# SOILS OF CO. WESTMEATH

An Foras Talúntais
National Soil Survey of Ireland

Soil Survey Bulletin No. 33

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# SOILS OF CO. WESTMEATH

*by*

*T. F. Finch*

(Report compiled by T. F. Finch and M. J. Gardiner)

## National Soil Survey of Ireland

An Foras Taluntais

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## *PREFACE*

This publication, Soil Survey Bulletin No. 33, presents the findings of the soil survey of County Westmeath. It is one of a series of county soil surveys being carried out by the National Soil Survey of An Foras Taluntais (The Agricultural Institute) for the purpose of providing basic information which can be used in optimum land-use planning.

The field mapping was carried out at a scale of 1 : 10,560 (6 in. = 1 mile;9.5cm= 1 km) but due to scale limitation the detail mapped on the field sheets is not shown on the published soil map. Copies of the field maps may be inspected in the Soil Survey Office at Johnstown Castle, Wexford.

Mr. T. F. Finch was mainly responsible for this survey; he commenced work in the county in 1969 and completed the field investigations in 1973. Mr. S. Diamond gave assistance and advice in soil correlation, classification and land-use interpretation, and Mr. R. F. Hammond in peat classification. Mr. M. Bulfin contributed information on aspects of land-use in relation to forestry. Technical assistance was provided from time to time by Mr. T. Martin, Mr. T. Radford and Mr. A. Comey.

Various members of the staff of the National Soil Survey and of the Soils Division of An Foras Taluntais contributed to the bulletin; Mr. G. A. Fleming and Mr. P. Parle wrote the chapter on trace elements and Dr. J. Lee, the chapter on grazing capacity.

The analytical data in Appendix 11 were provided mainly by the laboratory staff of the Soil Survey Department (with assistance from the Soil Fertility and Chemistry Department) and the Plant Nutrition and Biochemistry Department.

The colour maps and various figures and plates were prepared by the staff of the Cartographic Section, National Soil Survey, Johnstown Castle, Wexford.

Dr. T. Walsh, Director of An Foras Taluntias, gave the survey his enthusiastic support. The bulletin was edited by Dr. E. Culleton. Mr. F. Fegan was responsible for the design and layout.

Assistance also came from a number of outside sources. Chapter VI11 was contributed by Mr. J. J. Gallen, C.A.O., Mr. J. Sheehan, Agricultural Advisor, and Mr. P Isdell, Deputy C.A.O., Co. Westmeath. In compiling the information on soil suitability, personnel in the local Agricultural and Horticultural Advisory Services gave valuable assistance. Climatic data were abstracted from the Meteorological Service records.

The colour printing of the maps was done 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.

Grateful acknowledgement is made to all those contributors mentioned here and to others who helped in various ways.

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Johnstown Castle,
Wexford.

April, 1977.

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CHAPTER 1

GENERAL DESCRIPTION OF THE AREA

**Location and Extent**

County Westmeath (Fig. 1), situated in east-central Ireland, lies between 53° 19' and 53° 48' north latitude and 6° 57' and 7° 58' west longitude.

The county occupies an area of 1,838.88 sq.km (710 sq miles) equivalent to 183,892 ha (454,409 acres). The principal towns are Athlone, Mullingar, Moate, Tyrellspass, Kilbeggan and Castlepollard.

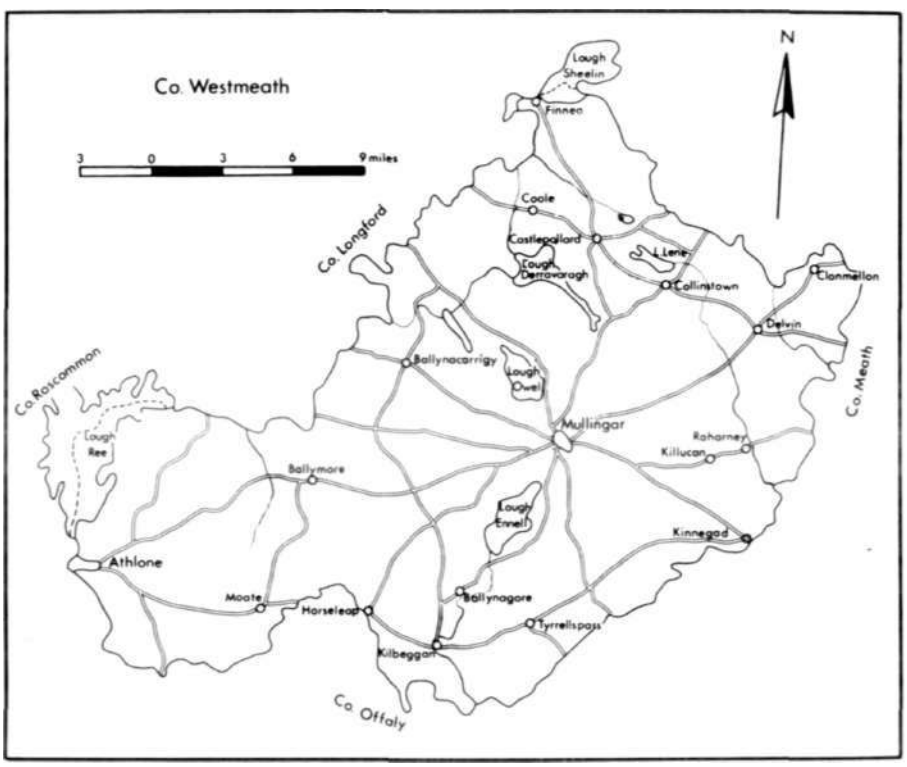



*Fig. 1: Co. Westmeath - geographical location and principal towns and villages*

## Topographic Features

The county consists largely of rolling topography. Mountains are almost absent, the highest point is at 280 m O.D. on the Hill of Mullaghmeen in the extreme north. Below this elevation the county can be divided into the following major topographic regions (Fig. 2).

(a) *Lowlands of the Inny river valley:* This region is relatively uniform in its lack of marked physical features and in its limestone geology, but some drumlins occur. In the north, near Finea there are moraines, and from here south as far as Ballynacarrigy, the river flows through great areas of raised bog. Other areas of cut-over raised bog exist down river as far as Lough Ree. Most of the region is above 60 m O.D.

(b) *Cherty limestone hill region:* This region is enclosed between Mullaghmeen Hill in the north-east and Multyfarnham, Mullingar and Collinstown. It consists of prominent hills topped with chert or cherty limestone. The hills frequently show crag-and-tail glacial phenomena. These tails of drift are aligned from north-west to south-east as are the rock ridges and the valleys. The hills reach over 260 m O.D. in the

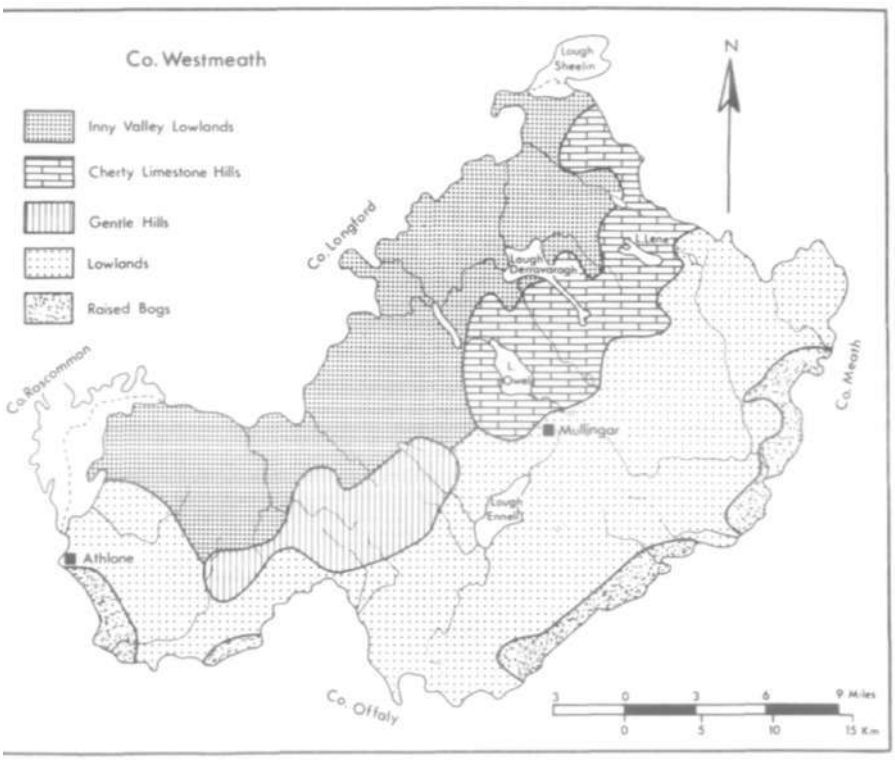



*fig. 2: Co. Westmeath -general topographic features*

north and fall to almost 150 m O.D. near Lough Owel. In the wide valleys, which are mostly aligned in a northwest-southeast direction, extensive peat deposits (mostly fen but with a few raised bogs) have developed.

(c) *Gentle hill region centered on the Hill of Usneach:* This region is enclosed between Rathcarrath, Ballymote, Mount Temple and Streamstown. These hills, whose maximum height is about 200 m, are mostly composed of limestone and are smooth and gentle. The areas between them are gently rolling with occasional north-west south-east ridges and a number of similarly aligned melt-water channels.

(d) *Lowlands of the east and south:* This region is generally flat but with many glacial depositional features such as moraines, eskers, kames and kettle holes. It is underlain almost entirely by limestone with the exception of two exposures of Old Red Sandstone, one near Moate and the other at Sion Hill, some four miles north of Killucan. Some beds of Upper Carboniferous shales occur east and north-east of Raharney close to the County Meath border. This region has elevations of about 60 m near Athlone in the west and rises gently towards the east and north to around 130 m.

(e) *Raised bogs of the Meath-Offaly border:* This region runs from east of Delvin past Kinnegad to Derrygolan and from south of Moate to the river Shannon. It is a distinct topographic entity consisting of a series of heather and *Sphagnum-covered* raised bogs, each of which may be two to four miles wide.

## Catchment Basins

The county is drained mainly by the river Shannon, through its tributaries, the Brosna and the Inny, with a small area just south of Athlone drained by the Boor (Fig. 3).

Tributaries of the Boyne, Athboy, Stonyford and Deel rivers, drain the eastern part of the county.

## Climate

Ireland has a typical west maritime climate with relatively mild, moist winters and cool, cloudy summers. For the greater part of the year maritime air associated with the Gulf Stream helps to moderate the climate. The prevailing winds are westerly to south-westerly. The average humidity is high. Average annual precipitation is highest on the west coast and in inland areas of high relief.

The information presented here on the climate of Co. Westmeath is based on records of the Meteorological Office.

### *Temperature*

Mullingar is the only temperature recording station in the county. Mean daily minimum and maximum temperatures recorded over the thirty year period (1931-1960) are shown in Table 1.

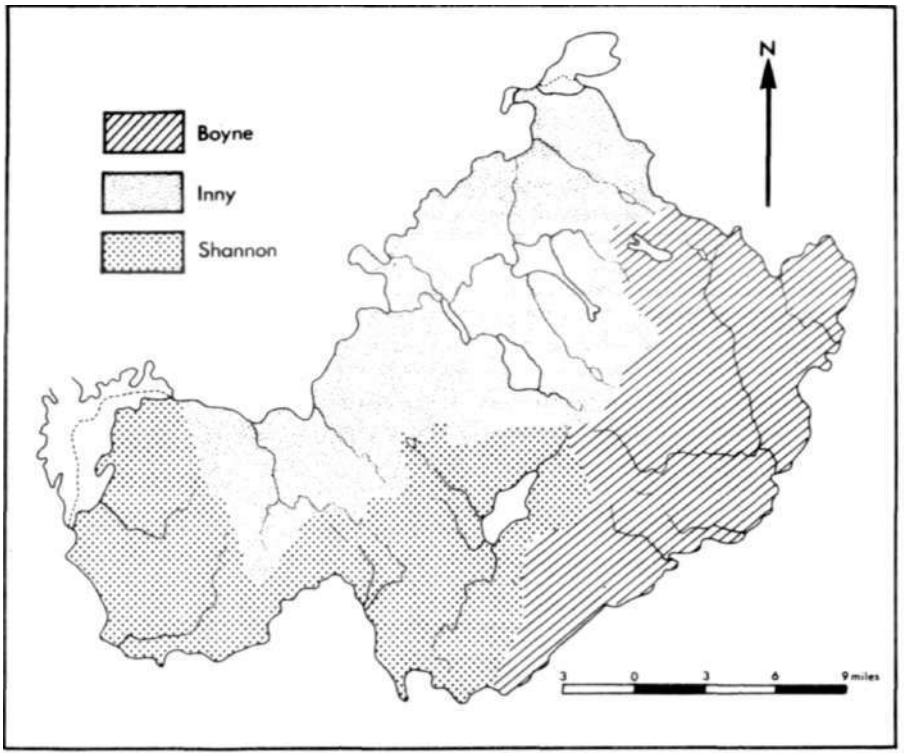



*Fig. 3: Co. Westmeath - rivers and their catchment basins*

**TABLE 1: Mean daily temperatures at Mullingar °C (1931-1960)**

| Mullingar | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean daily max. °C | 6.6 | 7.5 | 10.0 | 12.5 | 15.5 | 18.2 | 18.9 | 19.0 | 16.0 | 13.1 | 9.5 | 7.5 | 12.9 |
| Mean dafly min. °C | 1.1 | 1.4 | 2.6 | 3.9 | 6.1 | 8.9 | 10.6 | 10.5 | 9.7 | 6.0 | 3.2 | 2.1 | 5.4 |
| Mean | 3.9 | 4.5 | 6.3 | 8.2 | 10.8 | 13.6 | 14.8 | 14.8 | 12.7 | 9.6 | 6.4 | 4.8 | 9.2 |

*Frost*

The average latest date of spring frost (1947-1957) was April 28; the first date of winter frost, on average, was October 24.

*Rainfall*

Because of the absence of large variations in elevation the mean annual precipitation varies little within the county, (Table 2) ranging from 964 mm at Rathowen to 781 mm at Coole. Rainfall tends to be higher towards the west and north, while the relatively low rainfall is associated with the Shannon lakes area. Rainfall is evenly distributed over the year with the minimum occurring in April and a secondary dip in November.

**TABLE 2: Mean monthly and annual rainfall, 1961-1967**

| Stations | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (millimetres) | | | | | | |
| Athlone | 81.7 | 68.5 | 63.0 | 53.6 | 70.3 | 67.7 | 79.3 | 91.4 | 95.5 | 94.3 | 76.0 | 107.7 | 939.2 |
| Ballymore | 82.3 | 60.7 | 63.1 | 53.7 | 71.7 | 68.8 | 80.7 | 91.3 | 96.2 | 99.4 | 80.8 | 107.2 | 959.2 |
| Ballinacarrigy | 79.2 | 58.4 | 56.7 | 54.2 | 68.0 | 64.8 | 79.3 | 86.8 | 86.0 | 95.7 | 79.8 | 102.8 | 843.3 |
| Ballymahon | 70.2 | 50.5 | 53.3 | 46.4 | 61.0 | 56.4 | 76.2 | 74.0 | 88.3 | 86.2 | 70.0 | 93.6 | 822.3 |
| CastlepoUard | 84.7 | 56.9 | 53.9 | 48.2 | 51.2 | 71.9 | 86.0 | 82.7 | 93.6 | 89.4 | 77.2 | 106.6 | 912.4 |
| Castlctown-Geoghegan | 88.9 | 59.3 | 62.9 | 62.5 | 73.8 | 69.2 | 84.4 | 89.8 | 99.1 | 92.9 | 83.1 | 113.0 | 916.5 |
| Coole | 80.2 | 55.8 | 57.0 | 52.8 | 60.7 | 67.0 | 67.0 | 81.0 | 82.7 | 94.6 | 86.0 | 101.6 | 781.4 |
| Glasson | 77.0 | 53.7 | 57.2 | 52.0 | 64.5 | 66.2 | 76.0 | 86.6 | 94.9 | 93.3 | 75.5 | 99.2 | 869.0 |
| Kilbeggan | 78.4 | 57.1 | 59.4 | 56.2 | 66.2 | 60.7 | 82.1 | 81.6 | 89.9 | 90.8 | 74.2 | 100.8 | 902.3 |
| KUlucan | 84.9 | 64.3 | 65.2 | 57.8 | 67.4 | 62.7 | 79.7 | 82.3 | 94.7 | 97.4 | 87.3 | 101.0 | 941.3 |
| Moate | 78.7 | 60.1 | 53.4 | 51.9 | 69.2 | 65.8 | 90.3 | 88.7 | 94.1 | 96.8 | 72.6 | 104.4 | 921.1 |
| Mutlingar | 86.0 | 57.2 | 61.4 | 58.5 | 71.4 | 67.3 | 79.5 | 89.1 | 93.5 | 98.3 | 84.8 | 105.4 | 958.5 |
| Multyfamham | 87.3 | 58.8 | 66.5 | 56.9 | 65.2 | 70.1 | 86.4 | 89.5 | 95.5 | 97.7 | 75.3 | 105.5 | 946.0 |
| Rathowen | 84.1 | 61.3 | 61.0 | 55.2 | 69.7 | 69.2 | 85.4 | 95.4 | 93.7 | 100.2 | 85.0 | 108.3 | 964.4 |

CHAPTER 11

# GEOLOGY OF COUNTY

## Solid Geology*

The bedrock underlying Co. Westmeath is composed almost entirely of carboniferous limestone. The lower limestone series is generally pure but the middle and upper series contain a proportion of shale. The county is covered by deep deposits of glacial drift and rock exposures are rare.

Silurian shale and sandstone occurs as an inlier in the summit of a ridge a few kilometres north of Killucan; Devonian sandstone with shale is exposed in a few places on the same hill and also on a hill one kilometre north-west of Moate.

The rest of the county is underlain by Carboniferous strata. In the south the limestone, which is relatively pure, has been assigned to the lower limestone series for the most part, though this is based on very few observations, the principal exposure being that north east of Tyrellspass.

In the west the lower limestone exposed near Athlone becomes shaly towards the north until near Ballnacarrigy an exposure of pure shale occurs. Further north the calp limestone is found. In the Geological Memoir (1865) the area north of Mullingar and west of Castlepollard is described as follows: "No pure limestones are met with on the eastern side of the district but black and dark grey very impure earthy limestones occur, varying in thickness from flags of a few inches to beds three to four feet thick and having numerous beds of black shale and chert". This is typical of the area between the Hill of Mael and Lough Bane in the north and Mullingar in the south. The chert beds often form the summits of the hills in this region; between these beds shale and limestone occur intermittently. The Calp limestone is well exposed on the hills just north of Lough Owel and was quarried for flags at Bunbrosna. In the area east of the chert hills the Calp limestone changes into the relatively pure lower limestone series towards the south.

## Glacial Geology

The bedrock is overlain by a drift mantle laid down by the most recent of several ice sheets which covered the county. However, no traces of earlier glaciations were found.

The readvance phase of the Midlandian (Weichsel) Glaciation(l) covered the north of the county. This pushed as far southeast as the moraine at Athlone and ran northeast by the Hill of Usneach to Bunbrosna. Northeast and east of Bunbrosna the endmoraine of this readvance is broken up into a complex of retreat phases extending from east of Lough Lene towards Lough Sheelin in the northern tip of the county (Fig. 4).

***The co-operation of members of the staff of the Geological Survey of Ireland is gratefully acknowledged.***

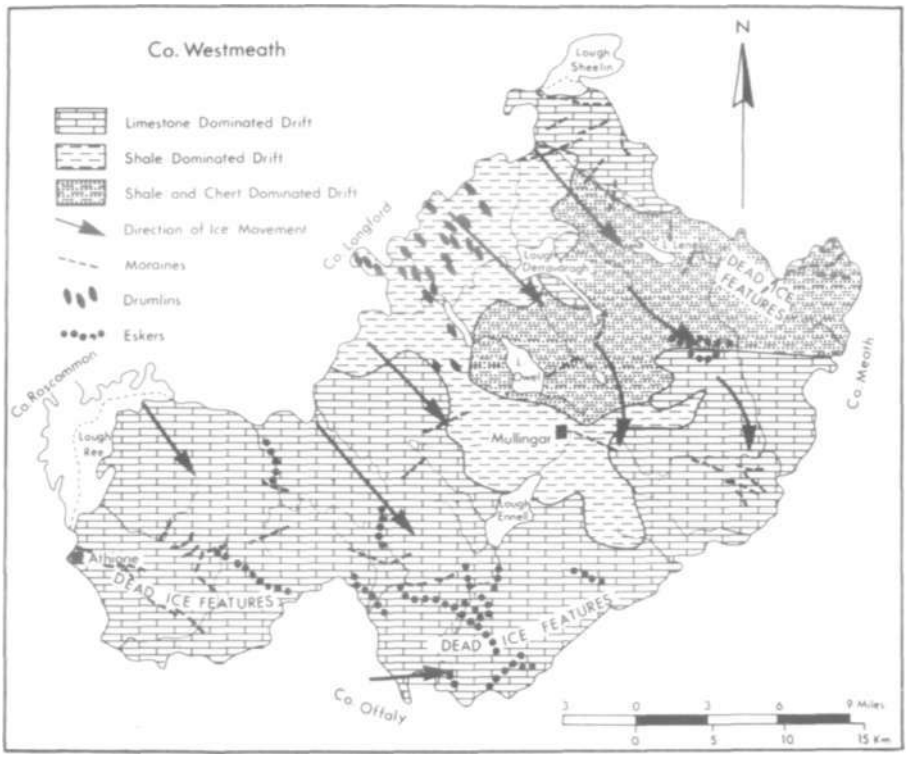



*Fig. 4: Co. Westmeath - glacial geology*

On the islands and peninsulas in Lough Ree drumlins reach down to within seven miles of Athlone. One drumlin occurs to the north of Ballymahon and two drumlin-like ridges to the west. The Co. Longford drumlin field continues from Ballynacarrigy through RatJiowen to Lismacaffry.

The shape of the lakes in the north of the county is probably related to the movement of the Midlandian ice sheet. Except for Lough Sheelin, which is partially dammed by the recessional moraine running through Finnea, the rest of the lakes are aligned in a northwest - southeast direction. The similar direction of ice flow can be seen in the drumlin alignment and in various striae on the cherty limestone hills that rise between the lakes. Lough Derravaragh, Glore and Lene certainly look like ice-gouged lakes between the harder cherty hills on either side.

Throughout these hills there are a number of melt-water channels, all trending south and southeastwards. The old Royal Canal follows one northwestwards from north of Lough Ennel; another, paralleled on one side by an esker, flows south by southeast through an old glacial lake along the river Tang. A similar feature occurs some two miles south of the Hill of Uisneach.

Southeast of a line through Athlone-Mullingar-Collinstown there is an area of mixed fluvioglacial and till deposits left by disintegrating ice. Isolated recessional moraines, usually less than a mile in length are common, such a moraine runs from southeast of Clonmellon in a southwesterly direction. Frequent lines of kames and kettle-hole topography are raised above the surrounding countryside (Plate 1). In other cases, e.g., south and southeast of Killucan. mounds of till occur in several individual clusters within the one area.

Areas of out wash materials are also common: one such deposit lies some two miles northeast of Milltownpass, another occurs south of Killucan in the complex of recessional moraines already mentioned.

The eskers. which form such distinct topographic features in the Westmeath-Offaly area, originate some three miles southwest of Delvin. For the most part they run southeastwards either as eskers or as crevasse fillings. However, in the extreme south below a line from Kilbeggan to Tyrrellpass a number run eastwards and northeastwards.

