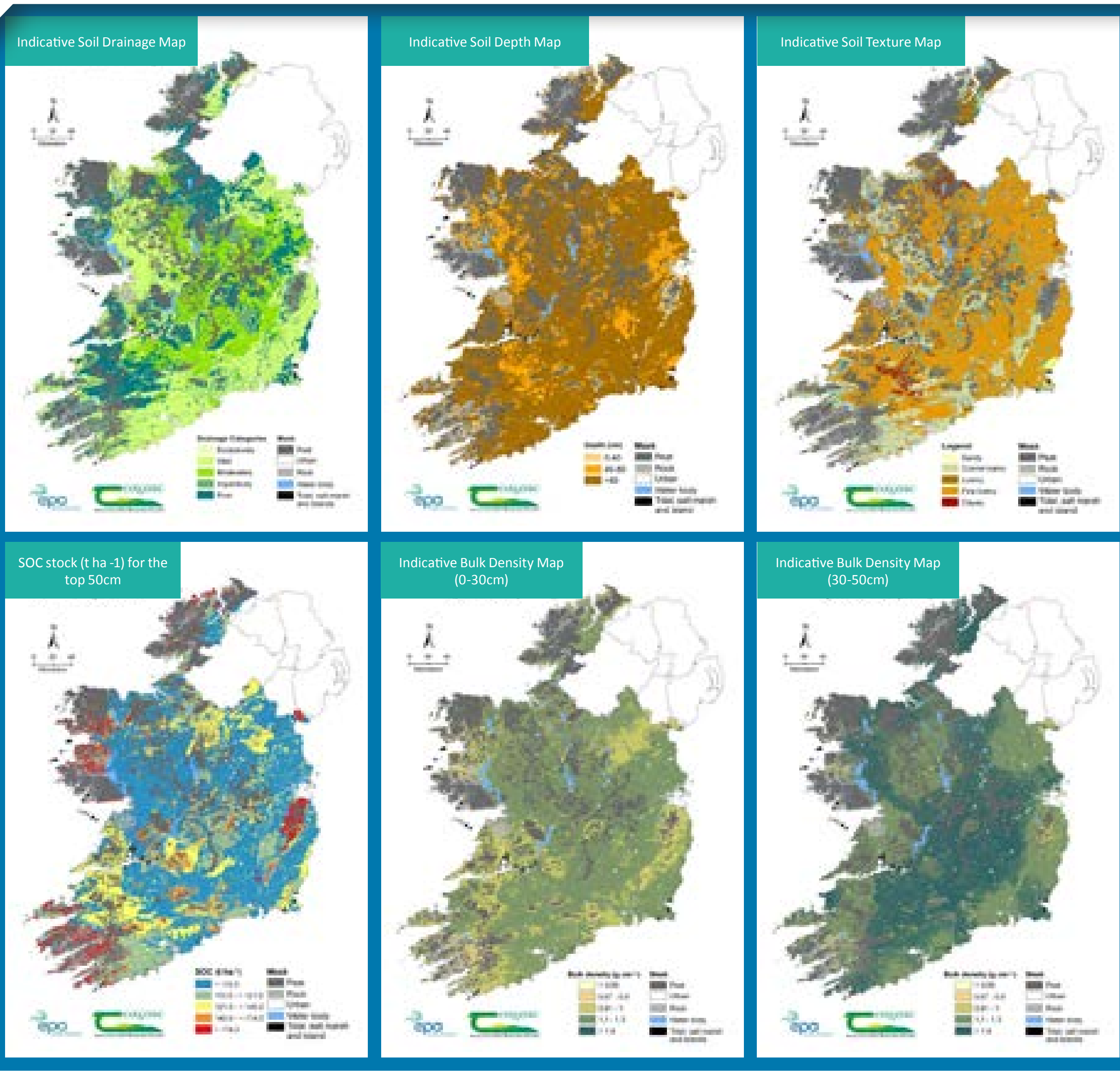
Report No. **204**

epa Research
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

Soil Property Maps

Authors: Rachel E. Creamer, Iolanda Simo, Lilian O'Sullivan, Brian Reidy, Rogier P.O. Schulte, Reamonn M. Fealy.



Roinn Cumarsáide, Gníomhaithe ar son na hAeráide & Comhshaoil
Department of Communications, Climate Action & Environment

www.epa.ie

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities *(e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources);*
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

National Environmental Enforcement

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

Water Management

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports).*

Regulating Ireland's Greenhouse Gas Emissions

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

Environmental Research and Development

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

Strategic Environmental Assessment

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

Radiological Protection

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

Guidance, Accessible Information and Education

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision-making *(e.g. My Local Environment, Radon Maps).*
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

Awareness Raising and Behavioural Change

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiological Protection
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

EPA RESEARCH PROGRAMME 2014–2020

Irish Soil Information System: Soil Property Maps

(2007-S-CD-1-S1)

End of project report available for download at http://erc.epa.ie/safer/reports

Prepared for the Environmental Protection Agency

by

Teagasc

Authors:

Rachel E. Creamer, Iolanda Simo, Lilian O'Sullivan, Brian Reidy, Rogier P.O. Schulte and Reamonn M. Fealy

ENVIRONMENTAL PROTECTION AGENCY
An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle, Co. Wexford, Ireland

Telephone: +353 53 916 0600 Fax: +353 53 916 0699
Email: info@epa.ie Website: www.epa.ie

ACKNOWLEDGEMENTS

This report is published as part of the Research Programme 2014–2020. The programme is financed by the Irish Government. It is administered on behalf of the Department of Communications, Climate Action and the Environment by the EPA which has the statutory function of co-ordinating and promoting environmental research.

This project involved many staff and students based at Teagasc Johnstown Castle, Teagasc Athenry, Cranfield University and University College Dublin. Many thanks go to all the staff, PhD students, placement students and FAS placements who contributed to this project. We also wish to thank the Steering Committee, Dr Alice Wemaere (EPA), Dr John O'Neil, Dr Brendan O'Neil, Mark Gibson (Teagasc), Professor Peter Loveland, Professor Erika Michéli and Dr Arwyn Jones.

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

EPA RESEARCH PROGRAMME 2014–2020
Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-84095-694-8 December 2016

Price: Free Online version

Project Partners

Teagasc – Environment, Soils and Land Use Centre
Johnstown Castle
County Wexford
Ireland
Tel.: +353 53 917 1200
Email: rachel.creamer@teagasc.ie

Teagasc – Spatial Analysis Group, Rural Economy and Development Programme
Ashtown
Dublin
Ireland
Tel.: +353 1 805 9953
Email: reamonn.fealy@teagasc.ie

Contents

List of Figures

Executive Summary

The Irish Soil Information System (Irish SIS) project was established in 2008, following a comprehensive inventory of Irish soil data compiled by Daly and Fealy (2007) which highlighted that the soil data coverage of Ireland was incomplete in both detail and extent. The SIS project is funded under the Environmental Protection Agency Research Programme 2014–2020 and is co-funded by Teagasc. It was led by Teagasc with the participation of researchers from Cranfield University (UK) and University College Dublin. The overall objective of the SIS project was to conduct a programme of structured research into the national distribution of soil types and to construct a soil map, at a scale of 1:250,000, which identifies and describes the soils according to a harmonised national legend. This map is now available in digital format and it forms the basis of a new soil information system for Ireland (http://gis.teagasc.ie/soils/).

