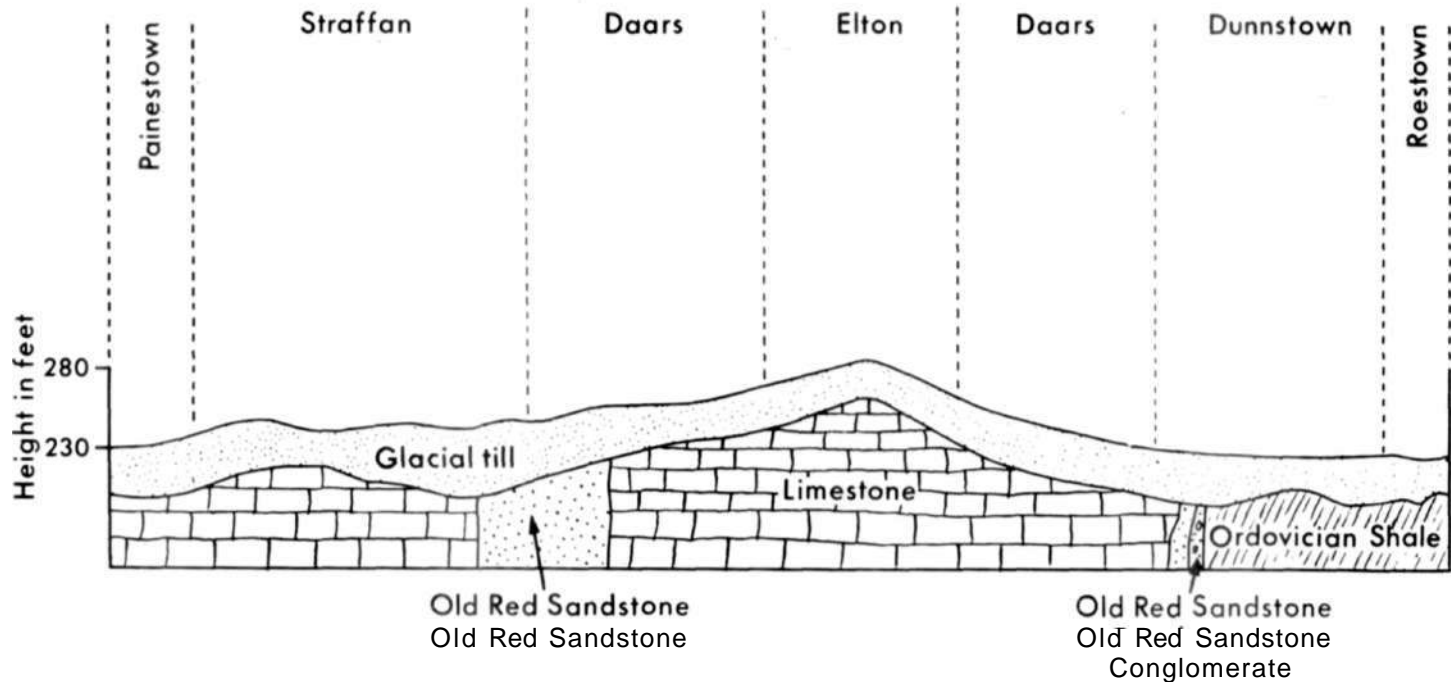


Fig. 9 - Diagrammatic representation of the soils of the Straffan Complex in relation to landscape features and geology

soil components on the scale of mapping employed. Consequently, the soils have been mapped as the Straffan Complex.

Six major soils have been recognised within the complex:

- 1) *Elton Series*: These soils, which have been described previously, occur on the higher portions of the landscape. They occupy less than 10% of the complex.
- 2) *Daars Series*: This series also occupies less than 10% of the complex. The soil consists of a deep, free-draining Podzolic Gley. The soil was formerly imperfectly drained but a combination of closed field and open drains have improved the drainage to such an extent that the soil is now free-draining but it still retains its original mottled appearance.

The profile consists of a greyish-brown, clay loam surface horizon with moderately good structure and friable consistence overlying a strongly mottled B horizon which in turn rests on the mottled and gleyed parent material.

- 3) *Dunnstown Series*: These soils, which have been previously described, occur on the more lowlying positions in the landscape. This series occupies less than 5 % of the Complex.
- 4) *Straffan Series*: This series is the improved counterpart of the Dunnstown Series. The soil profile has all the characteristics of a poorly drained gley soil. But as a result of large scale artificial drainage these soils have been improved enormously and behave as free-draining soils. The artificial system involved, firstly, the deepening of rivers and streams, then deepening the open drains and installing closed field drains. These closed field drains usually consist of stone or tile drains placed at a depth of 36 to 42 inches. A large part of this work can be attributed to the encouragement given by the Duke of Leinster in the 19th century. Reclamation work has continued down to the present time.

The profile is characterised by the greyish-brown, slightly mottled clay loam to loamy Al horizon overlying strongly gleyed A2 and B horizons which vary in depth from 24 to 36 inches (61-90 cm). The surface horizon contains 24 to 30% clay, 40 to 45% silt and 2.3 to 4.7% organic carbon. The lime content of many of those soils is generally satisfactory and some areas are calcareous to the surface. This series occupies over 65 % of the complex.

- 5) *Roestown Series*: This series consists of a very poorly drained, Peaty Gley and is found, associated with the Dunnstown Series, in concave depressional areas. The profile consists of a peaty surface horizon which overlies strongly gleyed sub-soil horizons. The very poorly drained condition and peaty development are due to the almost continuously waterlogged nature of the soil. This series occupies less than 5 % of the complex.
- 6) *Painestown Series*: This series is the reclaimed counterpart of the Roestown Series. The soil profile consists of a very dark grey, peaty loamy surface horizon less than 10 inches deep overlying intensely gleyed compact sub-soil horizons. As a result of deepening the water courses and installing closed field drains the internal drainage properties have been improved to such an extent that the soils can produce excellent tillage crops in favourable seasons. This series occupies less than 5 % of the complex.

Profile descriptions and analyses are given in Appendix 3.

*Soil suitability*: The soil suitability of the Elton Series has been described previously.

The Daars Series has the same use-range as Elton and can grow the same wide range of crops. However, they have some limitations when compared with the Elton Series; they are more liable to poaching particularly in early spring and late autumn and it is also more difficult to provide a good tilth in wet seasons.

The soil suitability of the Dunnstown Series has also been described previously.

The Straffan Series has a wide use-range. Although these soils are heavy textured they are relatively easily tilled in favourable seasons. With an adequate supply of nutrients these soils can grow a wide range of corn and root crops. However, cereal crops, particularly wheat, ripen somewhat later; this is due probably to their more northerly situation. With proper management and attention to lime and fertiliser treatments they have a high potential for grass production. If unduly overstocked in wet periods or grazed throughout the winter severe poaching damage can occur. Early grass production is difficult to obtain partly because of its more northern situation and partly because of excess moisture regime in early spring. A high proportion of stud farms are situated on this series. The present land use range and surface vegetation of these improved soils is strikingly similar to that of their well-drained counterpart, the Elton Series. This series is a good example of the enormous improvement that can be obtained as a result of artificial drainage.

The Roestown Series, in its present state has a very limited use-range and is only suitable for rough summer grazing.

The Painestown Series, like the Straffan Series, has a fairly wide use-range for farm crops. Again, like the Straffan Series it has some serious limitations. Owing to the difficulty of producing a desirable tilth in unfavourable springs the sowing date is often unduly delayed. Consequently, harvesting is also delayed so that the risk of obtaining poor quality low yielding crops, especially cereals, is increased enormously. Similarly, under grass production the risk of causing poaching damage by grazing stock in early spring and late Autumn, is much greater than on the Elton Series.

In general it can be stated that the Straffan Complex has a wide use-range. The soils can support a wide range of arable crops but in unfavourable seasons the difficulty of producing a good tilth in spring and consequently late harvests can increase the risk of obtaining uneconomic returns. The soils as a whole are probably best suited to grass production. With adequate fertiliser use high outputs can be obtained but good management techniques are necessary to prevent undue poaching and to obtain maximum utilisation.

## Peats

### *Allen Series*

These soils in their undisturbed state are natural organic formations characteristic of the Central Plain of Ireland which have formed in depressed topography, on calcareous glacial drift. Although formed in basin areas their mode of formation has resulted in a characteristic "raised" appearance, hence the term "raised bog". In County Kildare they are at their easterly limit in the Midland Plain. The depth of organic material within these formations can vary from 9 to 24 feet (3-8 metres) and comprises a layer of acid peat over a peat formed under base rich conditions. The vegetation on the surface of the bog consists of *Sphagnum* species and depending on the drainage regime, *Calluna vulgaris* (heather), *Erica tetralix* (cross-leaved heath), *Narthecium ossifragum* (bog asphodel), *Trichophorum caespitosum* (deer grass), *Eriophorum*

suitability for forestry production, grassland production and horticulture which includes vegetable crops and nursery stocks. In the overall evaluation of these areas the amenity aspect warrants special consideration. However, the selection of the particular land use enterprise which should be followed will depend largely on soil type and future economic and social circumstances.

#### *Banagher Series*

*Soil character:* These organic soils occur in flat expanses of variable extent and show the effects of previous cultivation. They occupy 11,680 acres (4,727 hectares) or 2.79 % of the county. In many instances the vegetation has reverted to a very poor condition (rushes and sedges) although field outlines are still discernible, either by the presence of fence lines or "filled-in" drains.

The soil profile shows a black, well decomposed surface horizon of variable thickness (10-50 cm) with a relatively good structure where artificial drainage has been maintained. The presence of stones within this horizon indicates the addition of mineral matter which improved its fertility, raised the pH and reduced poaching damage. The sub-surface horizon is dark reddish-brown in colour with recognisable wood and herbaceous plant remains in a humified matrix. The presence of sulphides in the lower horizons indicates a permanent water table. These soils are usually deep (> 100 cm or 40 inches) and in many cases they are substantially deeper (> 150 cm or 60 inches). The underlying mineral substratum varies from shell marl to glacial drift materials.

*Soil suitability:* The present land-use consists mainly of rough summer grazing and very small areas used by householders for arable cropping. Although at the present time the high water-table in winter and spring is a serious limitation, improved management and the application of fertilisers would increase production substantially. Very little permanent improvement can be attained, however, without improving the arterial drainage system and providing adequate open and closed field drains.

#### *Pollardstown Series*

A small area, 440 acres (178 hectares) of fen peat (swamp) exists in a modified condition in the vicinity of Newbridge.

TABLE 2—Classification of main series in Co. Kildare into Great Soil Groups and the relative extent of each group

Great Soil Group	Series	Area		% of total area	
		Acres	Hectares		
Grey Brown Podzolics (46.38%)	Donaghcumper	1,460	591	0.35	
	Elton	85,493	34,599	20.42	
	Fontstown	70,731	28,624	16.89	
	Grange	1,380	558	0.33	
	Kellistown	6,640	2,687	1.59	
	Kennycourt	16,050	6,495	3.83	
	Mortarstown	12,400	5,018	2.79	
<b>Brown Earths</b>	<b>Hughstown</b>	<b>5,480</b>	<b>2,218</b>	<b>1.30</b>	
<b>Podzols</b>	<b>Cupidstownhill</b>	<b>1,080</b>	<b>437</b>	<b>0.26</b>	
Gleys (11.71%)	Surface-water				
		Garristown	920	372	0.22
	Ground-water	Dunnstown	22,600	9,146	5.40
		Kilpatrick	9,320	3,772	2.23
		Mylerstown	12,500	5,059	2.99
		Newtown	2,160	874	0.52
Sawyerswood	1,460	591	0.35		
Regosols (Alluvium)	Liffey	9,060	3,666	2.16	

TABLE 3—Relative extent of various peats in Co. Kildare

Basin peat (14.79%)	Series or complex			% of total area
		Acres	Hectares	
<b>Raised bog (partly cutover)</b>	<b>Allen Series</b>	<b>29,460</b>	<b>11,922</b>	<b>7.04</b>
<b>Cutover raised bog</b>	<b>Boora Complex</b>	<b>3,260</b>	<b>1,319</b>	<b>0.77</b>
	<b>Clonsast Complex</b>	<b>17,060</b>	<b>6,904</b>	<b>4.08</b>
<b>Fen peat</b>	<b>Pollardstown Series</b>	<b>440</b>	<b>178</b>	<b>0.11</b>
<b>Reclaimed peat</b>	<b>Banagher Series</b>	<b>11,680</b>	<b>4,727</b>	<b>2.79</b>

TABLE 4—Extent of Complexes in Co. Kildare and classification of components into Great Soil Groups

Complex	Component Soils	Great Soil Group	Acres	Hectares	% of total area
Allenwood	Mylerstown Series Very poorly drained component Organic component	Gley Peaty Gley Peat	3,820	1,546	0.91
Athy	Moderately deep component Shallow component Imperfectly drained component Poorly drained component	Grey-Brown Podzolic Brown Earth Brown Earth with Gleying Gley	27,520	11,137	6.57
Finnery	Alluvium component Organic component	Regosoi Peat	10,460	4,233	2.50
Straffan	Elton Series Daars Series Dunnstown Series Straffan Series Roestown Series Painestown Series	Grey-Brown Podzolic Grey-Brown Podzolic Gley Gley (Peaty) Gley (Peaty) Gley	56,211	22,749	13.42

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## CHAPTER III

### SUMMARY OF PROFILE CHARACTERISTICS AND SOIL SUITABILITY\*

#### Soil Characteristics

The important soil profile characteristics are summarised in Tables 5 and 6. More detailed information on each soil is given in the previous chapter.

#### Soil Suitability

Soil suitability classification is essentially a grouping of soils according to the use or uses to which they are most adaptable and is based principally on the significance of the more permanent characteristics of the soils. A further step in the suitability classification consists of an assessment of the production potential of each soil for the normal range of farm and forest crops under defined management standards. This provides the essential link between the physical and economic aspects of the use of soils. However, for this purpose reliable quantitative data on the productive capacity of each soil are required: these can only be provided by detailed field experimentation and yield observations over a number of years on sample areas representative of the particular soil. Sufficient information of this nature for County Kildare is not so far available. Therefore, the present system of soil suitability evaluation and classification is largely a qualitative rather than a quantitative appraisal of the potentialities of the different soils in the county.