A second area of moraines running east-west, tiirough Ballynahown and from Athlone to Kilcleagh Park, indicates a separate centre of ice disintegration with its attendant moraines, eskers and other dead ice features.

*Plate 1: Kame and kettle topography*

The 'Drumlin End Moraine', deposited by a readvance of the late Midlandian glaciation, crosses the county from Lough Sheelin to Athlone. Drumlins occur to the northwest while morainic deposits, crevasse fillings, eskers, kames and kettle holes lie to the southwest.

Shale-dominated drifts occur on the north and western shores of Lough Sheelin. The limestone content increases towards the east and seems to be related to the width of the lake which has a limestone base. The lower Palaeozoic shales of the northern shore influence the drift as far south as Ballynacarrigy.

The ice which overran the hills around Multyfarnham, Castlepollard and the Hill of Mael became charged with cherty limestone debris. The cherty till deposited reaches southeast of these hills as far as Clonmellon, Delvin and the east side of Lough Ennell.

The limestone areas north of Athlone and east as far as the Westmeath border are relatively uniform in lithology. As a result the drifts are consistently high in limestone and the soils developed are of predominantly limestone composition. To the northwest of Mullingar an increase in the shale content in the drift is reflected in the soil types occurring.

*].Synge, F. M. (1950). The glacial deposits around Trim, Co. Meath. Proc. Roy. Irish Acad., 53 B, 99-110*

CHAPTER **111**

# SOIL SURVEY METHOD

Soil survey and classification require detailed descriptions of the various layers of soil which are exposed in any vertical section. The criteria used for differentiating between such layers and the reasons for their occurrence, together with details of the soil survey method, are summarised here.

## 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 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 (Fig. 5). 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 (0 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. Where horizons need to be sub-divided on the basis of significant 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 processes of soil formation that have been operative and they present a picture of the true nature and salient characteristics of a soil which are important in its use and management.

*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

*See Appendix 1

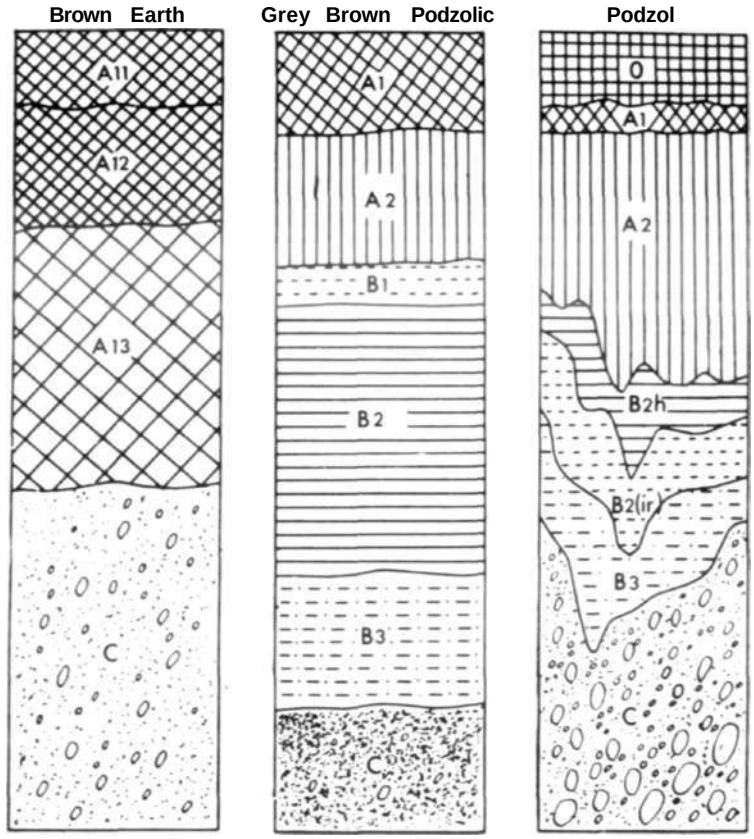



*Fig. 5: Diagrammatic representation of hypothetical soil profiles showing horizon sequence*

other constituents besides. Two sub-divisions of the A horizon are commonly made, namely, Al and A2. Either the Al or both may be represented in a profile. The Al is a surface mineral 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. The A3 signifies a transition zone between the A and B horizon.

*The B horizon*: This horizon lies immediately beneath the A and corresponds closely to the so-called 'sub-soil'. 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 horizons. 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 pronounc-

ed 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 constitutents within the B horizon, several divisions of the horizon, e.g., Bl, 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. Bl and B3 denote transitional 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 (podzolised) mineral soils. Where little or no decomposition has taken place the symbol 01 is used; 02 denotes more advanced decomposition. The organic matter content of 0 horizons is commonly several times greater than that of the underlying mineral horizons or of surface A horizons.

During die survey of any area, profiles typical of each soil are selected for special study. Fresh pits are opened for this purpose. The depth of pit varies according to soil depth but in Co. Westmeath is usually about one metre. 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 hard-pans 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 11.

## Soil Mapping

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.

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.

Although it is true that great variability exists, the distribution of soils 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 Series*

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

*Soil Variants*

Variants are separate soil series that are too small in extent to be shown at certain scales of mapping. A soil which is recognised and defined as a variant in one survey area, however, may be designated as a separate series later in another area, depending on its extent.

*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. Several such phases have been segregated in Co. Westmeath.

*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 *Vi* 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 Co. Westmeath, 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, introduced 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 a scale of 1:126,720 it is possible to show a minimum area of 25 acres. This means that 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.

## CHAPTER IV

## THE SOILS AND THEIR USE-RANGE

Twenty-three soil* series have been recognised and mapped in Co. Westmeath. The soil series has been defined in the previous chapter. The different series have been given geographic names based on the location in which particular soils are best exemplified or are most widely found. Frequently the series name occurred in a previously surveyed county, e.g., Elton Series occurs in Elton in south-east Limerick and is named after the area where it was typically developed. Fifteen soil complexes, three phases and seven soil variants have also been recognised and described, the phases and variants are included within the series to which they are related.

Soils can be classified on a broad scale into great soil groups, each of which consists of a collection of closely related soil series. Each great soil group consists of soils sharing one or more distinguishing feature in common. A certain latitude in profile variation is permissable at this level of classification, but there is an overall similarity of quite a high order. The great soil group is not confined to one particular geological parent material since soils are classified on the basis of profile characteristics.

The descriptions of soil series mapped in Co. Westmeath are arranged according to great soil groups in the following pages; soil derived from alluvial deposits, complexes and variants are treated separately. Table 3 shows the soil series grouped into great soil groups. The extent of each series and group as a percentage of the total area of the county is also given. Soil variants are also classified according to great soil groups (Table 3).

The main soil parent materials occurring within the county and the different series separated on them are shown in Table 4.

### 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 be classified as a Grey Brown Podzolic, a soil must have a B horizon significantly higher in clay content than the A or C horizons; this is then termed a textural B or Bt horizon. The occurrence of clay skins on the structural ped surfaces within the Bt horizon is a further characteristic. These soils normally show a proportion of limestone in the parent material.

In general, the grey brown podzolic soils possess a somewhat heavier texture than the brown earth or brown podzolic soils; they are well to moderately well drained, possess a moderately well developed structure and are usually moderately acidic to neutral in reaction. The organic matter content in the soil is medium to high and the humus is of the desirable mull type.

•The Crush Series has not been mapped separately but is included in the Baggotstown - Crush Complex; the Finnea Series occurs only within the Finnea - Banagher - Allen Complex

TABLE 3: Oassification of soils into great soil groups and the relative extent of each group in Co. Westmeath

| Great Soil Group | Series and Phases | % of total area |
|---|---|---|
| Grey Brown Podzolic | Elton | 0.53 |
| | Mortarstown | 0.05 |
| | Patrickswell | 30.36 |
| | Patricks well Bouldery Phase | 0.64 |
| | Rathowen | 9.29 |
| | Rathowen Cherty Phase | 9.62 |
| Brown Podzolic | linnea* | |
| Brown Earth | Baggotstown | 0.31 |
| | Ballinacurra | 0.13 |
| | Ladestown | 0.28 |
| Rendzina | Burren Deeper Phase | 0.11 |
| | Crush* | |
| Lithosol | Knockeyon | 0.08 |
| Regosol | Milltown Pass | 0.11 |
| Gley | Bally shear | 0.19 |
| | Howardstown | 2.50 |
| | Mylerstown | 0.16 |
| | Street | 2.07 |
| | Camoge | 1.03 |
| | Coolalough | 0.57 |
| | Drombanny | 0.24 |
| Peats | Banagher | 5.98 |
| | Pollardstown | 0.36 |
| | Allen | 3.64 |
| | Gortnamona | 4.31 |

ily as part of soil complexes on the map

| Great Soil Group | Soil Variant |
|---|---|
| Podzol | Knockeyon-Slightly Peaty Podzol |
| | Rathowen Cherty Phase-Podzol |
| Grey Brown Podzolic | Patrickswell-Shallow |
| Brown Earth | Rathowen-Brown Earth |
| | Rathowen Cherty Phase-Brown Earth |
| Gley | Howardstown Lithic |
| Podzolic Gley | Street Podzolic Gley |

Under Irish climatic conditions, the lighter-textured members of the grey brown podzolic group are good all-purpose soils. When adequately manured and managed they are very productive under most agricultural enterprises. The heavier textured members are more suitable grassland soils, responding well to good manurial and management practices. In the north west of the county the somewhat weak structure of these soils limits their use range to grassland, with tillage possible only under good management. Pasture utilization of these heavy soils also demands a high standard of grazing management.

The grey brown podzolic soils are generally not available for forestry but should be highly productive for this purpose.

TABLE 4: Soils in Co. Westmeath grouped according to parent materials

| Soil Series | Parent Materials |
|---|---|
| Ballinacurra<br>Bally shear<br>Elton<br>Howardstown<br>Patrickswell<br>Mortarstown<br>Mylerstown | Glacial till of predominantly limestone composition |
| Baggotstown<br>Crush | Fluvioglacial materials of predominantly limestone composition |
| Burren | Limestone bedrock |
| Rathowen<br>Street | Glacial till composed of limestone and shale |
| Rathowen Cherty Phase | Glacial till composed of limestone, shale, and an admixture of chert |
| Ladestown | Fluvioglacial materials composed of limestone, shale and chert |
| Knockeyon | Carboniferous chert bedrock |
| Camoge<br>Coolalough<br>Milltownpass | Alluvium derived principally from limestone |
| Drombanny | Peat over marl over lake alluvium |
| Allen<br>Banagher<br>Gortnamona<br>Pollardstown | Organic |

*Elton Series*

This series occupies 0.53% (934 ha, 2,307 acres) of the county and occurs principally on glacial till and also in the inter-kame areas in kame-and-kettle topography. Within the county this soil frequently occurs associated with the Patrickswell, Baggotstown, Howardstown series and with peat, and occasionally with Burren Series Deeper Phase. With these series it occurs frequently as a minor part of a soil complex. It is usually found on flattish topography with slopes rarely exceeding 5°. The soil is classed as a minimal grey brown podzolic, since the clay content in the Bt is rarely more than 2 to 3% greater than that in the A horizon.

The soils are well drained and are generally of gravelly loam to clay loam texture but may vary to sandy loam or sandy clay loam. The Al horizon is normally 20-46 cm in

depth and dark brown to brown in colour. The B2t horizon may be 25 to 51 cm thick. In the B2t horizon clay movement is evidenced by the coatings on the vertical structural cracks and the occasional clay skins on the finer peds. pH values are high, despite leaching through rainfall.

*Soil Suitability:* These soils have a wide use-range. They are highly productive grassland soils and can be grazed over a long season but good management is necessary to exploit them to the full, because of their somewhat weak surface structure. Despite good drainage, soil waterholding properties would dispose them to poaching and surface compaction if stocked during wet periods.

High yields of cultivated crops, including cereals, roots and vegetables can be obtained but lodging of wheat may be a problem. Due to structure deterioration under tillage a short rotation is desirable.

Profile description and analysis - Appendix 11, p. 65.

*Mortarstown Series*

In Co. Westmeath this series, which occupies 0.05% (85 ha, 210 acres) of the county, is associated with kame and kettle topography and especially with esker regions. Because of the highly variable pattern of soil formation on these parent materials this series seldom forms large individual units. It occurs in the kettle holes where considerable late-and post-glacial infill of fine material has occurred. Because of its topographic association it occurs mainly as a member of a soil complex. The main characteristic of this soil is its heavy texture. It consists of a clay loam to gravelly clay loam over a Bt horizon of clay texture. The structure in the surface is weak. This gives it a reputation of not being a good tillage soil.

*Soil Suitability:* These soils have a somewhat limited use-range. They are highly adapted to grass production and have a high stock carrying capacity. However, this presupposes good management practices because under heavy stocking in wet weather poaching occurs.

The high water-holding capacity of the clayey Bt horizon may cause lodging in cereals but high yields can be obtained under good management in climatically favourable years. The weak structure also entails short rotations under cereals with the emphasis on grass.

Profile description and analyses - Appendix 11, p. 66.

*Patrickswell Series*

This series occupies 30.4% (53,200 ha, 31,404 acres) of the county. It is the most widespread of the limestone soils in the county, stretching from near Delvin in the east, to Kinnegad, Kilbeggan, Mullingar and Ballinacarrigy. It is also associated in complexes with other limestone soils (Plate 2). This soil occurs dominantly on glacial till but in places has a fluvioglacial content. Slopes in these areas are generally 2 to 5°.

Surface textures of loam to silt loam overlie a Bt horizon with a clay loam to silty clay loam texture. In contrast to Limerick and Gare the soils in this series in Westmeath usually have a higher silt content due to the greater amount of shale in the parent material. However, in certain areas, especially where there has been fluvioglacial influence the texture is generally loam over clay loam. The structure is well developed and the pH is normally high. The soil is well drained.

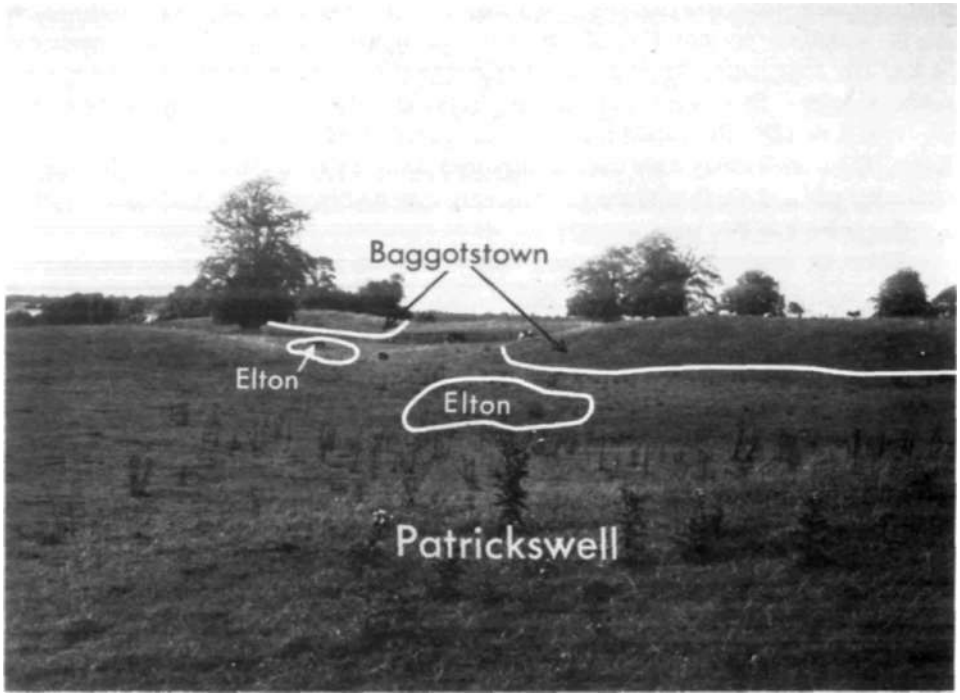



*Plate 2: Complex association of limestone-derived soils*

The soil has a wide use-range and is suitable for both tillage or pasture but the structure, though more stable than that of Elton Series, can deteriorate under constant tillage. For this reason good management is required. Because of the good drainage, these soils have a wide use-range but poaching and compaction are frequently visible under grazing.

Profile description and analyses - Appendix 11, p. 67, 68.

*Patrickwell Series - Bouldery Phase*

The phase is similar to the series except for the presence of many limestone boulders both within the soil and on the land surface. This considerably reduces the use-range, which is mainly confined to pasture. It occupies 0.64% (1,120 ha, 2,768 acres) of the county.

*Patrickwell Series - Shallow Variant*

This variant occurs chiefly in the southern part of the county, close to the Offaly border. It is frequently found on excessively-drained outwash deposits associated with eskers. The texture is a little lighter and depth to the C horizon is only 30-45 cm.

The use-range is somewhat narrower than in the series since the soils are more liable to drought.

*Rathowen Series*

This series occupies 9.29% (16,277 ha, 40,221 acres) of the county and is found in the west

and northwest, from Ballynacarrigy to Lough Sheelin, and in the east as far as the line of cherty limestone uplands (Fig. 2). It is associated with Patrickswell and Baggotstown Series. The topography varies from drumlin or drift ridges to till plains and kame and kettle moraines. This means that the series is associated with a wide range of slopes ranging from 0 to 12°. The parent material is composed mainly of limestone with about 25% shales. These shales may have been transported from the Ordovician shale, siltstone and sandstone of Co. Longford to the north or they may be derived from local bedrock which is rather impure in this area.

These are moderately well-drained soils of medium pH status. They are usually 80 to 110 cm in depth but in places may be less than 60 cm. In the shallower situations the Bt horizon is not well developed. Surface texture is gravelly loam while the Bt horizon is generally clay loam. Structure is weak and water-holding capacity is high.

*Soil Suitability:* This soil has a limited use-range and is suitable mainly for pasture. Because of the weak structure and high water-holding capacity good pasture management is essential. The soil is liable to poaching and compaction if grazed when wet.

Profile description and analysis - Appendix 11, p. 69.

*Rathowen Series - Cherty Phase*

This phase covers 9.62% (16,842 ha, 41,614 acres) of the county. The soil is moderately well drained with weak structure and high silt content. It is associated with the chert-rich shaly limestone of the Hill of Mael and the line of hills south as far as Mullingar. There is a layer of chert gravel at around 15 cm depth and frequently the chert content is high throughout the profile. The shale and limestone content, however, rise as depth increases. As in the series the clay increase in the Bt horizon is less where the soil is shallow.

The pH of these soils is low, despite the limestone in the parent material. The Al horizon is 10 to 25 cm in depth above a 20 to 25 cm thick B2t horizon; structure is weak. The C horizon generally shows mottling at 60 cm.

*Soil Suitability:* This phase, with its weak structure, high water-holding capacity and high silt content is liable to poaching and to compaction. It has a limited use-range. Tillage can be carried out. but trafficability is a problem in wet seasons: for this reason it is more suited to pasture.

Profile description and analyses - Appendix 11, p. 70.

*Rathowen Cherty Phase - Podzol Variant*

This variant occurs throughout the cherty phase wherever drainage is excessive. It is most commonly found on the coarse-textured recessional moraines and on kame crests in the northwest around Collinstown and as far southeast as Clonmellon and Delvin. In these situations the limestone has been removed through leaching and a podzol formed on the base-deficient chert parent material. This soil occurs in areas too small to delineate at the scale of mapping used.

*Soil Suitability:* This soil is similar to the cherty phase in its use-range.

Profile description and analyses - Appendix 11, p. 71.

*Rathowen Series - Brown Earth Variant*

This variant occurs occasionally throughout the Rathowen Series and is of very limited extent. Its occurrence is related to an increase in the proportions of shale in the parent

material. The soils are well drained with a.well-structured brown to dark-brown Al horizon. The Bl horizon which occurs between 28 and 40 cm depth has a weak prismatic structure. Solum depth is about 100 cm.

*Soil Suitability:* This soil is suitable for grass production and forestry.

Profile description and analyses - Appendix 11, p. 72.

*Rathowen Cherty Phase - Brown Earth Variant*

This variant occurs through the cherty phase of the Rathowen Series and has the characteristic layer of cherty gravel at about 10 cm. The dark-brown loamy Al horizon generlly has a good structure but the Bg horizon, which occurs at about 35 to 58 cm, shows a much weaker structure, a silt loam texture and fine mottling. The soil varies from well-drained to imperfectly drained.

*Soil Suitability:* This soil has a similar use-range to the phase.

## Brown Earth Group

The brown earths are relatively mature, well-drained, mineral soils possessing a rather uniform profile, with little differentiation into horizons. Since they have not been extensively leached or degraded there is no evidence 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.

Some brown earths are derived from parent materials poor in lime or other 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 distinguished 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 also develop on lime-rich parent materials under conditions conducive to excessive depletion of bases.

Brown earths normally possess medium textures (sandy loam, loam, sandy clay loam), 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 can support high quality grassland and are also ideally suitable for a wide range of forest tree species.

*Baggotstown Series*

This series is of limited extent as single landscape units occupying 0.31% (546 ha, 1,350 acres) of the county. However, it also occurs widely in complexes*. It is found over fluvioglacial sands and gravels of predominantly limestone composition. This series occurs in association with Patrickwell. Howardstown, Elton and Mortarstown Series and also in complexes with these series. The soils are shallow, usually less than 50 cm, and are excessively drained; textures vary from gravelly loam to gravelly sandy loam. The pH values are high and roots are well developed.

*The reason for the complex soil distribution pattern is discussed on p.

*Soil Suitability:* These soils have a wide use-range. They are suitable for tillage and pasture, but because of their coarse texture they can be affected by drought in dry periods. They are very suitable for early and late grazing but will not always sustain growth throughout the summer.

Profile description and analyses - Appendix 11, p. 73.

*Ballinacurra Series*

This series occupies 0.13% (219 ha, 540 acres) of the county. It occurs mostly as a member of a complex in which it is closely associated with the Burren, Elton and Patrickswell Series. It occurs separately also at altitudes generally less than 90 cm on rolling landscape with occasional steep slopes. Parent material consists of shallow drift, composed mostly of limestone with sandstone and shale as impurities, and varying in depth from 15 to 46 cm over the limestone bedrock.

The soils are of loam, gravelly loam and silt loam texture and are well to excessively drained. The top soil is friable but the structure and consistence deteriorate in the B horizon. Roots are abundant and penetrate to the bedrock on which there is occasionally a thin coating of humic material.

*Soil Suitability:* This soil has a limited use-range. Its shallowness and frequent rock exposures preclude tillage except on a very limited scale. Excessive drainage in places may limit production in dry spells but pasture can be grazed over a long season with little danger of poaching. The soil is not generally suited to forestry, except in the deeper phases where larch and Scots pine are the most suitable species.

Profile description and analyses - Appendix 11, p. 74.

*Ladestown Series*

This series covers 0.28% (494 ha, 1,220 acres) of the county and occurs on kames composed of shales, chert and limestone. The soils are of silty clay loam to silt loam texture. They are relatively shallow, being only 30 to 40 cm in depth, and are excessively drained.

The series is frequently associated in soil complexes with Rathowen Cherty Phase, and Podzol Variant, Patrickswell, Howardstown, Camoge Series and with peat in some cases.

*Soil Suitability:* This series is of limited use-range being handicapped by the high silt content and the possibility of poaching, despite its shallow depth. It is used almost entirely for pasture.

Profile description and analyses - Appendix 11, p. 75.

## Rendzina Group

These are shallow soils, usually not more than 50 cm deep, derived from parent material containing over 40% carbonates. The surface horizon is dark in colour with a moderately strong structure and neutral to alkaline reaction. A calcareous (B) horizon may be present. Drainage is always free to excessive.

