ORDNANCE SURVEY GB

OS TERRAIN 5™ – OVERVIEW

Version history

Version	Date	Description
1.2	03/2017	Minor updates.
2.0	04/2022	Original combined User Guide and Technical Specification document divided into separate Overview and Technical Specification documents. Document title changed from User Guide to Overview. Minor formatting updates.

Purpose of this document

This document provides information about and insight into the OS Terrain 5 product and its potential applications. For information on the contents and structure of OS Terrain 5, please refer to the Technical Specification.

The terms and conditions on which OS Terrain 5 is made available to you and your organisation are contained in that Ordnance Survey customer contract. Please ensure your organisation has signed a valid current customer contract to be able to use OS Terrain 5.

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Contact details

OS website 'Contact us' page (https://www.ordnancesurvey.co.uk/contact-us).

Contents

1. Introduction to the product

OS Terrain is the name given to Ordnance Survey's two height products. The two products provide detailed three-dimensional digital terrain models (DTMs) of Great Britain. A DTM primarily defines the ground surface, having removed all protruding features (such as buildings and trees) elevated above the bare earth. The main difference between the two products is their level of resolution:

- **OS Terrain 5** is a mid-resolution DTM, designed to be interoperable with our large-scale data.
- **OS Terrain 50** is a lower-resolution DTM product, designed for landscape visualisation and analysis over large areas. It is an OS OpenData product and, as such, it is free to view, download and use for commercial, educational, and personal purposes.

OS Terrain 5 is published as both grid and contours, each in a variety of formats. Both data types are created from the same source data and are supplied as 5km-by-5km tiles.

- **OS Terrain 5 grid**: a grid of heighted points with regular 5m post spacing.
- **OS Terrain 5 contours**: a contour dataset of 5m interval standard contour polylines, which includes index contours at 25m intervals, mean high and low water boundaries and spot heights.

1.1 Key features of the product

- The product is maintained by our integrated 3 to 5 year flying programme and is synchronised with our other product updates.
- There is specific modelling of significant features, particularly networks.
- **DTM grid data** is available in ASCII (American Standard Code for Information Interchange) grid and Geography Markup Language (GML) 3.2.1, using Open Geospatial Consortium (OGC) Simple Features Profile (level 0).
- **DTM contour data** is available in GML 3.2.1, and Esri shapefile.
- There is full coverage of Great Britain.
- It is designed to work with Ordnance Survey's large-scale data.
- Supplied as grid and contours with spot heights.
- The product is updated quarterly.
- It is based on the INSPIRE elevation specification.

1.2 Product applications

OS Terrain 5 provides an ideal base to enable the third dimension for other data within an appropriate geographical information system (GIS). The height data has been created from a source that is also used to update our large-scale data products.

OS Terrain 5 can be used in conjunction with various Ordnance Survey digital products for analytical, modelling, planning and visual purposes. These uses enable customers to undertake the following:

- Asset / site management
- Environmental analysis
- Line of sight planning
- View shed modelling
- Landscape visualisation and fly-through sequences
- Planning and development
- Signal propagation
- Wind farm location planning
- Flood risk assessment
- Foundation for 3D modelling

1.3 Accuracy

OS Terrain 5 has been measured against with GPS points in a range of sample areas to provide a root mean square error (RMSE) value, being the average of the mean height points in each geographic area: urban and major communication routes, rural, and mountain and moorland.

- Urban and major communication routes 1.5m RMSE
- Rural 2.5m RMSE
- Mountain and moorland 2.5m RMSE

1.4 INSPIRE compliance

OS Terrain 5 is designed to be INSPIRE-ready. Ordnance Survey is a leading member of the UK Location Programme, which is charged with delivering INSPIRE, a directive that applies to all member states and aims to enable more joined-up data across public bodies for environmental applications.

At the time of OS Terrain product development, the INSPIRE elevation specification had not been finalised. The data structures of OS Terrain products, and the details of the GML encoding, have been based on the draft INSPIRE specification. For more information about INSPIRE and UK Location, please view the INSPIRE webpages (https://inspire.ec.europa.eu/data-specifications/2892).

1.5 Product supply details

1.5.1 Available formats for the product

OS Terrain 5 is available as:

- 5m grid in ASCII grid and GML 3.2.1 (simple features profile – level 0)
- 5m contours and spot heights in Esri shapefile or GML 3.2.1 (simple features profile – level 0)

1.5.2 Product supply mechanism

OS Terrain 5 data is provided as a full set of Great Britain in tiles and is available as a download only from the OS Data Hub (https://osdatahub.os.uk/) or OS Orders (https://orders.ordnancesurvey.co.uk/sso/login.shtml). The national dataset is supplied as 5km-by-5km tiles of data. There are 10 579 data tiles in the product representing each 5km-by-5km tile grid square. Please note that there are slightly fewer data tiles in the contour set (10 572) due to the lack of real-world changes in height in those areas. There are metadata files for these tiles.