The Irish SIS project has utilised existing data and maps from the previous National Soil Survey (NSS), which was conducted by An Foras Talúntais (AFT; forerunner organisation to Teagasc). The NSS produced mapping at a scale of 1:126,720 for 44% of the country, a General Soil Map of Ireland, a National Peatland map – both at a scale of 1:575,000 – and other miscellaneous large-scale mapping of experimental farms. Additionally, more recent map products have been included in the Irish SIS project, such as the Indicative Soil and Subsoil mapping (Fealy *et al*., 2009), which has national coverage using geographical information system (GIS) and remote sensing techniques.

The integration of soil information at European scale has led to the requirement to harmonise and coordinate soil data across Europe and, in the light of the demands for soil protection on a regional basis within EU Member States, there is a growing need to support policy with a harmonised soil information system. The European Soil Bureau Network (ESBN) Technical Working Group dealing with Soil Monitoring and Harmonisation recommended that 1:250,000 would be an economically feasible intermediate scale for a soil map of Europe, which would be able to identify specific problems at a regional scale (Montanarella and Jones, 1999).

The Irish SIS project adopted a methodology that combined utilising novel predictive mapping techniques with traditional soil survey applications. This unique combination at a national scale has resulted in the development of a new national soil map for Ireland. Building upon the detailed work carried out by the AFT survey (known as “Terra Cognita”), the Irish SIS project generated soil-landscape models at a generalised scale of 1:250,000 for the counties of Carlow, Clare, Kildare, Laois, Leitrim, Limerick, Meath, Offaly, Tipperary South, Waterford, Westmeath, Wexford, West Cork, West Mayo and West Donegal. These soil-landscape models (also referred to as soilscapes) were used as the baseline data for statistical models. To validate the methodology, this work was supported by a 2.5-year field survey, in which 11,000 locations were evaluated for soil type, by using an auger bore survey approach. These data were used to check the predicted soil mapping units (or associations) for counties Cavan, Dublin, East Cork, East Donegal, East Mayo, Galway, Kerry, Kilkenny, Louth, Monaghan, Roscommon, Sligo, Tipperary South and Wicklow, where a detailed soil survey map was not available. Where new soil information was generated, as a result of previously unknown combinations of soil-landscape units, profile pits were selected at representative locations across the country. These 246 pits were described and sampled in detail, with purposive laboratory analyses adding considerably to the quantitative database for Irish soils, and were used to generate a new soil classification system for the country. The final product is a unique combination of new and traditional methodologies as well as soils data from both the AFT and the Irish SIS project. This final soil association map of Ireland consists of 58 associations (excluding urban areas and areas of alluvium, peat, rock or marsh) that are made up from 213 soil series. Associated representative profile information is available in the online soil information system (http://gis.teagasc.ie/soils/).

A key component of the Irish SIS project has been the development of a soil and land information system and its associated public website. This system has been designed to hold the complete set of information deriving from both the Irish SIS field programme and

modelling activity, as well as the previously existing legacy soils information available for Ireland. Drawing on this information system, the website is designed to hold and disseminate this information online, in both cartographic and tabular form, to stakeholders. Prior to this development, there was no harmonised computerised system in place to hold and manipulate national Irish soils data. The information system therefore addresses the pressing need and requirement for a publicly accessible, integrated IT framework based upon contemporary informatics standards to serve the many and varied stakeholders who have an interest in soils information in Ireland.

This report is about the Irish Soil Information System: soil properties map report (FTR18). All final technical reports arising from the Irish SIS project are available online at http://erc.epa.ie/safer/reports.

1 Introduction: Soil Attribute Maps

The Irish Soil Information System (Irish SIS) project was established in 2008, following a comprehensive inventory of Irish soil data compiled by Daly and Fealy (2007), which highlighted that the soil data coverage of Ireland was incomplete in both detail and extent. The SIS project is funded under the Environmental Protection Agency Research Programme 2014–2020 and is co-funded by Teagasc – Agriculture and Food Development Authority. It was led by Teagasc with the participation of researchers from Cranfield University (UK) and University College Dublin. The overall objective of the SIS project was to conduct a programme of structured research into the national distribution of soil types and to construct a soil map, at 1:250,000 scale, that identifies and describes the soils according to a harmonised national legend. This map is now available in digital format and it forms the basis of a new soil information system for Ireland (http://gis.teagasc.ie/soils/).

On 10 September 2013, a consultation workshop was held on the SIS project. This workshop included stakeholders from a range of disciplines, including education, consultancy, planning, local authority, government, public sector and research. It covered topics such as soil science, drainage, biodiversity, ecological planning, teaching science, peat protection, climate change, water quality, engineering and food security. The purpose of the meeting was to highlight the work done to date on the SIS project and to present a draft third edition national soil map; this was followed by a consultation process, which asked stakeholders for recommendations of further maps to be derived from the SIS.

On average, 41 responses were provided for each of the proposed soil property attributes that may be suitable for mapping; these included pH, drainage, soil carbon, soil organic matter, depth and soil type. A number of respondents pointed out that soil carbon and soil organic matter were essentially the same issue and these will therefore be considered only once as soil carbon. To generate many of these attribute maps from the third edition national soils map, it was necessary to aggregate the detail of the national soil map soil associations into soil subgroups. Soil subgroups describe the intermediate level of classification between “great groups” (coarse detail) and “soil series” (detailed description) (Figure 1.1). This intermediate level is