Where they are sufficiently deep, rendzinas are suitable for tillage and pasture but in many places lack of soil depth precludes tillage.

*Burren Series - Deeper Phase*

This phase occupies only 0.11% (186 ha, 460 acres) of the county and is usually less than 25 cm in depth. It generally occurs on the crests of some of the steeper hills where chert is absent. It is also found in areas between Horseleap and Kilbeggan at elevations of only 67 to 76 metres where limestone comes to the surface.

These excessively-drained soils of organic, silty clay loam texture have a high pH value. The profile consists of a dark brown A horizon with moderate crumb structure. Limestone bedrock outcrops frequently; roots are abundant.

*Soil Suitability:* These soils have a limited use-range due to their shaUowness and frequent rock outcrops. Conventional tillage is not practicable and grazing, particularly overwintering of livestock is common. Forestry is generally not feasible.

Profile description and analyses - Appendix 11, p. 76.

*Crush Series*

This soil occurs frequently along the steeply sloping crests of eskers (Plate 3) but because it is present only in small enclaves, it was not possible to delineate it at the scale of mapping employed. It is excessively drained due to the loamy sand texture of the fluvioglacial parent material, which is composed mainly of limestone with a proportion of shale in places.

These are shallow soils, (30 cm in depth) of excessive drainage, and with high pH values. The soil shows a good structure, and root development is excellent.

*Soil Suitability:* This soil has a limited use-range, mainly because of the steep slopes and its liability to drought in dry periods. For these reasons it is usually kept under pasture. Unless properly managed it reverts very quickly to scrub (hawthorne, gorse and hazel).

Profile description and analyses - Appendix 11, p. 77.

## Lithosol Group

This group consists of skeletal, stony soils, often of an organic nature, overlying, in most cases, solid or shattered bedrock. Generally, such areas have frequent rock outcrops. Lithosols are usually associated with podzols and climatic peats at higher elevations. Their use-range is limited mainly to rough grazing but forestry may be practicable in places.

*Knockeyon Series*

This soil covers 0.08% (144 ha, 355 acres) of the county. It is found only on the crests of the cherty limestone hills (Plate 4) so that although its occurrence is frequent its extent is limited. Frequently the areas are too small to be shown on the soil map.

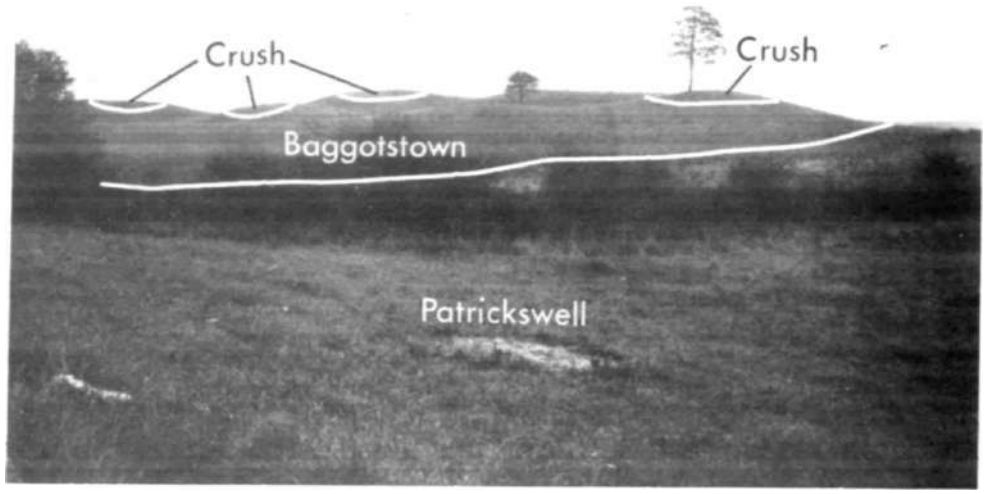



*Plate 3: Intricate distribution pattern of soil series on eskers*

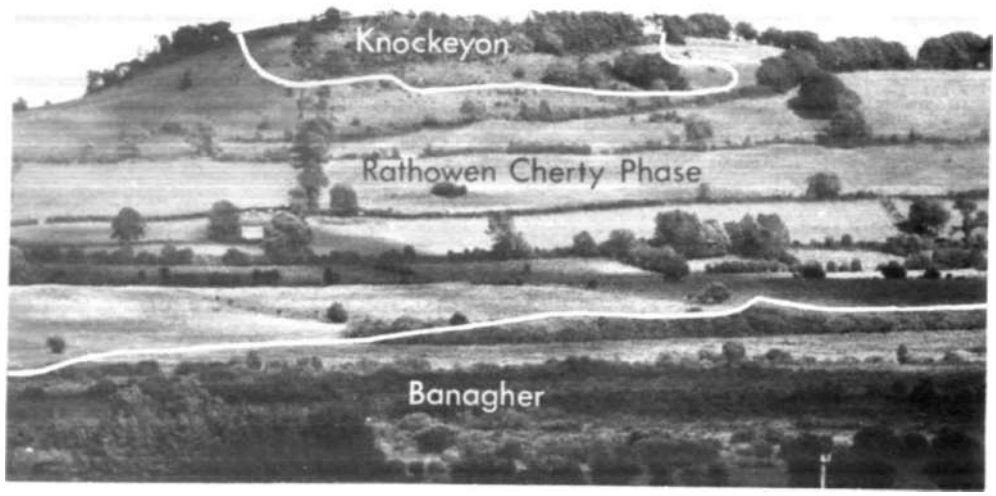



*Plate 4: Distribution of soils around cherty limestone hills*

The soil is usually less than 25 cm in depthand consists of an organic silt loam overlying rock which may be shattered in places. Structure is excellent and root development is very good. pH values are low.

*Soil Suitability:* This series has a very limited use-range. It is only suitable for pasture and even then is handicapped by drought at times due to the shallowness of the soil. Local experience indicates cobalt and copper deficiency in the soil and care must be taken to supplement the animal diet.

Profile description and analyses - Appendix 11, p. 78.

*Knockeyon Series - Slightly Peaty Podzol Variant*

This variant occurs sporadically downslope from the series in the same region and occupies areas usually less than one hectare in extent. It is generally found where fine material has been translocated from the soil upslope giving rise to a deeper soil than in the series.

This soil, which is of clay loam texture in the surface, is strongly leached and has a relatively low pH. Drainage is good, with a tendency towards excessive on steep slopes.

*Soil Suitability:* Because of its greater depth this soil has a wider use-range than the Knockeyon Series but it is of very limited extent.

## Regosol

This group comprises mineral soils which are immature and show no distinct horizon development. The soils occur mostly in lowlying flat areas along river courses and at river estuaries, but they are also found on young deposits such as aeolian (windblown) sands. Depending on the source of the deposits such soils may vary in nutrient status and also in physical and drainage characteristics.

*Milltownpass Series*

This soil covers 0.11% (194 ha, 479 acres) of the county. Being formed from river alluvium it is confined to narrow strips along the river courses and to one extensive area south of Milltownpass along the small Milltown river. It is classified as a well-drained regosol. It consists of a well-drained very dark brown silty clay loam, with good structure, over a very dark grey sandy loam with single grain structure.

*Soil Suitability:* Due to danger of flooding this soil has a limited use-range. It has good potential for grass production and its rapid permeability and good structure enables grazing to commence early in spring. Where the water-table has been lowered by arterial drainage the soil may be suitable for tillage.

Profile description and analyses - Appendix 11, p. 79.

## Gley Group

Gleys are soils in which the effects of drainage impedance dominate and which have developed under conditions of permanent or intermittent water-logging. The impeded condition 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 some places, by both of these factors, together with excess run-off from higher slopes. For these

reasons, 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 it is 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 groups, depletion of bases and other constituents is not so pronounced. Usually, however, rooting depth is limited, aeration poor, rate of decomposition of organic matter slow and many other unfavourable features prevail.

In podzolised gleys there is evidence of soil formation processes similar to that of brown podzolics or podzols; podzolic gleys refer to soils displaying evidence of grey-brown podzolic characteristics associated with gleying.

The majority of gley soils have weak structure, and in the wet state tend to become very sticky. Due to their poor physical properties these soils, except in very favourable seasons, present difficulties in cultivation especially in the development of a desirable tilth. The 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 sward utilised. Despite their physical short-comings, 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. Many could have much greater yields if drained and manured. However, windthrow caused by poor root penetration is a common hazard.

*BaUyshear Series*

This soil covers 0.19% (349 ha, 863 acres) of the county in the areas between Mylerstown Series and the cutover bogs. It is developed on limestone drift.

It has a black, slightly peaty surface layer with good crumb structure overlying a greyish-brown, massive A2 horizon. The Btg horizon consists of a very dark greyish-brown, gravelly, clay loam with moderate structure overlying the parent material at about 50 cm. *Soil Suitability:* These soils have a limited use-range due mainly to their low-lying position in the landscape and consequent poor drainage. They are suited mainly to grass production which, because of the poor drainage, requires good management for optimum utilization.

Profile description and analyses - Appendix 11, p. 80.

*Howardstown Series*

This series is widely developed over limestone drift parent material and covers 2.50% (4,383 ha, 10,830 acres) of the county. It is classified as a podzolic gley but the Al and A2 horizons are frequently inter-mixed. These soils occur in badly-drained hollows and around the edges of former lakes which have since been drained, principally in the south and east of the county.

Texture of the surface soil is silty clay loam to silt loam, while the C horizon consists of a silty clay loam. Soil structure is weak, drainage is poor and the soils are dominated by dull grey colours in the A2, Bg and Cg horizons. pH values are usually high and the roots are mostly confined to the surface horizon with a few. chiefly rush roots, penetrating to die Bg and Cg horizons.

*Soil Suitability:* The limited use-range of this series is dictated by its rather weak structure and poor drainage. It is best suited to grass production and forestry. Liability to poaching when wet is a problem and careful management is necessary to sustain maximum production.

Profile description and analyses - Appendix 11, p. 81.

*Howardstown Series - Lithic Variant*

This variant occurs between Glasson and Tang, north of Athlone, and also near Milltownpass. Generally, it is very limited in extent and occurs only in tracts of 0.5 to 1.0 ha. For this reason it is not shown on the map. It is similar to the series except that limestone bedrock occurs at about 38 cm. Textures are gravelly loam throughout.

*Soil Suitability:* This variant has the same limited use-range as the series, though because of its shallowness, it can dry-out sooner and be less liable to water-logging in the spring.

Profile description and analyses - Appendix 11, p. 82.

*Mylerstown Series*

This series covers 0.16% (275 ha, 679 acres) of the county. It occurs chiefly on the edge of cut-over bogs where it originally developed under peat which has now been cut away. The humus-rich waters of the peat have subjected the soil to leaching. Recent drainage has enabled the soils to dry out in summer but they remain very wet in winter. Because of water-logging, gleying is evident.

This soil occurs in the southern part of tiie county on the edge of the raised bogs and has developed on stony, coarse textured limestone-shale till. pH values are high. The soils have a silt loam texture and are relatively shallow, being, at maximum, 70 cm deep.

*Soil Suitability:* Similar to the Ballyshear Series.

Profile description and anlyses - Appendix 11, p. 83.

*Street Series*

This series covers 2.07% (3620 ha, 8,945 acres) of the county and is found in poorly-drained basins. The parent material consists of drift of limestone, calp and shale composition. It is generally associated with Rathowen Series and Rathowen Cherty Phase although lacking the characteristic cherty horizon of the phase. In the northwest it occurs in the inter-drumlin hollows, with Rathowen Series formed on the drumlins.

These soils have a heavy texture, weak structure, and plastic consistence. Permeability is slow; pH values are medium to low.

*Soil Suitability:* The soils have a limited use-range being confined to grassland and forestry. Rushes are ubiquitous and pastures are generally of poor quality. Because of the weak structure and poor drainage great care must be taken to ensure that poaching is kept to a minimum.

Profile description and analyses - Appendix 11, p. 84.

*Street Series - Podzolic Gley Variant*

This soil occurs frequently throughout the series in very small enclaves. It is distinguished from the series by the presence of an A2 horizon: movement of humus into the A2 or into the Bg horizons is sometimes evident.

*Soil Suitability:* The use range is similar to the series.

Profile description and analyses - Appendix 11, p. 85.

*Alluvial Soils*

The remaining gley soils are all formed from fresh-water alluvial deposits. The material laid down by rivers is usually found in the vicinity of existing stream and river courses whilst lacustrine deposits occur in landscape depressions, which were originally the sites of glacial or post-glacial lakes. The composition of river or lake alluvium is usually related to the geological formations in their vicinity.

Most of these alluvial soils are very immature and show little or no profile development. They are differentiated on the basis of such factors as origin and composition of parent material, texture and drainage. The latter two frequently vary, even within individual series, giving rise to phases which are too small in extent to map.

The use-range of these soils is generally limited.

*Camoge Series*

This series covers 1.03% (1^75 ha, 4,434 acres) of the county. It consists of a poorly-drained gley soil and is found in most river valleys in the county. Because of the depositional pattern the texture varies but, in general, it is a silty clay loam over clay. The dark brown surface horizon has a weak structure. The parent material has a massive or weak prismatic structure with marked mottling throughout. Root development is good in the surface but poor deeper down.

*Soil Suitability:* These soils have an extremely limited use-range. Poaching is a serious problem and tillage is precluded because of the heavy texture and risk of flooding.

Profile description and analyses - Appendix 11, p. 86

*Coolalough Series*

This soil covers approximately 0.57% (1,001 ha, 2,473 acres) of the county and is formed from lake alluvium. It occurs throughout the lowlands wherever the glacial deposits blocked drainage channels and caused lakes to form. These subsequently dried up leaving alluvial deposits, formed mainly from limestone, shale and some sandstone. Textures are mostly silty clay loams and pH values are high in the subsoil. The soils are poorly-drained groundwater gleys. Occasionally the surface may be organic or peaty; a root mat is often developed in the weakly-structured surface horizon.

*Soil Suitability:* These soils have a limited use-range. Drainage is poor to very poor and very high standards of management are necessary to sustain grass yields and to keep poaching to a minimum.

Profile description and analysis - Appendix 11, p. 87.

*Drombanny Series*

This series, occupying 0.24% (411 ha, 1,015 acres) of the county, occurs frequently along

river flats, and occasionally on the edge of the cut-over Allen Series and in lake beds throughout the county. It usually consists of about 30 cm of organic clay or cut-over peat overlying 10 to 60 cm of marl deposited in old lake basins by lime-rich water. Below this marl is a variable thickness of lake alluvium over glacial till.

*Soil Suitability:* The use-range of Drombanny Series is limited to grass production. Because of the high pH values forestry would be confined to certain species.

Profile description and analyses - Appendix 11, p. 88.

## Peat Soils

Peats are characterised by a high content of organic matter (over 30%) and by being at least 30 cm in depth. Two basically different types, basin and blanket peat, occur in the country but only basin peats are found in Co. Westmeath.

*Basin Peats*

This peat type formed under the influence of base-rich groundwater and is composed mainly of the remains of reeds, sedges and other semi-aquatic or woody plants. Variations in concentration of the component plant remains depend on the topographic situation and nutrient content of the water supply. Peat soils of this type occur in river valleys and interdrumlin hollows. They have been mapped as one group but vary somewhat in botanical composition, nutrient status and soil reaction.

Two fen peats occur in Westmeath. One is reclaimed fen peat (Banagher Series) and die other is unreclaimed fen peat (Pollardstown Series).

*Raised Bog Peat*

Under suitable climatic conditions raised bog peat may be built up on top of fen peat. As the depth of fen peat increases, its living vegetation is less influenced by groundwater and more dependent on atmospheric precipitation as a source of moisture. This change in moisture supply results in the growth and development of a raised bog with its characteristic convex surface and acid plant remains.

The profile usually consists of a basal layer of fen or woody fen peat overlain by a layer of acid ombrogenous peat characterised mainly by its high content of *Sphagnum* mosses, variable quantities of bog cotton *(Eriophorum* spp.) and ericaceous remains *(Calluna).* In their natural state fen peats vary considerably in depth and are typically acid in reaction.

Extensive areas of raised bog in Co. Westmeath have been cut-over and large areas on the southern border are under development by Bord na Mona for sod and milled peat.

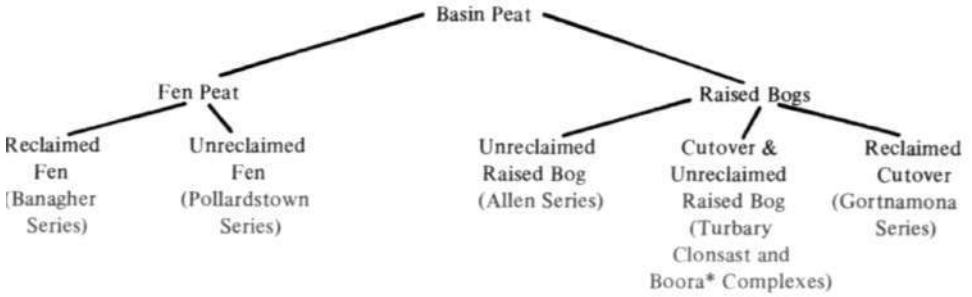
The relationship of different peat soils in the county is shown in Fig. 6.

*Banagher Series*

This series occupies 5.98% (10,466 ha, 25,875 acres) of the county. It occurs not only as large individual units but also within many of the soil complexes which predominate in the kame and kettle topography. Most of the small streams within these complexes are surrounded by Banagher Series. It is formed under base-rich groundwater conditions and the plant community is characteristically minerotrophic.

*Plate 5: Rough grazing on the Banagher Series in foreground, Rathowen Series in background*


*Plate 6: Cutover raised bog is now being reclaimed and grazed*




* Boora complex occurs only to a limited extent in Co. Westmeath and is not shown on die soil map

*Fig. 6: Relationship of different peat soils in Co. Westmeath within overall classification scheme*

The profile has an organic surface horizon with well-developed structure and abundant roots. Mineral materials present in some places indicate that 'marling' was carried out to improve fertility. Structure disimproves with depth and root content also decreases rapidly in the sub-surface horizon. The permanent water table occurs at around 70 cm below the surface.

*Soil Suitability:* These soils have a moderately wide use-range. Frost hazard and low base status are the main problems.

The present land-use tends to be rough grazing with rushes and sedges dominating the vegetation (Plate 5). Where the water courses are cleaned and the water-table lowered, as has been done along the Inny river, production can be improved considerably.

Profile description and analyses - Appendix 11, p. 89.

*Pollardstown Series*

This series occupies only 0.36% (621 ha, 1,535 acres) of the county. It is limited in extent since almost all the fen peat has been drained with only the small area constituting this series left in its original condition. No samples of this soil were taken.

*Soil Suitability:* In its present condition this soil is not suitable for agriculture but has potential for amenity or wild life conservation.

*Allen Series*

This series occupies 3.64% (6,371 ha, 15,736 acres) of the county. In the unreclaimed state peat depth can reach 5.0 m. The basal peat layer, which is generally highly humified and locally termed 'block peat', consists of remains of plants which grew under the influence of base-rich ground waters. This layer is overlain by a variable thichness of acid peat mostly composed of *Sphagnum* moss with cyperaceous and ericaceous plant remains (Plate 6).

The profile is comprised of alternating layers of variably humified *Sphagnum* mosses. Fibre contents vary over short distances from less than 35% for *Sphagnum cuspidatum* peat to over 75% for other poorly-humified *Sphagnum* species. Little profile development has taken place and the soil is typical of an initial raw peat soil.

The profile is wet throughout (85 to 91% water), and in the undrained stage, the water-table is very close to the surface. At the outer edges of the raised bog, where localised drainage has been carried-out to facilitate manual turf-cutting, the profile may be somewhat drier.

*Soil Suitability:* In their natural state, no physical 'ripening', i.e., loss of water and aeration of profile, has taken place and the soils are unsuited to any type of agricultural enterprise. However, with drainage, liming and fertilizing, grass production and forestry are feasible.

Profile description and analyses - Appendix 11, p. 90,91.

*Gortnamona Series*

Where some of the raised bogs have been drained, levelled and reclaimed they are mapped as the Gortnamona Series (Plate 6). This series occupies 4.31% (7,561 ha, 18,676 acres) of the county. The soil profile usually consists of alayer of acid peat strippings ("top sod") of variable thickness (100 to 150 cm) over basin peat (wood or fen plant remains). The drier surface is colonised by heathers *(Calluna-Erica* spp.) and bog cottons *(Eriophorum* spp.) with *Eriophorum angustifoluim* and *Sphagnum* spp. in the wetter areas.

*Soil Suitability:* These areas have a definite potential for afforestation, grassland, and, in some instances, a range of crops such as cereals, carrots and celery. Cropping potential depends on the proximity of a drainage outfall and is therefore, often restricted to the outer edges of bog areas except in the case of large Bord na Mona developments. With suitable drainage and management the physical nature of such soils presents little or no difficulty and nutritional problems are also easily overcome.

Profile description and analyses - Appendix 11, p. 92, 93

## Peat Complexes

*Turbary Complex*

When some raised bog areas are cut-over but not reclaimed because of a high water-table, the area is mapped as the Turbary Complex (Plate 6). These areas consist of both wet and dry peat, some having a few centimetres of soil developed, while others remain under water. The complex occupies 5.32% (9,316 ha, 23,011 acres) of the county.

*Soil Suitability:* These areas are unsuited to agricultural development.

No profile descriptions are included.

*Gonsast* and Boora** complexes*

Since the late nineteen-thirties, Bord na Mona (Irish Peat Development Authority) has developed large expanses of raised bog (Allen Series) for the production of sod and milled peat. The removal of sod peat, which is typified by the method used at Clonsast bog, Co. Offaly, gives rise to peat soils which have been mapped as the Clonsast Complex. Similarly the method used at Boora bog, Co. Offaly, for the production of milled peat give rise to peat soils which have been mapped as the Boora Complex.

*The Clonsast Complex occupies 1.94% (3,399 ha, 8,398 acres) of the county.

**The Boora Complex occurs only to a limited extent in Co. Westmeath and is not shown on die soil map

*Soil Character:* The natural profile sequence, as described for the Allen Series, is materially altered by peat production since the major part of the peat profile is removed. In most cases the lowest peat layer is left unaltered (Boora Complex), but in sod peat areas it is covered by a 50 cm layer of poorly-humified acid *Sphagnum* peat strippings cut from the original surface layer (Clonsast Complex).

*Soil Suitability:* The suitability of the two complexes is basically dependent on the depth and type of peat which remains after production has ceased and on the type of sub-peat "soil". Various enterprises are being experimentally evaluated at the present time to assess uieir suitability for forestry, grassland, and horticultural crops including vegetables 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 to be followed will depend largely on soil type and future economic and social circumstances.

No profile descriptions are included.

## Mineral Soil Complexes

Where the distribution pattern of soils is so intricate as to defy clear-cut delineation of each individual soil unit on the map a soil complex is shown (Fig. 7). In Co. Westmeath a relatively large number of soil complexes have been mapped. The reasons for this are related mainly to the intricate depositional pattern of the glacial drift in parts of the county.

About half of the area is covered by kame and kettle-hole topography (Fig. 2) which originated either as recessional morainic features, fluvioglacial deposits or dead-ice features. The kames usually consist of hills up to 20 metres in height and of varying shapes. They seldom cover more than 0.2 ha in extent. The kettle-holes also vary in shape and frequently have internal drainage.

In this type of topography a number of different soils were formed; shallow brown earths (Baggotstown Series) occur on the kame summits, while shallow grey brown podzolics (Elton Series) occur in the kettle hole positions (Plate 2).