Although the physical, chemical and biological properties of the soil merit foremost consideration in assessing soil suitability, environmental factors such as elevation, aspect, local climate, distance from the sea and factors such as accessibility, proximity to markets and consumer demands must also be taken into account. In general statements concerning soil suitability one must bear in mind, therefore, that environmental and other factors can influence considerably the economics of production and hence can modify the use-range to which the soils are otherwise ideally suited.

Furthermore, the concept of land quality has changed radically in recent years. With modern fertiliser technology, natural nutrient fertility problems in soils have become subordinate to physical ones such as defective natural drainage, "heavy" texture and poor structure, which are more difficult and more costly to rectify. Besides, an abundant farm labour supply no longer obtains, and its replacement by mechanisation has drastically altered the feasible cultural and management practices on many soils.

\*This chapter can be considered a summary of soil characteristics and suitability discussed at length in Chapter II.

TABLE 5—Summary of characteristics of Soil Series in Co. Kildare

Series	Great Soil Group	Surface texture	Depth of soil profile	Drainage	Parent material
Allen	Peat	Peat	Variable (generally > 8 feet)	—	—
Banagher	Peat	Peat	Deep (>33')	—	—
Cupidstownhill	Podzol	Peaty loam	Moderately deep (15-18')	Impeded	Ordovician shale
Donaghcumper	Grey Brown Podzolic	Loam to clay loam	Moderately deep (15-22')	Moderately well to well drained	Limestone bedrock
Dunnstown	Gley	Loam	Moderately deep to deep (24-38')	Poor	Calcareous limestone till
Elton	Minimal Grey Brown Podzolic	Loam	Deep (25-48')	Well drained	Calcareous limestone till
Fontstown	Grey Brown Podzolic	Sandy loam to loam	Variable (7-24')	Well drained to excessively drained	Calcareous limestone till
Garristown	Gley	Clay loam	Deep (30-36')	Imperfect	Till composed of shale, sandstone and limestone
Grange	Grey Brown Podzolic	Clay loam	Deep (28-33*)	Well drained	Calcareous limestone till
Hughstown	Brown Earth	Loam	Moderately deep (15-18')	Well drained	Ordovician shale
Kellistown	Grey Brown Podzolic	Sandy loam	Deep (36-54')	Well drained	Calcareous limestone-granite till
Kennycourt	Minimal Grey Brown Podzolic	Loam	Deep (24-44*)	Well drained	Calcareous limestone-shale till
Kilpatrick	Gley	Loam	Moderately deep to deep (20-36')	"Free draining"*	Calcareous limestone till
Liffey	Regosol	Loam	Deep (36-58')	Free draining (subject to occasional flooding)	River alluvium
Mortarstown	Grey Brown Podzolic	Loam to clay loam	Deep (30-38')	Well drained	Calcareous limestone till

TABLE 5 (Contd)

Mylerstown	Gley	Loam	Moderately deep to deep (20-38*)	"Free draining"*	Calcareous limestone till
Newtown	Gley	Peaty sandy loam	Deep (30-40")	Poor	Calcareous limestone-granite till
Pollardstown	Peat	Mucky peat	>30 inches	Very poor	—
Sawyerswood	Gley	Clay loam	Moderately deep to deep (19-44")	Poor	Calcareous limestone till

•Artificially drained.

TABLE 6—Summary of characteristics of Soil Complexes in Co. Kildare

Complex	Component of complex	Great Soil Group	Surface texture	Depth of soil profile	Drainage	Parent material
Allenwood	Mylerstown Series	Gley	Loam	Moderately deep to deep	"Free draining"*	Calcareous limestone till
	Peaty Gley	Gley	Peaty loam	Moderately deep to deep (20-30")	Very poor	
	Peat	Peat	Peat	Shallow « 33 "	—	
Athy	Moderately deep	Grey Brown Podzolic Brown Earth	Sandy loam	Moderately deep (20-36")	Well drained	Calcareous fluvio-glacial gravels
	Shallow		Sandy loam	Shallow (9")	Excessively drained	
	Imperfectly drained	Brown Earth (with gleying)	Sandy loam	Moderately deep (15-26")	Imperfect	
Boora	Poorly drained	Gley	Peaty sandy loam	Moderately deep to deep (20-28")	Very poor to poor	—
	Peats of variable composition with variable sub-peat mineral "soils"	Peat	Peat	Variable	—	

TABLE 6 (Contd)

Clonsast	Peats of variable composition with variable sub-peat mineral "soils"	Peat	Peat	Variable	—	—
Finnery	Organic Alluvium	Peat Regosols	Peat Variable	Variable (12-36) Deep	Very poor Very poor (subject to regular flooding)	River alluvium
Straffan	Elton Series	Grey Brown Podzolic	Loam	Deep (25-48")	Well drained	
	Daars Series	Gley	Clay loam	Deep (24-30")	"Free draining"*	
	Dunnstown Series	Gley	Loam	Deep (24-38")	Poor	
	Straffan Series	Gley	Loam to clay loam	Deep (24-38")	"Free draining"*	Calcareous limestone till
	Roestown Series	Gley	Peaty loam	Deep (24-36")	Very poor	
	Painestown Series	Gley	Peaty loam	Deep (24-36")	"Imperfect"*	

•Artificially drained.

The general suitability, use range and major limitations of the soils of County Kildare are summarised in Table 7. Even with optimum manurial and management practices, certain differences in overall productive capacity persist between the soils included in each class as a result of inherent differences between series. Nevertheless, the soils in any one class have sufficient characteristics of importance in their use and productive potential in common to warrant their inclusion in the same suitability class. Furthermore, it should be borne in mind that certain series placed in one general suitability class may be borderline to a neighbouring class.

*Suitability Class A:* All the soils included in this class (Table 7) have a wide use-range and are generally suitable for tillage crops, pasture, meadow and forestry. With the exception of the Liffey Series all the soils in Class A are Grey Brown Podzolics. As a group they constitute some of the most inherently fertile soils in the country and are responsible for Kildare's reputation for good quality soils.

The soils of the Fontstown and Kellistown Series have a wide use-range being generally suitable for tillage crops, pasture, meadow and forestry but they are especially noted for tillage cropping; they are largely responsible for South Kildare's reputation as a tillage area. These "medium-light" textured friable soils with good structure easily produce a desirable tilth under normal cultural practices. With

TABLE 7—Soil suitability classification

Suitability class	Sub-class	Use-range	Type of limitation	Series (except where stated)	Percentage of total area
A					
Suitable for tillage, pasture, meadow and forestry  203,214 acres or 82,238 hectares (48.54%)	A 1	Wide	Local anomalies in soil molybdenum levels	Kellistown	1.59
	A 2		Moisture deficit in very dry periods; sporadic occurrence of manganese toxicity	Fontstown	16.89
	A 3		Pastures somewhat liable to poaching	Elton, Grange, Donaghcumper Mortarstown	21.10
	A 4		Pastures somewhat liable to poaching; cultivation and harvesting difficult in unfavourable seasons.		2.97
	A 5		Pastures somewhat liable to poaching; somewhat high elevations and some steep slopes	Kennycourt	3.83
	A 6		Pastures liable to poaching; small portions subject to flooding	Liffcy	2.16
B					
Suitable to moderately-suitable for tillage, pasture and meadow; suitable for forestry 105,551 acres or 42,717 hectares (25.21 %)	B 1	Moderately wide to wide	Moisture deficit in places in dry periods; crops mature unevenly: some steep slopes	Athy Complex	6.57
	B 2		Liable to poaching; difficult to produce good tilth in wet spring and consequent late sowing and late harvesting	Kilpatrick, Mylertown, Straffan Complex, Newtown (improved Phase)	18.64
C					
Moderately to poorly suitable for tillage; moderately suitable to suitable for pasture, meadow and forestry 6,400 acres or 2,590 hectares (1.52%)	C 1	Somewhat limited	Liable to severe poaching; adverse physical properties.	Garristown	0.22
	C 2		Somewhat high elevations and steep slopes; moisture deficit in very dry periods	Hughstown	1.30

TABLE 7 (Contd)

D					
Poorly suitable for tillage; moderately to poorly suitable for pasture and meadow; moderately suitable for forestry			Particularly low nutrient status; partial drainage impedence; somewhat high elevations	Cupidstownhill (Improved Phase)	—
40,500 acres or 16,390 hectares (9.68 %)	D1	Limited	Serious drainage problem; adverse physical conditions; liable to severe poaching	Newtown, Dunnstown, Sawyerswood	6.27
	D 2		High water-table in winter and spring	Allenwood Complex Finnery Complex	3.41
Unsuitable for cultivation, meadow or intensive grazing; moderately suitable for extensive grazing and forestry	E 1		Particularly low nutrient status; ironpan formation—impeded drainage and root development; somewhat high elevation	Cupidstownhill (unimproved)	0.26
1,080 acres or 437 hectares (0.26%)		Very limited			
Unclassified	U	—		Allen Series, Banagher Series Boora Complex Clonsast Complex Pollardstown	14.79
61,900 acres or 25,049 hectares (14.79%)					

regular attention to fertiliser requirements and liming they are capable of supporting high levels of production under a wide range of cereals, root crops and vegetable crops. The Fontstown Series is ideally suitable for producing barley, including malting barley, but is somewhat less suitable for wheat production. The Kellistown Series on the other hand, is more suitable for wheat production. In some areas liming may be a limiting factor. The potential for grass production and utilisation is high but in very dry seasons a moisture deficit may be a serious limiting factor on the Fontstown soils.

The soils of the Elton, Grange and Donaghcumper Series are moderately deep to deep, well drained soils, with "medium-heavy" textures and weak to moderately good structure. With proper management, including regular attention to lime and fertiliser requirements, they are capable of high levels of production. The Donaghcumper Series usually do not require the application of lime. Although they are generally amenable to cultivation, some difficulty in cultivation and harvesting is normally encountered in unfavourable seasons. The soils are considered unsuitable for malting barley and are better suited to wheat production although late harvesting may be a limiting factor, particularly in the northern part of the county. For grass production these soils have a particularly high potential. Their physical constitution permits a relatively long grazing season and satisfactory utilisation of the fodder, but if unduly overstocked in wet conditions or grazed throughout the winter, poaching damage can occur. A high proportion of stud farms are located on these series.

The soils of the Mortarstown Series are deep, well-drained, "medium-heavy" textured soils with a weak to moderately good structure. Again with proper management and attention to lime and fertiliser requirements, they are capable of high levels of production. Although they are generally amenable to cultivation a desirable tilth is difficult to produce in unfavourable seasons. Whereas the structure of these soils is in all cases well developed under pasture, it deteriorates under constant tillage. Great care should be given to rotation and to cultural and management practices that help to maintain structure. Some difficulty may be experienced also with harvesting, especially in wet seasons. Despite such difficulties these series have a high reputation for arable cropping. This is particularly true in the Churchtown area near Athy; although its textural B horizon is heavy enough for the manufacture of bricks, some farms are constantly under arable crops.

The Kennycourt Series is very similar to the Elton Series and likewise has a wide use range. However, due to the higher elevation spring sowing is usually later and harvesting is delayed. Although the soils are derived from calcareous limestone till they respond well to lime and fertiliser treatment. For grass production these soils have a high potential; their physical properties permit a long grazing season and satisfactory utilisation of the fodder but if overstocked in wet periods or grazed throughout the winter poaching damage can occur. Early spring grass is more difficult to obtain on account of the higher elevation.

The deep, well drained fertile, alluvial soils of the Liffey Series also have a wide use-range and are capable of growing a wide range of farm crops. They are also first class grassland soils. With proper management and attention to lime and fertiliser requirements they are capable of high levels of production. Winter grazing, however, usually causes severe poaching damage.

The soils of Class A are not devoted to any extent to forestry but should prove highly productive for this enterprise. On some soils such as the Fontstown Series, low moisture retention and/or high lime content could have a depressing effect on the growth of the high-yielding, non-native conifers such as Sitka spruce and Douglas Fir.



Plate 7 - *Thoroughbred breeding is a major enterprise on the medium-heavy textured lime. (Elton Series) in North-East Kildare*

Although the soils are some of the most inherently fertile soils in the county, a major limiting factor to production in the past has been their slow release of nutrients. Appropriate fertiliser and lime applications, based on soil analyses and experience of crop requirements on the various soils, easily overcome these problems. Generally, all the series, with the exception of the Donaghcumper Series require lime. Due to "fixation" special attention must be given to potassium requirement on all these limestone derived soils.

All the soils can support tillage cropping in a well managed, well-balanced rotation. But in unfavourable seasons some difficulty may be experienced in producing a desirable tilth on all the soils with the possible exception of the Fontstown Series. This latter series, however, is liable to severe drought in very dry periods. Pastures on most of these soils are capable of early spring growth and can be highly stocked over a prolonged grazing season. There is a much higher concentration of tillage on the Fontstown Series which covers the bulk of the southern half of the county when compared with the deeper, heavier textured soils (mainly Elton and Kennycourt Series) of the north and east of the county. However, all these soils offer a greater latitude in cropping practice and production than those with more adverse physical properties. Under changing economic and social circumstances they have the great advantage of being highly adaptable to alternative agricultural enterprises.

The soils of Class A occupy 203,214 acres (82,238 hectares) or 48.54 % of the county. This means that nearly half of the county consists of good, arable soils with a wide agricultural use potential and virtually devoid of any serious limitations.

### *Suitability Class B*

The soils in this Class (Table 7) have a slightly more limited use-range than those in Class A.

Although smaller proportions of the Athy Complex have major limiting factors the soils in general are of a fairly high quality. The soils of the very shallow component are liable to develop a moisture deficit almost every year and those of the poorly drained component are more suited mainly to grass production. Over 60% of the soils, however, are suitable for the production of a wide range of farm, fruit and vegetable crops. These "light" textured friable soils are readily cultivated; the soils are noted for tillage and particularly, for malting barley production. However, uneven ripening in cereal and vegetable crops related to a variable soil moisture regime, may be a major disadvantage locally. Due to "fixation" in the soil, potassium may be limiting and for best results in most crops, special attention must be given to potash in the fertiliser programme. The potential of these soils for grass production and utilisation throughout the growing season is also good. On the deeper components of the complex a moisture deficit only occurs in prolonged dry periods. This complex has been previously classified with Class A (Conry and Ryan 1967) but in Co. Kildare it is difficult to put them in Class A because of the high proportion of the shallow component (30%) with rather steep slopes on hummocky topography which renders mechanical cultivation almost impossible. This is particularly true of this complex in the eastern part of the county but in the Barrow Valley and southern part of the county where the topographic changes are less pronounced the complex could be classified as Class A soils. A further factor which must be taken into consideration is that large areas of these gravels, particularly in the north-east of the county are removed annually for road material and the building industry.