It is recommended that a download manager is used to extract the data as this additional functionality will be able to automate the process and organise the data folders as desired. There are many commercial and open-source download clients available to help manage the data.

1.5.3 Coverage and file sizes

OS Terrain 5 is full national coverage of Great Britain. Terrain 5 is derived from the same source data as our large-scale revision programme.

Data will be compressed using the zip compression method and is not encrypted. The respective file sizes for a full national supply of OS Terrain 5, in each format, is approximately:

- Grid: 16GB compressed
- Contours (GML): 2.6GB compressed
- Contours (shapefile): 2.5GB compressed

1.5.4 Product update schedule

OS Terrain 5 is supplied to customers quarterly as a full tile resupply in January, April, July, and October, incorporating any updates made by the revision programme.

1.6 Pre-requisites for using OS Terrain 5

1.6.1 Computer hardware

This product may be used on a wide range of hardware platforms (provided sufficient memory and storage facilities are available), varying from tablets or computers using GIS or computer-aided design (CAD) to mainframe computers with specialised translators and applications. Please see Coverage and file sizes for more information. Your system supplier will be able to advise on your requirements.

1.6.2 Computer software

OS Terrain 5 is supplied as inert data in a variety of formats and does not include software for data manipulation.

GML is an open standard format, and the data may need to be translated into the appropriate format for use within a GIS application. A wide range of GIS software can read the GML contour data without translation.

2. Data structure

This section describes the structure of the data in grid and contour forms.

2.1 Grid

2.1.1 Introduction

The height data is presented as a raster dataset of height values, which are calculated at the centre of the pixel. Coordinate reference systems for DTMs may be used to calculate the DTM origin and coordinates of individual posts.

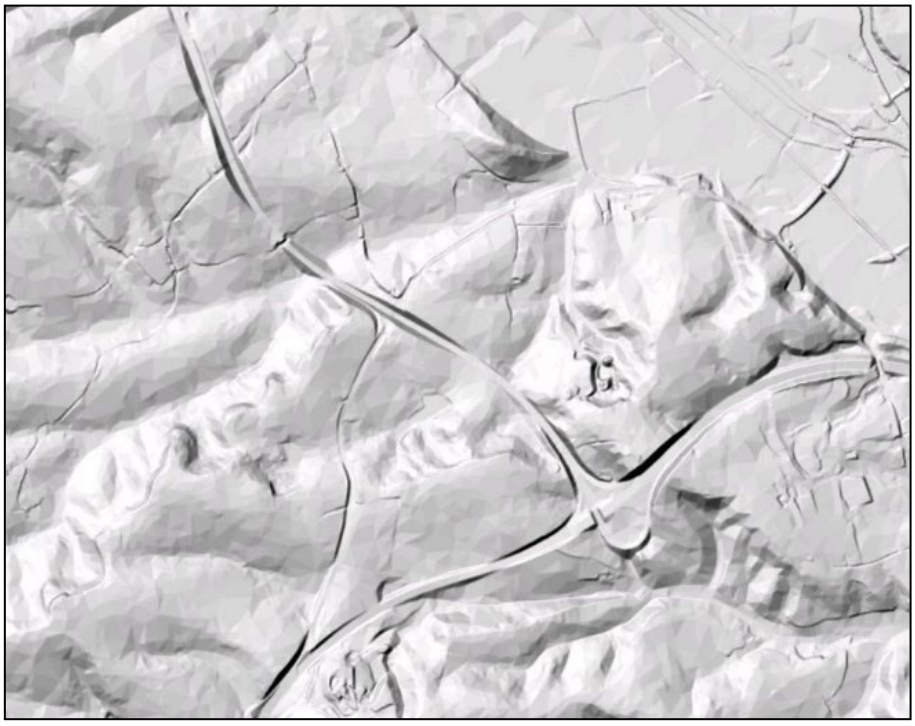


Figure 1: OS Terrain 5 posts displayed as a heighted, shaded raster in a GIS

2.1.2 Mean high and low water representation in grid

Due to local tidal conditions, the height of the mean high and low water mark varies continuously around the coast of Britain. The mean high and low water lines have been derived from our large-scale mapping and assigned constant height values, based on the average for each tile. This average value has been determined from local tide tables. The mean high and low water lines were used as heighted breaklines when creating the grid to ensure the grid product is consistent with the contour product. This means that there may be a small discrete step in the height of tidal water between adjacent tiles. For areas of permanent tidal water, the height of the mean low water has been extended out to the tile edge to ensure that the tile is complete. Heights in the foreshore area are interpolated between the mean high and low water heights.