More complex patterns emerge if, for example, the kames are laid down over glacial till. In this case a gley is likely to be formed in the kettle-hole, but, where the distance between kames increases peat occurs in this position; in some places alluvium is also found. Where there is a change in parent material, e.g., a kame composed mainly of shale superimposed on a predominantly limestone till, the pattern is further complicated.

Eskers tend to form a special complex, (Plate 3), with brown earths in the higher positions and deep, grey brown podzolics in the occasional kettle hole.

The soil complexes occuring in the county are briefly described below. They are shown also in Table 5. Each complex occurs on kame and kettle-hole topography with particular variations as indicated above.

Because of the intricate soil distribution pattern these areas are shown as complexes on the published soil map (scale 1.126,720).

*Baggotstown - Crush Complex*

This complex, which occupies 2.06% (3,603 ha; 8,899 acres) of the county, is almost solely associated with eskers, although it also occurs on some of the larger kames. The

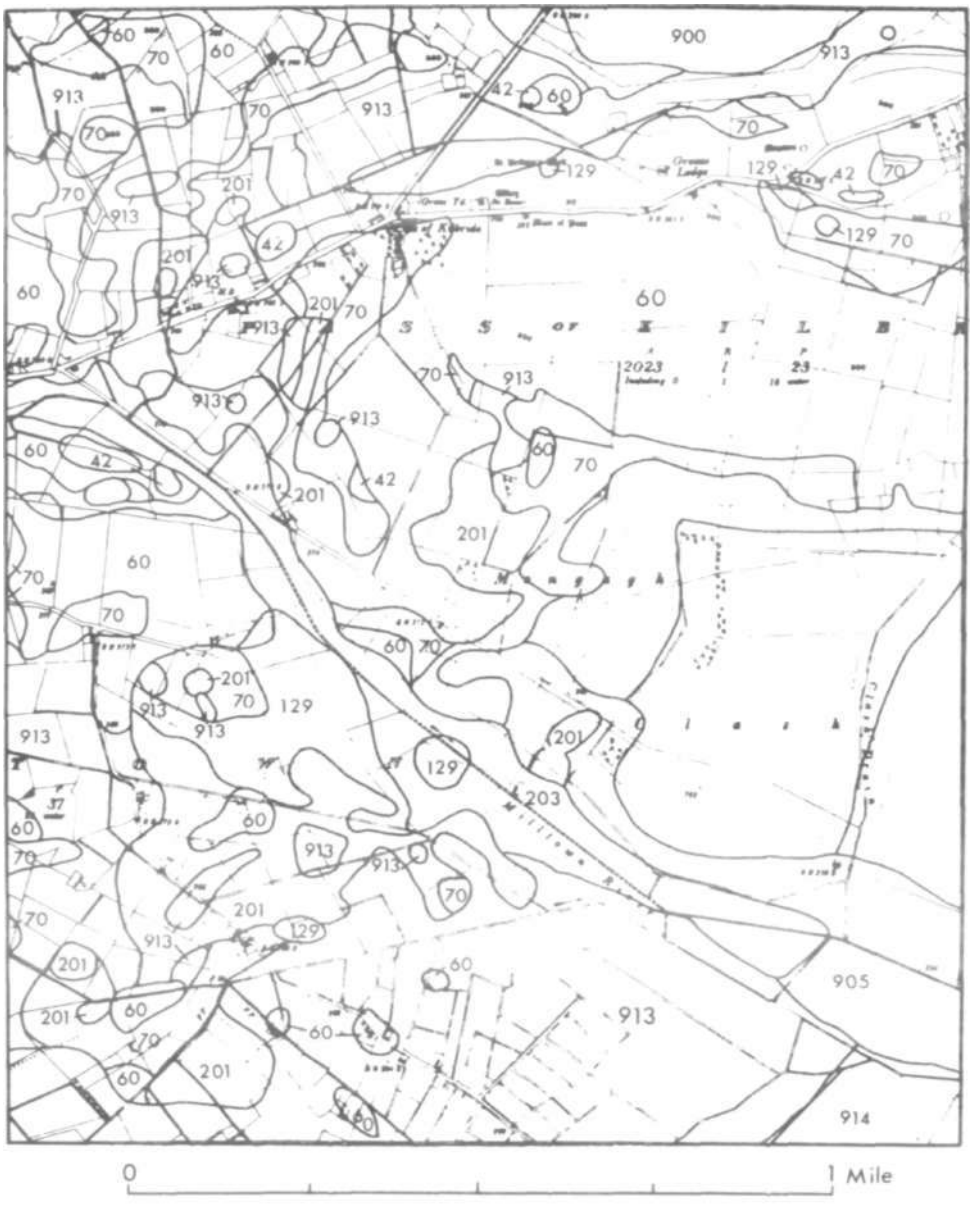



*Fig. 7: Complex soil distribution pattern southeast of Milltownpass.*

TABLE 5: Soil complexes and their extent in Co. Westmeath

| Complex | % of total area |
|---|---|
| Baggotstown - Crush | 2.06 |
| Patrickswell - Ladestown | 0.04 |
| Patrickswell - Rathowen | 1.65 |
| Patrickswell - Baggotstown | 5.97 |
| Patrickswell - Baggotstown-Elton | 0.22 |
| Ladestown - Rathowen | 0.07 |
| Rathowen - Ladestown - Rathowen | 2.65 |
| Ladestown - Rathowen - Rathowen Podzol Variant | 0.31 |
| Howardstown - Baggotstown | 0.28 |
| Howardstown - Patrickswell | 4.82 |
| Bally shear - Patrickswell | 1.47 |
| Finnea-Banagher-Allen | 0.14 |
| Clonsast | **1.94** |
| Turbary | 5.32 |
| TOTAL | 26.94 |

Crush Series occurs on the crests of the eskers and kames, while extensive areas of Baggotstown Series occur on the flanks. On the edges of the eskers, and in the occasional kettle holes, Patrickswell Series is found, with occasional areas of Elton Series towards the centre of some of the kettle holes (Plate 7). The proportions in which the various series occur are Baggotstown 60%, Crush 5%, Patrickswell 30% and Elton 5%.

*Patrickswell - Ladestown Complex*

This complex of Patrickswell, Rathowen and Ladestown Series, occupies 0.04% (69 ha; 170 acres) of the county. Typically it consists of Patrickswell and Rathowen Series on the gently sloping topography with Ladestown Series occurring on the kames. Patrickswell and Rathowen, in variable proportions, comprise 50-70% of the complex with Ladestown forming the remainder.*

*Patrickswell - Rathowen Complex*

This complex, occupying 1.65% (2,899 ha; 7,161 acres) of the county, consists of Patrickswell and Rathowen Series with very occasional kames of Patrickswell Shallow Variant. It occurs predominantly on till, with the proportions of the two series varying from 25-50%.

*The proportions of the different series given for each complex are estimates and should only be used for general purposes

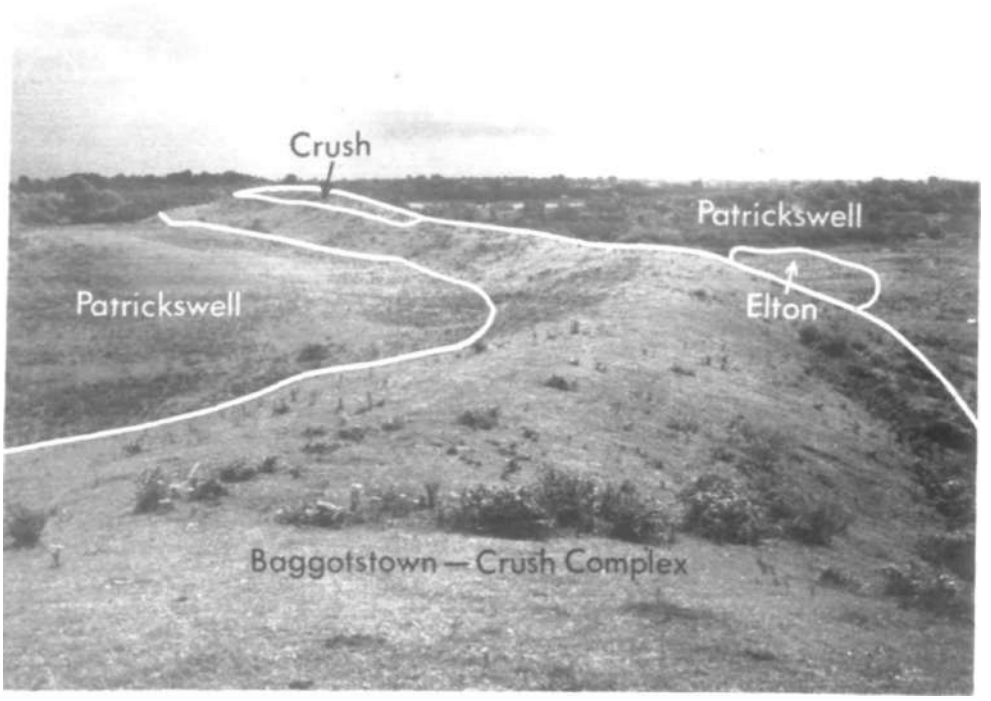



*Plate 7: Typical soil complex found on eskers*

*Patrickswell - Baggotstown Complex*
This is a typical kame and kettle complex occupying 5.97% (10,461 ha; 25,850 acres) of the county. Baggotstown Series and occasionally Patrickswell Shallow Variant occur on the kames; Patrickswell Series occurs in the kettle holes which are small and close together. The proportion of each series is approximately 50%.

*Patrickswell - Baggotstown - Elton Complex*
This complex, which occupies 0.22% (391 ha; 965 acres) of the county, is similar to Patrickswell-Baggotstown except that the kettle holes are larger (up to 2 ha). The Elton Series occurs on material formed partially by weathering of the glacial drift and partially by in-wash of fine material. The approximate proportions of soils are Patrickswell 50%, Baggotstown 40% and Elton 10%.

*Ladestown - Rathowen Complex*
This complex is very similar to Patrickswell-Baggotstown, except for the soil parent material, which is composed mainly of shale. In this case Rathowen Series occurs in the kettle holes while Ladestown occurs on the kames. The complex occupies 0.07% (121 ha; 300 acres) of the county.

*Rathowen - Ladestown - Rathowen Podzol Variant Complex*

In soil-landscape relationships this complex is similar to the Patrickswell-Baggotstown-Elton Complex. Rathowen Series occurs in most of the kettle holes while Ladestown Series is found on the kames. Rathowen Podzol Variant occurs on the crests of the kames. The proportions are approximately 60%, 20% and 20% respectively. This complex covers 0.31% (552 ha; 1,363 acres) of the county.

*Howardstown - Baggotstown Complex*

This complex only occupies 0.28% (486 ha; 1,200 acres) of the county. On the kames of fluvioglacial composition Baggotstown Series occurs while Howardstown Series occurs on the glacial till; peat (Banagher Series) is found in the hollows. The proportions are variable but Howardstown usually forms 50% or more while Banagher and Baggotstown form some 25% each.

*Howardstown - Patrickswell Complex*

The soil distribution pattern is extremely intricate in this complex which occupies 4.82% (8,442 ha; 20,852 acres) of the county. Parent material is mainly Carboniferous limestone till. The complex is generally found on the edge of raised bogs in the south of the county. Peat occurs as Allen and Gortnamona Series and as the Turbary Complex; Camoge Series occurs in places on alluvium while Patrickswell, Mylerstown, Elton and Howardstown Series occur on the glacial till. The proportions vary from place to place but Patrickswell and Howardstown combined always comprised over 50%.

*Ballyshear - Patrickswell Complex*

This complex occupying 1.47% (2,564 ha; 6,333 acres), is typically developed in the southeast of the county. The Mylerstown and Ballyshear Series are found interspersed between the ridges of Patrickswell. Ballyshear Series is usually dominant (up to 50%) with variable proportions of Patrickswell and Mylerstown forming the other 50%.

*Ladestown - Rathowen - Banagher Complex*

The soil distribution pattern within this complex, which occupies 2.65% (4,650 ha; 11,489 acres) of the county and includes five different series is extremely intricate. Parent material varies from glacial till to fluvioglacial sands and gravels, lake alluvium and peat. Ladestown Series occurs on the kames and Rathown Series in the kettle holes. Howardstown Series occurs on poorly-drained glacial till in some of the lowlying positions, while Camoge and Banagher Series occur respectively where alluvium and peat deposits exist. Without detailed mapping it is very difficult to estimate the proportion of each series present, but none of them occupies more than 40% of the complex.

*Finnea - Banagher • Allen Complex*

like most of the other complexes in the county, the Finnea-Banagher-Allen Complex is found on kame and kettle topography. It occupies only 0.14% (251 ha; 620 acres) of the county and occurs on the western end of the moraine which encloses Lough Sheelin on its western and southern shores.

Because some of the kettle holes connect with the raised bog to the north, Allen Series occurs within the complex. Other kettle holes situated on the limestone bedrock are permanently or intermittently waterlogged. Because of the high carbonate content Banagher Series has formed in these situation. The proportions in which the three series occur are approximately Finnea 70%, Banagher 20%, Allen 10%.

Of the mineral components of the complex the Finnea Series consists mainly of an excessively drained Brown Podzolic, of gravelly sandy loam texture, formed from fluvioglacial sand and gravels of predominantly shale composition. The other mineral components consist of a Brown Earth which is not more than 60 cm in depth and a shallow Brown Earth which is not more than 50 cm in depth.

Profile descriptions and analyses - Appendix 11, p. 94,95,96.

## Classification of the Soils according to Natural Drainage Condition

The soils have been grouped (Table 6) into six drainage classes: (a) excessively drained, (b) well drained, (c) imperfectly drained, (d) poorly drained, (e) very poorly drained, and (f) variable drainage. All drainage classes refer to the natural drainage condition of the soil; artificial drainage would upgrade the drainage condition of some of the soils in the lower categories.

The soils in Class (a) have a moisture deficit for long periods of the year due to excessive run-off of rainfall. The soils in Class (b) can hold sufficient moisture for the normal growth of a wide range of crops throughout the average growing season; in very prolonged dry periods, however, these soils with moderate to rapid permeability are liable to a temporary moisture deficit. The soils in Class (c) are similar to those in Class (b) except that they may have slight trafficability problems in wet seasons. In the soils in Class (d), artificial drainage is a basic prerequisite to any form of sustained improvement and higher output. The soils in Class (e) have variable drainage.

For each drainage class the main factors conditioning the drainage regime of the soils are outlined. For example, in the case of the soils with defective drainage, contributing factors may be water table, or slow permeability, or both. Methods of artificial drainage to improve these soils must be adapted to the factors responsible, if the best results are to be attained.

The extent of occurrence of each drainage class is also given in Table 6. About 50% of the soils of the county have free internal drainage. Some 7% are poorly drained as well as the peats which, although they have been unclassified in Table 10, are mainly poorly drained and comprise another 22% of the county. Some 20% have variable drainage (mineral soil complexes) but when these are broken down into component series another 14% (approx.) can be added to the free draining soils of the county. The other 3% (approx.) of the soils within complexes are mainly poorly to very poorly drained.

TABLE6 : Classification of soil series according to natural drainage

| Natural Drainage Class | Conditioning factors | Soils | Area Acres | Area Hectares | %of county |
|---|---|---|---|---|---|
| (a) Excessively drained | Rapid internal drainage | Baggotstown, Crush*, Ladestown | 2,570 | 1,040 | 0.59 |
| | Rapid run-off and permeability, temporary watertable on bedrock | Ballinacurra, Burren, Knockeyon | 1,355 | 549 | 0.32 |
| (b) Well drained | Moderate permeability, deep watertable, moisture retention in Bt horizon | Elton, Milltownpass, Mortarstown, Patricks-well and Bouldery Phase | 137,167 | 55,533 | 31.69 |
| (c) Moderately well drained | Silty texture, deep watertable | Rathowen, Rathowen Cherty Phase | 81,835 | 33,119 | 18.91 |
| (d) Poorly drained | Heavy texture, low perm-eability, seasonal high watertable | Ballyshear, Howards-town, Mylerstown, Street | 21,277 | 8,614 | 4.92 |
| | Heavy texture, low perm-eability, high watertable | Camoge, Coolalough, Drombanny | 7,921 | 3,207 | 1.84 |
| (e) Variable | | Soil Complexes | | | 19.71 |
| Unclassified (mainly peat) | | Allen, Banagher, Gortnamona, Pollards-town, Clonsast, Turbary | 93,203 | 37,734 | 21.55 |

* Not shown on the soil map due to small extent of occurrence

CHAPTER V

# SOIL SUITABILITY

Soil suitability classification is essentially a grouping of soils according to the potential use or uses to which they are most adaptable, and is based principally on the significance of the more permanent characteristics of the soil. 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. So far, the only information of this nature available within the county is confined to forestry on certain soil series and to pasture production. These quantitative assessments are presented for forestry potential and grazing capacity but apart from these the system of soil suitability evaluation used is 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 and local climate, must also be taken into account. For instance, local features such as exposure to strong winds and late spring frosts can limit forest tree growth no matter how deep and fertile the soils may be. 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, farm labour is no longer abundant, and its replacement by mechanisation has drastically altered the feasible cultural and management practices of many soils.

## Suitability for Grassland and Cultivation

*S. Diamond, M. J. Gardiner and T. F. Finch**

### *Suitability Classification*

A widely-used system for the interpretation of soil survey data from the point of view of land classification consists of assessing the capacity of each soil unit for permanent sustained production, and arranging the units according to the U.S.D.A. system of Land

*National Soil Survey, An Foras Taluntais

Capability Classification (1). This is a standard eight class system in which classes 1 to IV are suited to cultivated crops, classes V to VI1 are suited to grazing and forestry and class VI11 is suited only to wild life.

The U.S.D.A. system emphasises the adaptability of a soil for a range of uses and implies a hierarchy of use capacity *viz.* cropping, grazing, forestry. In relation to land use practice in Ireland this hierarchy is not relevant as the priority use of land is dairy livestock production which has a large grazing component. Since economic priorities change with time, value judgements based on economic criteria should be excluded as far as possible from a technical land classification.

The system recently adopted in Ireland (2) is to evaluate the degree of suitability of each soil unit for a set of uses, *viz.* cultivation and grassland, where all types of use have equal rank. This system could be extended to include suitability for forestry or urban development where appropriate. Choice of optimum use of a soil unit could be derived at any time from the suitability classification by assigning a weighting to each type of use based on the prevailing economic circumstances.

Soil suitability depends largely on the physical properties of the soil and the environment. These are rarely ideal and the limitations affect productivity and cultural practices. The degree of limitation is assessed from such factors as wetness (w), drought (d), liability to flooding (f), slope (s), rockiness (r), boulders (b), textural and structural properties affecting tilth and susceptibility to poaching (t). On the basis of these factors the soils are grouped into five classes designated A, B, C, D, E, for grassland and 1, 11, 111, IV, V, for cultivation. Productivity is the dominant criterion in the ranking of suitability for grassland and the suitability classes A, B, C, D, E parallel the grazing capacity classification. In the case of cultivation the dominant criterion is the effect of soil properties on the ease of cultivation.

In the legend the suitability classes are divided into sub-classes by principal limiting factor. Sub-classes are indicated by a subscript which indicates the type of limitation, for example - w = wetness, s = slope, etc. The degree of limitation increases from the higher to the lower categories.

Every map separation can be represented by the class letter for grassland, the class number for cultivation and the subscript letter for kind of dominant limitation e.g., (1) Al d indicates class A for grassland, Qass 1 for cultivation and liability to drought as the dominant limitation. (2) C 111 w indicates class C for grassland, class 111 for cultivation and wetness as the dominant limitation.

*Suitability classes: County Westmeath*

For grassland, 51.8% of the soils are placed in Class A, their principal limitations vary from slight drought in dry periods, slopes which make machinery use less easy and slight susceptibility to poaching. They are subdivided into classes 1 and 11 for cultivation, the only soils remaining in Class 1 being the Patrickswell soils on flatter topography which comprise 4.22% of the total land area. Those Patrickswell soils on undulating topography and the Baggotstown soils have been placed in Class 11 for cultivation because of slight machinery-use difficulties on slopes or hummocks.

Soils of the Elton, Mortarstown and Rathowen series, the Rathowen Cherty Phase and the Patrickswell-Rathowen complex have also been placed in Qass 11 for cultivation because of tilth difficulties associated with somewhat heavy textures.

Some 8.0% of the soils occur in Class B for grassland, their principal limitation consisting of slopes which interfere with machinery use. These slopes are associated with either the hummocky nature of the Baggotstown soils or the kame and kettle-hole topography in which the Patrickswell, Baggottstown, Elton, Ladestown and Rathowen soils often occur in close association in Westmeath and have therefore been mapped as complexes.

For cultivation the Baggotstown-Crush Complex and the Rathowen-Ladestown Complex soils have been placed in Class 111 because of the more frequent occurrence of slopes while the remainder of the Class B grassland soils (with the exception of the Milltownpass Series which has a flooding hazard and is therefore placed in Class 111) have been placed in Gass 11 for cultivation. Their dominant limitation is also slope but slopes occur less frequently than in the Baggottstown-Crush and Rathowen-Ladestown soils.

Some 24.1% of the soils have been placed in Class C for grassland, their principal limitation being wetness except in the cases of the Baggottstown-Crush Complex (whose principal limitation is slopes associated with hummocky or kame and kettle topography) and the Patrickswell bouldery phase whose principal limitation is the presence of boulders.

For cultivation, these latter soils have been placed in Class V while the other soils in Class C have been subdivided into Classes 111 and IV on the basis of the degree of wetness present.

Grassland Class D contains 3.2% of the soils and these are subdivided into Class IV and V for cultivation. The principal limitation is wetness except in the case of the Ballinacurra soils whose principal limitation is rockiness.

Class EV soils occupy 9.5% of the county, their principal limitations being either rockiness (as in the Burren and Knockeyon soils) or wetness as in the case of the Allen, Turbary and Pollardstown soils.

Most soils have secondary as well as principal limiting factors and these can be seen in the soil suitability description for each soil series. Sometimes these secondary limitations are important as for example drought (d) in the Baggottstown soils or poaching hazards (t) under grassland in soils such as the Mylerstown, Howardstown and Ballyshear soils.

Wetness is a major limitation in soils of Classes C, D and E and almost rules out consideration of these for cultivation.

Slope is the dominant limitation in the drier soils in Westmeath which would otherwise be suitable for cultivation. These slope problems militate against the easy use of tillage and grassland machinery. They arise mainly because of the extensive occurrence of Patrickswell and Baggottstown soils on kame and kettle-hole topography.