All the soils in Sub-Class B2 have been improved by artificial drainage much of which was initiated by the Duke of Leinster in the nineteenth century and continued down to the present time under the Land Project and Arterial Drainage Schemes.

Prior to that, these imperfectly drained to very poorly drained Gleys were generally unsuitable for tillage crops and were best suited to grass production. Deepening the river and stream systems and the installation of field drains improved the drainage properties of these soils to such an extent that they now behave almost as free-draining soils and are generally suitable for the production of a wide range of farm crops as well as being first class grassland soils. There is a striking similarity between the present land use-range and surface vegetation of these improved soils and their well drained counterparts. Much of the improvement has been so successful that they could possibly have been included in suitability Class A. However, without exception all these soils are more susceptible to poaching damage and more difficult to cultivate in unfavourable seasons, than their well-drained counterparts.

Without having quantitative data available on crop production it is very difficult to place these soils with certainty in this sub-class. It is quite possible that when this information becomes available some of these, such as the Mylerstown Series, may be downgraded while other soils such as the better drained portions of the Straffan Complex may be upgraded.

With the exception of the shallow component of the Athy Complex the soils in Class B are suitable for the production of a wide range of forest trees but like the soils in Class A they are not devoted to any extent to forestry.

The soils of Class B occupy 25.21 % (105,551 acres) of the county. Their general suitability for normal agricultural purposes is moderately good to good. Adding their extent to Class A shows that over 73 % of the county may be said to have a capacity

for high levels of production without the necessity for further artificial drainage or reclamation or the application of extraordinary cultural and management techniques.

#### *Suitability Class C*

The soils included in this class (Table 7) have a somewhat limited use-range.

The Garristown Series has defective natural drainage. These heavy, poorly structured, imperfectly drained Gleys are generally unsuitable for tillage crops because of difficulty in preparing a good tilth and harvesting, especially in adverse seasons. These soils have a high potential for grass production but again there are some limitations. The production of early spring grass is possible with judicious fertiliser use but there is a problem of utilising this "early bite" because of possible poaching damage. Late autumn grazing is not possible either for the same reason. Consequently a large amount of the grass produced must be conserved for winter feed.

The limitations of the Hughstown Series include steep slopes and high elevations. At lower elevations these soils have a moderately wide to wide use-range. They can support a wide range of farm crops, pasture and meadow provided lime and fertilisers are applied in sufficient quantities. However, on steep slopes mechanisation is almost impossible. A high level of management and fertiliser application is necessary to control bracken and furze in grassland. At high elevations (above 700 feet approximately) the range of tillage crops which can be grown successfully is rather limited because of the shorter growing season. Furthermore, without cultivation, proper rotation and particularly, the application of lime and fertilisers, pastures degenerate rapidly. Both soils in this class are suitable for forestry. The soils in this class cover only 1.52% (6,400 acres) of the county.

#### *Suitability Class D*

The soils included in this class (Table 7) have a limited use-range.

The reclaimed phase of the Cupidstownhill Series is limited by extremely low fertility levels, high elevation and some drainage impedece. Unless grassland is heavily limed and fertilised and properly managed the sward quickly degenerates to heather, furze and poverty tolerant grasses. Even with adequate attention to these factors production is limited by the shorter growing season which prevails at these higher elevations. Arable cropping is limited to less fertility demanding crops such as potatoes, cabbage, rape, kale and swedes.

The poorly drained condition of the Newtown, Dunnstown, Mylerstown and Sawyerswood Series is the result mainly of high water-table; springs and water seepage are sometimes contributing factors. In general, these soils are unsuitable for tillage cropping and are best suited to summer grass production. The improved nature of such soils as the Straffan Series is an indication of the improvement that could be obtained in similar soils by artificial drainage where a suitable outfall could be provided.

The land use-range of the Finnelly and Allenwood Complexes is presently limited mainly to rough summer grazing and madowing. However, by providing a suitable outfall and the installation of field drains all these soils could be improved substantially and could carry a wide range of arable crops as well as substantially increasing the output from grassland.

The soils in this class can satisfactorily produce a wide range of forest trees with the exception of hardwoods such as beech, oak and sycamore. High lime content can depress the growth of conifers in many areas.

The soils in this class occupy 9.68 % of the county.



Plate 8 – Cattle grazing on reclaimed milled peat bog (Boora Complex shallow phase) at Peatland Experimental Station, Lullymore

### *Suitability Class E*

The Cupidstovnhill Series is the only soil in this Class. It has a very limited use-range being suitable only for extensive grazing or forestry. Because of its very small area, 1,080 acres (437 hectares), it is of negligible importance.

### *Unclassified*

This group contains the vast areas of lowlying bog which occur mainly in the west-central portion of the county. Although they are unclassified in the present table of Soil Suitability (Table 7) it does not mean that they are unsuitable for any enterprise. In the past the peats have provided fuel for the small householders in the immediate vicinity of the bog while the reclaimed cutover areas on the edge of the "raised bogs" were suitable for producing a limited range of arable crops and pasturage. The industrial development of large tracts of the "raised bogs" in the 1940s has provided an invaluable source of income. At the present time there is every expectation that horticultural crops, grassland and forest trees can be economically grown on the areas previously used for industrial purposes.



**Plate 9 - Vegetable trials on milled peat (Boora Complex, deep phase) at Peatland Experimental Station, Lullymore, with celery in the foreground**

## CHAPTER 4

### FARMING IN COUNTY KILDARE\*

#### Historical

The present farming pattern in Co. Kildare has been shaped largely by developments in the county during several centuries. In the 14th century the Norman farmers who had settled in the Cloncurry area in north Kildare divided the area into large and small farms and sowed wheat and oats.<sup>1</sup> Other Norman settlers in the county kept large flocks of sheep and were primarily interested in producing wool.<sup>2</sup> By 1640 there were numerous corn and cloth mills throughout the county. There were still large tracts of woodland in areas that are now under pasture and crops. After the Cromwellian Wars in the 1650 period some surveyors complained that they could not get information on an area in north Kildare, because the inhabitants were either dead or transplanted into Connaught.<sup>3</sup> In 1712 a traveller in south Kildare reported that the area was still unenclosed and devoted largely to sheep grazing.<sup>4</sup> By the middle of the 18th century, the population had begun to increase and tillage was becoming popular. Maps made of the Duke of Leinster's Estate in Co. Kildare by Rocque in the 1750 period show the area divided into fields and most of the people living in cabins. Through drainage works in the 19th century much of the land that was once wet and unprofitable was reclaimed and good houses were built to replace the old cabins.

When Arthur Young<sup>5</sup> visited Kildare in 1776 he found the farmers growing crops of corn and potatoes and some were growing turnips. Both oxen and horses were used for tillage work. Lime, gravel and dung were applied to the crops. Cows and bullocks were fattened on many farms and the county still had a large number of sheep. Hedges were being planted and drains made. Farmers secured labour in return for leasing cabins and potato gardens to the workers. In the Naas area Young found that the average farm was 250 acres.

Rawson<sup>6</sup> in 1807 wrote that the Kildare farmers had a rotation of fallow, wheat and oats which they repeated until the land was exhausted. Both oxen and horses were still used for ploughing and gravel was the main manurial material used. The farm houses were generally long, low thatched buildings with barns and stable on one side and the cattle houses on the other. Farmers married at a relatively young age in those days; the men usually married before 25 and the women before 20 years of age.

\*This chapter was contributed by the advisory staff of County Kildare Committee of Agriculture.

<sup>1</sup> O'Loan, J.—*J. Dep. Agric. Repub. Ire.*, Dublin, Vol. LVIII, 14-36, 1961.

<sup>2</sup> Calendar—Justiciary Rolls of Ireland 1305-1307, 1914.

<sup>3</sup> Th: Civil Survey of Co. Kildare 1654-56, Dublin, 1952.

<sup>4</sup> *J. Co Kildare Archaeological Soc*, Vol. 5, No. 4, 1907.

<sup>5</sup> Young, A., 1810, *A Tour in Ireland, 1776, 1779*.

\* Rawson, J.—*Statistical Account of Co. Kildare*, 1807.

In the years prior to the mid-19th century famines, when the population of Ireland increased rapidly, Kildare landlords (such as the Duke of Leinster) did not favour the division of large holdings into smaller units. In the 1870 period, therefore, the farms were still large in areas where the land was of good quality. In poorer areas and along the edges of bogs, however, there was a large population living on small plots of land. The farmers, who were still largely engaged in tillage work, hired labourers from the poorer parts of the county and they also engaged casual labourers who came from the west of Ireland to work during the spring and autumn.

The Great Famine (1846-47) had little direct effect on the population of the good farming areas in Co. Kildare. However, the distressing economic conditions forced many smallholders to give up their farms and emigrate. In the south of the county much of this land was taken over by farmers from Britain who settled on enlarged holdings as tenants of the Duke of Leinster.<sup>7</sup>

In the period after 1850, there was a swing away from tillage in Kildare and a corresponding increase in the numbers of cattle and sheep. Farm labour was abundant and cheap. In 1860 an estate of 600 acres in north Kildare gave employment to about 24 men. A man earned 8/6d for a 6-day week. Little tillage was done on the estate but it carried about 100 cattle of all ages and a flock of about 100 breeding ewes. The number of stock carried was small by present day standards.

Tillage farming continued to decline in Co. Kildare until 1940, when war conditions made the growing of tillage crops necessary. In this period the first tractors appeared on Kildare farms. Mechanised farming was to expand very rapidly immediately after the war. In the past 20 years with improved cereal varieties, increased use of fertilisers and of weed and disease controls, with the development of more efficient farm machines and with favourable prices, tillage has become very popular in many parts of Kildare. Advances in the science and practice of agriculture helped in the progress made. Stocking rates have been increased considerably so that production from animals as well as from crops is now much higher than in former times. In the last 50 years significant changes have taken place in the farm structure of Co. Kildare. The Irish Land Commission has purchased many of the large farms that have always been a feature of the county and has divided them into smaller units. The owners of these new holdings have come mainly from the congested areas of the country.

The number of agricultural holdings (over 10 acres) in Co. Kildare in 1960 is shown in Table 8. Over half (approx. 52%) of all holdings in the county are under 50 acres and some 31 % are under 30 acres in size; 27 % are over 100 acres and roughly 10% are over 200 acres in size. There is still a large proportion of the land of the county under the bigger holdings.

TABLE 8—Number of agricultural holdings in Co. Kildare (1960)

Size of holding (acres)									Total no. of holdings over 10 acres
	10-15	15-30	30-50	50-100	100-150	150-200	200-300	Over 300	
No. of holdings	285	988	872	867	439	266	219	180	4,116

Agricultural Enumeration 1960, C.S.O. Dublin

<sup>7</sup> Senior—Ireland, Journals, Conversations and Essays, 1868.

## Principal Farm Enterprises

In 1965 roughly five-sixths or 350,000 out of a total of some 420,000 acres were devoted to agriculture. Of that area, no less than 240,000 acres were under pasture and about 46,000 acres under hay. The most important and widespread livestock enterprises in Co. Kildare are discussed here.

### *Cattle production*

In 1965 there were 151,534 cattle of all types including cows in the county (Agricultural Enumeration C.S.O.).

*Beef:* Many cattle are bred and reared in the county, but large numbers have always been bought in from outside the county for further feeding and fattening. These cattle come principally from the west and midlands, and most of them are carried during the grazing season and then sold as fat cattle or as forward stores. In the last few years, however, many of the owners of bigger farms have started to feed large numbers of cattle in yards on hay, silage and meals and this trend towards finishing cattle during the winter months is increasing.

*Dairying:* Liquid milk production extended into Kildare about 50 years ago when the Dublin dairymen could no longer supply the city's milk needs from their own resources. While there are some large herds kept on the bigger farms, the majority of liquid milk producers have small farms carrying less than 20 cows. The liquid milk enterprise is concentrated mostly in the north and centre of the county.

While most farmers in this group use the traditional byre, many new lay-outs with milking parlours, cubicles, and self-fed silage have been erected over the last 10 years. During this period also, two creameries have been set up in Co. Kildare and are supplied with milk from all parts of the county. In 1965 there were almost 32,000 cows together with about 7,000 heifers-in-calf in the county.

### *Sheep production*

In 1965, there were about 203,000 sheep in Co. Kildare and the main products were wool, fat lambs for the early meat trade and store lambs to be sold later in the season for further feeding. Most of the flocks are found in the eastern and southern part of the county and almost all are kept on the larger farms which carry, on average, about 150 ewes. More than half the ewes in the county are of the Wicklow Cheviot breed.

### *Bloodstock production*

The production of race horses has always been important in Kildare. In 1965, of the 5,201 horses in the county, no fewer than 3,203 were thoroughbreds, more than in any other county in Ireland. While a small percentage of the thoroughbred horses are kept by farmers as a minor enterprise most of them are kept on large farms that have the production and training of these horses as the sole major enterprise. Most of these latter farms are found in the centre of the county particularly around the Curragh.

### *Pig production*

This is not a major enterprise in Kildare. In 1965 there were some 2,000 sows in the county and about 18,000 other pigs. Many of those who keep pigs have come from

other parts of Ireland where pig keeping is more traditional. In recent times Moorehill Co-operative pig fattening unit has been established and is progressing favourably.

#### *Cereal production*

*Wheat:* In 1965 there were about 14,000 acres of wheat in Co. Kildare. Over half of this acreage was grown in the southern portion of the county. While much wheat was grown in former years on farms of all sizes, the crop is now mostly sown on the large farms and very large investments in machinery have been made by farmers to deal with cereal crops.

*Barley:* Cf the 17,000 acres of malting barley grown in the county in 1965 no fewer than 15,000 acres were grown in the Athy area. In the same year 12,600 acres of feeding barley were grown. This feeding barley is grown all over the county and has come to be recognised as a valuable, easily managed crop, that is practically free from diseases or other losses. It is of interest that most of the feeding barley is sold at harvest and the amount retained for feeding on farms is small.

*Oats:* Only a small area of oats is grown in the county and most of it is sold to supply the needs of stud farms and the requirements of the oatmeal manufacturers.