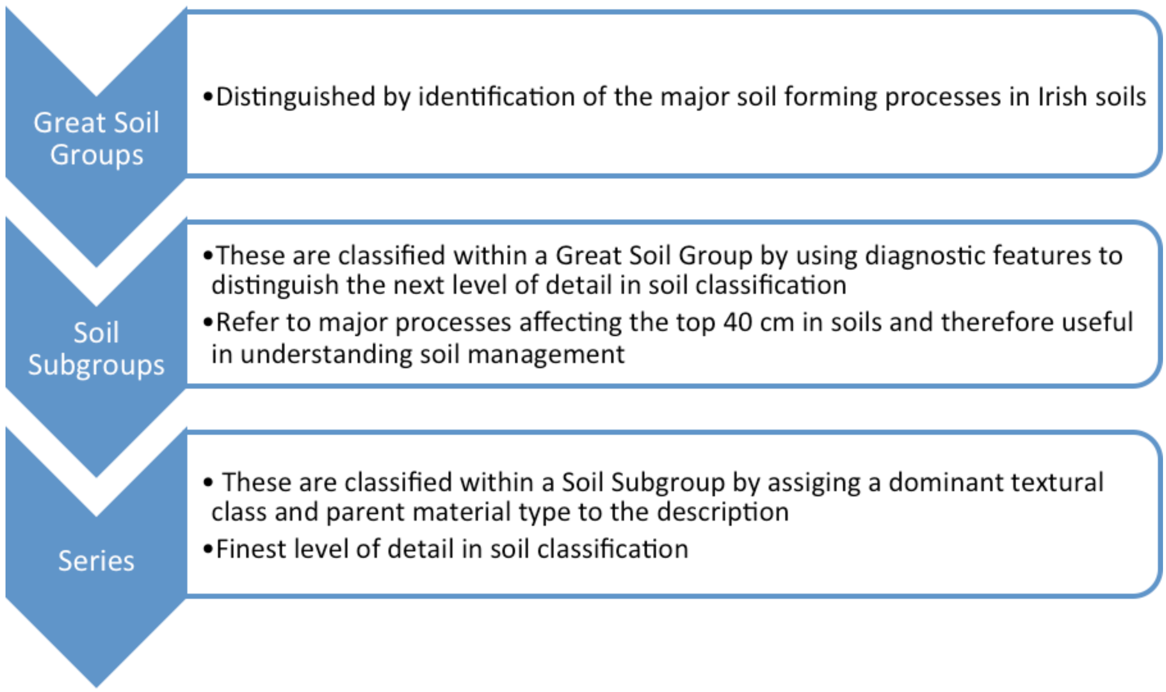


Figure 1.1. Explanation of hierarchical classification system applied in the Irish SIS.

considered most appropriate in terms of management practices on soils, as it describes the major processes found to occur in the top 40 cm of soils that will affect plant productivity and soil functional status.

The following chapter provides a brief overview of the methodology for the production of each map and a review of the map products for future use. Several of the maps are referred to as indicative. This term has been used because these maps are in part based on generalised classes or are reliant on only the lead subgroup of a soil association. Therefore, we can state that these maps imply the displayed characteristics, but only for the mapping unit (polygon), as a general rule, and there may be significant variation within the mapped polygon. The map scale from which these maps were derived is 1:250,000. This is a small map scale, which means that the maps are appropriate for only catchment and larger landscape scales. They are not appropriate for field- or farm-level assessment.

This report is part of the Irish SIS final technical reports. All final technical reports arising from the Irish SIS project are available online at http://erc.epa.ie/safer/reports.

2 Indicative Soil Drainage Map

In Ireland, soil drainage class is considered to have a predominant influence on soil processes (Schulte *et al*., 2012). The North Atlantic maritime climate of Ireland drives wet soil conditions, so excess soil moisture is considered a key constraint on achieving productivity and environmental targets (Schulte *et al*., 2012; O'Sullivan *et al*., 2015; Coyle *et al*., 2016). The following five drainage categories were created as legends for the map: excessively, well, moderately, imperfectly and poor. The categories were allocated to soil subgroups based on diagnostic criteria (see full report for details). The allocation of the drainage class to the lead subgroup of an association for the indicative soil drainage map, as can be seen in Figure 2.1, means that only a general statement can be made about the drainage class of that mapping unit, based on the dominant subgroup present. While this approach presents a good overview of the range of soil drainage patterns at catchment scale and larger, it should not be applied to specific fields or farms. An example of the application of the soil drainage map can be found in Schulte *et al*. (2015).

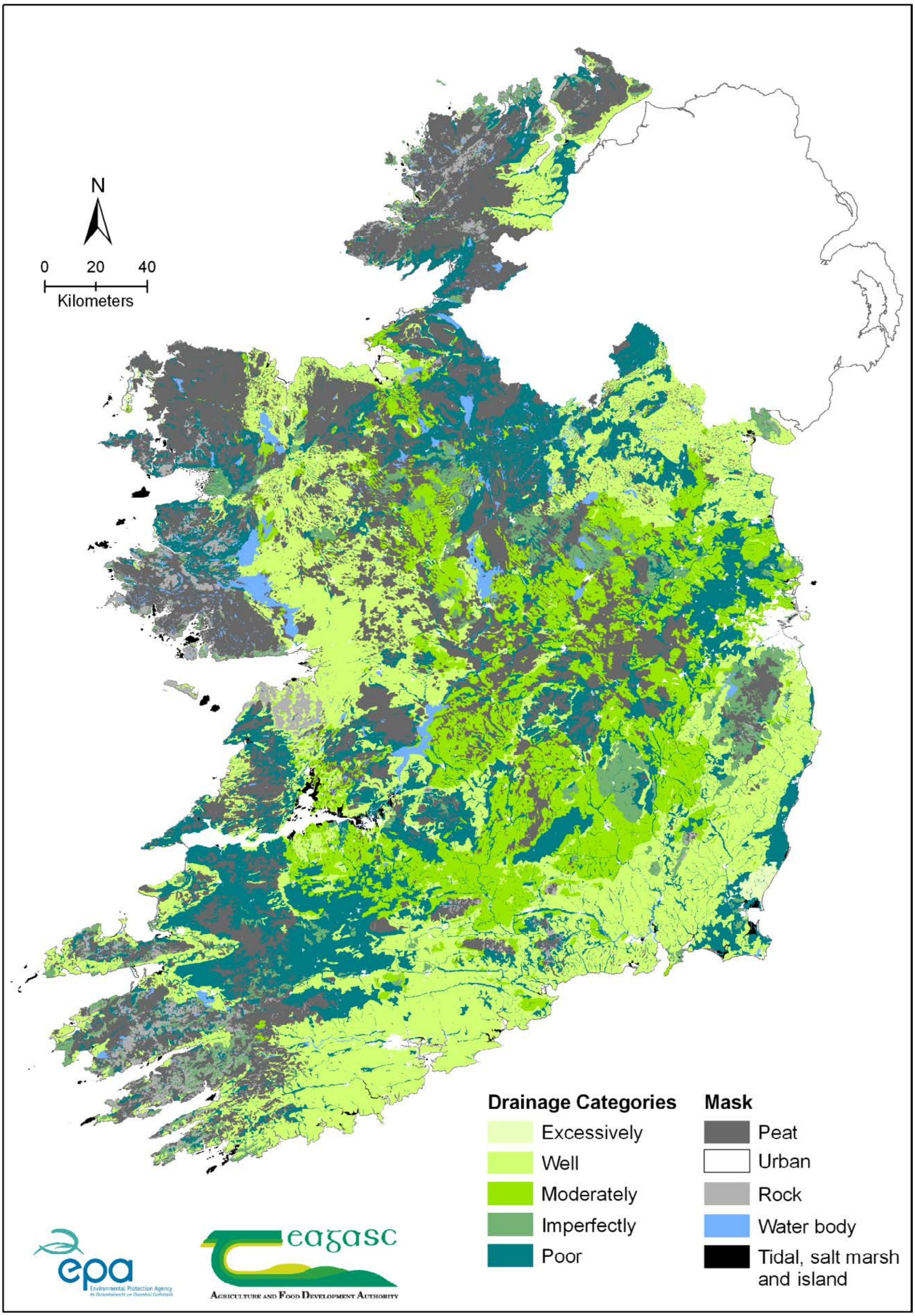


Figure 2.1. Indicative soil drainage map of agricultural soils in Ireland.