Climate is also a limiting factor for certain tillage crops. This climatic limitation is due mainly to relatively low solar radiation in Co. Westmeath as can be seen in the degree-day data presented in Table 7. This low solar radiation would strongly militate against

TABLE 7: Degree days (>6°C) 1961-1970

| Period | Mullingar | Roches Point | Rosslare | Kilkenny | Dublin Airport |
|---|---|---|---|---|---|
| **Annual** | **1466** | **1679** | **1634** | **1540** | **1540** |
| **Oct. - Apr. (incl.)** | **365** | **523** | **489** | **422** | **412** |
| **Feb. -Oct. (incl.)** | **1386** | **1510** | **1481** | **1429** | **1430** |

TABLE 8: Soil suitability for grassland and cultivation - Co. Westmeath

| Suitability class | | Principal | Area | % total | |
|---|---|---|---|---|---|
| Grassland | Cultivation | limitation* | Hectares | land area | Mapping unit |
| A | 1 | d | 7,391 | 4.22 | Patrickswell ("part of) |
| | 11 | s | 46,213 | 26.39 | Baggotstown, Patrickswell (part of) |
| | 11 | t | 37,037 | 21.14 | Elton, Mortarstown, Rathowen, Rathowen Cherty Phase, Patrickswell - Rathowen Complex |
| B | 11 | s | 11,678 | 6.67 | Patrickswell-Baggotstown Complex<br>Patrickswell-Baggotstown-Elton Complex<br>Ladestown, Patrickswell-Ladestown Complex<br>Ladestown-Rathowen Complex |
| | 111 | s | 2,881 | 1.43 | Baggotstown-Crush Complex (part of) Rathowen-Ladestown-Rathowen Complex |
| | | f | 194 | 0.11 | Milltownpass |
| C | 111 | w | 26,570 | 15.17 | Mylerstown,<br>llowardstown, Mowardstown-Baggotstown Complex<br>Clonsast, Banagher, Gortnamona |
| | IV | w | 12,801 | 7.31 | Ballyshear-Patrickswell Complex<br>Camoge<br>Howardstown-Patrickswell Complex |
| | V | s | 1,274 | 0.94 | Baggotstown-Crush Complex (part of) |
| | | b | 1,120 | 0.64 | Patrickswell Bouldery Phase |
| D | IV | w | 5,368 | 3.06 | Ballyshear, Street, Coolalough, Drombanny |
| | V | r | 219 | 0.13 | Ballinacurra |
| E | V | r | 330 | 0.19 | Burren, Knockeyon |
| | | w | 16,308 | 9.31 | Allen, Turbary, Pollardstown |
| Variable | | | | | |
| Bll xCIV | | s,w | 4,650 | 2.65 | Ladestown-Rathowen-Banagher Complex |
| Bll xEV | | s,w | 251 | 0.14 | Finnea-Banagher-Allen Complex |

* d = drought w = wetness s = slope b = boulders f = liability to flooding
r = rockiness t = textural and structural properties affecting tilth and susceptibility to poaching

crops such as sugar beet whose solar radiation requirement is high. It would also result in late ripening of wheat crops. This would give rise to difficult harvesting operations, conditions which would not be encountered to the same extent with barley because of its shorter growing season.

## Potential Forest Productivity

*M. Bui fin**

The species suitable to each soil series along with the main limitations of the various soils for timber production are given in Table 9.

The possible potential yield of Sitka spruce from each soil series is also detailed. Sitka spruce is chosen because it is currently the major timber tree in Irish forestry; it can be easily established and grows satisfactorialy under a wide range of conditions. Its primary requirement is for adequate moisture; Sitka rarely does well where annual rainfall is less than 100 cm (40 inches). It currently accounts for 64% of the planting programme of the Forest and Wildlife Service. Thus, this tree gives the best indication of productivity over a wide spectrum of soil types.

While Sitka spruce grows well on a wide variety of soil types and will produce very high volumes on some, other species may be preferable on some sites. Douglas, fir, larch and Abies grandis are possible choices on the Brown Earth or Brown Podzolic soils while Contorta pine may be best on raw peat soils.

The range of yield classes for each soil series is shown in Table 9. Yield class is the method used in forestry to indicate site productivity. It is a measure which takes in not only soil productivity but other site factors such as, elevation, aspect and, indirectly, climate factors such as rainfall, temperature and windspeed.

The yield class of a particular stand of trees is determined from its height/age relationship; the taller the trees at a given age the greater their yield class. Yield class is expressed as the average volume production per hectare per annum of a stand of trees over a full rotation. Thus, if a 45-year old stand of Sitka spruce produces a total of 1080 cubic metres of timber it will be classed as yield class 24 i.e., the average annual production was 24 cubic metres per hectare per annum. The British Forestry Commission Management Tables for Sitka Spruce show a range of yield classes from 6 to 24 cubic metres per hectare per annum (3). A recent study of Sitka spruce production in Co. Leitrim showed higher production levels than the British figures for the wet mineral lowland soils (4).

It is possible, therefore, that the upper limits of production on the gleyed soils in Westmeath may be conservative. Table 9 shows that some 53% of Co. Westmeath has a high to very high potential for Sitka Spruce while another 10% has a moderate potential.

References

1 KJingebiel, A. A. and Montgomory, P. H. (1961). Land Capability Classification U.S. Dept. Agric, Soil Conservation Agric. Handbk. No. 210.
2 Finch, T. F. (1971). Soils of Co. Clare. An Foras Taluntais, Dublin.
3. Hamilton, G. J., and Christie, J. M. (1971). Great Britain Forestry Commission Booklet No. 34, HMSO.
4. Bulfin, M., Gallagher, G., and Dillon, J. (1973). Leitrim Resource Survey, Part 1, An Foras Taluntais.

*National Soil Survey, An Foras Taluntais

TABLE 9: Soil suitability for forestry - Co. Westmeath

| Suitability class | Series | Suitable species | Main limitations | Possible potential yield (cu. m. per ha. per annum) | Area | | %of county |
|---|---|---|---|---|---|---|---|
| | | | | | Acres | Hectares | |
| Very good | Elton, Howardstown, Mortarstown, Patrickswell, Rathowen, Rathowen Cherty Phase | All species | None | 18-24 | 226,551 | 91,721 | 52.35 |
| Good | Howardstown Lithic Variant, Street | Spruce | No limitations for spruce. Other species limited by poor drainage and frost hazard | 16-24 | 8,945 | 3,620 | 2.07 |
| | Camoge, Milltownpass | Spruce | | 14-22 | 4,913 | 1,989 | 1.14 |
| | Coolalough | Spruce | | 14-20 | 2,473 | 1,001 | 0.57 |
| | Ballinacurra, Baggotstown, Ladestown, Patrickswell Bouldery phase | All species | Shallow soils with liability to drought | 12-22 | 5,878 | 2,379 | 1.36 |
| Moderate | Banagher, Gortnamona | Spruce or Pine | Variable conditions, nutrient deficiencies, frost hazard | 12-20 | 44,527 | 18,027 | 10.29 |
| | Ballyshear, Mylerstown | Spruce | Shallowness, high pH pll on edge of bogs | 12-22 | 1,509 | 611 | 0.35 |
| Poor | Allen | Spruce or Pine | Variable conditions, nutrient deficiences, frost hazard | 12-18 | 15,736 | 6,371 | 3.64 |
| | Drombanny | Spruce | Peat over marl is inhibiting factor | 12-18 | 1,015 | 411 | 0.24 |
| Very poor | Burren, Crush, Knockeyon, Pollardstown | | Very shallow soils of variable pH. Water-table on surface | 12-18 | 2,350 | 951 | 0.55 |
| Variable | Soil complexes | | | - | 116,638 | 47,204 | 26.94 |

# CHAPTER VI

## QUANTITATIVE GRAZING CAPACITY OF SOILS

*I. Lee**

The objective of this part of the study is to determine the potential of the county and of different regions within it for livestock based on grass production and utilisation. Such quantitative measurements are possible only when the nature of the soil and climate is known and when pasture and animal production experimental data are available. The completion of the Soil Survey of the county has now made this possible. By comparing the potential targets thus obtained with present livestock numbers, the possible improvements in livestock density can be ascertained.

*Trend in grazing livestock numbers*

Grazing livestock numbers for each of the years 1958 to 1973 were obtained from the agricultural returns of the Central Statistics Office. Stock numbers were converted to standardised livestock units (L.U.) according to the method described by Attwood and Heavey (1). The results are shown in Table 10. The number of livestock units increased by 34% which is below the national average increase of 40% which took place over the same period.

*Present grazing livestock numbers*

In 1973 there were 184,700 grazing livestock units in the county, representing an average of 135 L.U./100 ha (54 L.U./100 acres) of land devoted to grazing livestock. This compares to a national average stocking rate of approximately 148 L.U./100 ha (60 L.U./100 acres) of lowland grazing. Stocking rates on the mineral soils are relatively uniform throughout the county.

TABLE 10: Grazing livestock units in Co. Westmeath (1958-1973)

| Year | No. of L.U. (000) | Year | No. of L.U (000) |
|---|---|---|---|
| 1958 | 138.1 | 1966 | 155.9 |
| 1959 | 142.1 | 1967 | 152.5 |
| 1960 | 144.2 | 1968 | 150.0 |
| 1961 | 145.0 | 1969 | 153.8 |
| 1962 | 145.6 | 1970 | 164.3 |
| 1963 | 144.8 | 1971 | 167.3 |
| 1964 | 152.6 | 1972 | 177.7 |
| 1965 | 159.5 | 1973 | 184.7 |

*'National Soil Survey, An Foras Taluntais,*

TABLE 11: Composition of grazing livestock categories in Westmeath and Republic of Ireland

| | % of total L.U. 1973 | | | |
|---|---|---|---|---|
| | Cows and heifers-in-calf | Other Cattle | Sheep | Horst |
| Westmeath | 25 | 66 | 8 | 1 |
| Ireland | 38 | 49 | 11 | 2 |

Table 11 indicates the composition of the grazing livestock populations in the county. The proportion of cows and heifers-in-calf is considerably lower than the national average and in fact Westmeath has the second lowest proportion of cows and heifers-in-calf in the country. By contrast the county has the highest proportion of 'other cattle' in the country.

There are, however, considerable intra-county differences in these proportions. Some areas in the east of the county have 3543% of the total grazing livestock units in the cow category, whilst the Rathowen-Ballymore-Rathconrath area has only 10-12%, with a correspondingly high 70-80% in the 'other cattle' category. The ratio of beef to dairy cows in the county was approximately 55 : 45 in 1971 compared to a national average ratio of 30 : 70. However, the ratio can vary from 15 : 85 in parts of the eastern region to 95 : 5 in the dominantly dry stock areas.

*Gross grazing capacity of soils*

The physical output data necessary for evaluation of the grazing capacity of the different soils in Westmeath were extrapolated from experimental sites to related areas defined by soil and climate. The grazing capacity estimates for the soil series and complexes are set out in Table 12 and are shown on the accompanying grazing capacity map. The estimates are based on nitrogenous fertilise* inputs of 48 kg and 230 kg/ha (43 lb and 206 lb/acre) together with adequate phosphorus and potassium. Artificial drainage of wet soils is assumed. Pasture dry matter production data from experimental sites in the Central Plain of Ireland provide the basis for the grazing capacity estimates for the well drained soil series and complexes. In addition to the pasture data, animal production data from An Foras Taluntais Research Centre at Grange were also used, in addition to data from An Foras Taluntais Research Farms at Ballinalack in Westmeath and Ballintubber in Roscommon.

Grassland productivity research indicates that pastures on well drained soils in the south of Ireland have a 5% advantage or so in annual dry matter production over comparable pastures on soils such as Patrickswell Series in Westmeath. The southern part of the country has a climatic advantage for early growth of grass particularly. This is reflected in the target date of grazing commencement which is early to middle April in Westmeath compared to early March in the south.

The grazing capacity estimates for the gley soils are based on the extrapolation of animal production data from An Foras Taluntais Research Stations at Mullinahone and Herbertstown, in addition to pasture output data from experimental sites in the Central Plain. The estimates for the reclaimed peats and Clonsast Complex are based on animal production data from An Foras Taluntais Peatland Research Station at Lullymore.

TABLE 12: Grazing capacity of County Westmeath soils

| Soils | Area (ha) | 48 kg N/ha Grazing capacity (L.U./100 ha) | 48 kg N/ha Gross grazing capacity (L.U.) | 230 kg N/ha Grazing capacity (L.U./lOOha) | 230 kg N/ha Gross grazing capacity (L.U.) |
|---|---|---|---|---|---|
| Patrickswell | 53,200 | 215 | 114,380 | 265 | 140,980 |
| Mortarstown | 85 | 215 | 183 | 265 | 225 |
| Elton | 934 | 215 | 2,008 | 265 | 2,475 |
| Baggotstown | 396 | 215 | 851 | 265 | 1,049 |
| Patrickswell/ Rathowen | 2,899 | 212 | 6,146 | 262 | 7,595 |
| Rathowen | 16,277 | 210 | 34,182 | 260 | 42,320 |
| Rathowen Cherty Phase | 16,842 | 210 | 35,368 | 260 | 43,789 |
| Patrick swell/Baggotstown/Elton | 391 | 207 | 809 | 257 | 1,005 |
| Patrickswell/Baggotstown | 10,461 | 203 | 21,236 | 253 | 26,466 |
| Ladestown | 494 | 203 | 1,003 | 253 | 1,250 |
| Patrickswell/ Ladestown | 69 | 203 | 140 | 253 | 175 |
| Milltownpass | 194 | 203 | 394 | 253 | 491 |
| Ladestown/Rathowen | 121 | 198 | 240 | 248 | 300 |
| Baggotstown/Crush (East) | 2,888 | 198 | 5,718 | 248 | 7,162 |
| Rathowen/Ladestown/Rathowen Podzol Variant | 552 | 187 | 1,032 | 231 | 1,275 |
| Finnea/Banagher/Allen | 251 | 185 | 464 | 227 | 570 |
| Ladestown/Rathowen/Banagher | 4,560 | 185 | 8,603 | 227 | 10,556 |
| Patrickswell Bouldery Phase | 1,120 | 183 | 2,050 | 222 | 2,486 |
| Mylerstown | 275 | 180 | 495 | 219 | 602 |
| Howardstown/Baggotstown | 486 | 178 | 865 | 220 | 1,069 |
| Howardstown | 4,383 | 173 | 7,583 | 212 | 9,292 |
| Baggotstown/Crush (West) | 591 | 170 | 1,005 | 209 | 1,235 |
| Ballyshear/Patrickswell | 2,564 | 170 | 4,359 | 209 | 5,359 |
| Gortnamona | 7,561 | 168 | 12,702 | 207 | 15,651 |
| Banagher | 10,466 | 168 | 17,583 | 207 | 21,665 |
| Clonsast | 3,399 | 168 | 5,710 | 207 | 7,036 |
| Howardstown/Patrickswell | 8,442 | 161 | 13,592 | 203 | 17,137 |
| Camoge | 1,759 | 161 | 2,890 | 200 | 3,590 |
| Ballyshear | 336 | 158 | 531 | 197 | 662 |
| Street | 3,620 | 158 | 5,720 | 197 | 7,131 |
| Coolalough | 1,001 | 158 | 1,582 | 197 | 1,972 |
| Drumbanny | 411 | 148 | 608 | 187 | 769 |
| Ballinacurra | 219 | 136 | 298 | - | |
| Knockeyon | 144 | 90 | 130 | - | |
| Burren | 186 | 62 | 115 | - | |
| Gross total | 157,703 | | 310,575 | | 383,412 |

The soil complexes.which include wet mineral and peat components, present problems from a grazing potential evaluation viewpoint. The grazing estimates are, of necessity, averages for the complexes and may not be applicable to the entire area of any complex because of possible geographic variation in the balance of components within a particular complex. Similarly, because of mapping limitation, the estimates for some series, while applicable to the major extent of the series, may not necessarily be applicable to its entire area. This is often attributable to the topographic factor which may preclude normal use of machinery for fertilisation or silage harvesting.

Because of inaccessibility to conventional mechanization for fertilisation, the grazing capacity of Ballinacurra, Burren and Knockeyon Series is based on natural production. This factor is also taken into consideration in estimating the grazing capacity of a number of the soil complexes in the county. Topographic limitation is particularly relevant in complexes which include Ladestown and Crush soils.

*Net grazing capacity - comparison with 1973 livestock numbers*

Table 13 shows the net grazing capacity of the county. This includes the grazing capacity of improved and reclaimed peat areas and also the industrial sod peat areas (Clonsast Complex). Table 14 compares livestock numbers (1973) with possible stocking estimates.

TABLE 13: Net grazing capacity of Co. Westmeath

| | Area | | Grazing capacity (L.U.) | |
|---|---|---|---|---|
| | Ha | Acres | 48 kg N/ha | 230 kg N/ha |
| Lowland and hill | 136,356 | 336,799 | 274,885 | 339,368 |
| Reclaimed peat and Clonsast complex | 21,426 | 52,922 | 35,995 | 44,352 |
| Less | | | | |
| Urban, roads, fences etc. | 12,353 | 30,511 | 24,335 | 30,140 |
| Tillage crops not devoted to livestock (1973) | 3,640 | 8,990 | 7,535 | 9,355 |
| Forest (1971) | 3,290 | 8,126 | 3,880 | 4,300 |
| Net | 8,499 | 342,094 | 275,130 | 339,925 |

Table 14: Livestock numbers (1973) and possible stocking estimates

| Livestock No. (1973) (L.U.) | Possible total (L.U.) 48 kg N/ha | 230 kg N/ha |
|---|---|---|
| 184,700 | 275,100 | 339,900 |

The unreclaimed peat areas (Allen series, Pollardstown series) and Turbary complex are excluded (17,000 ha). Assuming that these latter areas were reclaimed, work u An Foras Taluntais Peatland Research Centre at Lullymore shows that potential stocking rates of 168 L.U. and 207 L.U./lOO ha based on low and high nitrogen inputs respectively are technically possible, particularly on the Turbary complex.

Under a moderate level of grassland management (48 kg N/ha) livestock numbers in the county could be expanded by about 50%, whereas under intensive management (230 kg N/ha) an increase of over 80% in number of livestock units is technically possible. The average grazing capacity of the mineral soils is 200 L.U. and 247 L.U./lOO ha (80 and 100 L.U./lOO acres) under the low and high nitrogen inputs respectively.

Reference

1. Attwood, E. A. and Heavey, J. F. (1964), Ir. J. agric. Res. 3 : 249.

## CHAPTER VI1

### TRACE ELEMENT CONTENT OF SOILS

*P. J. Parle and G. A. Fleming**

Because a rigid definition is not possible, the term 'trace element', in the present context, will be taken to include any element whose content in soils lies below 1% (10,000 parts per million) and whose content in agricultural crops is usually not greater than 100 parts per million. This excludes such elements as phosphorus, which rarely exceeds 0.5% in soil but is normally far in excess of 100 parts per million in crops.

The range of trace elements encountered in soils may be quite large (Table 15) and a hundred fold variation in content is by no means exceptional In this respect trace elements differ appreciably from elements such as calcium, phosphorus and potassium - often referred to as major elements - where variations in excess of tenfold are quite uncommon.

*Interpretation of data*

Extractable trace element data on various soils in Co. Westmeath given in Table 16 provide a guide to the availability of some nutritionally important trace elements to plants, and indirectly to grazing stock. The soil values below which deficiencies might be expected to occur are as follows: for copper and zinc 1.0 ppm, molybdenum 0.01 ppm, manganese 40 ppm, and cobalt 5.0 ppm. It must be stressed, however, that these figures can only be regarded as broad guidelines. More precise information for different soils can only be achieved after calibration experiments linking extractable levels with plant uptake. Nevertheless the figures can be used to draw attention to likely anomalous areas and to indicate where corrective measures are advisable.

TABLE 15: Normal ranges of some trace elements in soils; total contents in parts per million (ppm)

| Element | Range (ppm) | Element | Range (ppm) |
|---|---|---|---|
| **Tin** | 1-10 | Lead | 2-200 |
| Gallium | 5-70 | Molybdenum | 0.2-5 |
| Vanadium | 20-500 | Copper | 2-100 |
| Silver | **0.1-1** | Cadmium | 1-1 |
| Zinc | 10-300 | Nickel | 5-500 |
| Cobalt | M 0 | Chromium | 5-1000 |
| Titanium | 1000-10000 | Manganese | 200-3000 |
| Selenium | 0.1-2 | | |

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TABLE 16: Trace elements - ranges of extractable contents (ppm)

| Great soil group | Soil series | No. samples | Horizon | Cu | Mn | Zn | Mo | B | Co | %loss on ign. |
|---|---|---|---|---|---|---|---|---|---|---|
| Rendzina | Burren | 1 | A | 4.6 | 280 | 45.5 | 0.40 | 4.1 | 2.1 | 41.2 |
| Brown Earth | Baggotstown | 3 | A | 6.2-18.2 | 245-340 | 5.2- 6.7 | 0.11-0.32 | 1.6-1.9 | 6.0-113 | 10.8-13.0 |
| | Ladestown | 4 | A | 7.0-10.1 | 240-510 | 10.9-36.8 | 0.04-0.75 | 1.9-5.0 | 7.4-10.8 | 13.8-26.6 |
| Grey Brown Podzolic | Elton | 3 | A | 1.0-11.4 | 235^615 | 2.3- 7.9 | 0.18-0.43 | 1.3-2.1 | 6.0-11.3 | 5.0-11.2 |
| | Patrick swell | 7 | A | 3.0-12.1 | 310-630 | 5.4-19.0 | 0.18-0.89 | 1.0-2.9 | 5.6- 9.1 | 10.0-15.2 |
| | Rathowen | 6 | A | 4.5-15.2 | 180-645 | 3.5- 9.9 | 0.18-0.65 | 1.0-2.6 | 3.8-10.0 | 11.2-14.6- |
| | Rathowen Cherty Phase | 2 | A | 4.0- 4.8 | 245-290 | 3.8-13.8 | 0.40-0.47 | 1.7-1.8 | 4.8- 6.5 | 6.8-16.4 |
| Gley | Howardstown | 2 | A | 4.1- 4.6 | 75- 85 | 4.0- 4.6 | 0.11-0.22 | 0.8-1.4 | 5.6 | 12.4-14.4 |
| | Mylerstown | 1 | A | 3.6 | 110 | 6.8 | 0.11 | 2.4 | 3.3 | 17.4 |
| | Ballyshear | 2 | A | 14.5-17.3 | 270430 | 13.4-19.7 | 1.05-1.19 | 1.5-2.5 | 7.4-7.9 | 22.2-29.4 |
| | Street | 2 | A | 3.8- 5.7 | 120-125 | 5.6- 6.4 | 0.36-0.40 | 2.6-2.8 | 2.1-6.5 | 7.4-14.0 |
| | Camoge | 1 | A | 9.0 | 85 | 16.2 | 0.11 | 2.4 | 3.3 | 17.4 |
| | Coolalough | 1 | A | 18.4 | 270 | 25.1 | 0.60 | 2.8 | 7.4 | 37.4 |
| Regosol | Milltownpass | 1 | A | 6.5 | 145 | 9.5 | 0.32 | 12 | 3.3 | 19.4 |
| Lithosol | Knockeyon | 1 | A | 2.6 | 230 | 30.8 | 0.43 | 2.6 | 2.5 | 28.8 |
| Soil Complexes | Baggotstown—Crush | 2 | A | 0.8-12.4 | 165-250 | 3.3-16.2 | 0.11-0.25 | 2.2-5.0 | 3.84.8 | 10.0-18.6 |
| | Finnea—Banagher—Allen | 4 | A | 1.6-19.4 | 85480 | 1.9- 5.6 | 0.18-0.36 | 1.0-2.0 | 8.7-10.8 | 7.6-14.0 |

*Rendzinas*

Examination of the Burren Series for trace element content showed that this soil is inherently low in cobalt. All other essential trace elements are adequate.

*Brown Earths*

Two series from this group were examined - Baggotstown and Ladestown. Both are adequately supplied with trace elements, but low cobalt values may be found in herbage as a result of high soil manganese content. High easily reducible manganese values found within the Ladestown series could give rise to manganese toxicity at low pH's. One sample within Ladestown had a higher than normal extractable molybdenum.

*Grey Brown Podzolics*

All the soils examined within this group are adequately supplied with trace elements except the Rathowen series where some low soil cobalt values occur. High easily reducible manganese values found within Elton, Patrickswell and Rathowen could give rise to manganese toxicity where pH values are low and also could be reflected by a low cobalt herbage content. Higher than normal extractable molybdenum levels are found within Patrickswell and Rathowen which would necessitate care in the application of lime (1).