2.2 Contours

2.2.1 Introduction

The contours are presented as polyline and spot height features. The contour lines have been divided into tiles for product supply. The contour values can be viewed and analysed in a GIS.

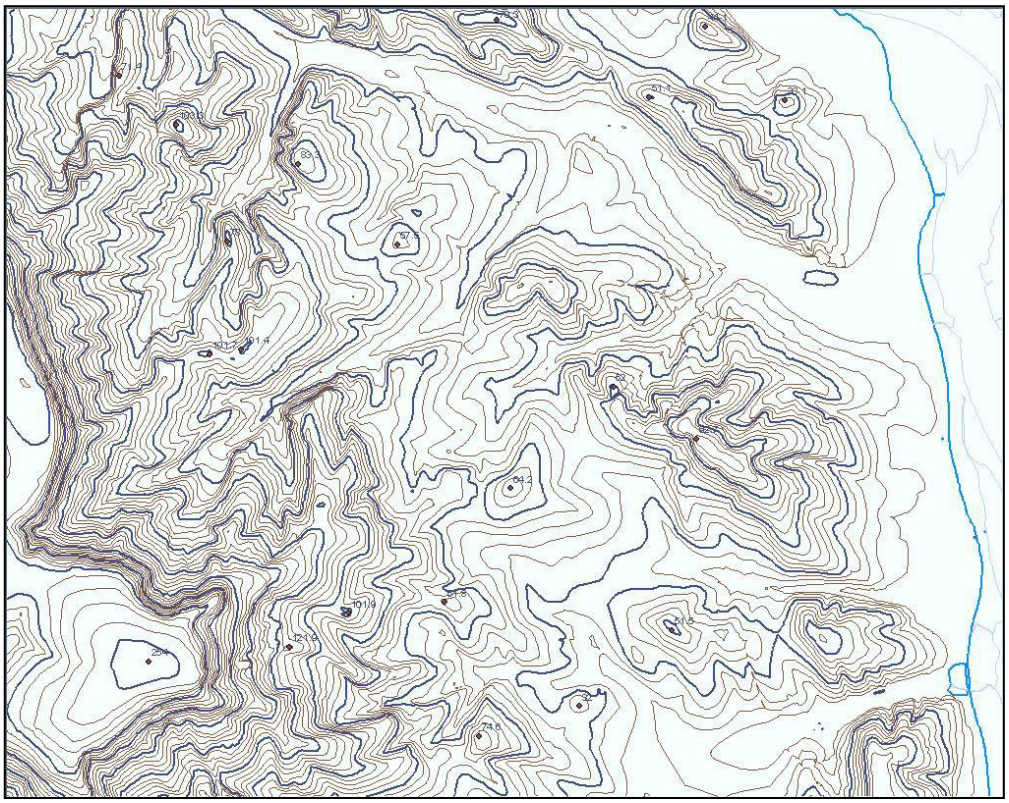


Figure 2: OS Terrain 5 master and ordinary contours, tidal boundaries, and labelled spot heights

2.2.2 Feature types

The terms used for the feature types are drawn from the INSPIRE elevation specification. The draft INSPIRE elevation specification requires height values to be held in an attribute called 'propertyValue', which has been implemented in the new OS Terrain contour GML. In the shapefile format, the GML feature types and attributes have been followed but with the 10-character limit on shapefile fields, 'propertyValue' is abbreviated to 'PROP_VALUE'.

The contours are named 'master' and 'ordinary', which are equivalent to 'index' and 'standard' contours in the withdrawn Ordnance Survey height product, Land-Form PROFILE.

2.2.3 Mean high and low water representation in contours

In the contour products, the mean high and mean low water lines have been derived from our large-scale mapping and assigned constant height values, based on the average for each tile. This average value has been determined from local tide tables. Inevitably, this means that there is a small discrete step between adjacent tiles. There are no contours supplied between the mean high and low water lines.

The 'LandWaterBoundary' feature type has an attribute of 'waterLevelCategory', which has four possible sub-values: 'meanHighWater' and 'meanLowWater' or, for Scotland, 'meanHighWaterSprings' and 'meanLowWaterSprings'. This attribution allows their display parameters to be changed to show individual features, as desired.

2.2.4 Spot heights

These have been created using an algorithm that selects the highest source data point (masspoint) within every enclosed contour that has a difference in height of at least 1m.