3 Indicative Soil Depth Map

Three depth categories have been derived from the third edition national soils map and associated database: 0–40 cm, 40–80 cm and >80 cm. All soil series were allocated a depth based on their modal profile description (Creamer *et al*., 2014). Using a combination of data from the soil profile pits and auger records, the dominant depth was mapped for each association. The map in Figure 3.1 presents a good spatial representation of the three depth categories across the country. As this is based on a national soil map, this information is not appropriate for point locations, because the minimum mapping unit is >250 ha in size.

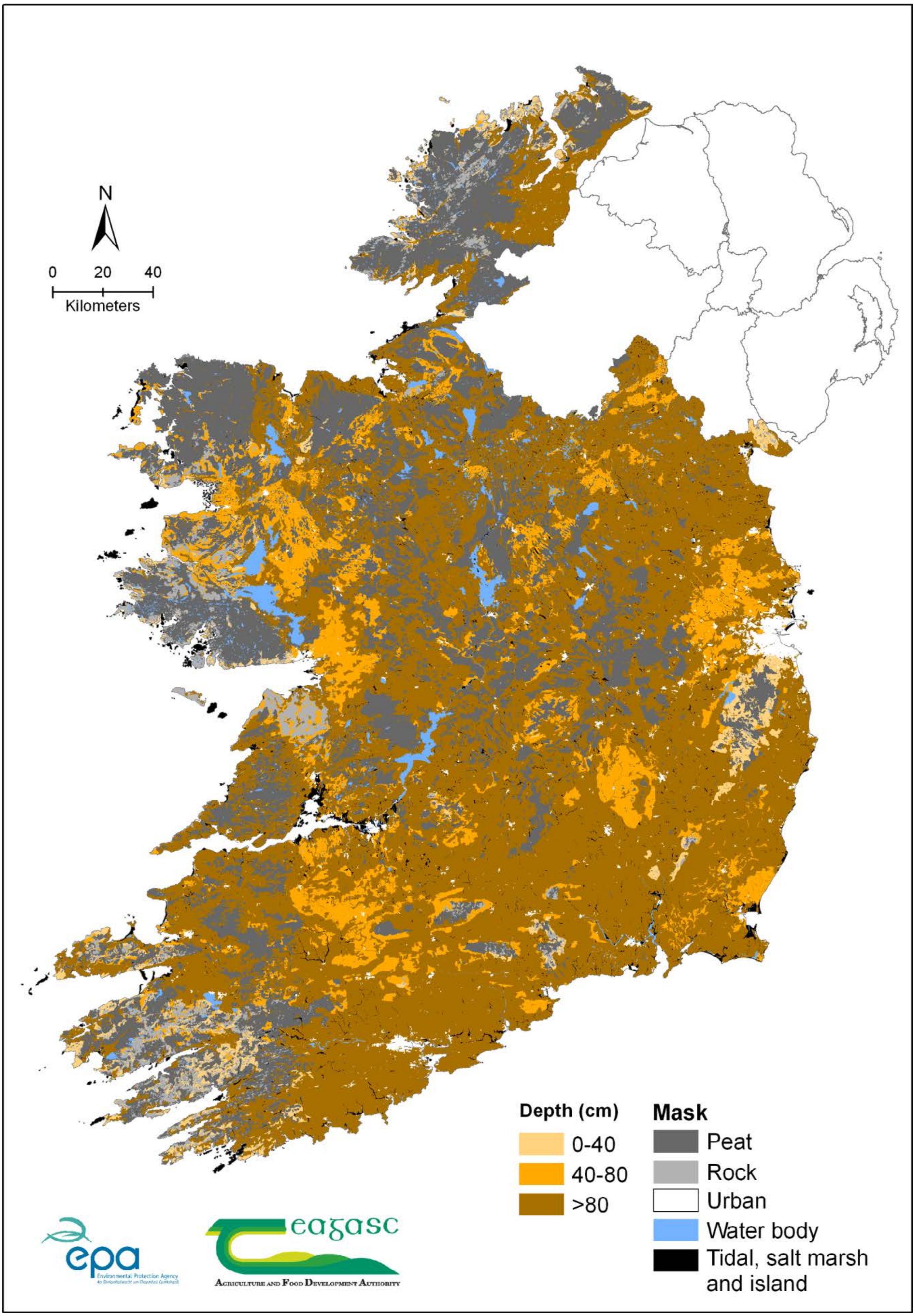


Figure 3.1. Indicative soil depth map of agricultural soils in Ireland.

4 Indicative Soil Texture Map

The textural class of soil is determined by the percentage of sand, silt and clay. Several soil properties are influenced by texture, including drainage, water holding capacity, aeration, susceptibility to erosion, cation exchange capacity (CEC), pH and buffering capacity. Soil texture also influences how much water is available to the plant; for example, clay soils have a greater water holding capacity than sandy soils.

To derive a soil texture map (as can be seen in Figure 4.1) from the third edition soils map and associated database, the lead soil series of each mapped association was used to infer the main textural characteristics for that mapped unit. This was supported by a large number of field observations taken all over the country, where texture was estimated by hand. Samples collected as part of the profile pit campaign had their texture measured in a laboratory. The cut-off for the various texture categories is based upon clay content of the soil (%). In reality, soils will vary in their texture by 1–5% in most fields and by up to 20% in more extreme cases. Therefore, this map can provide only a broad overview of the range of textural classes found in Ireland, so it is not appropriate for detailed mapping purposes or field-level descriptions. This map provides only an overview of the range of soil textural classes that occur in conjunction with the main geological landscapes found in Ireland.