During the last few years, intake facilities to deal with the modern methods of harvesting cereal crops have improved very much in Co. Kildare.

#### *Other crops*

Cf the 3,227 acres of sugar-beet recorded in 1965, 3,100 acres were grown in the tillage area in the south of the county. While most farmers all over the county grow small areas of potatoes, only a few farmers grow them as a cash crop and the number of these continues to decline. In 1965 there were about 6,500 acres under turnips, mangels, kale and field cabbage. The area under these crops has fallen rapidly in recent years and many farmers who once grew these crops for winter feeding now rely on silage, hay and concentrates. Even on small dairy farms the area under these crops continues to decline. In recent years a comparatively large acreage of peas, beans and root vegetable crops is grown for sale to the vegetable processing concerns. Again, the southern portion of the county is the most popular for these crops.

In the Celbridge area several glasshouses have been erected to produce tomatoes which are mostly sold in Dublin. Considerable quantities of mushrooms are produced at a number of centres in the county.

### **Future Trends**

The relatively prosperous state of the economy over recent years has had many effects on the farmers of Co. Kildare. A great number of them have improved their dwelling houses and farm buildings and have continued to improve the productivity of their farms. Increasing farm costs and expenses are a major threat to continued expansion. The high prices being paid for farms at present also make it difficult to start farming.

The many opportunities that exist in the Kildare area for industrial employment have caused a sharp fall in the number of farm workers in the county. On the large farms in particular the greatest problem is to engage a labour force that is competent and content to do farm work. This shortage of labour has caused many farmers to alter their systems of farming. Many are getting rid of enterprises that demand a lot of labour and are employing contractors to do the work.

If the present relatively prosperous conditions continue to exist, we can expect further changes to occur on the farms of Co. Kiidare. On large farms there will be a further shift towards less intensive enterprises with the least labour content. On smaller farms that are being farmed intensively the owners will continue with their present system while they can economically do so. It is doubtful, however, if their successors will continue with the same system. It is probable that many of these will continue to hold outside employment after they get control of a holding.

In a county, however, where a large non farming population continues to increase and to demand more farm products and where expanding industries give employment to those of the family who are not needed on the farm, the farmer of Co. Kiidare is part of a prosperous and progressive environment.



Plate 10 - *Lyons House, Faculty of Agriculture (U.C.D.), Celbridge*

## APPENDIX 1

### CONSIDERATIONS IN SOIL SURVEY

#### **Introduction**

Soil is the natural medium for the growth of land plants. Although the soil mantle of the earth is far from uniform, all soils have certain factors in common. Every soil consists of mineral and organic matter, living organisms, water and air. The relative proportions of these components vary between different soils. As a small segment of the earth's surface, every soil extends downwards as well as laterally over the surface and must, therefore, be regarded as being three-dimensional, having length, breadth and depth (Plate 11).

#### The Soil Profile

The soil profile refers to a vertical section of the soil down to and including the geological parent material. The nature of the soil profile is important in many aspects of plant growth, including root development, moisture storage and nutrient supply. The profile is, therefore, the basic unit of study in assessing the true character of a soil. It usually displays a succession of layers that may differ in properties such as colour, texture, structure, consistence, porosity, chemical constitution, organic matter content and biological composition. These layers, known as **soil horizons**, occur approximately parallel to the land surface.

#### *Soil horizons*

Most soil profiles include three main horizons that are usually identified by the letters A, B, C. The combined A and B horizons constitute the so-called solum or 'true soil' whilst C refers to the parent material beneath. Certain soils lack a B horizon and are said to have AC profiles. In some soils also, organic layers (O horizons) overlie the mineral horizons.

Some soils may have a relatively uniform profile with A and C horizons whilst others are so complex that they possess not only A, B and C horizons, but also several sub-horizons (Fig. 10). Where horizons need to be sub-divided on the basis of minor differences, the sub-horizons are identified by the horizon designation plus a suffix number thus: A1, A2, A3, B1, B2, etc. The various horizons in a soil and their character reflect the process of soil formation that has been operative and present a picture of the true nature and salient characteristics of a soil which are important in its use and management.

A LANDSCAPE SECTION showing the variation that can be found in topographic features, in soil profile characteristics (horizon development etc.), and in associated land use pattern.

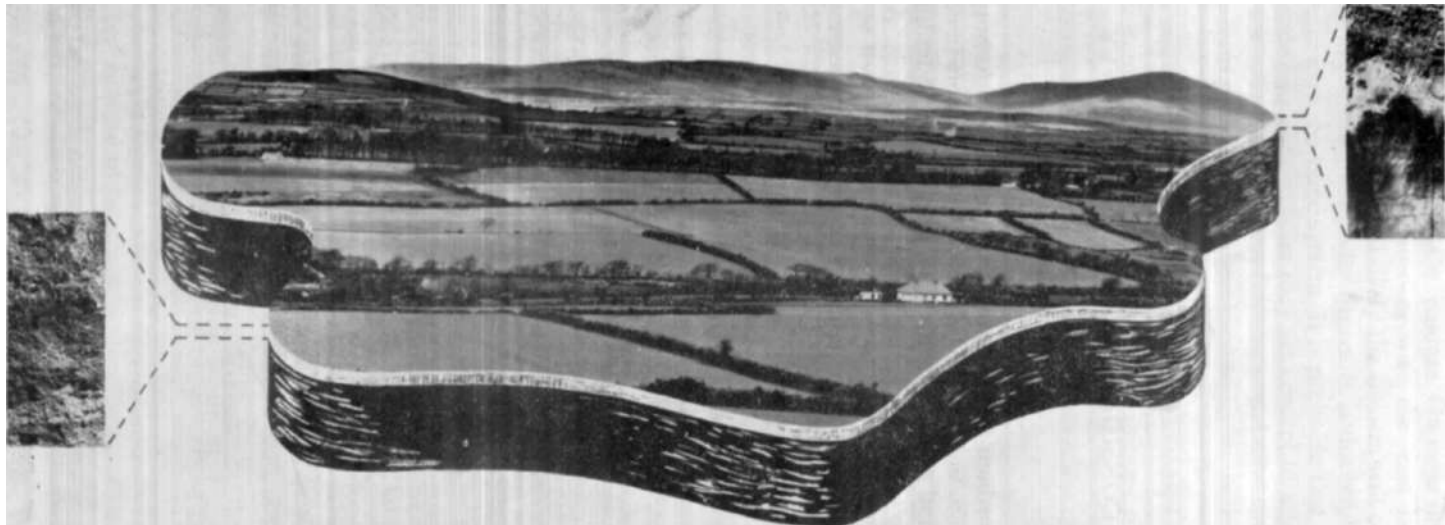


Plate 11 - *The soil is the surface layer of the earth's crust*

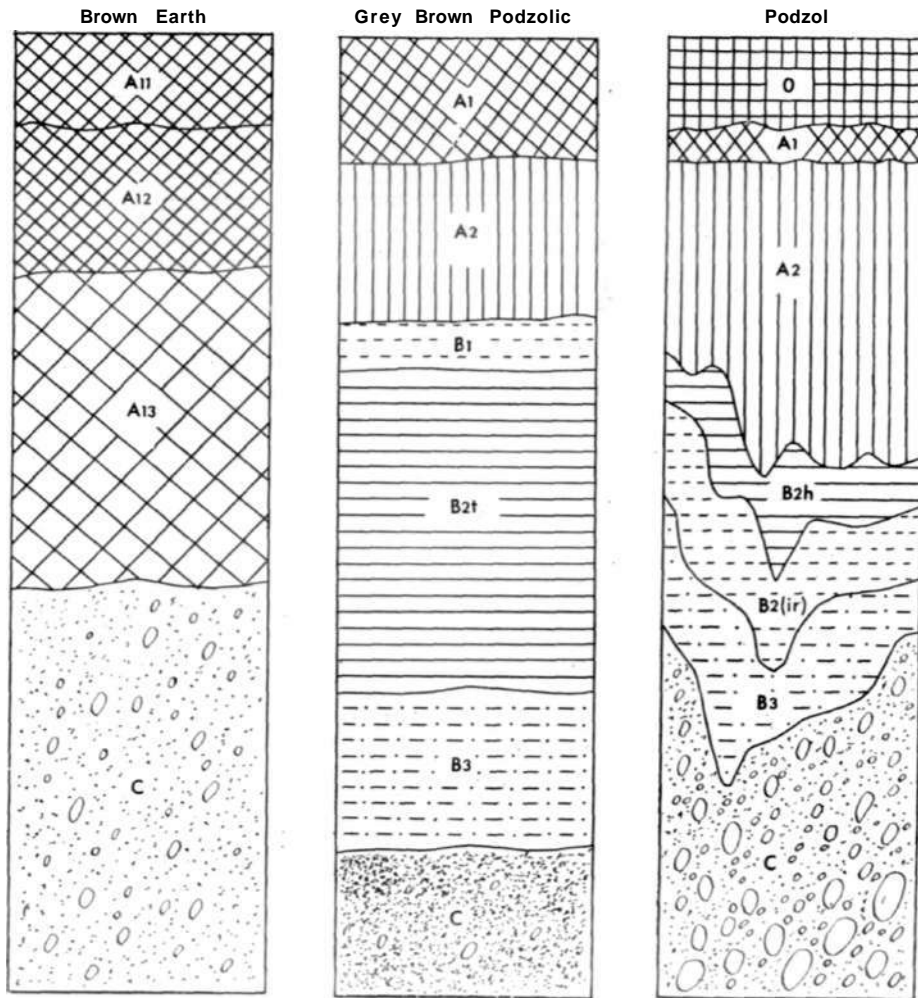
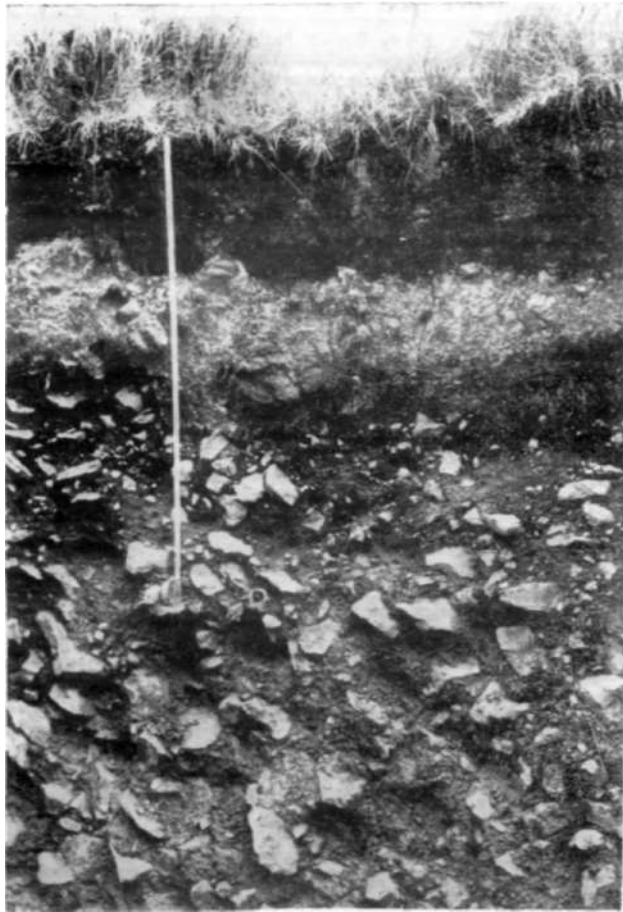


Fig. 10 - Diagrammatic representation of hypothetical soil profiles showing horizon sequences

*The A horizon:* This horizon is the uppermost layer in mineral soils and corresponds closely with the so-called 'surface soil'. It is that part of the soil in which living matter, e.g. plant roots, bacteria, fungi, earthworms, and small animals, is most abundant, and in which organic matter is usually most plentiful. Being closest to the surface, this horizon is the first to be reached by rainfall and is, therefore, more leached than underlying horizons. The A horizons in most Irish soils have been depleted of soluble chemical substances and, in certain cases also, of some of their very fine clay particles. Where the soils have been strongly leached they may be depleted of iron and aluminium oxides and of other constituents besides (Plate 12).

Two sub-divisions of the A horizon are commonly made, namely, A1 and A2. Either the A1 or both may be represented in a profile. The A1 is a surface mineral



**Plate 12-11** Podzol profile showing the surface horizon enriched with poorly decomposed organic matter, overlying the grey, strongly leached A2 horizon and underneath this the dark-coloured B2 horizon with its accumulation of iron oxides and humus.

horizon that usually contains a higher proportion of organic matter, incorporated with the mineral matter, than any of the underlying horizons. In cultivated soils this horizon corresponds to the plough layer and may be designated Ap. The A2 is a comparatively light-coloured horizon and frequently has a bleached appearance. The A2 always refers to the horizon which has undergone the greatest degree of leaching. This is reflected in the lighter colour, mostly the result of a partial removal of colouring constituents, principally iron. A3 signifies a transition zone or horizon between the A and B horizons.

*The B horizon:* This horizon lies immediately beneath the A and corresponds closely to the so-called 'subsoils'. Lying between the A and C horizons, it possesses some of the properties of both. Living organisms are fewer than in the A but more abundant than in the C horizon. Compared with the A horizon, the B horizon is one of

accumulation and usually has a relatively high content of iron and aluminium oxides, humus or clay that, in part at least, have been leached from the overlying horizons. Usually a more pronounced blocky or prismatic structure is found where this horizon is clay-enriched. Stronger colours are apparent in the B horizon, especially when the accumulation products are iron oxides or humus, or both.

Depending on the degree and pattern of accumulation of constituents within the B horizon, several divisions of the horizon, e.g. B1, B21, B22, B3, may be warranted, B2 representing the zone of most intense accumulation. Besides, symbols such as B2t, B2ir and B2h are used to denote significant accumulations of clay, iron and humus respectively. B1 and B3 denote transition horizons from A to B and from B to C horizons, respectively. If the B horizon is without any appreciable accumulation of leached products but has distinctive colour or structure characteristics, it is usually referred to as (B) horizon.

*The C horizon:* This horizon refers to the geological material beneath the A and B horizons (solum). It consists of the upper part of the loose and partly decayed rock or other geological material, such as glacial drift, similar to that from which the soil has developed. It may have accumulated locally by the breakdown of the native rock or it may have been transported by ice, water or wind. The C horizon is less weathered, has less organic matter and is usually lighter in colour than overlying horizons.