*Gleys*

Mylerstown, Camoge and parts of Street soils are inherently low in cobalt, while low herbage cobalt values may be found in parts of Ballyshear. All other essential trace elements are in adequate supply. Ballyshear has higher than normal extractable molybdenum values which could cause problems with animals.

*Regosol*

Miltownpass, the one soil classified as being in this group, is inherently low in cobalt, otherwise it has an adequate supply of trace elements.

*Lithosol*

Knockeyon was the only soil classified as being in the group and examination for trace elements content showed it to be low in cobalt. All other essential trace elements appear adequate.

*Soil Complexes*

Of the soils examined for trace elements in this group Baggotstown - Crush was found to be low in cobalt. Copper deficiency may occur on parts of this complex particularly where high nitrogen is applied. High easily-reducible soil manganese values from Finnea-Banagher-Athy suggest that low cobalt levels may be found in herbage in areas within this complex.

*Peaty Lake Alluvium - Drombanny Series*

High selenium values are found within this series which could cause toxicity problems for the grazing animals. Extractable molybdenum levels also tended to be higher than normal (Table 17).

TABLE 17: Ranges of total selenium and extractable molybdenum levels in Drombanny Series

| Parent material | No. of samples | Horizon | Total Se (ppm) | Extract. Mo (ppm) |
|---|---|---|---|---|
| Peaty Lake Alluvium | 3 | A | 2.7-18.6 | 0.20-1.0 |

Toxic levels of both selenium and molybdenum have been reported from the Drombanny series in Co. Limerick where animals have been affected. The condition leading to an excess of these elements in this soil involves organic matter. Discussion of these soils and the selenium levels in crops grown on them may be found in "The Soils of Co. Limerick" (National Soil Survey Bulletin No. 16), and the reader is referred to this work for further information. It may be stated, however, that while the area of seleniferous soils in Co. Limerick is not large, problems are associated with them. Attention must be drawn to these soils from a public health point of view, as excessive intakes of selenium have been associated with a higher than normal incidence of dental caries, though it must be pointed out that slightly elevated intakes of molybdenum are held to be beneficial in this regard.

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# CHAPTER VI11

## FARMING PATTERN IN THE COUNTY*

Westmeath is primarily a cattle farming county with dairying, sheep, pigs and tillage playing a supporting role. Cattle production constitutes over 80% of the total agricultural output in the county. During the last 20 years livestock numbers have been increasing steadily, in 1952 the county supported 138,655 livestock units, by 1972 this figure had reached 190,900. Over this period cattle increased by 52.5% and sheep by 44%.

That cattle are now being marketed at a much younger age than previously is illustrated in Table 18.

TABLE 18: Percentage of dry cattle, by age group, 1952 and 1972

| Age group (years) | Over 3 | 2-3 | 1-2 | Under 1 |
|---|---|---|---|---|
| 1952 | 24 | 35 | 25 | 16 |
| 1972 | 8 | 31 | 35 | 26 |

Compiled from, Area under Crops and Pasture and Number of Livestock, June 1952 and June 1972, Central Statistics Office, Dublin

A study of cattle movement in Ireland (1) identified Westmeath as a major importer of calves, one in every four coming from the southern counties. In addition, the county is a major importer of yearling cattle. There is some evidence that the intensity of cattle production in the county is not reflected in the national statistics. Many of the yearling cattle are imported after June 1 and a substantial number are shipped or slaughtered before the next enumeration. The findings of the above study would seem to bear this out. O'Sullivan refers to the level of turnover of cattle in the county. "The data reveal the strikingly high level of turnover or throughput of cattle in Westmeath. The extremely heavy flow through the county to finishing or live export from Ireland denotes considerable intensity and efficiency of production" (2).

This intensification of cattle production is reflected in the development of intensive and efficiently-run cattle production units along modern lines.

### Cattle Production Systems

Significant changes have occured in the methods of cattle production in the county. Traditionally, Westmeath was a store cattle producing county. Forward stores produced on grass were sold in October and November for shipping to the United Kingdom. Intensive winter feeding was not a general practice, cattle being carried over on rough grazing or winterage.

•Compiled by the Staff of Co. Westmeath Committee of Agriculture, in particular Mr. J. J. Gallen, C.A.O., Mr. Jeremiah Sheehan, Agricultural Instructor, and Mr. P. J. Isdell, Deputy C.A.O.

The advent of the meat factory and the development of modern methods of food conservation and housing systems have influenced a change from this system on the larger farms. It is now the practice on many of these farms to finish cattle for sale to slaughter and a decreasing proportion of cattle go elsewhere for finishing.

### Suckling Herds

In a county where drystock farming was so firmly entrenched by tradition it was difficult to forecast the probable response to the Beef Incentive Bonus Scheme, introduced in 1969 to encourage the expansion of suckler herds. However, suckling developed as a major farm enterprise and there are now over 2,000 suckling herds in the county with approximately 50% of the herd owners having 10 animals or more engaged in suckling.

### Dairying

The growth of creameries in the south of Ireland in this century had the effect of bringing about a decline in the dairy industry in Co. Westmeath. The manufacture of home-produced butter declined and supplies were mainly purchased from the creameries of the south. In 1958, Snowcream (Midlands) Ltd., Moate, set up a milk pasteurisation plant for liquid milk and in 1960, Westmeath Co-Operative Agricultural and Dairy Society began operations at Mullingar. The provision of these outlets for milk stimulated a new interest in dairying. At present there are 1,000 dairy herds in the county, or approximately 25% of the total effective herds producing creamery or liquid milk. With the increase in suckling and dairy herds the cow population increased from 24,400 to 46,200 between 1961 and 1973, representing an increase of 53%.

### Sheep

As cow numbers increased over the last decade sheep numbers declined. This trend has been noticeable in other counties also, since sheep tend to compete with cows for early grazing. The Galway ewe crossed with the Suffolk ram predominates and the main emphasis is on mid-season lamb production. Where introduced, the Grey Face and Borris-type ewe have proved very satisfactory. There would seem to be a place for the extensive grazing of sheep on drystock farms without any reduction in cattle stocking rate.

### Pigs

A feature of the pig industry in the county is that the bigger pig enterprises are located on the larger farms rather than the smaller farms, where pig production would be more important in contributing significantly to the viability of the holding. Pig production was never a major enterprise in Co. Westmeath. The tendency in latter years has been for the small unit to disappear and the declining pig numbers to become located in a small number of large units.

## Horses

Horse numbers have declined steadily in line with national trends. The horse industry is mainly confined to the stud farms. In addition there is a sound nucleus of Irish draft mares which are bred pure or crossed with a thorough bred.

## Tillage

The production of both cereals and root crops continues to decline in the county. In 1973 less than 20,000 acres (i.e., 4.4%) were under crops. Wheat, once a prominent crop among the cereals, has dropped to less than 2,000 acres and this has been off-set to some extent by an increase in the feeding barley acreage. Barley would seem to be the most suitable cereal crop and a further increase in acreage would provide supplement to the winter fodder supply.

## Summary

Apart from the free-draining gravel soils in the south and large tracts of bogland throughout the county the soils tend to be of a retentive nature and well suited to highly productive grassland.

Soil type and climatic factors largely determine the type of farming that can be carried out. Low temperatures can be experienced late into spring and early in autumn. Difficulties are also experienced with ground conditions in wet weather due to the heavy, retentive nature of the soils. These factors dictate that the main farming systems should be based on grassland. The majority of farmers are involved in cattle production, breeding and finishing; dairying, while traditionally a minority enterprise in the county, is on the increase and there is scope for substantial development in this area. Where farm size is the limiting factor dairying can provide incomes of an acceptable level which could not be obtained from a drystock system. The farm structure would suggest that dairying will continue to develop and become an important enterprise along with, and complementary to, the main enterprise of cattle production.

## References

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# APPENDIX 1

## DEFINITION OF TERMS USED IN PROFILE DESCRIPTIONS* AND ANALYSES

### Texture

Soil texture refers to the relative proportions of the various size particles in the mineral fraction of a soil. More especially, it refers to the relative proportions of clay, silt and sand in the mineral fraction less than 2 millimetres in diameter. Texture, which is one of the more important of the soils'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, 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 (Fig. 8).

*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 breaking.

*Silt Loam: A* silt loam contains a moderate amount of sand, a relatively small amount of clay and more than 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.

*day Loam: A* clay loam contains more clay than a loam and usually breaks into 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.

*Clay: A* clay has a preponderance of 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'.

*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.

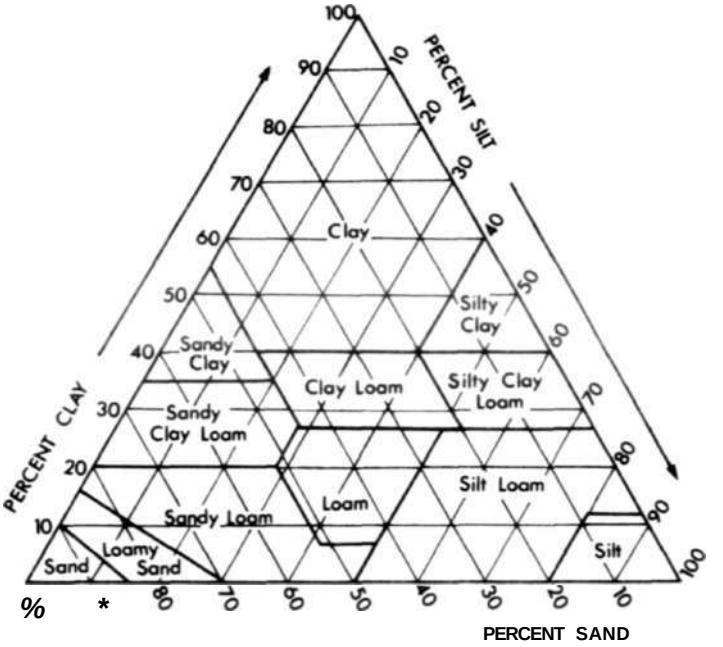


*Fig. 8: Chart showing the percentages of clay (less than 0.002 mm) silt (0.002 to 0.05 mm) and sand (0.05 to 2.0 mm) in the basic soil texture classes (After Soil Survey Manual, U.S.D.A. Handbook No. 18, Washington, D.C., 1951)*

*General Grouping of Soil Textural 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:

| *General terms* | | *Basic soil textural class* |
|---|---|---|
| Sandy Soils | Coarse-textured soils | Sands |
| | | Loamy sands |
| | Moderately coarse-textured soils | Sandy loams |
| | | Loams |
| Loamy Soils | Medium-textured soils | Silt loams |
| | | Silts |
| | | Gay loams |
| | Moderately fine-textured soils | Sandy clay loams |
| | | Silty clay loams |
| | | Sandy clays |
| Gayey Soils | Fine-textured soils | Gays |

## 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 indicate 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 verticle line and bounded by relatively flat verticle surfaces
c) Blocklike - with particles arranged around a point and bounded by relatively flat or curved 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 blocklike are angular blocky (with sharp-angled faces) and sub-angular 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 and 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 distrubed, 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 a little non-aggregated mat-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 soil 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 condition 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 elevation of soil consistence is usually considered at three levels of soil moisture - wet, moist and dry.

*Consistence Mien 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: Noncoherent.
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; barely crushable between thumb and finger.

*Consistence When Dry*

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

0. Loose: Noncoherent.
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 brittle but harder than that which 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.

*pH*

pH is a measure of soil acidity or alkalinity. A soil having a pH of 7.6 to 8.3 is moderately alkaline; pH 7.1 to 7.5, slightly alkaline; pH 7.0, neutral; pH 6.6 to 6.9, nearly neutral; pH 6.0 to 6.5, slightly acid; pH 5.3 to 5.9, moderately acid; pH 4.6 to 5.2, strongly acid; and pH below 4.5, very acid.

*Total Neutralising Value (TNV)*

This is an index of the level of carbonates present in a soil. These carbonates modify the solubility of other nutrients. Soils showing positive TNV values in the surface horizons contain adequate or excess neutralising materials and are not in need of liming.

*Carbon and Nitrogen*

The level of organic carbon indicates the amount of organic matter in a soil (C x 1.72 = organic matter). The content and nature of organic matter are of fundamental importance. Due to its high cation exchange capacity, organic matter acts as a reservoir for plant nutrients, which are gradually released to meet the requirements of the growing plant. At the same time, acid humus supplements the supply by influencing the extraction of nutrients from the mineral fraction of soils. Organic matter creates favourable physical conditions for crop growth; it promotes granulation of structure by reducing plasticity, influences cohesion and increases the water-holding capacity of the soil. Organic matter in the surface also influences the temperature of soils and, thus, seasonal growth.

Depending on organic carbon content, soils are classified as follows: over 30% peats; 20 to 30%, peaty; 10 to 20%, slightly peaty; and those with 7 to 10% are usually referred to as 'organic'. In the case of the terms 'peaty', 'slightly peaty', and 'organic', the mineral textural class is included in the definition of the soil, e.g., peaty sandy loam; slightly peaty clay loam; organic loam. The surface horizon of mineral soils in Ireland normally contains 3 to 6% organic carbon.

Nitrogen, which is normally present in soils in relatively small amounts, is extremely important as a plant nutrient. It is easily leached from the soil and supplies need to be constantly replenished. The ratio of carbon to nitrogen (C/N ratio) indicates generally the degree of decomposition of organic matter; a ratio between 8 and 15 is considered satisfactory and indicates conditions favourable to microbial activity. Ratios higher than 15 are associated with a slower decomposition rate and with the accumulation of raw organic matter or, in more extreme cases, with peat development, and are indicative of unfavourable conditions for microbial activity.

*Free Iron*

A localised accumulation of free iron in a soil profile (Bir horizon), as is evident in brown-podzolic and podzol soils, indicates that leaching and podzolising processes have been operative. On the other hand, a uniform distribution of free iron throughout a profile, as is the case in the Brown Earths, indicates that the soils have not been strongly leached.

*Summary of Analytical Methods*

*Particle Size Analysis:* Determined by the International Pipette Method as described by Kilmer and Alexander (1949), using sodium hexametaphosphate as dispersing agent.

*pH:* Determined on 1.2 soil/water suspension using a glass electrode.

*Total Neutralising Value:* Determined on HC1 extract using phenolphthalein as indicator and titrating against NaOH. CaCC>3 was used as a 100% standard.

*Organic Carbon:* Estimated by the Walkley-Black dichromate oxidation method as described by Jackson (1958), modified for colorimetric estimation. Values were read off on a Spekker Absorptiometer using Orange Filter No. 607. A recovery factor of 1.1 was used.

*Total Nitrogen:* Estimated by a modification of the method of Piper (1950) by digesting soil with cone. H2SO4 using selenium as a catalyst, distilling into boric acid and titrating with HC1.

*Free Iron:* Extracted with buffered sodium hydrosulphite (Mehra and Jackson, 1960). Fe determined colorimetrically using o-phenanthroline.

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## APPENDIX 11

## PROFILE DESCRIPTIONS AND ANALYSES

### Elton Series

| | |
|---|---|
| Location: | Westmeath N 65 62* |
| Topography: | Gently rolling |
| Slope: | ,0 -O . ,0 , |
| Altitude: | 1 - 2 in 5 slope |
| Drainage: | 82 m O.D. |
| Parent Material: | Well drained |
| Great Soil Group: | Limestone drift with some shale |
| | Grey Brown Podzolic (minimal) |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A1 | 0-15 | Gravelly clay loam; brown to dark brown (10 YR 4/3); moderate, fine crumb structure; moist friable; mat of roots; clear smooth boundary: |
| A12g | 15-32 | Silt loam; brown (10YR5/3) with root traces of yellowish brown (10 YR 5/8); weak medium crumb with sub-angular blocky structure; moist friable; plentiful roots; clear and wavy boundary: |
| B2tl | 32-35 | Gay loam; dark yellowish brown (10 YR 4/4); massive to weak, fine sub-angular blocky structure; moist plastic to dry friable; few roots; worm casts present; gradual boundary: |
| B2t2 | 35-82 | Clay loam; dark greyish brown to dark brown (10 YR 4/2 to 3/3); massive structure; almost wet plastic; few roots; clay movement obvious with clay skins on the peds and pinhole structure; gradual smooth boundary: |
| CI | 82 + | Gravelly clay loam; brown to dark brown (10 YR 4/3); massive; moist plastic, slightly sticky; no roots apparent |

### TABLE 1 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand % | sat % | Qay% | PH | C% | Free iron % | TNV % |
| A1 | 13 | 11 | 47 | 29 | | 3.4 | 1.7 | · |
| A12g | 13 | 11 | 53 | 23 | 5.2 | 1.3 | 2.1 | . |
| B2tl | 11 | 11 | 46 | 32 | 6.5 | 0.5 | 3.2 | 0.0 |
| B2t2 | 11 | 11 | 44 | 34 | 6.8 | 0.7 | 3.2 | 0.0 |
| CI | 13 | 10 | 48 | 29 | 7.9 | 0.3 | 1.9 | 23.9 |

**National Grid reference*
*TNV = Total neutralizing value*
*Coarse sand = 2.0 - 0.20 mm; Fine sand = 0.20 0.05 mm; Silt = 0.05- 0.002 mm; Clay <0.002 mm*

## Mortarstown Series *

| | |
|---|---|
| Location: | Co. Kildare S 64 95 |
| Topography: | Flattish |
| Slope: | 0° |
| Altitude: | 70 m O.D. |
| Vegetation: | Barley |
| Drainage: | Well drained |
| Parent Material: | Calcareous drift composed mainly of limestone |
| Great Soil Group: | Grey Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Ap | 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 | 20-36/43 | Loam to clay loam, brown to yellowish brown (10 YR 5/3-54); massive tending towards moderate fine granular; moist firm *in situ;* few roots; clear wavy boundary to: |
| B2t | 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; abnjpt wavy boundary to: |
| | 89 + | Gritty clay loam; light brownish grey (10 YR 6/2); structureless; moist firm; no roots; calcareous |

TABLE 2 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | sat % | Clay% | PH | C% | N% | C/N | Free iron % | TNV % |
| AP | 16 | 26 | 36 | 22 | 6.2 | 2.0 | 0.20 | 10.0 | 1.7 | 0.0 |
| A12 | 14 | 27 | 35 | 24 | 6.7 | 1.0 | 0.13 | 7.7 | 1.7 | 0.0 |
| | 5 | 9 | 42 | 44 | 6.9 | 0.5 | . | . | 3.1 | 0.0 |
| C | 9 | 11 | 41 | 39 | 8.2 | 0.5 | - | - | 1.9 | 30.2 |

**Model profile from Soils of Co. Kildare*

## Patrickswell Series - Silty Texture

| | |
|---|---|
| Location: | WestmeathN4520 |
| Topography: | Gently rolling ground moraine |
| Slope: | 1° |
| Altitude: | lOOmO.D |
| Drainage: | Well drained |
| Parent Material: | Limestone drift with shales |
| Great Soil Group | Grey Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-14 | Silty clay loam; very dark grefish brown (10 YR 3/2); weak, fine crumb structure towards sub-angular blocky; moist plastic; root mat; gradual and clear boundary: |
| A12 | 14-30 | Silty clay loam; yellowish brown (10 YR 5/4); weak, fine sub-angular blocky structure; moist friable; some roots present; gradual and smooth boundary: |
| B2t | 30-70 | Sflty clay loam; brownish yellow (10 YR 6/6); massive structure; moist slightly plastic; few fine grass roots; clay skins on some of the peds; gradual and smooth boundary: |
| | 70-90 | Silt loam; yellowish brown (10 YR 5/6); weak, coarse sub-angular blocky structure; moist plastic; very few roots |

TABLE 3 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay % | PH | *C%* | N% | C/N | Free iron % |
| A11 | 6 | 8 | 57 | 29 | 5.3 | 4.9 | 0.53 | 9.2 | 1.2 |
| A12 | 6 | 5 | 60 | 29 | 7.1 | 2.4 | 0.30 | 8.0 | 1.2 |
| B2t | 4 | 5 | 59 | 32 | 7.2 | 0.4 | . | - | 1.7 |
| C | 3 | 6 | 64 | 2^ | 8.0 | 0.4 | - | - | 1.5 |

## Patrickswell Series - Sandy Texture

| | |
|---|---|
| Location: | Westmeath N 1950 |
| Topography: | Kame at side of an esker |
| Slope: | 4° |
| Altitude: | 80 m O.D. |
| Drainage: | Well drained |
| Parent Material: | Limestone, sands and gravels with some shale |
| Great Soil Group: | Grey Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A1 | 0-15 | Fine sandy loam; dark reddish brown (5 YR crumb structure; moist friable; root mat; gradual boundary: |
| A12 | 15-35 | Fine sandy loam; dark yellowish brown (10 YR 4/4); weak, fine to medium sub-angular blocky structure; moist friable; abundant diffuse rooting; gradual boundary: |
| Bl | 35-55 | Sandy loam; reddish brown (5 YR 4/4); medium, fine sub-angular blocky structure; moist friable; plentiful diffuse rooting; gradual boundary: |
| B2t | 55-75 | Sandy clay loam; brown to dark brown (7.5 YR 4/4); weak, fine sub-angular blocky structure; moist friable; roots become scarcer; gradual boundary: |
| C | 75+ | Sandy loam; light brownish grey (10 YR 6/2); single grain structure; moist loose; very few roots |

TABLE 3 A - AnalyticaJ data

| | Particle-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay% | PH | C% | Free iron % |
| A1 | 34 | 28 | 27 | 11 | 6.0 | 3.4 | 1.1 |
| A12 | 45 | 18 | 18 | 19 | 7.1 | 1.3 | 1.1 |
| Bl | 44 | 22 | 15 | 19 | 7.4 | 0.7 | 1.1 |
| B2t | 47 | 30 | 0 | 23 | 7.2 | 0.8 | 0.9 |
| C | 64 | 15 | 10 | 11 | 8.0 | 0.2 | 0.4 |

## Rathowen Series

| | |
|---|---|
| Location: | Westmeath N 3370 |
| Topography: | Gently rolling |
| Slope: | 1° |
| Altitude: | 76 m O.D |
| Drainage: | Moderately well drained |
| Parent Material: | Limestone and shale drift |
| Great Soil Group | Grey Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-12 | Gravelly loam; light brow grey (10 YR 6/2); weak, fine sub-angular blocky with crumb structure; moist sticky and slightly plastic; root mat present; clear, smooth boundary: |
| A12 | 12-36 | Gravelly loam; very dark greyish brown (10 YR 3/2); weak, fine to medium sub-angular blocky structure; moist sticky and slightly plastic diffuse rooting; clear, smooth boundary: |
| B2tl | 36-63 | Gravelly loam to clay loam; yeBowish brown (10 YR 5/4 &. 5/5); weak, fine to medium sub-angular blocky structure; moist sticky; plentiful diffuse rooting; clear, smooth boundary: |
| B2t2 | 63-78 | Gravelly sandy clay loam; yellowish brown (10 YR 5/4); weak, medium prismatic structure breaking into weak fine sub-angular blocky; moist sticky; few roots; clear smooth boundary: |
| B3g | 78-101 | Gravelly loam; yellowish brown (10 YR 5/4) with few fine distinct mottles, moist sticky; very few roots |

TABLE 4 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay% | PH | *C%* | Free iron % |
| Al | 17 | 18 | 43 | 22 | 5.7 | 4.8 | 0.9 |
| A12 | 20 | 16 | 40 | 24 | 5.9 | 1.6 | 0.9 |
| B2tl | 15 | 16 | 42 | 27 | 6.6 | 0.5 | 1.2 |
| B2t2 | 29 | 18 | 24 | 29 | 7.3 | 0.4 | 1.1 |
| B3g | 17 | 18 | 39 | 26 | 7.7 | 0.2 | 0.8 |