As they are from an interpolated surface of the real world, they cannot be guaranteed as summits or highest points of the feature. The GML data model lists the spot height sub-value, 'spotHeightType', which allows the potential for formSpot, generic, mountainPass or summit to be used in future releases of the product.

Currently, all spot height features are attributed as 'generic'.

It is possible that there will be some instances of spot heights recording lower height values than the enclosing contour, but it is likely that these are the result of genuine depressions.

3. OS Terrain 5 source data

3.1 Introduction

The source DTM for OS Terrain products is captured as a triangulated irregular network (TIN) by editing with mass points and breaklines and / or automated techniques within a photogrammetric environment. The TIN is a superior model for three-dimensional data as it uses triangles, which can retain the edges of features more accurately than a grid, for example.

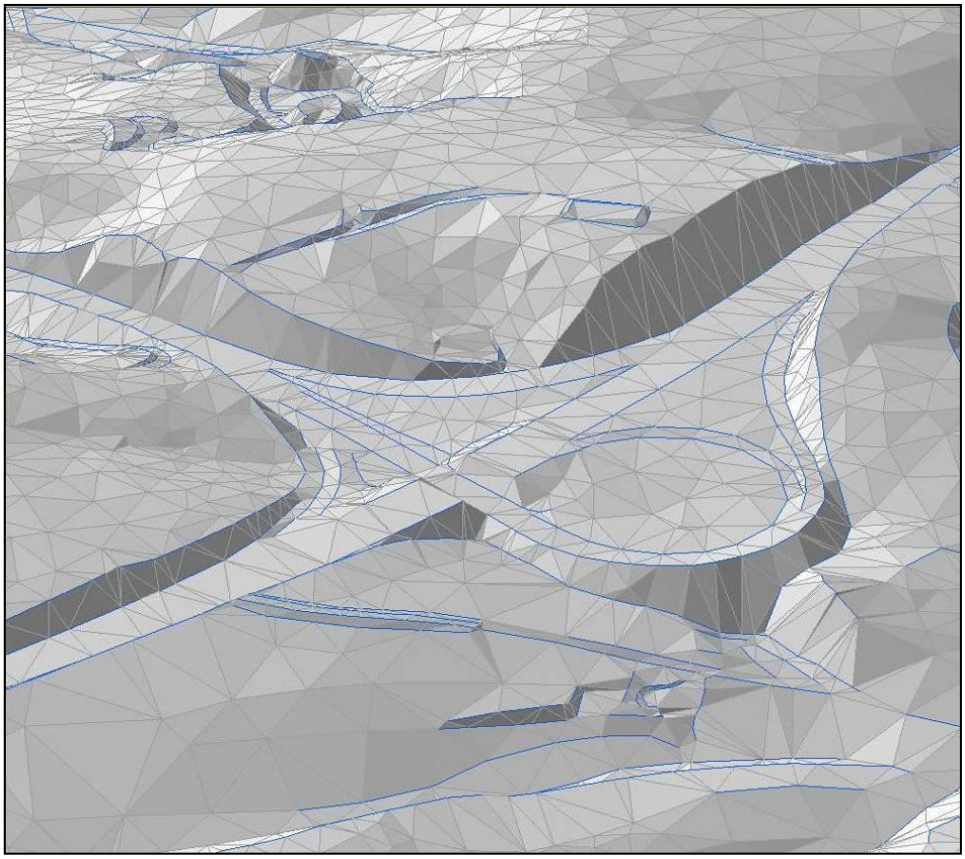


Figure 3: Triangulated Irregular Network (TIN) modelling of 3D data

The source data capture is subject to demanding rules defined by the height capture specification. Particular attention is paid to communication routes and features significant to height applications. This section describes some of the key capture requirements from the detailed capture specification that we endeavour to achieve in the source data.

The grid and contour products are both interpolated from this source TIN model.

3.2 Coverage

The minimum coverage of the data extends out to the low water mark, defined by Hydrographic Office tables with a height value for each 5km-by-5km tile. For England and Wales, the low water mark is mean low water (MLW) and for Scotland, mean low water (springs) (MLW(S)).

All land wholly within inland water bodies that is represented by topographic area features is captured according to the positional accuracy requirements of the area. The minimum requirement is to capture the outer edge of the feature. The surrounding water will remain flat.

Any other land within inland water bodies captured by automated processes will be removed from the data.