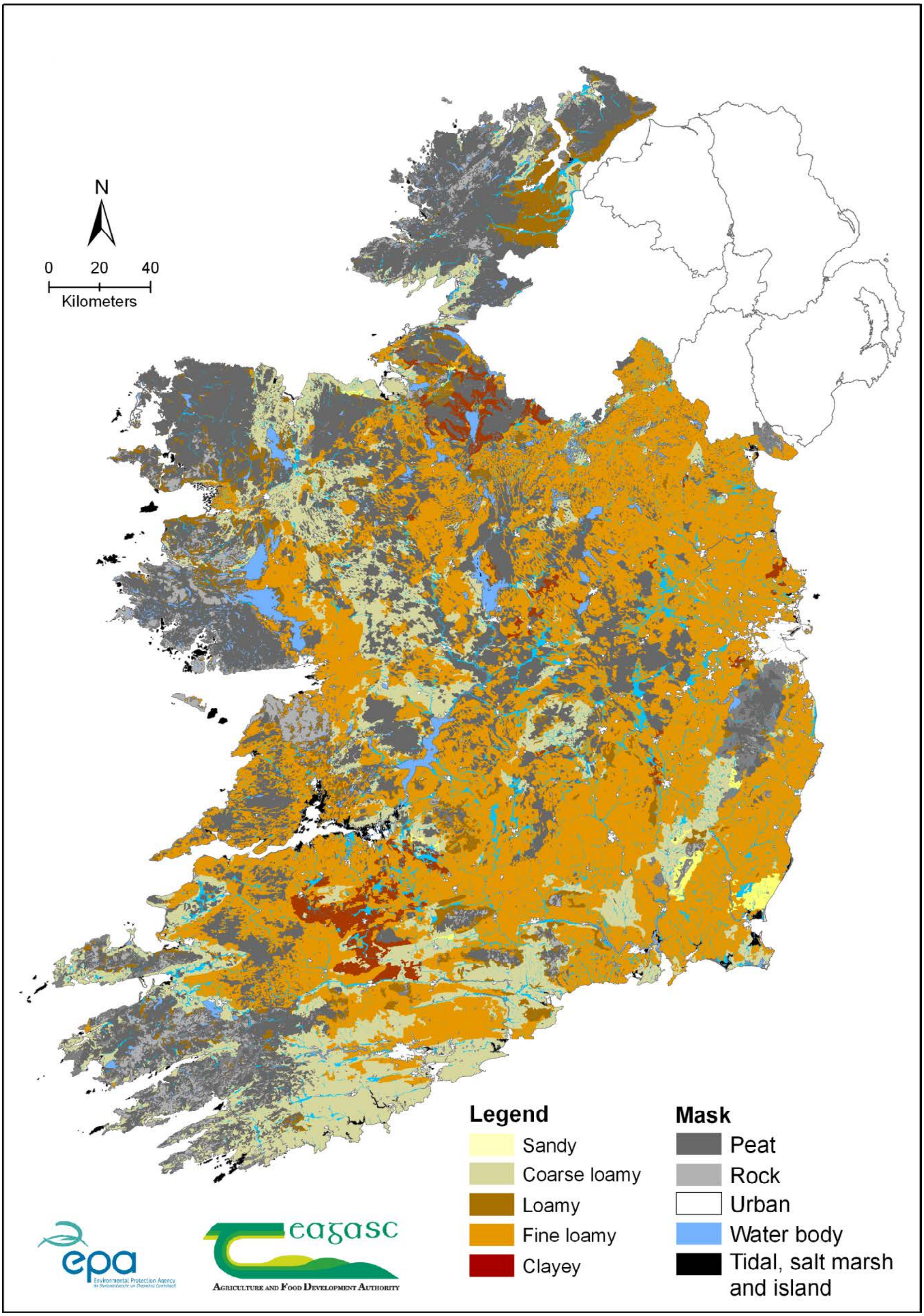


Figure 4.1. Indicative soil texture map of agricultural soils in Ireland.

5 Indicative pH Map

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. In the first instance, soil pH plays a key role in soil fertility. Obtaining complete pH data for all soils in all locations is unfeasible, so the use of spatial extrapolation models is widely practised in soil science for map development. In Ireland, pH data were collected from 667 profile pits surveyed, 237 as part of the Irish SIS and 430 from the AFT survey; data for only the top 30 cm were used. Although the pH map was created using the best available data from the SIS and AFT surveys, the 40-year interval over which the data were collected, in addition to the overriding effect of land management, meant that there is a very poor relationship between soil type and pH class. The methodology, however, is comparable between surveys (Massey *et al*., 2014). The map was also tested using data from the Soil H project (Kiely *et al*., 2013), which started data collection in 2009. Therefore, it is the recommendation of the project team that this map is not fit for purpose, as it does not reflect current soil pH values across the country; instead, it reflects the pH of the soil under the land management systems that were being applied at the time of sampling, although the map does clearly confirm the variation in pH between managed and natural systems. As a result, it was decided not to include the map in the final report, a decision that was also recommended by the project steering committee.

6 Indicative Bulk Density Maps

Bulk density (BD) reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. During 2012–2013, 246 profile pits were excavated to provide a full description of the range of soil series occurring across the country. Bulk density data were collected from representative profiles during the SIS field programme 2012–2013. However, these data do not exist for the AFT detailed soil series maps (Terra Cognita) produced from the 1950s to the 1990s. Therefore, to develop pedotransfer functions (PTFs) for estimation of bulk density, datasets had to be compared to derive soil bulk density values for soils in Terra Cognita. Details of this methodology can be found in Reidy *et al*. (2016).

Rather than categorising mapping units by soil series or soil subgroup, the eventual bulk density in surface horizons map was developed using universal Kriging, a geo-statistical technique that produces interpolated values from a series of scattered points. The map was validated for 0–30 cm (Figure 6.1) and 30–50 cm (Figure 6.2), using data from the Soil C project (Kiely *et al*., 2010). These maps show the increase in bulk density with depth, which is to be expected. Bulk density is mainly driven by soil management practice, rather than soil type per se, so caution must be applied when using these maps for estimating bulk density at a local scale. These maps should be used only to show general trends in soil bulk density. The lower bulk densities of < 1.1 are associated with upland soils because of an increase in soil organic carbon (SOC).