## Rathowen Series - Cherty Phase

| | |
|---|---|
| Location: | WestmeathN4961 |
| Topography: | Gently rolling |
| Slope: | 1° |
| Altitude: | 107mO.D. |
| Drainage: | Moderately well drained |
| Parent Material: | Till of shale, chert and limestone composition |
| Great Soil Group: | Grey Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-12 | Silt loam; dark brown (10 YR 3/3) is the overall colour which is made up of dark grey (10 YR 4/1) with common fine, faint mottles of yellowish brown (10 YR 5/8); weak, fine sub-angular blocky with crumb structure; moist slightly sticky, slightly plastic; root mat present; clear, smooth boundary: |
| A12 | 12 | A layer of cherty gravel |
| Bl | 12-35 | Gravelly silt loam; weak, medium to fine sub-angular blocky structure; moist slightly plastic and friable; abundant roots; gradual boundary: |
| B2t | 35-60 | Sflt loam; brown to dark brown (10 YR 4/3); prismatic to massive structure; wet plastic and slightly friable; roots are few and scattered; clay movement is obvious with clay skins on some ped surfaces and with pinhole structure; overall dark grey colour of limestone gravel; single grain structure; wet slightly sticky: |
| CI | 60-80 | Gravelly sandy loam; overall dark grey colour of limestone gravel; single grain structure; wet slightly sticky: |
| C2 | 80-90-100 | A layer of rocks underlain by till |

TABLE 5 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand% | Sflt % | Clay% | PH | C% | N% | C/N | Free iron% | TNV % |
| A11 | 11 | 11 | 57 | 21 | 5.3 | 6.4 | 0.65 | 9.8 | 0.8 | |
| A12 | 15 | 12 | 54 | 19 | 5.2 | 4.7 | 0.49 | 9.6 | 1.0 | |
| Bl | 16 | 11 | 53 | 20 | 5.6 | 1.1 | 0.15 | 7.3 | 1.2 | . |
| B2t | 15 | 10 | 51 | 24 | 7.1 | 0.4 | . | | 1.9 | 0.0 |
| C | 40 | 12 | 36 | 12 | 8.0 | 0.3 | | - | 0.8 | 25.5 |

## Rathowen Cherty Phase - Podzol Variant

| | |
|---|---|
| Location: | N4760 |
| Topography: | Almost flat top to moraine in rolling terrain |
| Slope: | 1° |
| Altitude: | 119mO.D. |
| Parent Material: | Mixed till composed of shale, chert and limestone |
| Great Soil Group: | Podzol |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A1 | 0-15 | Gravelly silt loam; dark greyish brown (10 YR 4/2); weak, fine crumb structure; moist friable; root mat poorly developed; clear smooth boundary |
| A 2 | 15-17-60 | Gravelly silt loam; grey (10 YR 5/1); massive structure; moist friable; fibrous grass roots present; stones occur; clear, irregular boundary |
| B2irh | 60-70 | Gravelly silty clay loam; yellowish brown (10 YR 5/4); massive structure; moist firm and undurated; few fibrous grass roots; stones present, gradual boundary; an iron pan, very dark grey in colour (5 YR 3/1) occurs at variable depth in this horizon |
| | 70-100 | Gravelly silt loam; brown to dark brown (10 YR 5/3 to 4/3); massive breaking into weak, medium angular blocky structure; wet slightly sticky; very few roots; stones present |

## TABLE 5A - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay % | pH | C% | N% | C/N | Free iron % |
| A1 | 20 | 11 | 55 | 14 | 5.3 | 3.3 | 0.33 | 10.0 | 0.4 |
| A2 | 13 | 11 | 61 | 15 | 6.6 | 0.6 | | | 0.6 |
| B2irh | 6 | 7 | 55 | 32 | 6.9 | 4 2 | 0.53 | 7.9 | 1.6 |
| C | 15 | 11 | 52 | 22 | 5.1 | 0.2 | | | 1.6 |

## Rathowen Series - Brown Earth Variant

| | |
|---|---|
| Location: | Westmeath N 3244 |
| Topography: | Gently rolling ground moraine |
| Slope: | 1° |
| Altitude: | 61 mO.D. |
| Drainage: | Moderately well drained |
| Parent Material: | Shale and limestone till |
| Great Soil Group: | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-10 | Loam; brown to dark brown (10 YR 4/3); moderate, fine to medium sub-angular blocky structure with crumb; moist friable; abundant roots; clear, wavy boundary: |
| A12 | 10^0 | Loam; dark yellowish brown (10 YR 4/4); moderate, fine to medium sub-angular blocky structure with crumb; moist friable, slightly sticky; plentiful roots to 25 cms, few below; gradual, smooth boundary: |
| (B)1 | 40-60 | Silt loam; yellowish brown (10 YR 5/8); weak to moderate, coarse prismatic structure; moist friable, slightly sticky, slightly plastic; few roots; clear smooth boundary: |
| (B)2 | 60-100 | Silt loam; light yellowish brown (10 YR 6/4); weak, coarse to moderate prismatic structure; moist friable, slightly sticky, slightly plastic; very few roots; gradual, clear boundary: |
| | 100 + | Gravelly sandy loam; greyish brown (10 YR 5/2); single grain structure; moist loose; no roots |

TABLE 6 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | |
|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay% | PH | C% |
| A11 | 11 | 19 | 46 | 24 | 4.7 | 3.6 |
| A12 | 12 | 19 | 46 | 23 | 5.9 | 1.1 |
| (B)1 | 7 | 19 | 52 | 22 | 6.6 | 0.4 |
| (B)2 | 7 | 21 | 55 | 17 | 7.0 | 0.1 |
| C | 34 | 22 | 33 | 11 | 8.4 | 0.1 |

## Baggotstown Series

| | |
|---|---|
| Location: | Westmeath N 1950 |
| Topography: | On side of kame beside an esker |
| Slope: | 9° |
| Altitude: | 61 mO.D. |
| Drainage: | Excessively drained |
| Parent Material: | Limestone sands and gravels |
| Great Soil Group : | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-20 | Sandy loam; dark yellowish brown (10 YR 3/4); moderate, fine crumb astructure; moist friable; a mat of roots; abrupt, smooth boundary: |
| (B) | 20-30 | Gravelly sandy loam; dark yellowish brown (10 YR 3/4 to 4/4); weak, fine sub-angular blocky structure; moist friable; plentiful diffuse roots; abrupt, wavy boundary: |
| | 30-45 | Gravelly sand; grey (10 YR 5/1); single grain; moist loose; no roots apparent |

TABLE 7 - Analytical data

| | Par tide-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Sflt% | Clay% | PH | *C%* | Free iron % |
| Al | 52 | 21 | 13 | 14 | 7.3 | 2.2 | 0.7 |
| (B) | 45 | 28 | 14 | 13 | 7.7 | 0.9 | 0.6 |
| C | - | - | - | - | 8.0 | 0.1 | 0.2 |

## Baljinacurra Series

| | |
|---|---|
| Slope: | 16° |
| Altitude: | 12 m O.D. |
| Vegetation: | Old pasture *CCentaureo-Cynosuretum,* Sub. ass of *Galium verumj-* often invaded by *Pteridium aquilinum* and *Ulex europeus* |
| Drainage: | Well to excessively drained |
| Parent Material: | Drift of limestone composition (with a little sandstone and shale) over limestone rock |
| Great Soil Group: | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| All | 0-12 | Gravelly loam; very dark greyish-brown (10 YR 3/2); moderate, medium crumb structure; friable; abundant rooting; gradual, smooth boundary to: |
| A12 | 12-22 | Gravelly loam; very dark greyish-brown (10 YR 3/2); weak, fine sub-angular blocky to weak, medium crumb structure; friable; plentiful rooting; clear, smooth boundary to: |
| (B) | 22-30 | Gravelly silt loam; pale brown (10 YR 6/3); weak, fine crumb structure; friable; few roots; abrupt, irregular boundary to: |
| R* | Below 30 | Limestone rock |

TABLE 8 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand % | Silt% | Clay % | pH | C% | N% | C/N | Free iron % | TNV % |
| **All** | 19 | 26 | 34 | 21 | 7.7 | 6.9 | 0.63 | **11.0** | 1.3 | **11.4** |
| A12 | 19 | 25 | 34 | **22** | 8.0 | 3.2 | 0.30 | 10.7 | 0.9 | 19.1 |
| (B) | 11 | 19 | 54 | 16 | 8.0 | 1.5 | 0.16 | 9.4 | 0.6 | 41.4 |

**Profile description and analyses from Co. Limerick Soil Survey Report*

## Ladestown "Series

| | |
|---|---|
| Location: | Westmeath N 4249 |
| Topography: | Gently rolling kame and kettle |
| Slope: | 2° |
| Altitude: | 92 m O.D. |
| Drainage: | Excessively drained |
| Parent Material: | Kame of shale, chert and limestone composition |
| Great Soil Group: | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-18 | Silty clay loam; very dark brown (10 YR 2/2); moderate, fine crumb structure; moist friable; a diffuse root mat present; clear, smooth boundary: |
| (B) | 18-35 | Gravelly silt loam; greyish brown (10 YR 5/2); weak, fine sub-angular blocky structure; moist friable; plentiful roots; gradual boundary: |
| C | 3545 | Gravelly sflt loam; light brownish grey (10 YR 6/2) to pale brown (10 YR 6/3); weak, very fine sub-angular blocky structure almost single grain; moist friable; plentiful diffuse roots |

TABLE 9 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | sat % | Clay % | PH | C% | N% | C/N | Free iron % | TNV % |
| Al | 6 | 7 | 60 | 27 | 5.3 | 4.4 | 0.54 | 8.1 | 1.8 | · |
| (B) | 6 | 7 | 61 | 26 | 6.9 | 3.0 | 0.37 | 8.1 | 1.9 | 0.0 |
| C | 7 | 5 | 60 | 28 | 7.4 | 1.5 | 0.20 | 7.5 | 1.6 | 4.7 |

## Burren Series - Deeper Phase

| | |
|---|---|
| Location: | Westmeath N 4665 |
| Topography: | Hilltop in hilly topography |
| Slope: | 5°-10° |
| Altitude: | 216mO.D. |
| Drainage: | Excessively drained |
| Parent Material: | Limestone bedrock |
| Great Soil Group: | Rendzina |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| **A11** | 0-12 | Cobbly slightly peaty, silt] :lay loam; very dark brown (10 YR 2/2); strong, fine crumb; dry firm, roots are plentiful between the cobble-stones; clear smooth boundary: |
| A12 | 12-24 | Cobbly organic silt loam; very dark brown (10 YR 2/2); moderate, fine crumb structure; dry firm; roots are frequent going down between the coblestones; arthropods and worms are present; clear and irregular boundary; |
| | **24 +** | |

TABLE 10 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | |
|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay% , | PH | C% |
| A11 | 6 | 3 | 61 | 30 | 6.1 | 14.8 |
| **A12** | **18** | 6 | 53 | 23 | 7.6 | 6.8 |

## Crush Series

| | |
|---|---|
| Location: | Westmeath N 1950 |
| Topography: | At crest of esker |
| Slope: | 1° above 15° |
| Altitude: | 81 mO.D. |
| Drainage: | Excessivley drained |
| Parent Materials: | Limestone and shale gravels |
| Great Soil Group. | Rendzina |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-14 | Sandy loam to sandy clay 1 im; very dark greyish brown (10 YR 3/2); coarse, weak crumb structure breaking readily into fine strong crumb; moist friable; many grass roots in a mat interspersed with roots of bushes, clean, smooth boundary |
| Cl | 14 + | Sand to loamy sand: Grey (10 YR 5/1); this is the background colour of the varied sand grains; sand; singlegrain with a tendency towards fine, weak crumb structure; moist; loose; no roots |

TABLE 11 - Analytical data

| Horizon | Particle-size analysis of mineral fraction Coarse sand% | Fine sand% | Sflt % | Clay % | PH | C% | N% | C/N | Free iron % | TNV % |
|---|---|---|---|---|---|---|---|---|---|---|
| All | 55 | 8 | 18 | 19 | 6.8 | 8.0 | 0.73 | 11.0 | 0.9 | nd |
| CI | 69 | 8 | 11 | 2 | 8.7 | | | | 0.2 | 47.0 |

## Knockeyon Series

| | |
|---|---|
| Location: | Westmeath N 4664 |
| Topography: | Hilltop in hilly topography |
| Slope: | 16° |
| Altitude: | 216mO.D. |
| Drainage: | Excessively drained |
| Parent Material: | Chert beds in limestone |
| Great Sofl Group: | Lithosol |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A1 | 0-20 | Silt loam; dark greyish bi vn (10 YR 4/2); strong, fine to mediui crumb structure; dry firm; roots throughout; clear irregular boundary: |
| | 20 + | Cherty bedrock |

TABLE 12 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay % | PH | C% | Free iron % |
| A1 | 18 | 5 | 51 | 26 | 5.1 | 10.2 | 0.6 |

## Milltownpass Series

| | |
|---|---|
| Location: | Westmeath N 5243 |
| Topography: | River flat |
| Slope: | 0° |
| Altitude: | 82 m O.D. |
| Drainage: | Well drained |
| Parent Material: | Alluvium derived from limestone and shale |
| Great Soil Group | Regosol |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Ap | 0-10 | Silty clay loam; very dark greyish brown crumb structure; moist slightly plastic; plentiful roots with no mat developed; smooth, abrupt boundary: |
| A12 | 10-25 | Loam; dark brown (7.5 YR 3/2); weak, fine columnar structure breaking into weak, medium sub-angular blocky; moist slightly plastic; plentiful roots; smooth and abrupt boundary: |
| C | 25-30 | Sandy loam; very dark grey (10 YR 3/1); single grain structure; moist slightly friable; many roots; abrupt smooth boundary: |
| Ab | 30-40 | Sandy loam; black (7.5 YR N 2/-); massive structure; organic consistency; many roots; diffuse, smooth boundary: |
| Cb | 40-60 | Gravelly sandy loam; very dark grey (10 YR 3/1); weak, medium sub-angular blocky structure; moist friable; some roots |

TABLE 13 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay % | PH | C% | *S7<* | C/N | Free iron % | TNV *7c* |
| AP | 3 | 10 | 58 | 29 | 5.5 | 6.6 | 0.67 | 9.9 | 2.6 | |
| A12 | 16 | 14 | 48 | 22 | 6.0 | 4.2 | 0.32 | 13.1 | 0.9 | . |
| C | 46 | 26 | 19 | 9 | 6.3 | 3.8 | 0.25 | 15.0 | 0.2 | . |
| *\b* | 53 | 20 | 20 | 7 | 6.8 | 5.0 | 0.41 | 12.2 | 0.3 | . |
| Cb | 37 | 2? | 28 | 12 | 77 | 04 | | - | 0 1 | 46.8 |

## Ballyshear Series

| | |
|---|---|
| Location: | Westmeath N 5045 |
| Topography: | Almost level |
| Slope: | 0° |
| Altitude: | 80 m O.D. |
| Drainage: | Poorly drained |
| Parent Material: | Limestone drift |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| 02 | 0-20 | Slightly peaty loam; black (10 YR 2/1); moderate fine crumb; moist friable; plentiful roots; abrupt, smooth boundary: |
| A 2 | 20-36 | Gravelly loam; greyish brown (10 YR 5/2); massive structure; moist slightly plastic to slightly friable; some roots present; clear, smooth boundary: |
| Btg | 36-50 | Gravelly clay loam; very dark greyish brown (10 YR 3/2) with common, fine, faint mottles of yellowish brown (10 YR 5/6); weak, medium angular blocky structure; moist plastic, very few roots, clear, smooth boundary; |
| | 50 + | Gravelly loam; the overall colour is very dark grey (10 YR3/1); single grain structure; moist loose; no roots |

TABLE 14 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay % | pH | C % | N % | C/N | Free iron ' | TNV |
| 02 | 22 | 12 | 42 | 24 | 6.3 | 8.1 | 0.66 | 12.3 | 1.7 | 0.0 |
| A2 | 21 | 17 | 4D | 22 | 7.6 | 1.6 | 0.16 | 10.0 | 0.6 | 3.6 |
| Btg | 22 | 10 | 31 | 37 | 7.9 | 0.9 | 0.09 | 10.0 | 0.5 | 31.8 |
| C | 38 | 8 | 36 | 18 | 8.0 | 0.4 | - | . | 0.4 | 46.6 |

## Howardstown Series

| | |
|---|---|
| Location: | Westmeath N 5243 |
| Topography: | Very gently undulating topography |
| Slope: | 2° |
| Altitude: | 88mO.D. |
| Drainage: | Poorly drained |
| Parent Material: | Limestone drift |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-10 | Silt loam; greyish brown (10 YR 5/2) (dry); weak fine crumb structure; dry firm; root mat; clear and gradual boundary: |
| A12g | 10-30 | Gravelly silt loam; greyish brown (10 YR 5/2) (dry); weak, fine sub-angular blocky structure; dry firm; plentiful roots; clear, smooth boundary: |
| A: | 30-50 | Gravelly clay loam; dark grey (10 YR 4/1) (dry); massive structure; dry firm; a few grass roots persist; diffuse, smooth boundary: |
| B2irg | 50-70 | Gravelly, cobbly loam; grey (10 YR 5/1) and brownish yellow (10 YR 6/6) in common, medium, distinct mottles; massive structure breaking into weak, medium sub-angular blocky; moist plastic; only a few rush roots persist; clear and smooth: |
| B3g | 70-90 | Loam; brown (10 YR 5/3) and brownish yellow (10 YR 6/6) in common, medium, distinct mottles; massive structure; moist plastic; no roots: |

TABLE 15 - Analytical data

| | Particle-size analysis **of mineral fraction** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Horizon** | Coarse **sand %** | **Fine sand %** | **Silt%** | **Clay%** | **pH** | **C%** | **N%** | **C/N** | **Free iron %** | **TNV %** |
| **Al** | **14** | **14** | **52** | **20** | **6.3** | **5.0** | **0.43** | **11.6** | **0.4** | |
| **A12g** | 14 | **15** | **5 2** | **19** | **6.0** | **1.0** | **0.10** | **10.0** | **0.5** | **-** |
| **A2** | 8 | **17** | **42** | **33** | **.** | **0.6** | **.** | **.** | **0.2** | **.** |
| **B2lrg** | 14 | **12** | **4M** | **25** | **7.8** | **0.5** | | | **1.6** | **18.0** |
| **B3g** | 19 | **IS** | **44** | **19** | **8.0** | **0.2** | **-** | **-** | **0.5** | **36.9** |

## Howardstown Series - Lithic Variant

| | |
|---|---|
| Location: | Westmeath N 52 43 |
| Topography: | Level expanse on edge of bog |
| Slope: | 1° |
| Altitude: | 88mO.D. |
| Drainage: | Poorly drained |
| Parent Material: | Limestone drift with a little shale |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-15 | Gravelly loam; dark greyish brown (10 YR 4/2); weak, fine crumb structure; dry friable; mat of roots to 10 cms and abundant to 15 cms; clear, smooth boundary: |
| A2g | 15-20 | Gravelly loam; dark, greyish brown (2.5 Y 4/2); massive structure; moist friable; few roots; clear, smooth boundary; a line of gravel exists in the top of A2: |
| B2irg | 20-38 | Gravelly loam; brown to dark brown (10 YR 4/3) and light yellowish brown (10 YR 6/4) and greyish background in common, medium, distinct mottles; massive structure with a tendency towards prismatic; moist plastic; few roots; abrupt, smooth boundary: |
| R | 38+ | Limestone bedrock |

TABLE 16 - Analytical-data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand % | sat % | Clay % | PH | C% | N% | C/N | Free iron % |
| Al | 14 | 12 | 48 | 26 | 5.7 | 4.1 | 0.34 | 12.0 | 0.6 |
| A2g | 24 | 9 | 46 | 21 | 6.0 | 1.7 | 0.20 | 8.5 | 0.9 |
| B2irg | 13 | 14 | 49 | 24 | 7.4 | 0.7 | - | - | 1.5 |

## Mylerstown Series

| | |
|---|---|
| Location: | Westmeath N 6154 |
| Topography: | Very gently rolling |
| Slope: | 0° |
| Altitude: | 83 m O.D. |
| Drainage: | Poorly drained |
| Parent Material: | Limestone - Shale drift |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A | 0-15 | Gravelly silt loam, grav very fine; dark brown (7.5 YR 3/2); a fine weak crumb in sub-angular blocky structure; moist friable; a root mat to 9 cm and plentiful to 15 cms; clear, smooth boundary: |
| Bg | 15-34 | Gravelly clay loam, gravel is not so fine as in A; dark grey (10 YR 4/1) with common fine, distinct mottles of brown and yellowish brown; fine weak sub-angular blocky structure; moist plastic; some roots present; clear smooth boundary: |
| Cg | 34+ | Gravelly loam; grey (2.5 Y N 5/-) and dark grey (2.5 Y N 4/-) with many, fine, faint mottles of brown and yellowish brown; massive though broken by gravel; moist plastic with very few roots |

TABLE 17 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | sat % | Clay % | PH | C% | N% | C/N | Free iron % |
| A | 17 | 12 | 64 | 7 | 6.2 | 6.1 | 0.58 | 10.5 | 0.6 |
| Bg | 20 | 12 | 40 | 28 | 6.5 | 1.7 | 0.14 | 12.1 | 0.6 |
| Cg | 25 | 12 | 44 | 19 | 6.9 | 0.4 | - | - | 0.4 |

## Street Series

| | |
|---|---|
| Location: | Westmeath N 33 68 |
| Topography: | Hummocky |
| Slope: | 4 in level landscape |
| Altitude: | 107 m O.D. |
| Drainage: | Poorly drained |
| Parent Material: | Drift of limestone, calp and shale composition |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-10 | line gravelly loam to silt loam; dark brown fine crumb structure; moist friable and slightly plastic; root mat; dear smooth boundary: |
| A12 | 10-20 | Gravelly loam to silt loam; dark brown (10 YR 3/3); with root mottles of reddish brown (5 YR 4/4); weak fine blocky structure; moist plastic; plentiful roots; glacial boundary: |
| Big | 20-43 | Gravelly loam to silt loam; grey (2.5 YN 5/) and strong brown (7.5 YR 5/8) fine, few distinct mottles; prismatic structure; moist plastic and slightly friable; few roots; gradual boundary: |
| B2g | 43-61 | Gravelly clay loam; grey (2.5 YR N5/ ), greyish brown (10 YR 5/2) and yellowish brown (10 YR 5/6) in few, medium distinct mottles; prismatic structure; moist plastic; very few roots; clean, smooth boundary: |
| B3g | 61+ | Gravelly clay loam; same as in B2ig in few, medium and faint mottles; massive structure; wet sticky: no roots |

TABLE 18 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay% | PH | *C%* | N% | C/N | Free iron % | TNV % |
| Al | 13 | 16 | 47 | 24 | 4.4 | 4.4 | 0.36 | 12.2 | 0.9 | |
| A12 | 16 | 15 | 46 | 23 | 5.6 | 1.3 | 0.11 | 11.8 | 0.9 | |
| Big | 13 | 15 | 46 | 26 | 6.3 | 0.4 | . | . | 0.9 | |
| B2g | 13 | 14 | 42 | 31 | 6.7 | 0.4 | - | | 1.6 | - |
| B3g | 11 | 14 | 45 | 30 | 8.2 | 0.3 | | - | 1.3 | 22.0 |