*The O horizon:* This horizon refers to a surface layer of raw or partly decomposed organic matter more usually associated with very poorly drained or very degraded (podzolized) mineral soils. Where little or no decomposition has taken place the symbol O1 is used; O2 denotes more advanced decomposition. The organic matter content of O horizons is commonly several times greater than that of the underlying mineral horizons or of surface A horizons.

### **Factors of Soil Formation**

The character of every soil can be attributed largely to the interaction of five major factors of soil formation: parent material, climate, living organisms, topography and time. These factors control the rate of weathering of rocks, the constitution and composition of the resultant soils, and subsequent gains, losses and alterations within the profile. The relative influence of these factors is responsible for many of the differences in our soils. A sixth factor influencing many non-virgin soils is man's interference with the natural development processes, and his modification of the soils for his own particular purposes.

#### *Parent material*

Parent material may be either solid rock which has weathered or some superficial deposit such as glacial drift or alluvium which has been derived from weathered rocks and transposed. Rocks vary greatly in composition, and such variation is reflected in the soils derived from them. For example, quartzite is highly resistant to weathering and, during its slow weathering process, little clay is formed and release of mineral nutrients is poor. Besides being inherently poor, soils on such materials degrade easily as the leaching process outpaces the rate of weathering. Fortunately, most rocks are mixtures of many minerals, few of which are able to withstand weathering as well as quartz. Glacial drift, the most common parent material of Irish soils, varies considerably in constitution and in geological composition, giving rise to many different soils.

### *Climate*

Even on a uniform parent geological material, soils may vary widely due to the environmental factors that influence them, in their genesis, formation and development. One of the most active agents in this regard is climate. It is now recognised that our post-glacial climate showed distinct variations over time, and current climate varies widely from season to season and from region to region. The main element of our climate influencing soil development is the rainfall-evaporation regime. With the ratio balanced well in favour of rainfall, most of our soils tend to be leached to varying degrees, being strongly podzolized in more extreme cases. Apart from leaching the humid climate is also partially responsible for the extensive areas of wet gley soils and for much of the peat formation in the county.

### *Living organisms*

Living organisms in the soil include plants, animals, insects, fungi, bacteria and other biological forms. These play an important role in soil development, such as determining the kind and amount of organic matter that is incorporated in the soil under natural conditions. They also govern the manner in which organic matter is added, whether as leaves and twigs on the surface or as fibrous roots within the profile. The rate of organic matter decomposition is strongly influenced by the type and activity of living organisms present. Plants can reverse the leaching process in part: the roots take up calcium, potassium, phosphorus and other elements from the lower horizons and, on the decay of leaves, roots and other plant remains, return them to the surface.

The nature of the vegetative cover itself is known to have a decided influence on soil development. Other factors being equal, a forest cover promotes a different soil-forming process than either grass or cultivated crops. Trees also differ in their influence on soil development: in general, conifers are more conducive than broadleaved trees to soil degradation and podzol formation, particularly on acid parent materials. Certain forms of ground cover, e.g. heath, are also very conducive to podzol formation.

Earthworms, insects, and micro-organisms, e.g. fungi and bacteria, strongly affect soil character and behaviour.

### *Topography*

Since topography governs the position of a soil on the landscape, it is important in many respects, especially in its effect on water runoff and drainage. The amount of water that moves through a soil is less on steep than on gentle slopes, or lowlying or flat area. This accounts, to some extent, for the preponderance of poorly drained soils in lowlying areas. Soils of poor drainage, however, may be found on steep slopes where the lower soil horizons or parent material are of poor permeability, leading to retardation of water movement.

Elevation, with its attendant climatic and vegetational changes, strongly influences the soil development pattern. Topography is important in its effect on aspect and in deciding the use of soils.

### *Time*

Considerable time is needed for the accumulation of soil parent material and for the development of horizons in the soil profile. The degree of maturity of a soil depends to a large extent on age, and also on the parent material and other factors. Soils developed on young deposits, such as alluvium, show less distinct horizons, in general, than those developed on old materials over a longer period.

## Differences and Similarities among Soils

None of the five factors of soil formation is universally uniform. There are many kinds of rocks, many types of climate, many combinations of living organisms, great variation in topography and in age of different land surfaces. As a result there are innumerable combinations of the factors of soil formation, giving many different soils.

Differences among soils are both local and regional. Most farms consist of local kinds of soil, which have importance to management and productivity, whilst over the whole country there are also many different soils. Although it is true that great variability exists, the distribution is not so haphazard as might be expected. Each soil reflects the environment in which it has formed, occupies a definite geographic area and occurs in certain patterns with other soils. By recognising the main factors of soil formation and by distinguishing the reflected characteristics in the soils themselves, we can segregate geographic soil units. Thus similarities and differences among soils can be recognised, and the various soils can be classified and their distribution mapped.

### Soil Mapping

#### *Soil series*

It is principally on the basis of profile character, as expressed by the nature of the various horizons, that soils are classified and mapped. Although each profile has its individual character, some have so many important features in common that they can be placed together in a single primary category. The primary category used in mapping is the **soil series**, which comprises soils with similar type and arrangement of horizons, and developed from similar parent material. The soil series is also a basic category in soil classification.

A major problem in mapping soils is the delineation of boundaries between different series. Typical profiles of two different soil series may differ widely but, where the series are contiguous, it is usual for them to merge, sometimes over a considerable distance. Consequently, a line on the map very often defines the merging zone between soils rather than a sharp change in the soil character.

A soil series is named usually after the location in which the particular soils are best expressed or occur most widely.

#### *Other soil units*

Soils within a series may be further sub-divided into **soil types** on the basis of surface textural differences. Different **soil phases** may also be mapped covering variations in features, such as slope, depth or stoniness, that are important in soil behaviour and land use. Segregation at these levels requires more detailed survey than that employed in County Kildare.

#### *Scale of mapping*

Field mapping is carried out on a scale of 6 inches to 1 mile (1:10,560), but this detail is reduced to a scale of  $\frac{1}{2}$  inch to 1 mile (1:126,720) for publication. Since one 6-inch sheet covers an area of 24 square miles, to publish on this scale would necessitate, in the case of County Kildare, at least 40 individual map sheets. Considerations such as the cost of colour printing, ease of handling and general use of the map warrant reduction to the smaller scale.

This reduction, however, introduces certain difficulties. It has been found necessary to consolidate and, in some cases, delete some of the least extensive soil separations

shown on the larger scale. On the scale of 1:126,720 it is possible to show a minimum area of 25 acres, and so any uniformly coloured area on the published map may include enclaves of less than 25 acres. Where soil series are recognised, but where their distribution pattern with contiguous series is so intricate as to defy clear-cut delineation on the map, a **soil complex** is mapped. The component series within the complex are named and, where possible, their relative proportions are given.

To accommodate those who are interested in more detail for special purposes, the field sheets (at a scale of 1:10,560) showing the entire field survey records are being retained for consultation at the National Soil Survey headquarters, Johnstown Castle, Wexford.

### **Description of Soil Profiles**

During the survey of an area, profiles typical of each soil series are selected for special study. Fresh profile pits are opened for this purpose. The depth of pit varies according to soil depth but is usually about 4 to 5 feet. Each profile is thoroughly examined and described and a record made of its salient characteristics.

A soil profile is described by first noting certain features of the soil's environment, followed by details of its general characteristics. The characteristics which apply to the site include relief, slope, aspect, altitude and vegetation. Drainage conditions and the pattern of horizon development within the profile are considered next and, finally, properties of the individual soil horizons such as texture, structure, consistence, colour, mottling, amount of organic matter, stoniness, presence of hardpans and root development are described.

A bulk sample from each soil horizon is analysed physically and chemically at the Soil Laboratory. The analytical data supplement many of the field observations and provide a more complete picture of the true soil character. The results of these analyses for representative profiles of each soil series are given in Appendix 3.

## APPENDIX 7

### DEFINITION OF TERMS USED IN PROFILE DESCRIPTIONS\*

#### Texture

Soil texture refers to the relative proportions of the various size particles in the mineral fraction of a soil. More specifically, it refers to the relative proportions of clay, silt and sand in the mineral material of less than 3 millimeters in diameter. Texture, which is one of the more important of the soil's physical characteristics, influences such factors as moisture retention, drainage and tilling properties of soils, their resistance to damage by stock and heavy machinery, and earliness of crop growth.

Classes of texture are based on different combinations of sand, silt and clay; the proportions of these are determined by mechanical analyses in the laboratory. The basic textural classes in order of increasing proportions of the finer separates are sand, loamy sand, sandy loam, loam, silt-loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay and clay. Definitions of the basic classes in terms of clay (less than 0.002 mm), silt (0.002 to 0.05 mm) and sand (0.05 to 2.0 mm diameter size) are presented in graphic form (Figure 11).

#### *Field Estimation of Soil Textural Class*

The estimation of soil textural class is made in the field by feeling the moist soil between the fingers. The field estimation is checked in the laboratory. In arriving at an estimation in the field the following considerations are taken into account.

*Sand:* Sand is loose and single grained. The individual grains can readily be seen and felt. Pressed when moist, a weak cast may be formed which easily crumbles when touched.

*Sandy loam:* A sandy loam contains much sand but has adequate silt and clay to make it somewhat coherent. If squeezed when moist, a cast can be formed that bears careful handling without breaking.

*Loam:* A loam has roughly equal proportions of sand, silt and clay. If squeezed when moist, a cast is formed which can be handled quite freely without braking.

*Silt loam:* A silt-loam comprises a moderate amount of sand, a relatively small amount of clay with over half the particles of silt size. A cast can be formed which can be freely handled without breaking, but when moistened and squeezed between thumb and finger it does not 'ribbon' but gives a broken appearance.

*Clay loam:* A clay loam contains more clay than a loam and usually breaks into

\*The terms and definitions used here are essentially those of the Soil Survey Manual, U.S.D.A. Handbook No. 18, Washington, D.C., 1951.

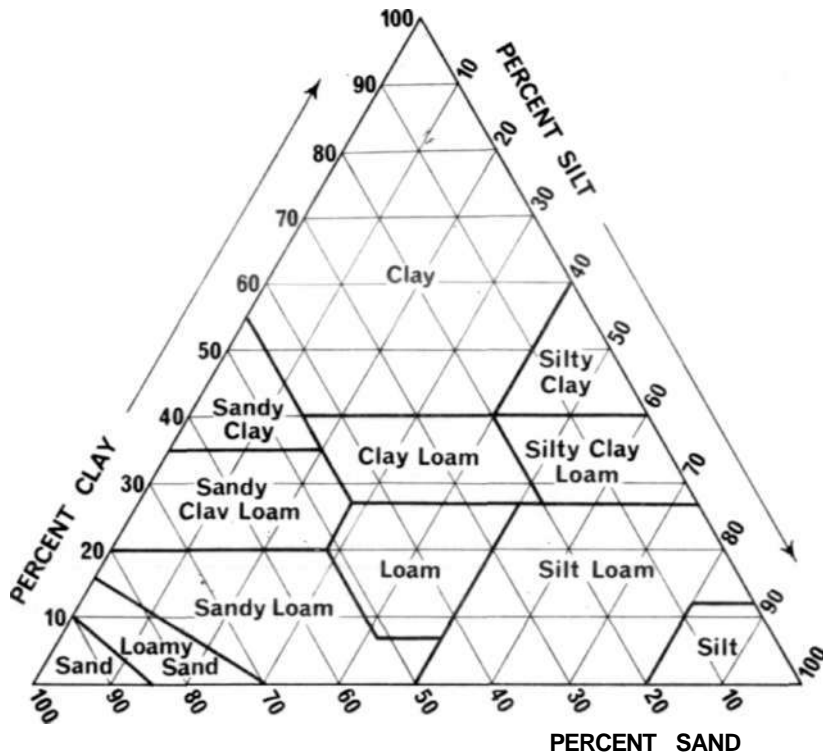


Fig. 11 - Chart showing the percentage of clay (less than 0.002 mm) silt (0.002 to 0.05 mm) and sand (0.05 to 2.0 mm) in the basic soil texture classes (After Soil Survey Manual, U.S.D.A Handbook No 18, Washington, D.C, 1951).

clods or lumps that are hard when dry. In the moist state it is plastic and can be formed into a cast which can withstand considerable handling. When kneaded in the hand, it does not crumble readily, but tends to work into a heavy compact mass.

<i>General terms</i>		<i>Basic soil texture class</i>
Sandy Soils	Coarse-textured soils	Sands Loamy sands
	Moderately coarse-textured soils	Sandy loams
Loamy Soils	Medium-textured soils	Loams Silt loams Silt
	Moderately fine-textured soils	Clay loams Sandy clay loams Silty clay loams
Clayey Soils	Fine-textured soils	Sandy clays Silty clays Clays

*Cloy*: A clay has a preponderance of the finer particles, contains more clay than a clay loam and usually forms hard lumps or clods when dry, but is quite plastic and sticky when wet. When pinched out between thumb and finger in the moist state it forms a long, flexible 'ribbon'.

#### *General Grouping of Soil Texture Classes*

Often it is convenient to refer to texture in terms of broad groups of textural classes. Although the terms 'heavy' and 'light' have been used for a long time in referring to fine and coarse textured soils, respectively, the terms are confusing as they do not bear any relation to the weight of soil; the terms arose from the relative traction power required for ploughing. An outline of acceptable terms is as follows:

### Structure

Soil structure refers to the aggregation of primary soil particles into compound particles, which are separated from adjoining aggregates by surfaces of weakness. An individual natural soil aggregate is called a ped.

The productivity of a soil and its response to management depend on its structure to a large extent. Soil structure influences pore space, aeration, drainage conditions, root development and ease of working. Soils with aggregates of spheroidal shape have a greater pore space between peds, are more permeable, and are more desirable generally than soils that are massive or coarsely blocky.

Field descriptions of soil structure note the shape and arrangement, the size, and the distinctness and durability of the aggregates. Shape and arrangement of peds are designated as type of soil structure; size of peds, as class; and degree of distinctness, as grade.

#### *Type*

There are four primary types of structure:

- (a) Platy—with particles arranged around a plane and faces generally horizontal.
- (b) Prismlike—with particles arranged around a vertical line, and bounded by relatively flat vertical surfaces.
- (c) Blocklike—with particles arranged around a point and bounded by relatively flat or curved surfaces giving a general block-like appearance. The ped surfaces here are accommodated to adjoining aggregates.
- (d) Spheroidal—with particles arranged around a point and bounded by curved or very irregular surfaces that are not accommodated to the adjoining aggregates.