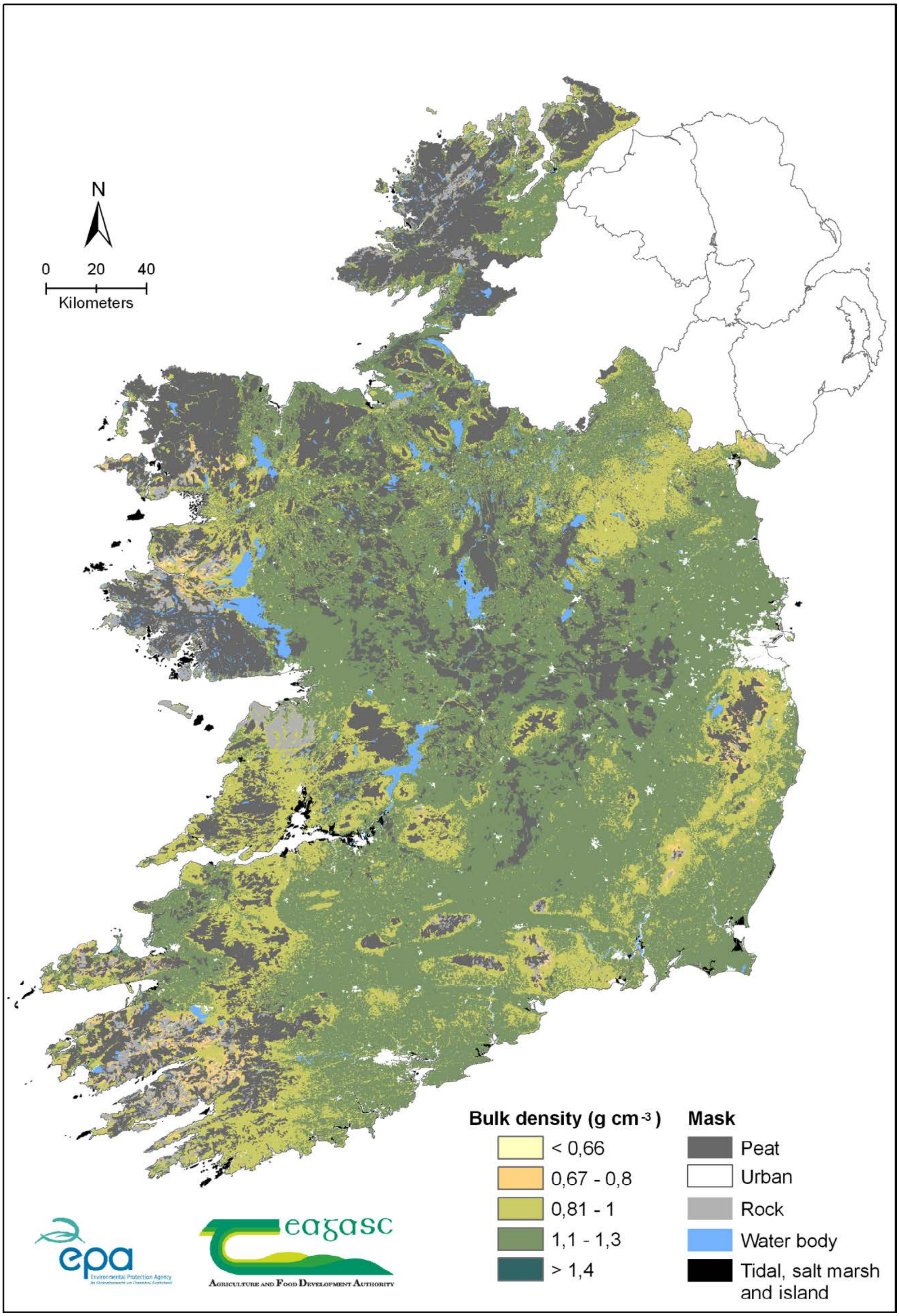


Figure 6.1. Indicative bulk density map of agricultural soils in Ireland (0–30 cm).

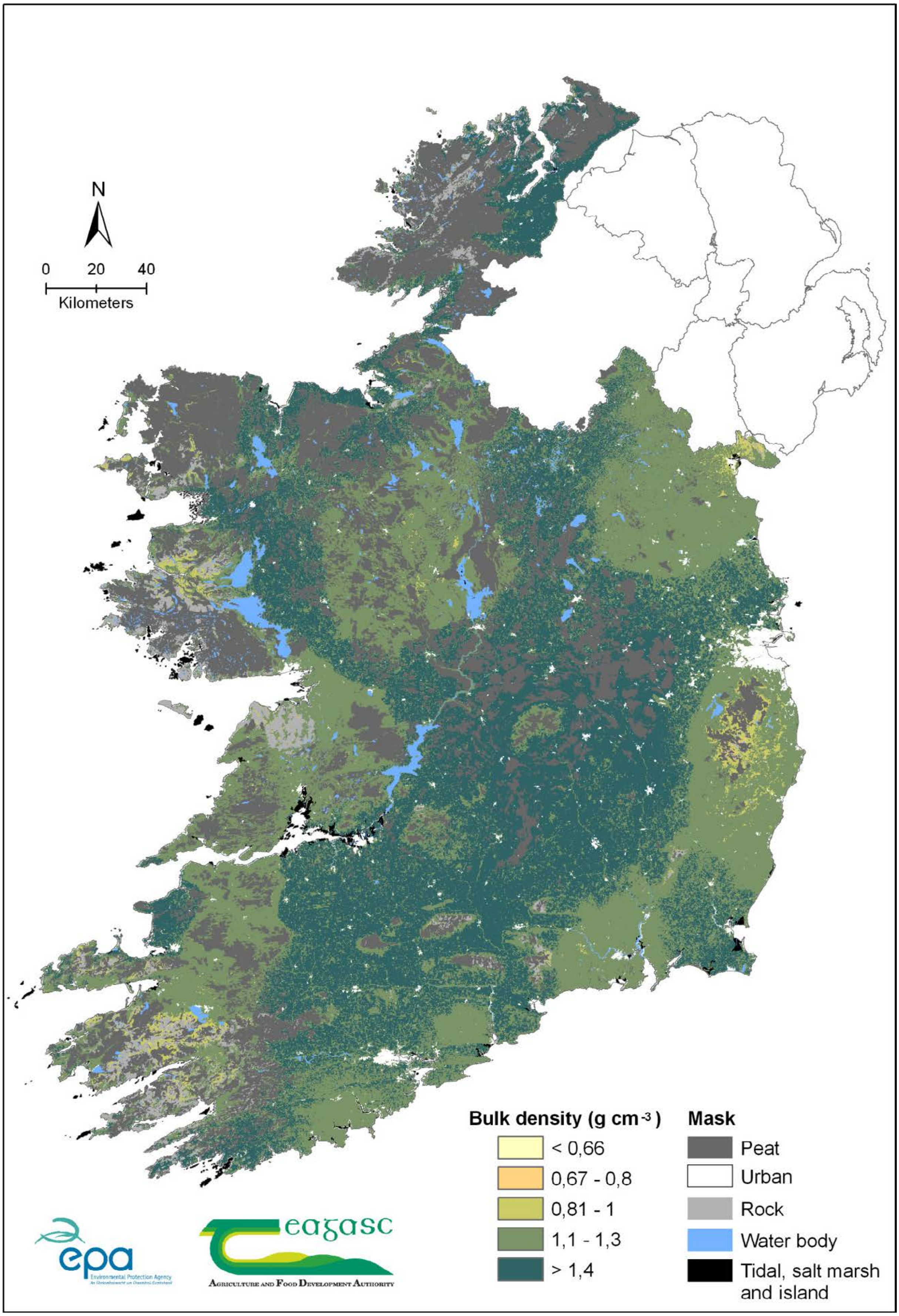


Figure 6.2. Indicative bulk density map of agricultural soils in Ireland (30–50 cm).

7 Indicative Soil Organic Carbon Map

The world's soils represent a significant reservoir of carbon of about 1500 PgC (Post *et al*., 1982; Eswaran *et al*.,1993). Soil carbon budgets can depend on management and are seen as having a potentially crucial influence on mitigating the effects of climate change. A number of methods can be applied to produce a soil carbon stock map and several maps have been presented for Ireland, or components of Irish soils, to date [e.g. Soil Geochemical Atlas of Ireland (Fay *et al*., 2009) and Soil C project (Kiely *et al*., 2010)]. This project has calculated the SOC stocks for the majority of mineral and organo-mineral soils in Ireland, with the exception of peat soils. This is because the full distribution and depth of peat soils, with associated bulk density data, are not yet recorded, except in the work done by Hammond (1979). It is a recommendation of this report that a single integrated map be created by combining updated peat data with this current map.

This SOC map has been created using a combination of data from modal profiles and bulk density data, as measured in the field or calculated through PTFs (Reidy *et al*., 2016) for all modal profiles. SOC levels were calculated for each mapped soil association based on the proportional contribution of each soil series within the association. Figure 7.1 shows a SOC stock map that was validated using data from the soil H project (Kiely *et al*., 2013). It should be used only at catchment scale and greater and not at farm/local scale. A second map was created for 0–1 m depth; however, this could not be validated for lack of data.