## Street Series - Podzolic Gley Variant

| | |
|---|---|
| Location: | Westmeath N 5267 |
| Topography: | Rolling morainic landscape |
| Slope: | 5° |
| Altitude: | 137mO.D. |
| Drainage: | Poorly drained |
| Parent Material: | Drift composed of limestone, shale and chert |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Descrinrinn* *Description* |
|---|---|---|
| A1 | 0-22 | Gravelly silt loam; brown to dark brown (10 structure; moist slightly plastic; mat of roots to 10 cms; clear, smooth boundary: |
| A2 | 22-30 | Gravelly silt loam; grey to light grey (10 YR 6/1); massive structure; moist firm, indurated; few roots; abrupt, smooth iron pan otherwise clear, smooth boundary: |
| A2h & Fe pan | 30-32 | Black (10 YR 2/1) and brown to dark brown (7.5 YR 4/4) intermittent pans. Plentiful roots: |
| Bg | 32-74 | Gravelly silt loam; yellowish brown (10 YR 5/6) and pale brown (10 YR 6/3) in common, medium, distinct mottles; massive indurated structure; moist firm; humus extending weakely from the A2h through this horizon; few roots; gradual boundary: |
| Cg | 74-125 | Gravelly silt loam; yellowish brown (10 YR 5/4) with light brownish grey (10 YR 6/2) in common, medium, faint mottles; weak, medium, sub-angular blocky structure; moist plastic; there are patches of sandy clay loam throughout Cg |

TABLE 19 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt % | Clay% | PH | C% | N% | C/N | Free iron % |
| Al | 22 | 13 | 52 | 13 | 5.4 | 3.0 | 0.2 | 15.0 | 0.5 |
| A 2 | 18 | 12 | 55 | 15 | 5.7 | 0.6 | . | - | 0.1 |
| A2h | 17 | 15 | 51 | 17 | 5.6 | 1.2 | 0.1 | 12.0 | 0.7 |
| Bg | 13 | 15 | 57 | 15 | 6.3 | 0.3 | . | . | 0.9 |
| Cg | 13 | 12 | 51 | 24 | 6.1 | 0.4 | - | - | 1.1 |

## Camoge Series

| | |
|---|---|
| Location: | Westmeath N 3749 |
| Topography: | River flat |
| Slope: | 0° |
| Altitude: | 104mO.D. |
| Drainage: | Poorly drained |
| Parent Material: | Alluvium from limestone glacial drift with some shales |
| Great Soil Group: | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-16 | Silty clay loam; dark brown (10 YR 3/3); fine, weak crumb in moderate sub-angular blocky structure; moist plastic; many fine roots, almost a mat; clear, smooth boundary: |
| Bg | 1647 | Sflt loam; dark grey (10 YR 4/1) with common, fine, faint mottles of brown; massive to prismatic; moist plastic; clay skins present on verticle faces; very few roots; clear, smooth boundary: |
| Clg | **47-57** | Gravelly sflt loam; grey (10 YR 5/1) with few, fine, faint mottles of light yellowish brown (10 YR 6/4); fine, weak angular blocky to massive; in the fine state it is wet plastic and in the coarse it is friable; very few roots; gradual boundary: |
| C2g | **57+** | Silt loam; grey (10 YR 5/1) intermixed with light grey (10 YR 7/1) with common, medium and faint mottles of light yellowish brown; massive; wet plastic; no roots |

TABLE 20 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand% | SUt% | Clay % | PH | C% | N% | C/N | Free iron % |
| Al | 3 | 10 | 56 | 31 | 5.6 | 6.2 | 0.58 | 10.7 | 0.8 |
| B2g | 3 | 25 | 53 | 19 | 6.4 | 2.2 | 0.22 | 10.0 | 0.6 |
| **Clg** | 12 | 20 | 56 | 12 | 8.2 | 0.6 | . | . | 0.2 |
| C2g | 7 | 14 | 61 | 18 | 8.3 | 0.5 | - | - | 0.3 |

## Coolalough Series

| | |
|---|---|
| Location: | WestmeathN 1752 |
| Topography: | Flat lake bed |
| Slope: | 0° |
| Altitude: | 63 m O.D. |
| Drainage: | Poorly drained |
| Parent Material: | Alluvium derived from limestone and shale glacial drift |
| Great Soil Group : | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-12 | Organic clay loam to silty clay loam; very dark greyis 3/2); fine, weak sub-angular blocky with crumb structure; moist plastic; root mat to 12 cms; clear, smooth boundary: |
| A12 | 12-30 | Organic loam; very dark brown (10 YR 2/2); fine weak, sub-angular blocky structure; moist plastic; plentiful roots; clear and irregular on small scale: |
| Clg | 30-45 | Silty clay loam; very dark grey (2.5 Y N 3/-) with fine, common, faint mottles; massive; wet plastic; few verticle roots; clear, smooth boundary: |
| C2g | 45-59 | Silty clay loam; grey (2.5 Y 5 N/-) with many, medium, distinct mottles of light olive brown (2.5 Y 5/4); massive; wet plastic; a few vertical roots; clear, smooth boundary: |
| C3g | 59-75 | Silty clay loam; dark grey (2.5 Y 4 N/-) with many, coarse, distinct mottles of light olive brown (2.5 Y 5/4); massive; wet plastic; no roots: |
| | 74 | Water table |

TABLE 21 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand % | Sflt % | Clay % | PH | C% | N% | C/N | Free iron % |
| A11 | 2 | 20 | 50 | 28 | 5.0 | 12.6 | 1.30 | 9.7 | 1.4 |
| A12 | 3 | 24 | 47 | 26 | 5.6 | 10.3 | 0.77 | 13.4 | 1.4 |
| C1g | 2 | 9 | S3 | 36 | 8.3 | 0.6 | - | - | 0.4 |
| C2g | 2 | 8 | 51 | 39 | 8.3 | 0.6 | - | - | 1.5 |
| C3g | 2 | 6 | <4 | 38 | 8.2 | 0.6 | - | - | 0.9 |

## Drombanny Series*

| | |
|---|---|
| Location: | Clare R 3180 |
| Topography: | Alluvial flat in area of limestone hillocks |
| Slope: | 0° |
| Altitude: | 12mO.D. |
| Drainage: | Poorly drained |
| Parent Material: | Alluvium derived from limestone drift with some Upper Carboniferous shales and sandstones |
| Great Soil Group | Gley |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-25 | Organic clay; very dark greyish-brown (10 YR 3/2); moderate, fine crumb structure; wet plastic; root mat 6 inches with abundant roots below; clear irregular boundary: |
| A12 | 25-37 | Organic clay; very dark brown (10 YR 2/2); massive structure; wet plastic; plentiful roots; clear, irregular boundary: |
| 02b | 37-50 | Slightly peaty silty clay; black; strong, coarse angular blocky structure; wet plastic; many living and dead roots; abrupt, -smooth boundary: |
| Clca | 50-74 | Clay loam; very pale brown (10 YR 8/3); massive structure; wet sticky; no roots; calcareous; clear, smooth boundary: |
| C2 | 74-86 | Sandy loam; grey (2.5 YN 5/-); single grain structure; wet plastic and moist friable; no roots, calcareous |

•Modal profile from Co. Clare Soil Survey Report

TABLE 22 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand% | sat % | Clay% | PH | C% | N% | C/N | Free iron% | TNV % |
| **A11** | 0 | 2 | 40 | 58 | 6.9 | 6.3 | 0.58 | 10.9 | 0.8 | |
| **A12** | 5 | 11 | 39 | 45 | 6.8 | 10.0 | 1.80 | 6.0 | 1.4 | |
| 02b | 2 | 2 | 46 | 50 | 6.9 | 20.0 | 1.50 | 13.3 | 14 | |
| Clca | nd | nd | nd | nd | 8.4 | 1.7 | 0.10 | 17.0 | 0.1 | 88.8 |
| C2 | 1 | 66 | 30 | 3 | 7.9 | 0.3 | nd | | 0.7 | 28.5 |

## Banagher Series

| | |
|---|---|
| Location: | Westmeath N 4964 |
| Classification: | Histosol, Limnic medisaprist |
| Parent Material: | Minerotrophic peat (Fen) |
| Vegetation: | Ryegrass, Timothy, Annual Meadow Grass, Clover, Butter cup, Silver Weed, Soft Rush |
| Topography: | Flat, in mid-lake basin |
| Drainage: | Well drained, moderate permeability; slow below 35 cm |
| Ground Water: | 90 cm |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Apl | 0-10 | Black (10 YR 2/1) peat; sapric; with dark greyish brown (10 YR 4/2) silty clay admixture of drain spoil; spoil has massive coherent structure, wet plastic; peat has fine medium crumb structure, moist friable; highly humified; common roots |
| Ap2 | 10-25 | Black (10 YR 2/1); peat; sapric; fine medium crumb structure; moist friable; highly decomposed amorphous no recognisable plant remains; after washing fine aggregates and recent root material, clear, wavy boundary to: |
| CI | 25-30 | Black (5R 2/1) sedge; peat; sapric; massive structure; moist friable; vertical drying cracks; highly humified; clear, wavy boundary to: |
| C2 | 30-50 | Black (10 YR 2/1); fen peat with coarser woody remains; sapric; massive structure with indiscriminate fracture; wet sticky; well humified; on washing amorphous material with fragmented roots and plant debris; clear, wavy boundary to: |
| C3 | 50-60 | Black (10 YR 2/1); fen peat with woody remains, sapric; massive structure; moist friable, wet sticky; moderately to well humified; on washing much woody debris (bark and twig fragments) clear wavy boundary to: |
| | 60-75 | Black (10 YR 2/1); woody fen peat; hemic; massive structure, wet slightly sticky; moderately well humified; on washing amorphous material, many fragmented rootlets, some fine twigs; fine charcoal fragments; clear wavy boundary: |
| | 75+ | Black (5 YR 2/1); sedge with phragmites fen peat; hemic; massive structure; wet sticky; well humified; on washing occasional woody debris, finely divided rootlets, *Characeae* oospores and mineral/organic lumps |

## TABLE 23 - Analytical data

| Horizon | Depth (cm) | Moisture | pH ($H_2O$) | Ash % | Dh g/cc | Fibre % | Pyrophosphate* extract colour |
|---|---|---|---|---|---|---|---|
| Apl | 0-10 | 59.09 | 7.30 | 67.2 | 0462 | 23.5 | 5YR 3/3 |
| Apl2 | 10-25 | - | 6.19 | 40.3 | | 14.1 | 5YR 3/3 |
| CI | 25-30 | 83.85 | 5.50 | 20.4 | 0.392 | 9.5 | 5YR2/1 |
| C2 | 30-50 | - | 5.31 | 16.1 | | 19.5 | 5YR 2/2 |
| | 50-60 | - | 6.70 | 13.9 | | 22.5 | 5YR 3/2 |
| | 60-75 | - | 4.70 | 11.4 | | 49.3 | SYR 4/2 |
| | 75+ | | 2.08 | 33.2 | | 46.5 | 10YR6/3 |

•Saturated sodium pyrophosphate extract colours indicate the degree of decomposition of the peat samples, i.e., decreasing Munsell values generally indicates increasing humification

## Allen Series

| | |
|---|---|
| Location: | WestmeathN4852 |
| Gassification: | Histosol Typic Sphagnofibrist (Raised bog) |
| Parent Material: | Ombrotrophic peat |
| Vegetation: | Heather and moss |
| Topography: | On cut edge of bog - slope of 1° |
| Drainage: | Poor |
| Permeability: | Poor |
| Altitude: | 100 m O.D. Slope 1° |
| Root Distribution: | Roots to 58 cm |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-27 | Dark reddish brown (5 YR *3/4);Calluna-Sp* humified; dominantly *Calluna* remains twigs and flower heads etc; clear wavy boundary to: |
| A12 | 27-58 | Dark reddish brown (5 YR 3/4); *Sphagnum* peat; fibric; poorly humified; on washing dark colour well preserved 100% *Sphagnum* clear, slightly wavy boundary to: |
| CI | 58-87 | Dark reddish brown (2.5YR 2/4); *Sphagnum* peat; fibric; poorly humified; on washing dominantly dark coloured *Sphagnum* with *Eriophorum* remains; abrupt wavy boundary to: |
| C2 | 87-118 | Black (SYR 2/1); *CallunaSphagnum* peat; fibric; poorly humified; on washing *Calluna* debris with *Sphagnum* and some *Eriophorum* |

TABLE 24 - Analytical data

| Horizon | Moisture % | PH ($H_20$) | Ash | Db g/cc | Fibre % | Pyrophosphate extract colour |
|---|---|---|---|---|---|---|
| Al | 88.86 | 3.42 | 3.0 | OJ061 | 69.1 | 10YR7/3 |
| A12 | - | 3.40 | 1.0 | - | 69.8 | 10YR8/1 |
| CI | 93.07 | 3.35 | 0.6 | 0.055 | 60.7 | 10YR 8/1 |
| C2 | - | 3.50 | 0.6 | | 65.6 | 10YR8/1 |

## Allen Series

| | |
|---|---|
| Location. | Westmeath N 6359 |
| Classification: | Histosol, Typic Sphagnofibrist (Raised bog) |
| Parent Material: | Ombrotrophic peat |
| Vegetation: | Heather, moss, grass, sedge and rush |
| Topography: | Gentle slope - flat topography - slope 1° |
| Altitude: | 80 m O.D. |
| Drainage: | Very poorly drained |
| Permeability: | Slow |
| Root Distribution: | Poor |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| 01 | 0-20 | Reddish yellow (7.5 YR 6/8) to dark brown (7.5 YR 4/4) fresh *Sphagnum* peat; fibric; very poorly decomposed; on washing pure *Sphagnum;* abrupt wavy boundary to: |
| CI | 20-39 | Dark reddish brown (5YR 3/ ); *Sphagnum* peat; fibric; poorly decomposed; on washing fresh looking *Sphagnum* gradual, wavy boundary to: |
| C2 | 39-62 | Reddish brown (SYR 4/4); *Sphagnum* peat; poorly to moderately decomposed; on washing fresh looking *Sphagnum* with *Eriophorum* |

TABLE 25 - Analytical data

| Horizon | Moisture % | PH ($H_20$) | Ash % | Db g/cc | Fibre % | Pyrophosphate extract colour |
|---|---|---|---|---|---|---|
| 01 | 93.31 | 3.51 | 2.3 | 0.091 | 63.3 | 10YR 8/2 |
| CI | | 3.50 | 1.7 | | 61.3 | 10YR 7/2 |
| C2 | | 4.55 | 1 5 | | 47.7 | 10YR 7/2 |

## Gortnamona Series

| | |
|---|---|
| Location: | Westmeath N 4852 |
| Classification: | Histosol Terric medisaprist (Reclaimed cutover) |
| Parent Material: | Minerotrophic peat |
| Vegetation: | Meadow sweet, Plantain, Soft Rush, Yorkshire Fog, Red Fescue, Annual Meadow Grass, Red Clover Crested Dogstail |
| Topography: | Flat |
| Altitude: | lOOmO.D. |
| Drainage: | Good |
| Permeability: | Moderate |
| Groundwater: | Within mineral substratum |
| Root Distribution: | Common in surface horizon, decreasing with depth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Ap | 0-14 | Very dusky red (2.5 YR 2/2); peat; sapric;fine to medium strong crumb structure; moist friable; very well humified strong root mat; clear, smooth boundary to: |
| A12 | 14-29 | Black (5YR 2/1); peat; sapric; massive structure breaks to sub-angular pieces; moist friable; very well humified; on washing; dark reddish brown amorphous lumps with finely fragmented woody debris, strong staining of supernatant water; clear smooth boundary to: |
| | 29-52 | Black (5YR 2/1); peat; sapric; massive structure well humified; on washing, finely fragmented wood debris with amorphous lumps; clear, gradual boundary to: |
| 1A1 | 52-55 | Weak red (2.5YR 4/2); peaty loam; massive structure wet sticky and slightly plastic; clear, smooth boundary to: |
| IC | 55 + | Greyish brown (10 YR 5/2); stony loam; pale brown (10 YR 6/3); common, coarse, faint mottles; massive coherent structure; wet plastic; vigorous effervescence |

TABLE 26 Analytical data

| Horizon | Moisture % | PH ($H_20$) | Ash % | Db g/cc | Fibre % | Pyrophosphate extract colour |
|---|---|---|---|---|---|---|
| Ap | 63.51 | 5.70 | 40.0 | 0.370 | 23.0 | 5YR2/2 |
| A12 | | 6.38 | 22.5 | | 25.9 | 7.5YR |
| C | 73.72 | 6.32 | 18.7 | 0.184 | 24.3 | 7.5YR |

## Gortnamona Series

| | |
|---|---|
| Classification: | Histosol, Typic medisaprist (Reclaimed cutover) |
| Parent Material: | Minerotrophic peat |
| Vegetation: | Red Fescue; Yarrow, Crested Dogstail, Yorkshire Fog; Buttercup, Silverweed |
| Topography: | Flat |
| Drainage: | Well drained |
| Permeability: | Good |
| Ground Water: | 110cm |
| Root Distribution: | to 100 cm |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Ap | 0-15 | Dark brown (7.5 YR 3/2);peat;sapric; medium, strong crumb structure; dry firm; well humified, on washing resistant structural elements; sand grains occasional weathered *Sphagnum* leaves; gradual, clear boundary to: |
| A12 | 15-35 | Black (2.5YR N2/ ); peat; sapric; medium, moderate sub-angular blocky structure; moist friable; on washing reddish to black amorphous material occasional mineral grains and *Sphagnum* leaves; clear, abrupt boundary to: |
| A13 | 35-75 | Black (10YR 2/1); fen peat with Phragmites and birch; massive structure; on washing heterogeneous mixture reddish brown amorphous material fragmented wood debris and rootlets; clear abrupt boundary to: |
| Cl | 75-110 | Very dark greyish brown (10 YR 3/2), on exposure turning black (10 YR 2/1); fen peat; massive structure; wet sticky on washing amorphous fragments fine rootlets and some fragmented leaf material |

### TABLE 27 - Analytical data

| Horizon | Moisture % | PH ($H_20$) | Ash | Db g/cc | Fibre | Pyrophosphate extract colour |
|---|---|---|---|---|---|---|
| Ap | 57.49 | 6.19 | 34.4 | 0.342 | 16.8 | 5YR2/2 |
| A12 | | 6.18 | 22.2 | | 16.2 | 5YR 2/2 |
| A13 | 82.88 | 6.20 | 10.8 | 0.171 | 38.8 | 5YR3/3 |
| C | - | 5.40 | 13.6 | | 44.9 | 7.5YR 2/2 |

Finnea Series - Brown Podzolic Member

| | |
|---|---|
| Location: | Westmeath N 4280 |
| Topography: | On top of steep kame over-looking peat filled kettle-hole |
| Slope: | 3° |
| Altitude: | 25mO.D. |
| Drainage: | Well drained |
| Parent Material: | Fluvioglacial materials of predominantly shale composition with some limestone |
| Great Soil Group: | Brown Podzolic |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| Al | 0-15 | Gravelly sandy loam; dark brown (10 YR 3/3); weak, fine crumb structure; moist friable; a poorly developed root mat; clear, smooth boundary: |
| A3 | 15-28 | Gravelly sandy loam; dark yellowish brown (10YR 4/4); weak, fine crumb to single grain structure; moist friable; plentiful roots; abrupt, wavy boundary: |
| B2ir | 28-50 | Gravelly sandy loam; weak red (2.5YR 4/2); single grain structure; moist loose; few scattered roots; abrupt, wavy boundary: |
| | 50-65 | Gravelly sandy loam; colour varies with parent material but dark greyish brown (10 YR 4/2) predominates; single grain structure; no roots |

TABLE 28 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Silt% | Clay% | PH | C% | Free iron % |
| Al | 41 | 18 | 24 | 17 | 5.3 | 4.2 | 0.9 |
| A3 | 37 | 20 | 25 | 18 | 5.9 | 2.2 | 1.1 |
| B2ir | 58 | 7 | 16 | 19 | 6.1 | 0.8 | 1.2 |
| C | 53 | 9 | 20 | 18 | 6.0 | 1.4 | 0.9 |

## Finnea Series - Brown Earth Member

| | |
|---|---|
| Location: | Westmeath N 4380 |
| Topography: | Subdued kame and kettle moraine, site in kettle hole |
| Slope: | l°-2° |
| Altitude: | 89 m O.D. |
| Drainage: | Weil drained |
| Parent Material: | Shale fluvioglacial sands and gravels with limestone |
| Great Soil Group: | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-8 | Loam; dark greyish brown (10 YR 4/2); weak, fine crumb to sub-angular blocky structure; moist slightly plastic, diffuse root mat; clear, smooth boundary: |
| A12 | 8-28 | Loam; brown to dark brown (10 YR 4/3); weak, fine sub-angular blocky structure; moist slightly plastic; plentiful roots; clear, smooth boundary: |
| BJ | 2840 | Loam; dark yellowish brown (10 YR 4/4); weak, medium, sub-angular blocky structure; moist plastic;plentiful roots; clear, smooth boundary: |
| (B) | 40-55 | Loam; dark yellowish brown (10 YR 4/4); weak medium to fine sub-angular blocky structure; moist plastic; plentiful roots; clear, smooth boundary: |
| B3 | 55-66 | Gravelly sandy loam; yellowish brown (10 YR 5/4);single grain structure; moist loose; few roots; clear, smooth boundary: |
| C | 66-92 | Gravelly sand to loamy sand; overall colour dark grey, single grain; moist loose; no roots |

## TABLE 29 - Analytical data

| | Particle-size analysis of mineral fraction | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand% | Fine sand % | Silt % | Clay % | PH | C% | Free iron % |
| A11 | 26 | 22 | 35 | 17 | 4.9 | 3.8 | 0.9 |
| A12 | 30 | 20 | 31 | 19 | 5.6 | 1.8 | 0.9 |
| Bl | 32 | 19 | 30 | 19 | 5.9 | 0.9 | 0.9 |
| (B) | 37 | 14 | 32 | 17 | 6.(1 | 0.7 | 1.1 |
| B3 | 64 | 14 | 13 | 9 | 6.1 | 0.5 | 0.8 |
| C | 76 | 12 | 5 | 7 | 6.0 | 0.2 | 0.7 |

Finnea Series - Shallow Brown Earth Member

| | |
|---|---|
| Location: | On side of kame in kame and kettle moraine on edge of raised bog |
| Slope: | 4° |
| Altitude: | 90 m O.D. |
| Drainage: | Well drained |
| Parent Material: | Shale fluvioglacial sands and gravels with limestone |
| Great Soil Group: | Brown Earth |

| *Horizon* | *Depth (cm)* | *Description* |
|---|---|---|
| A11 | 0-15 | Sandy loam: very dark greyish brown (10 YR 3/2); weak, fine crumb structure;moist friable; modest root mat; clear, smooth boundary: |
| A12 | 15-32 | Sandy loam; dark yellowish brown (10 YR 4/4); weak, fine sub-angular blocky structure to single grain; moist friable; well developed root system; clear, smooth boundary: |
| (B) | 32-50 | Sandy loam; brown to dark brown (7.5 YR 4/3); single grain structure; moist friable; plentiful roots; abrupt, smooth boundary: |
| C | 50-60 | Gravelly sand; strong brown (7.5 YR 5/6); single grain structure; moist loose to moist friable;no roots |

TABLE 30 - Analytical data

| | Particle-size analysis of mineral fraction. | | | | | | |
|---|---|---|---|---|---|---|---|
| Horizon | Coarse sand % | Fine sand % | Sflt% | Clay% | PH | C% | Free iron % |
| A11 | 36 | 33 | 17 | 14 | 4.9 | 3.3 | 0.9 |
| A12 | 29 | 43 | 17 | 11 | 5.2 | 1.1 | 0.9 |
| (B) | 32 | 42 | 14 | 12 | 5.3 | 0.8 | 0.9 |
| C | 43 | 47 | 7 | 3 | 5.5 | 0.2 | 0.7 |

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