Each of the last three types has two subtypes.

Under prismlike, the two subtypes are prismatic (without rounded upper ends) and columnar (with rounded ends). The two subtypes of block-like are angular blocky (with sharp-angled faces) and subangular blocky (with rounded faces). Spheroidal is subdivided into granular (relatively non-porous) and crumb (very porous).

#### *Class*

Five size classes are recognised in each type. The size limits of these vary for the four primary types given. A type description is generally qualified by one of the following class distinctions: very fine, fine, medium, coarse, very coarse.

### *Grade*

Grade is the degree of aggregation or strength of the structure. In field practice, it is determined mainly by noting the durability of the aggregates and the relative proportions of aggregated and non-aggregated material when the aggregates are disturbed or gently crushed.

Terms for grade of structure are as follows:

0. *Structureless*—No observable aggregation. This condition is described as massive if coherent, and single grain if noncoherent.

1. *Weak*—Poorly formed indistinct peds which when distributed break down into a mixture comprising some complete peds, many broken units and much non-aggregated material.

2. *Moderate*—Many well-formed, moderately durable peds that are not so apparent in the undisturbed soil. When disturbed, however, a mixture of many complete peds, some broken peds and a little non-aggregated material is evident.

3. *Strong*—Structure characterised by peds that are well formed in undisturbed soil, and that survive displacement to the extent that when disturbed, soil material consists mainly of entire peds, with few broken peds and little non-aggregated material.

The appropriate terms describing type, class, and grade of structure are combined in that order to give the structural description *e.g.* moderate, medium, sub-angular blocky; weak, fine crumb.

### Porosity

Porosity of a soil is conditioned by the shape, size and abundance of the various crevices, passages and other soil cavities, which are included under the general name of soil pores. In this bulletin, porosity refers mainly to the voids between the soil structural units which is strictly the structural porosity. Soil porosity is influenced largely by type of structure; it is also influenced by rooting and by the activity of earthworms and other macro-organisms.

Porosity determines, to a large extent, the permeability rate in the soil and the air to water ratio prevailing and is thus of considerable importance with regard to soil aeration and drainage regime.

### Consistence

Soil consistence is an expression of the degree and kind of cohesion and adhesion, or the resistance to deformation and rupture that obtains in a soil. Interrelated with texture and structure, and strongly influenced by the moisture content of the soil, this characteristic is most important in developing a good tilth under cultivation practices. On account of the strong influence of moisture regime, the evaluation of soil consistence is usually considered at three levels of soil moisture—wet, moist and dry.

#### *Consistence When Wet*

A. *Stickiness*: Stickiness expresses the extent of adhesion to other objects. To evaluate this feature in the field, soil material is pressed between thumb and finger and its degree of adhesion noted. Degrees of stickiness are expressed as follows:

0. Non-sticky: On release after pressure, practically no soil material adheres to thumb or finger.

1. Slightly sticky: After pressure, soil material adheres to thumb and finger but comes off one or the other rather clearly.

2. Sticky; After pressure, soil material adheres to both thumb and finger and tends to stretch somewhat and pull apart rather than pull free from either digit.

3. Very sticky: After pressure, soil material adheres strongly to both thumb and finger and is decidedly stretched when they are separated.

B. *Plasticity*: Plasticity is the ability to change shape continuously under applied stress, and to retain the impressed shape on removal of the stress. To evaluate in the field, the soil material is rolled between thumb and finger to form a 'wire'.

0. Non-plastic—no wire formable.

1. Slightly plastic—wire formable; soil mass easily deformed.

2. Plastic—wire formable; moderate pressure required to deform soil mass.

3. Very plastic—wire formable; much pressure required to deform soil mass.

#### *Consistence When Moist*

To evaluate in the field, an attempt is made to crush in the hand a mass of soil that appears moist.

0. Loose—Non-coherent.

1. Very friable—Soil material crushes under very gentle pressure but tends to cohere when pressed together.

2. Friable—Soil material crushes easily under gentle to moderate pressure between thumb and finger, and tends to cohere when pressed together.

3. Firm—Soil material crushes under moderate pressure between thumb and finger, but resistance is distinctly noticeable.

4. Very firm—Soil material crushes under strong pressure but is barely crushable between thumb and finger.

#### *Consistence When Dry*

To evaluate, an air-dry mass of soil is broken in the hand.

0. Loose—Non-coherent.

1. Soft—Soil is fragile and breaks to powder or individual grains under very slight pressure.

2. Hard—Soil can be broken easily in the hands but it is barely breakable between thumb and finger.

3. Very hard—Can normally be broken in the hands, but only with difficulty.

#### *Cementation*

Cementation of soil material refers to a brittle, hard consistence caused by various cementing substances. Different degrees of cementation occur.

1. Weakly cemented: Cemented mass is hard but brittle and can be shattered in the hand.

2. Strongly cemented: Cemented mass is brittle but harder than that which can be shattered in the hand; it is easily shattered by hammer.

3. Indurated: Very strongly cemented; brittle; does not soften when moistened and is so extremely hard that a sharp blow with a hammer is required for breakage.

## APPENDIX 3

### PROFILE DESCRIPTIONS AND ANALYSES

#### Donaghcumper Series—Modal Profile

Location:	Donaghcumper, Celbridge; 11/3 D28-29*
Topography:	Flattish
Slope:	0
Altitude:	180 feet OD.
Vegetation:	Old pasture
Drainage:	Moderately well drained
Parent Material:	Calcareous shaly limestone with some glacial influence
Great Soil Group:	Grey Brown Podzolic (Typic Habludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	inches	cm	
Ap	0-8	0-20	Loam to clay loam; dark brown (10 YR 3/3); moderate medium and fine subangular blocky structure; moist friable; plentiful roots; charcoal present; calcareous; abrupt boundary to:
A12	8-9/11	20-23/28	Clay loam to loam; brown to dark brown (10 YR 4 3); moderately strong medium to fine subangular blocky structure; moist friable; moderate root supply; clear boundary to:
B2t	9-13 15	23-33 38	Clay loam to clay; brown to dark brown (10 YR 4,3) on ped surface with faint dark yellowish brown mottles (10 YR 4/4) internally; weak to moderate medium and coarse subangular blocky; moist plastic; clay skins present; sparse roots; clear boundary to:
B3	13-16/17	33-41/43	Clay; dark greyish brown (10 YR 4/2) with many faint brown mottles; weak medium and coarse subangular blocky structure to structureless; moist plastic; no roots; weakly calcareous; abrupt boundary to:
C	16+	41 +	Rather similar to above but strongly calcareous.

\*Grid reference.

### Donaghcumper Series—Profile Analyses

Horizon	Ap	A12	B2t	<b>B3</b>	
Coarse sand %	16	14	7	3	1
Fine sand %	17	17	11	6	4
Silt % ...	41	42	4;	47	54
Clay % ...	26	27	39	44	41
pH	6.4	7.1	7.5	7.3	8.2
C.E.C. meq 100g . . . . .	35.0	21.4	23.4	25.6	20.8
T.E.B. meq/100g	22.7	17.9	22.6	25.3	24.8
Base saturation % . . . . .	65	84	97	99	Sat
C %	2.8	1.2	1.0	0.8	0.6
N %	0.33	0.15	0.15	—	—
C/N	8.5	8.0	6.6	—	—
Free iron %	2.8	2.7	3.6	3.6	3.0
T.N.V. %	0.0	0.7	1.0	1.9	27.0

Coarse sand 2.0-0.2mm; Fine sand 0.2-0.05mm; Silt 0.05-0.002mm; Clay >0.002mm diameter size.  
 C.E.C.=Cation Exchange Capacity; T.E.B.=Total Exchangeable Bases; C/N ratio —Carbon/  
 Nitrogen ratio; T.N.V. = Total Neutralising Value.

### Elton Series—Modal Profile

Location: Punchestown Racecourse; "M2 N 15  
 Topography: Undulating  
 Slope: 1-2°  
 Altitude: 475 feet O.D.  
 Vegetation: Old pasture  
 Drainage: Well drained  
 Parent Material: Calcareous, glacial till, of Weichsel age, composed mainly of limestone with some shale and sandstone  
 Great Soil Group: Grey Brown Podzolic (Typic Hapludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	<i>inches</i>	<i>cm</i>	
All	0-4*/5	0-11/13	Loam; dark greyish brown (10 YR 4/2); weak, fine to medium subangular blocky structure; moist friable; plentiful roots; gradual boundary to:
A12	4H6/17	11-41/43	Loam; brown to dark brown (10 YR 4/3); weak fine subangular blocky structure; moist friable; plentiful roots; clear wavy boundary to:
B2(B2t)	16-25/42	41-64/107	Sandy loam with pockets of loamy B2t; brown to dark brown (10 YR 4/3); coarse prismatic breaking to coarse subangular blocky structure; moist plastic; sparse roots; many earthworm channels; clear wavy boundary to:
	25 +	64+	Stony loam; light olive brown (2.5 Y 5/3); structureless; moist friable; no roots; calcareous, overlying coarse gravels at 47 inches (HO

### Elton Series—Profile Analyses

Horizon	All	A12	<b>B2</b>	(B2t)	
Coarse sand % . . . . .	20	23	28	19	19
Fine sand % . . . . .	23	23	32	21	16
Silt% . . . . .	38	34	25	37	46
Clay % . . . . .	.19	20	15	23	19
pH. . . . .	5.3	5.5	6.2	6.0	8.1
C.E.C. meq/100g . . . . .	21.8		6.4	11.6	8.0
T.E.B. meq/100g . . . . .	7.8	—	4.5	8.5	15.9
Base saturation % . . . . .	40		71	73	Sat
C % . . . . .	3.1	1.7	0.2	0.4	0.3
N % . . . . .	0.36	0.19	—	—	—
C/N. . . . .	8.6	8.9		—	—
Free iron % . . . . .	.17	1.7	—		14
T.N.V. % . . . . .	0.0	0.0	0.0	0.0	28.7

## Fontstown Series—Modal Profile

Location:	Suncroft Kildare, 28/3 K 3
Topography:	Undulating
Slope:	1°
Altitude:	277 feet O.D.
Vegetation:	Old pasture
Drainage:	Well drained (top excessively drained in places)
Parent Material:	Calcareous, stony till, of Weichsel age, composed mainly of limestone
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	inches	cm	
A11	0-6	0-15	Sandy loam to loam; brown to dark brown (10 YR 4/3-3/3); moderate fine to medium sub-angular blocky structure and weak fine granular structure; moist friable; abundant roots; clear boundary to:
A12	6-10i/II	15-27 2S	Sandy loam; brown to dark brown (10 YR 4/3); moderate fine granular; moist friable to dry firm <i>in situ</i> ; plentiful roots; clear boundary to A2, B2t or C horizons
A 2	10J-13/37	27-33/94	Loamy sand; pale brown (11 YR 6/3) with few yellowish brown clay bands (1 cm wide); structureless, moist friable; sparse roots; highly porous; many worm channels; clear tonguing boundary to B2t; less well developed portions have yellowish brown colour (10 YR 5/8) and sandy loam texture
B2t	11-18/42	28-46/107	Clay loam; brown to dark yellowish brown (10 YR 4/3-4/4); moderate medium to coarse sub-angular blocky structure; moist firm; wet plastic; sparse roots in deep parts of B2t; peds highly porous; abrupt tonguing boundary to:
	11 +	28+	Stony loam; light yellowish brown (10 YR 6/4); structureless; dry hard <i>in situ</i> ; no roots; strongly calcareous

Fontstown Series—Profile Analyses

Horizon	A11	A12	A:	B2t	
Coarse sand % . . . . .	.13	14	14	8	9
Fine sand % . . . . .	39	44	68	17	20
Silt % . . . . .	33	27	12	46	44
Clay % . . . . .	.15	15	6	29	27
pH . . . . .	7.6	7.7	7.5	7.8	8.2
C.E.C. meq/100g. . . . .	18.6	14.0	8.0	16.0	8.0
T.E.B. meq/100g. . . . .	17.2	10.9	2.7	15.5	12.8
Base saturation % . . . . .	92	78	34	97	Sat.
C % . . . . .	.14	0.5	0.3	0.3	0.3
N % . . . . .	0.17	0.08	—	—	—
C/N. . . . .	8.2	6.3			
Free iron % . . . . .	1.2	1.2	0.5	2.4	1.2
T.N.V. % . . . . .	2.8	1.2	0.7	3.3	45.4

## Grange Series—Modal Profile

Location:	Ravensdale, Maynooth; 6/3 P 26
Topography:	Undulating
Slope:	3-4°
Altitude:	225 feet O.D.
Vegetation:	Old pasture
Drainage:	Well drained
Parent Material:	Calcareous non-tenaceous till, of Weichsel age, composed mainly of limestone
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	inches	cm	
A11	0-4/4J	0-10/11	Clay loam to loam; dark greyish brown (10 YR 4/2) with abundant rusty root mottles; moderate medium and fine subangular blocky structure; moist friable; abundant roots; weakly calcareous; abrupt boundary to:
A12	4-12/12J	10-30/31	Loam to clay loam; brown to dark brown (10 YR 4/3); weak to moderate medium to fine subangular blocky structure; moist friable; burned lime observed; charcoal plentiful; fairly stony; plentiful roots; weakly calcareous; abrupt boundary to-
B2t	12-24/26	30-61/65	Clay loam; dark yellowish brown (10 YR 4/4); cloddy breaking down to moderate medium and fine subangular blocky; moist firm <i>in situ</i> to plastic when wet; sparse roots; weakly calcareous; clear boundary to:
B3	24-28/32	61-71/81	Loam; brown to dark brown (10 YR 4/3 nearest) with pale yellow and blackish mottles; weak fine granular structure; moist friable; sparse roots; weakly calcareous; gradual boundary to:
C	28+	81+	Gritty loam to sandy loam with some gravelly pockets; olive brown (2.5 Y 4/4); structureless moist friable; no roots; strongly calcareous.