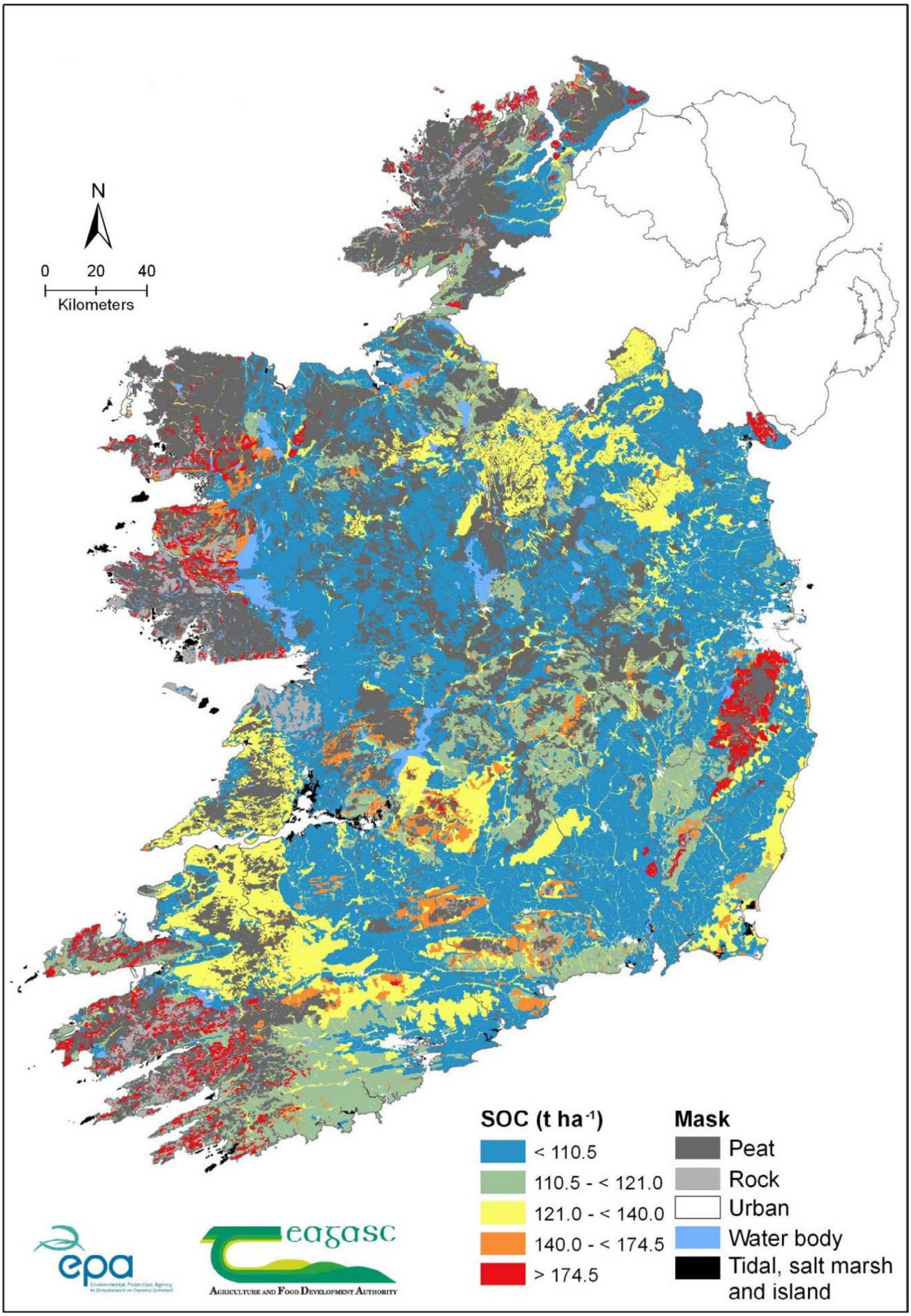


Figure 7.1. Indicative soil organic carbon stock map of agricultural soils (0–50 cm).

References

Coyle, C., Creamer, R.E., Schulte, R.P.O. *et al*., 2016. A Functional Land Management conceptual framework under soil drainage and land use scenarios. *Environmental Science & Policy* 56: 39–48.

Creamer, R.E., Reidy, B., Simo, I. *et al*., 2014. *Description and Classification of Representative Profiles*. SIS Final Technical Report 9. EPA, Johnstown Castle, Ireland. Available online: http://erc.epa.ie/safer/reports

Daly, K. and Fealy, R., 2007. *Digital Soil Information System for Ireland – Scoping Study*. EPA, Johnstown Castle, Ireland.

Eswaran, H., van de Berg, E. and Reich, P., 1993. Organic carbon in soils of the world. *Soil Science Society of America Journal* 57: 192–194.

Fay, D., Kramers, G. and Zhang, C., 2009. Soil Geochemical Atlas of Ireland. SAFER/EPA, Johnstown Castle, Ireland Available online: http://erc.epa.ie/safer/resource?id=4856ff8c-4b2b-102c-b381-901ddd016b14 (accessed 18 February 2016).

Hammond, R.F., 1979. The peatlands of Ireland. *Soil Survey Bulletin* 35: 1–60.

Kiely, G., Leahy, P., Lewis, C. *et al*., 2013. *Interactions of Soil Hydrology, Land Use and Climate Change and their Impact on Soil Quality*. SAFER/EPA, Johnstown Castle, Ireland. Available online: http://erc.epa.ie/safer/resource?id=e6df65fa-e1b8-11e3-b233-005056ae0019

Kiely, G., McGoff, N.M., Eaton, J.M. *et al*., 2010. *SoilC – Measurement and Modelling of Soil Carbon Stocks and Stock Changes in Irish Soils*. EPA, Johnstown Castle, Ireland. Available online: http://www.epa.ie/pubs/reports/research/land/STRIVE_35_Kiely_SoilOrganicC_syn_web.pdf

Massey, P., O'Connor, C., Sills, P. *et al*., 2014. *Laboratory Standard Operating Procedures*. SIS Final Technical Report 7. EPA, Johnstown Castle, Ireland. Available online: http://erc.epa.ie/safer/reports

Montanarella, L. and Jones, R.J.A., 1999. The European Soil Bureau. In Bullock, P., Jones, R.J.A. and Montanarella, L. (eds), *Soil Resources of Europe*. Office for Official Publications of the European Communities, Luxembourg, pp. 3–14.

O'Sullivan, L., Creamer, R.E., Fealy, R. *et al*., 2015. Functional Land Management for managing soil functions: a case-study of the trade-off between primary productivity and carbon storage in response to the intervention of drainage systems in Ireland. *Land Use Policy* 47: 42–54.

Post, W.M., Emanuel, W.R., Zinke, P.J. *et al*., 1982. Soil carbon pools and world life zones. *Nature* 298: 156–159.

Reidy, B., Simo, I., Sills, P. *et al*., 2016. Pedotransfer functions for Irish soils – estimation of bulk density (ρ_b) per horizon type. *SOIL* 2: 25–39.

Schulte, R.P.O., Fealy, R., Creamer, R.E. *et al*., 2012. A review of the role of excess soil moisture conditions in constraining farm practices under Atlantic conditions. *Soil Use and Management* 4: 580–589.

Schulte, R.P.O., Creamer, R.E., Simo, I. *et al*., 2015. A note on the Hybrid Soil Moisture Deficit Model v2.0. *Irish Journal of Agricultural and Food Research* 54: 126–131.

Abbreviations

AFT	An Foras Talúntais
EPA	Environmental Protection Agency
GIS	Geographical information system
Irish SIS	Irish Soil Information System
PTF	Pedotransfer function
SOC	Soil organic carbon
UCD	University College Dublin

Glossary

Alluvium	A loose, unconsolidated sediment that has been eroded, reshaped by water in some form, and re-deposited in a non-marine setting
Auger bore survey approach	Rapid classification of soil types using an instrument (auger) that allows the extraction of a column of soil at a point in the landscape. Augering is a much quicker and cheaper method of observing changes in soil characteristics with depth than digging soil profiles. However, unlike a soil profile, which exposes a relatively large area of the soil, only the characteristics of the specific sampling point can be observed with an auger. Properties such as soil structure cannot be observed on an auger bore
Geographical information system	A computer system designed to capture, store, manipulate, analyse, manage, and present all types of geographical data
Great soil group	Organised group of soils based on dominant soil forming factors, divided into 11 categories: (i) ombrotrophic peat soils, (ii) minerotrophic peat soils, (iii) rendzinas, (iv) lithosols, (v) alluvial soils, (vi) groundwater gleys, (vii) surface water gleys, (viii) podzols, (ix) brown podzolics, (x) luvisols and (xi) brown earths
Indicative map	A map derived from soil properties that indicates general trends
Minerotrophic peat	A peat (fen) formed under the influence of groundwater, with water percolating through and carrying nutrients. These fens typically have waters in which the predominant anion is HCO_3 and the predominant cation is Ca^{2+}. They have a pH > 4.0 (in $CaCl_2$ 1:2.5 undried, equivalent to pH 4.5 in 1:2.5 H_2O) in at least some part of the reference section (Jones *et al*., 2011)
National soil series	Soils within a subgroup that have horizons similar in colour, texture, structure, reaction, consistence, mineral and chemical composition and arrangement in the profile. Series names are usually named after the townland where they were first defined. Soil series are defined on the basis of the following hierarchy: great group, subgroup, texture and parent material
Profile pit	Excavation of soil at a field site, generally to depths of approximately 1 m, but can be extended until an impenetrable layer is reached. Soil pits are used to easily observe all of the soil horizons from the parent material to the surface for soil description and soil sampling
Representative profile	A good example of the series
Soil association	Mapping unit that describes a range of soil series associated in a landscape (i.e. they are often found to co-occur in particular landscapes). Soil associations usually have between 2 and 10 series co-occurring in a particular landscape pattern. The first soil series described is the most dominant and the soil association is usually named after this series. The second and third series will also occur commonly. Any remaining series is expected to occur in conjunction with the first three series, but cannot be ranked in terms of spatial extent
Soil classification	Grouping of soils with a similar range of properties (chemical, physical and biological) into units that can be geo-referenced and mapped
Soil map polygon	Delineation on the map shown by a close boundary on a soil map that defines the area, shape and location of a map unit within a landscape

Soil profile	The arrangement of soil horizons (i.e. various layers) in a soil; a vertical section of the soil that exposes a set of horizons from the ground surface to the C horizon or to the parent rock. Soil scientists (pedologists) observe and describe soil profiles and soil horizons to classify and interpret the soil for various uses
Soil quality	The ability of a soil to perform functions that are essential to people and the environment. Soil does all this by performing five essential functions: nutrient cycling, water relations, biodiversity and habitat, filtering and buffering, and physical stability and support
Soil series	Soil profiles that display a combination of similar soil properties (e.g. texture and parent material) within a subgroup classification
Soil subgroup	Soils within a great group that display similar diagnostic features (the main characteristics of a soil profile that describe the main soil-forming processes taking place). Sixty-six subgroups have been described within the Irish SIS classification system. These are based on the diagnostic differences found within the 11 great groups
Soilscape	A broad soil-landscape unit (or soil-landscape model) that encompasses a number of soil associations. It groups soils formed primarily on similar substrate types linked to large-scale landscape features
Universal Kriging	A method of interpolation for which the interpolated values assume a general polynomial trend model, such as a linear trend model

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:

- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha);*
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol (*m.sh. Timpeall an Tí, léarscáileanna radóin).*
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- An Oifig um Cosaint Raideolaíoch
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

EPA Research Report 204

Soil Property Maps

Authors: Rachel E. Creamer, Iolanda Simo, Lilian O'Sullivan, Brian Reidy, Rogier P.O. Schulte, Reamonn M. Fealy.

epaResearch
Climate - Water - Sustainability
Identifying pressures • Informing policy • Developing solutions

This report has synthesised the soil profile descriptions taken as part of the Irish Soil Information System project and developed a range of soil property maps to provide users with generalised descriptions of a range of soil properties which are relevant to soil science research and soil management advice in Ireland. The property maps include; soil texture, soil depth, soil pH, soil bulk density and soil carbon.

Identifying Pressures

Ireland, like all other EU Member States, faces the contemporary challenge of meeting a range of agri-environmental objectives in the context of the increasing food production in a post-quota environment. Examples include the need to obtain 'good quality' status for all waterbodies, as specified by the Water Framework Directive, the need to protect biodiversity under the Habitat and Birds Directives, the potential for offsetting agricultural GHG emissions through carbon sequestration and the need for sustainable recycling of nutrients under the Nitrates and Sewage Sludge Directives. It has been well documented that the capacity of land to deliver on each of these requirements depends primarily on soil properties and hence soil type. Therefore, meeting all targets simultaneously requires optimisation of the suite of soil functions delivered by each soil.

Informing Policy

ISIS will be an invaluable tool in developing policies on sustainable land management and the agrienvironment. Practical examples of the utility of the ISIS map for policy and practice include:

(i) The facilitation of a migration from Tier 1 to Tier 3 greenhouse gas reporting to the UNFCCC

(ii) The attribute maps derived from the ISIS maps are being used by DAFM for the new delineation of the Areas of Natural Constraints

(iii) The facilitation of the development of soil-specific nutrient advice (by subgroup)

(iv) The facilitation of the development of targeted and context-specific agri-environmental schemes

(v) The identification of priority areas and more targeted actions in the ongoing development and review of the River Basin District Management Plan.

Developing Solutions

The ISIS team has developed the concept of Functional Land Management to facilitate this approach, and has received an additional €1m funding from DAFM to further explore this concept. This approach will help with local scale farm management decisions, national scale legislation and reporting requirements as outlined above and European scale delivery of data and trends.

EPA Research: McCumiskey House, Richview, Clonskeagh, Dublin 14.

Phone: 01 268 0100
Twitter: @EPAResearchNews
Email: research@epa.ie

www.epa.ie

EPA Research Webpages
www.epa.ie/researchandeducation/research/