**Grange Series—Profile Analyses**

Horizon	A11	A12	B2t	B1	
Coarsesand%. . . . .	.11	14	6	7	10
Fine sand %. . . . .	.18	18	21	31	39
Silt %. . . . .	42	42	42	39	37
Clay %. . . . .	29	26	31	23	14
pH. . . . .	5.8	7.3	7.1	7.5	8.2
C.E.C. meq/100g. . . . .	42.8	29.0	20.8	20.0	12.2
T.E.B. meq/100g. . . . .	19.6	24.9	18.4	21.1	15.5
Base saturation %. . . . .	46	76	89	Sat	Sat
C %. . . . .	4.2	1.9	0.7	0.5	0.3
N %. . . . .	0.46	0.24	—	—	—
C/N. . . . .	9.1	8.0	—	—	—
Free iron %. . . . .	2.3	2.5	3.0	2.8	1.8
T.N.V. %. . . . .	3.0	2.8	0.9	2.8	29.6

## Kennycourt Series—Modal Profile

Location:	Kennycourt, Kilcullen; 29/3 O 20
Topography:	Rolling
Slope:	4°
Altitude:	525 feet O.D.
Vegetation:	Old pasture with furze
Drainage:	Well drained
Parent Material:	Calcareous, non-tenaceous till, of Weichsel age, composed mainly of limestone with shale and sandstone
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	inches	cm	
A11	0-4/4*	0-10/11	Loam; brown to dark brown (7.5 YR 4/2); moderate medium subangular blocky structure and very fine granular; moist friable; abundant roots; abrupt boundary to:
A12	4-14/16	10-36/41	Loam; dark yellowish brown (10 YR 3/4); moderate medium subangular blocky structure; moist friable; plentiful roots; charcoal present: clear boundary to:
A2	14-22/28	36-56/71	Loam; dark yellowish (10 YR 4/4); weak fine granular structure; moist friable; plentiful roots; gradual boundary to:
B2t	22-41/44	56-104/112	Loam; dark yellowish brown (10 YR 4/4); weak medium subangular blocky structure; moist slightly plastic; sparse roots; abrupt boundary to:
	41 +	104+	Stony loam; brown (10 YR 5/3); structureless; moist firm; no roots; strongly calcareous.

## Kennycourt Series—Profile Analyses

Horizon	A11	A12	A2	B2i	
Coarse sand % . . . . .	23	27	26	25	37
Fine sand % . . . . .	20	20	21	20	26
Silt % . . . . .	38	35	36	35	26
Clay % . . . . .	.19	18	17	20	11
pH . . . . .	5.3	5.8	6.0	6.2	8.4
C.E.C. meq/100g. . . . .	32.0	20.4	12.2	11.2	10.2
T.E.B. meq/100g. . . . .	.8.7	7.5	4.6	8.7	10.0
Base saturation % . . . . .	28	37	38	78	99
C % . . . . .	4.0	1.3	0.5	0.4	0.3
N % . . . . .	.0.36	0.15	—	—	—
C/N . . . . .	11.1	8.7			
Free iron % . . . . .	.14	1.6	1.8	1.9	1.1
T.N.V. % . . . . .	0.0	0.0	0.0	0.0	23.0

## Mortarstown Series—Modal Profile

Location:	Coursetown, Athy; 34/2 Y 30-31
Topography:	Flattish
Slope:	0°
Altitude:	230 feet O.D.
Vegetation:	Barley
Drainage:	Well drained
Parent Material:	Calcareous, non-tenaceous till, of Weichsel age, composed mainly of limestone.
Great Soil Group:	Grey Brown Podzolic (Typic Hapludalf)

Horizon	Depth		Description
	inches	cm	
Ap	0-8	0-20	Loam; brown to dark brown (10 YR 4/3) moderate fine to medium subangular blocky structure; moist firm to friable; plentiful roots; smooth boundary to:
A12	8-14/17	20-36/43	Loam to clay loam; brown to yellowish brown (10 YR 5/3-5/4); massive tending towards moderate fine granular; moist firm <i>in situ</i> ; few roots; clear wavy boundary to:
B2t	14-35/37	36-89/94	Clay; yellowish brown (10 YR 5/4) on ped surface and yellowish brown to dark yellowish brown internally (10 YR 5/4-4/4); abundant large worm channels are brown to dark brown (10 YR 4/3); moderate coarse prismatic breaking to coarse angular blocky structure; moderate root supply; non-calcareous; abrupt wavy boundary to:
	35+	89	Gritty clay loam; light brownish grey (10 YR 6/2); structureless; moist firm; no roots; calcareous.

## Mortarstown Series—Profile Analyses

Horizon	Ap	A12	B2t	
Coarse sand % . . . . .	16	14	5	9
Fine sand % . . . . .	26	27	9	11
Silt % . . . . .	36	35	42	41
Clay % . . . . .	22	24	44	39
pH . . . . .	6.2	6.7	6.9	8.2
C.E.C. meq/100g . . . . .	27.2	17.2	16.6	15.0
T.E.B. meq/100g . . . . .	15.0	13.3	15.3	18.3
Base saturation % . . . . .	55	78	92	Sat
C % . . . . .	2.0	1.0	0.5	0.5
N % . . . . .	0.20	0.13	—	—
C/N . . . . .	10.0	7.7	—	—
Free iron % . . . . .	.17	1.7	3.1	1.9
T.N.V. % . . . . .	0.0	0.0	0.0	30.2

### Garristown Series—Modal Profile

Location: Cappagh, Kilcock; 4/2 / 20  
 Topography: Rolling  
 Slope: 5-6°  
 Altitude: 325 feet O.D.  
 Vegetation: Pasture  
 Drainage: Imperfectly drained  
 Parent Material: Dense; non-calcareous glacial till derived from Upper Avonian shales and sandstones with a little limestone influence.  
 Great Soil Group: (Podzolic )Gley (Aquic Hapludalf)

<i>Horizon</i>	<i>Depth</i>		<i>Description</i>
	inches	cm	
A11	0-6/7	0-15/18	Clay loam; very dark greyish brown (10 YR 3/2) profuse-mottling; weak medium subangular blocky structure; moist friable; plentiful roots; clear smooth boundary to:
A12	6-11/13	15-28/33	Clay loam; dark greyish brown (10 YR 4/2); weak to moderate medium subangular blocky structure; moist friable; fair root supply; abrupt boundary to:
A2	11-20	28-51	Loam to clay loam; dark greyish brown (10 YR 4/2) with many yellowish brown (10 YR 5/6) mottles; structure is massive <i>in situ</i> but breaks up to medium subangular blocky; moist/dry firm to hard <i>in situ</i> ; fair root supply; clear wavy boundary to:
B2t	20-30/32	51-76/81	Clay loam; dark brown (10 YR 3 3) with abundant profuse blueish and yellowish brown (10 YR 5/8) mottles; structure is massive <i>in situ</i> ; wet plastic; sparse roots; abrupt smooth boundary to:
	30+	76+	Consists of interstratified layers of non-calcareous very dark brown clay loam bands and dark brown sandy loam bands which have weathered from underlying bedrock.

**Garristown Series—Profile Analyses**

<b>Horizon</b>	<b>A11</b>	<b>A12</b>	<b>A 2</b>	<b>B2t</b>	<b>C1</b>	<b>C2</b>
Coarse sand %.	18	20	19	11	8	28
Fine sand %.	24	25	24	22	18	45
Silt %.	29	28	31	36	40	14
Clay %.	29	27	26	31	34	13
pH	6.2	6.3	5.9	6.1	6.2	6.0
C.E.C. meq/100g.	31.0	22.4	17.8	33.6	33.6	20.0
T.E.B. meq/100g.	23.0	14.0	11.1	21.2	27.9	10.6
Base saturation %.	74	63	63	63	83	53
C %.	4.5	1.6	0.8	0.9	1.1	0.4
N %.	0.49	0.23	0.12	0.16	0.20	—
C/N.	9.2	7.0	6.7	5.6	5.5	
Free iron %.	2.8	3.0	2.9	3.2	3.1	2.8
T.N.V. %.	0.0	0.0	0.0	0.0	0.0	0.0

### Kilpatrick Series—Modal Profile

Location: Kilpatrick Farm, Lullymore, 12/2 J5  
 Topography: Undulating  
 Slope: 0°  
 Altitude: 274 feet O.D.  
 Drainage Class: Imperfectly drained  
 Parent material: Stony, compact, but non-tenaceous glacial till composed mainly of limestone  
 Great Soil Group: (Podzolic) Gley

Horizon	Depth		Description
	inches	cm	
<b>A1</b>	0-7	0-18	Loam; dark greyish brown (10 YR 4 2) with reddish brown (5 YR 4/4) root mottles; moderate medium angular blocky structure; moist friable; clear boundary to:
<b>A2</b>	<b>7-10/11</b>	18-25/28	Loam; light brownish grey (2.5 Y 6/2) with many medium and fine strong brown (7.5 YR 5/6) mottles; moderate medium angular blocky structure; clear wavy boundary to:
B2t	10-14/16	28-36/41	Loam to clay loam; yellowish brown (10 YR 5,4) with many distinct medium and fine strong brown (7.5 YR 5/4) mottles; weak angular blocky structure; clay skins distinct; abrupt tonguing boundary to:
Cg	14+	<b>36</b>	Silt loam; light grey ( <b>10</b> YR 6 1) with many distinct yellowish brown (10 YR 5/6) mottles; structureless; moist hard <i>in situ</i> ; no roots; calcareous.

Kilpatrick Series—Profile Analyses

Horizon	A1	A2	B2t	Cg
Coarse sand % . . . . .	19	16	9	10
Fine sand % . . . . .	22	25	20	13
Silt % . . . . .	44	44	46	62
Clay . . . . .	15	15	25	15
pH. . . . .	6.5	6.5	7.5	8.2
C.E.C. meq/100g. . . . .	18.9	6.7	12.4	4.0
T.E.B. meq/100g. . . . .	5.7	3.7	11.8	8.3
Base Saturation % . . . . .	30	55	95	Sat
C % . . . . .	3.4	0.6	0.5	0.3
N % . . . . .	.03		—	—
C/N. . . . .	.113		—	—
Free iron % . . . . .	0.77	0.57	1.74	0.34

## Sawyerswood Series—Modal Profile

Location: Sawyerswood, Athy; 35/1 R 25-26  
 Topography: Flattish  
 Slope: 0  
 Altitude: 200 feet O.D.  
 Vegetation: *Juncus* infested *Carex* pasture  
 Drainage: Poorly drained  
 Parent Material: Calcareous, tenaceous till, of Weichsel age, composed mainly of limestone over gravels at approximately 11 feet.  
 Great Soil Group: (Podzolic) Gley (Typic Ochraqualf)

Horizon	Depth		Description
	inches	cm	
All	0-5E	0-14	Slightly peaty clay loam; dark greyish brown (10 YR 4 2); weak fine granular structure; moist friable to plastic; abundant roots; weakly calcareous; gradual boundary to:
A12	5i-10	14-25	Clay loam; greyish brown (2.5 Y 5/2) with abundant rust root mottles; weak medium subangular blocky structure; moist friable; plentiful roots; weakly calcareous; clear boundary to A2g and B2g
A2g	10-14*	25-37	(Intermittant horizon) clay; grey to light grey (5 Y 6/1) with few brownish yellow (10 YR 6/6) mottles; coarse prismatic structure breaking to medium subangular blocky; wet plastic; plentiful rush ( <i>Juncus</i> ) roots; clear boundary to:
B2g	10-19/28	25-48/71	Clay; light brownish grey (2.5 Y 6/2) on prism faces with yellowish brown (10 YR 5/8) and light brownish grey (2.5 Y 6/2) internally; coarse prismatic structure, moist, wet plastic to firm; plentiful rush ( <i>Juncus</i> ) roots; manganese-iron concretions prominent; weakly calcareous; clear boundary to B3g and Cg
B3g	25-44	64-112	(intermittant horizon—only occurs in part of profile which has prominent A2g); clay; mottled grey to light grey (10 YR 6/1) and yellowish brown (10 YR 5/6); coarse prismatic structure less prominent than in B2g; moist firm—plastic; sparse roots; strongly calcareous; abrupt boundary to:
Cg	19-44+	48-112+	Stony clay loam; brownish grey with abundant faint yellowish brown mottles; structureless; moist firm to hard <i>in situ</i> ; no roots; strongly calcareous.

Sawyerswood Series—Profile Analyses

Horizon	All	A12	A 2	B2g	B3g	Cg
Coarse sand %.	.13	12	8	5	7	12
Fine sand %.	24	25	20	13	14	20
Silt %.	32	32	31	37	25	42
Clay %.	31	31	41	45	54	26
pH.	7.4	7.2	7.5	7.7	8.2	8.4
C.E.C. meq/100g.	48.0	36.4	20.0	32.0	15.8	11.2
T.E.B. meq/100g.	36.3	28.5	22.7	18.5	18.8	12.5
Base saturation %.	76	78	Sat	58	Sat	Sat
C %.	9.1	3.9	1.0	0.5	0.3	0.3
N %.	0.92	0.45	0.13	—	—	—
C/N.	9.9	8.7	7.7	—	—	—
Free iron %.	0.5	0.6	0.9	3.2	1.7	1.0
T.N.V. %.	1.0	12	12	10	40.4	49.2

### Liffey Series—Modal Profile

Location: Ardrass Upper, Celbridge; 10/4 Z 31  
 Topography: Flat  
 Slope: 0°  
 Altitude: 195 feet O.D.  
 Vegetation: Old pasture  
 Drainage: Free-draining (subject to occasional flooding)  
 Parent Material: River alluvium  
 Great Soil Group: Regosol (Aquic Udorthent)

Horizon	Depth		Description
	inches	cm	
	0-10	0-25	Loam; dark brown (10 YR 3/3); moderate medium and fine subangular blocky structure; moist friable; plentiful roots; gradual boundary to:
	10-25	25-64	Loam; dark brown (10 YR 3/3); moderate medium granular structure; moist friable; plentiful roots; gradual boundary to:
	25-35	64-89	Silty clay loam to silt loam; very dark greyish brown to dark brown (10 YR 3/2-4/2); weak medium subangular blocky; moist slightly plastic; fair root supply; gradual boundary to:
	35-48	89-122	Silty clay loam; very dark greyish brown (10 YR 3/2); weak medium subangular blocky; moist slightly plastic; sparse roots; gradual boundary to:
	48-58	122-147	Sandy loam; light olive brown (2.5 Y 5/4) with very prominent manganese-iron concretions in upper portion; wet; no roots; abrupt boundary to:
	58 +	147+	Hard manganese-iron pan.

### Liffey Series—Profile Analyses

Depth (inches)	0-10	10-25	25-35	J5-48	48-58
Coarse sand % . . . . .	9	9	1	2	57
Fine sand % . . . . .	27	34	10	4	17
Silt % . . . . .	45	41	61	61	14
Clay % . . . . .	.19	16	28	33	12
pH . . . . .	5.8	6.2	6.5	6.6	6.7
C.E.C. meq/100g . . . . .	33.6	17.8	25.0	28.4	9.2
T.E.B. meq/100g . . . . .	.134	9.8	19.8	23.4	9.0
Base saturation % . . . . .	40	55	79	83	98
C % . . . . .	3.2	0.8	1.3	1.3	0.5
N % . . . . .	0.36	0.11	0.17	0.18	—
C/N . . . . .	9.0	7.3	8.0	7.2	—
Tree iron % . . . . .	.16	1.6	2.0	2.7	1.2
T.N.V. % . . . . .	0.0	0.0	0.0	0.0	0.0

## Daars Series—Modal Profile

Location:	Daars South, Sallins; 14/4 F-G 7
Topography :	Flattish
Slope:	1-2°
Altitude:	250 feet O.D.
Vegetation:	Meadow
Drainage:	Imperfectly drained formerly; now free draining as a result of artificial drainage
Parent Material:	Calcareous glacial till of Weichsel age composed mainly of limestone with some shale and sandstone
Great Soil Group:	(Podzolic) Gley

Horizon	Depth	Description
	inches      cm	
A1	0-10      0-25	Clay loam; greyish brown (10 YR 5/2) with few faint mottles; moderate medium granular structure; moist/dry friable; plentiful roots; fairly calcareous; gradual boundary to:
B2(t)	10-20/21      25-51/53	Clay loam; brown (10 YR 5/3) on ped surface with abundant yellowish brown (10 YR 5/6) mottles and blackish manganese-iron concretions; moderate medium subangular blocky structure; moist-dry firm <i>in situ</i> ; sparse roots; weakly calcareous; gradual boundary to:
C1	20-36      51-91	Clay loam; mottled grey (10 YR 5/1) dark greyish brown (2.5 Y 4/2) and olive brown (2.5 Y 4/4); structureless; moist/dry firm to hard <i>in situ</i> ; sparse roots; strongly calcareous; gradual boundary to:
C2	36      91	Similar to above but rather stony.

## Daars Series—Profile Analyses

Horizon	A1	B2(t)	C1	C2
Coarse sand % . . . . .	.15	13	5	20
Fine sand % . . . . .	.17	14	7	11
Silt % . . . . .	.40	45	45	49
Clay % . . . . .	.28	28	43	20
PH . . . . .	7.0	7.6	8.1	8.3
C.E.C. meq/100g . . . . .	12.0	15.0	16.6	9.2
T.E.B. meq/100g . . . . .	23.2	17.4	20.8	14.4
Base saturation % . . . . .	Sat	Sat	Sat	Sat
<b>C%</b> . . . . .	2.6	0.5	0.5	0.4
N % . . . . .	0.35	0.10		
C/N . . . . .	7.4	5.0		
Free iron % . . . . .	.12	2.2	2.1	1.7
T.N.V. % . . . . .	.12	1.7	23.6	38.6

## Painestown Series—Modal Profile

Location:	Painestown, Kilcock, 10/3 C 18-19
Topography:	Flattish
Slope:	0°
Altitude	250 feet O.D.
Vegetation:	Barley
Drainage:	Very poorly drained; now artificially drained
Parent Material:	Calcareous glacial till, of Weichsel age, composed mainly of limestone with some shales and sandstone
Great Soil Group:	Peaty Gley

Horizon	Depth		Description
	inches	cm	
A1	0-8/10	0-20/25	Peaty sandy loam to loam; very dark grey (10 YR 3/1); weak fine granular structure; moist friable; plentiful roots; calcareous; clear boundary to:
A2g	8-17/19	20-43/48	Sandy loam to loam with sandy pockets; grey (10 YR 5/1) with many prominent dark yellowish brown (10 YR 5/6) mottles; weak fine granular structure; moist friable; sparse roots; calcareous; gradual boundary to:
Bg	17-28/36	43-71/91	Loam to silt loam with sandy pockets; grey (10 YR 5/1) with many very large prominent dark yellowish brown (10 YR 5/6) mottles; weak medium subangular blocky structure tending towards structureless; moist firm <i>in situ</i> ; sparse roots; strongly calcareous; clear wavy boundary to:
Cg	28 +	71 +	Stony clay loam; blackish (5 Y 2/2) to dark olive grey (5 Y 3/2); structureless; moist firm; no roots; strongly calcareous.

## Painestown Series—Profile Analyses

Horizon	A1	A2g	Bg	Cg
Coarse sand %	.26	.22	.16	.17
Fine sand %	.30	.35	.16	.15
Silt %	.26	.26	.4S	.41
Clay %	.18	.17	.20	.27
PH	7.6	8.4	8.3	<b>8.4</b>
C.E.C meq/100g	40.2	17.2	9.2	9.6
T.E.B. meq/100g	35.0	15.8	11.0	11.6
Base Saturation %	.87	.93	Sat	Sat
<b>C %</b>	4.0	<b>0.5</b>	0.3	0.6
N %	.037			
C/N	.108			
Tree iron %	.11	0.8	1.3	1.9
T.N.V. %	.145	13.6	<b>54.0</b>	36.4

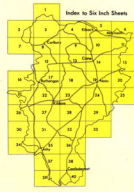
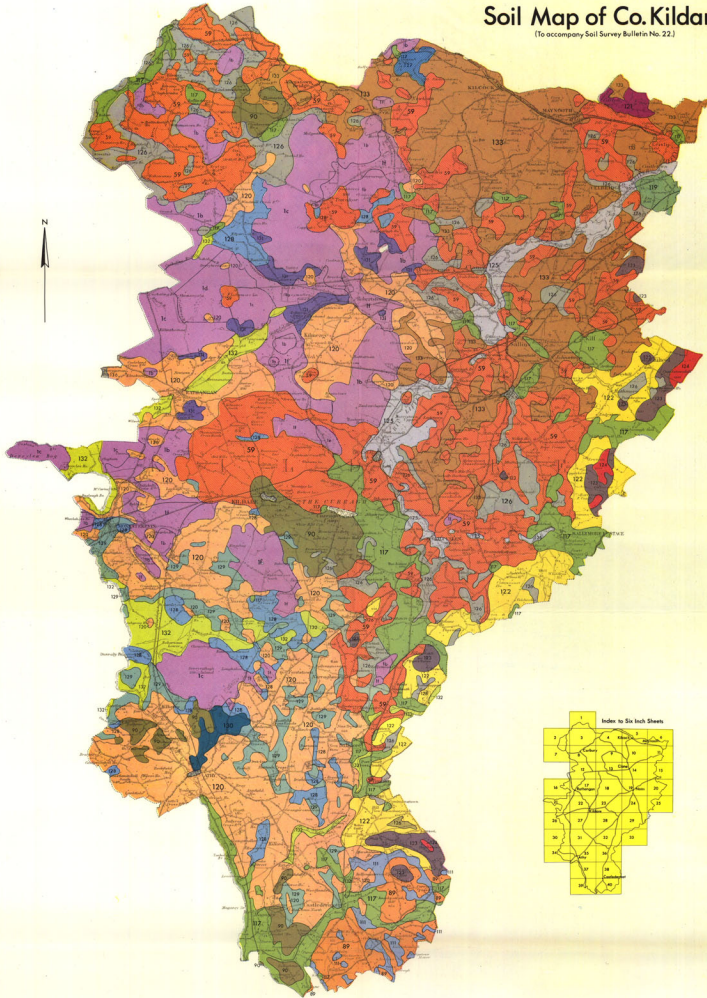
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### Soil Map of Co. Kildare

(To accompany Soil Survey Bulletin No. 22)



Great Soil Group	Grey Brown Podzolics						Brown Earths		Podzols	Regosols
	106	107	120	101	102	103	104	105	108	
Series	Donaghmore	Blun	Fennore	Orange	Kilmore	Kilmeacourt	Ministown	Highlands	Captownland	Ulton
Acres	1450	85,493	70,731	1380	6,640	10,650	12,400	5,480	1,080	9,040
Hectares	591	34,599	28,624	558	2,687	4,295	5,018	2,218	437	3,666
Per Cent of Total area	0.35	20.42	16.89	0.33	1.59	3.83	2.79	1.30	0.26	2.16

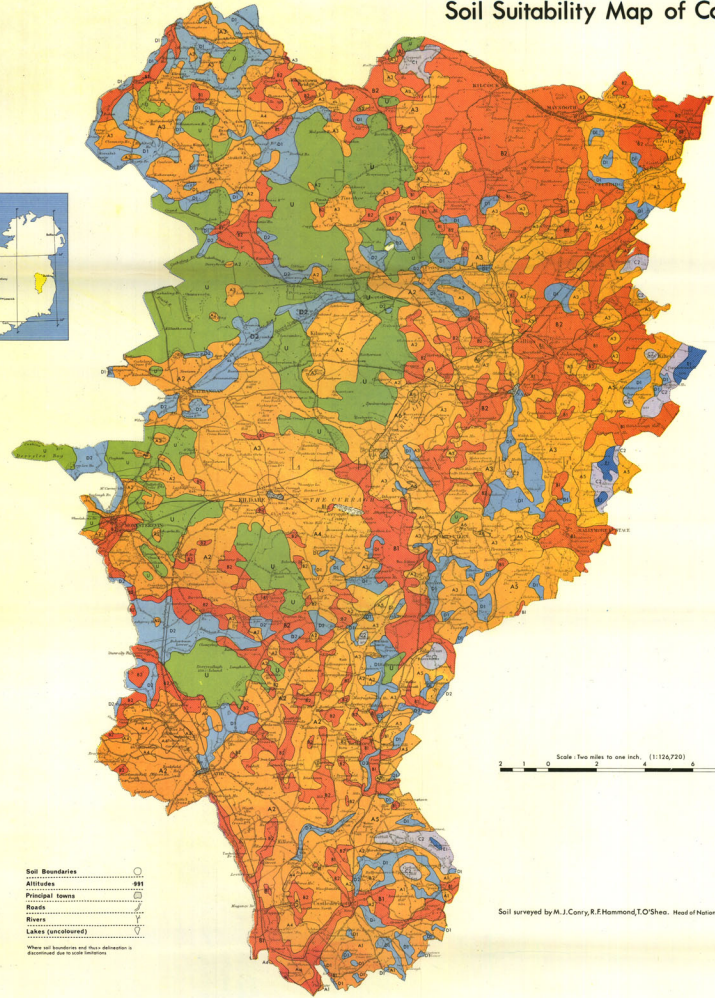
Numbers out of sequence refer to soils already mapped in other Counties

Great Soil Group	Clays					Complexes (mainly mineral soils)				Raised Bog		Fen Peat		Reclaimed Peat
	108	107	108	107	111	109	107	102	103	10	11	12	13	14
Series	Donnigan	Carleton	Kilpatrick	Ministown	Newtown	Seymourstown	Almwood	Ally	Rosary	Stoniton	Allen	Clonsilla	Black Bog	Black Bog
Acres	22,650	920	9,320	15,500	2,160	1,450	3,820	27,520	10,450	56,211	22,749	29,640	17,050	3,360
Hectares	9,146	375	3,772	6,259	874	591	1,546	11,157	4,233	22,749	9,222	6,904	1,319	440
Per Cent of Total area	9.40	0.22	2.23	2.99	0.52	0.35	0.91	6.57	2.50	13.42	7.04	4.08	0.77	0.11

Copies of this map and bulletin available from Publications Section, An Faois Teóilínis, 33 Merrion Road, Dublin 4. Price: Thirty shillings.

Cartography: J. Lynch, V. Skelton.

### Soil Suitability Map of Co. Kildare



Scale: Two miles to one inch (1:126,720) 0 1 2 3 4 5 6 Miles

Soil Boundaries  
 Altitudes  
 Principal towns  
 Rivers  
 Lakes (uncoloured)  
 When soil boundaries and their delineation is discontinuous due to scale reduction.

Soil surveyed by M. J. Conry, R. F. Hammond, T. O'Shea. Head of National Soil Survey, Parnce Ryan

MAP SYMBOL	SUITABILITY	USE-RANGE	Type of Limitation	Acres	Per cent of total area
A1			Local anomalies in soil multibedium levels.	6,640	1.59
A2			Marked deficit in very dry periods; sporadic occurrence of manganese toxicity.	70,731	16.89
A3			Features somewhat liable to poaching.	88,333	21.10
A4	Suitable for tillage, pasture, meadow and forestry.	Wide	Features somewhat liable to poaching; cultivation and harvesting difficult in unfavourable seasons.	12,400	2.97
A5			Features somewhat liable to poaching; some local high elevations and some steep slopes.	16,050	3.83
A6			Features liable to poaching; small portions subject to flooding.	8,060	2.16
B1	Suitable to moderately suitable for tillage, pasture and meadow; suitable for forestry.	Moderately wide to wide	Marked deficit in very dry periods; crop mature unevenly; some steep slopes.	27,520	6.57
B2			Liable to poaching; difficult to produce good till in wet spring and consequent late sowing and late harvesting.	78,023	18.64

MAP SYMBOL	SUITABILITY	USE-RANGE	Type of Limitation	Acres	Per cent of total area
C1	Moderately to poorly suitable for tillage, moderately suitable for pasture, meadow and forestry.	Somewhat limited	Liable to severe poaching; adverse physical properties.	920	0.22
C2			Somewhat high elevations and steep slopes; moisture deficit in very dry periods.	5,480	1.30
D1	Poorly suitable for tillage; moderately to poorly suitable for pasture and meadow; moderately suitable for forestry.	Limited	Serious drainage problem; adverse physical conditions; liable to severe poaching.	26,220	6.27
D2			High water-table in winter and spring.	14,280	3.41
R1	Unsuitable for cultivation, meadow or intensive grazing; moderately suitable for extensive grazing and forestry.	Very limited	Particularly low nutrient status; tramped formation; irregular drainage and root development; somewhat high elevation.	1,080	0.26
U	Unclassified			61,900	14.79

Based on the Ordnance Survey by permission of the Government. Printed at the Ordnance Survey Office, Dublin. March 1970

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