3.3 Positional accuracy requirements

The z values of the source TIN data must meet positional accuracy requirements according to their geographic location. The terrain has been divided into three classifications – urban and major communication routes, rural, and mountain and moorland – to ensure that modelling reflects customer requirements. The accuracy of the height value above Ordnance Datum Newlyn must achieve the RMSE set for each area, which are not the same as the stated product accuracy.

3.4 Modelling of features in source data

3.4.1 Representation of the surface

The height of the bare earth surface is recorded as a series of points with three-dimensional coordinates.

The X and Y coordinates are eastings and northings in OSGB36; the Z coordinate is height in metres relative to the datum for the area. Most areas will record a height relative to Ordnance Datum Newlyn. For a small number of offshore islands, a local datum has been used.

The bare earth surface excludes buildings, supported structures, and vegetation. Structures that form an obstruction at ground level – such as dams, breakwaters, and groynes (wide enough to affect the positional accuracy requirements), bridge revetments and earthworks – are considered to be part of the bare earth surface. Only permanent terrain features are modelled.

3.4.2 Underground and overhead features

Underground and overhead features are, by definition, not the ground surface and are thus not included in a DTM. Underground features are those that are obscured and require excavation to construct. Underground features are not recorded, and overhead features are removed from the data.

3.4.3 Terrain smoothness

The DTM will be free of spikes and wells that do not reflect the real-world terrain. A surface that is smooth; that is, one that consists of a regular plane (which may be angled); for example, a road carriageway or railway trackbed, will also appear smooth in the data.

Most data will present without visible tile edges or discernible height differences between tiles. In places there may be small edges present or a difference in feature modelling between new and older content. There will also be small edges in tidal areas due to local tidal differences.

3.4.4 Supported structures

Supported structures include bridges, viaducts, jetties or piers on legs, cranes, elevated buildings, and so on.

Supported structures are removed from the data where the structure departs from the bare earth surface and an air gap exists. All supported structures will be removed from the data.

3.4.5 Vegetation

Areas of vegetation, such as hedgerows and trees are removed to ensure the bare earth surface is correctly recorded.

3.4.6 Vertical features

Locations with a vertical change in height, or overhang, have the height of the top of the feature recorded at the correct planimetric location according to the positional accuracy requirements.

The height at the lowest point of the vertical feature is recorded according to positional accuracy requirements of the feature but offset from its real-world planimetric position to ensure that there is only one z value present in the same location.

3.4.7 Major communication routes

Major communication routes are major road and rail networks identified in our core database.

The limits of a road carriageway or railway track bed are modelled to ensure that the route reflects its real-world shape. Modelling is required for changes in height to meet the positional accuracy requirements, to smooth the surface and to remove extraneous features such as road furniture and bridges. Any associated slopes and embankments along the length of the route are also modelled.

In all other cases, the surface must be smooth, flat (not necessarily horizontal) and free from undulations

3.4.8 Man-made landforms associated with mineral workings and landfill

The outer limits, shape and depth of mineral extraction and landfill sites are captured to meet positional accuracy requirements. Temporary features that do not represent the terrain at the time of capture, for example spoil heaps, are removed from the data.

3.4.9 Contained water bodies greater than 0.7ha

To respond to the Flood and Water Management Act 2010, the extent of all flat-water bodies greater than 0.7ha in area (that is, greater than 7,000 cubic metres capacity) will have their limits captured to ensure that the presence of the water body can be inferred from the data.

The height of the water recorded is that at the lowest height of the surrounding data. The surface of the water will be flat.

3.5 Conformance

The following measurables are used to determine the accuracy and coverage of modelling in the source TIN data.

3.5.1 Positional accuracy

Any height value extracted from any point within the coverage and above the high-water mark will meet the positional accuracy requirements.

3.5.2 Geometric fidelity

The DTM will be free of spikes and reflect the general texture of the terrain.

3.5.3 Terrain smoothness

Measurable
The absence of spikes or wells in the data that cause a false height value on a data point or interpolated surface.

A surface smooth in the real world will appear smooth in the data.

Major communication routes will be smooth longitudinally, with no 'steps' in the data.

Conformity
There must be no spikes or wells in the data larger than the value required to meet the positional accuracy requirements of the geographic area.

3.5.4 Feature modelling

Measurable
Data added to model specific features will reflect the correct relationship to itself and immediately surrounding data.

Conformity
All features with parallel limits that require modelling will have parallel data points recorded in the data.

The relative heights of features in proximity will be in sympathy.

3.5.5 Absolute accuracy

Measurable
The coordinate position of any point on the surface as represented by the TIN data compared to the true elevation of the same point.

Conformity
The RMSE of a selection of points from the real world compared to the data will be within the values stated.

No single point will exceed the 99% confidence level.

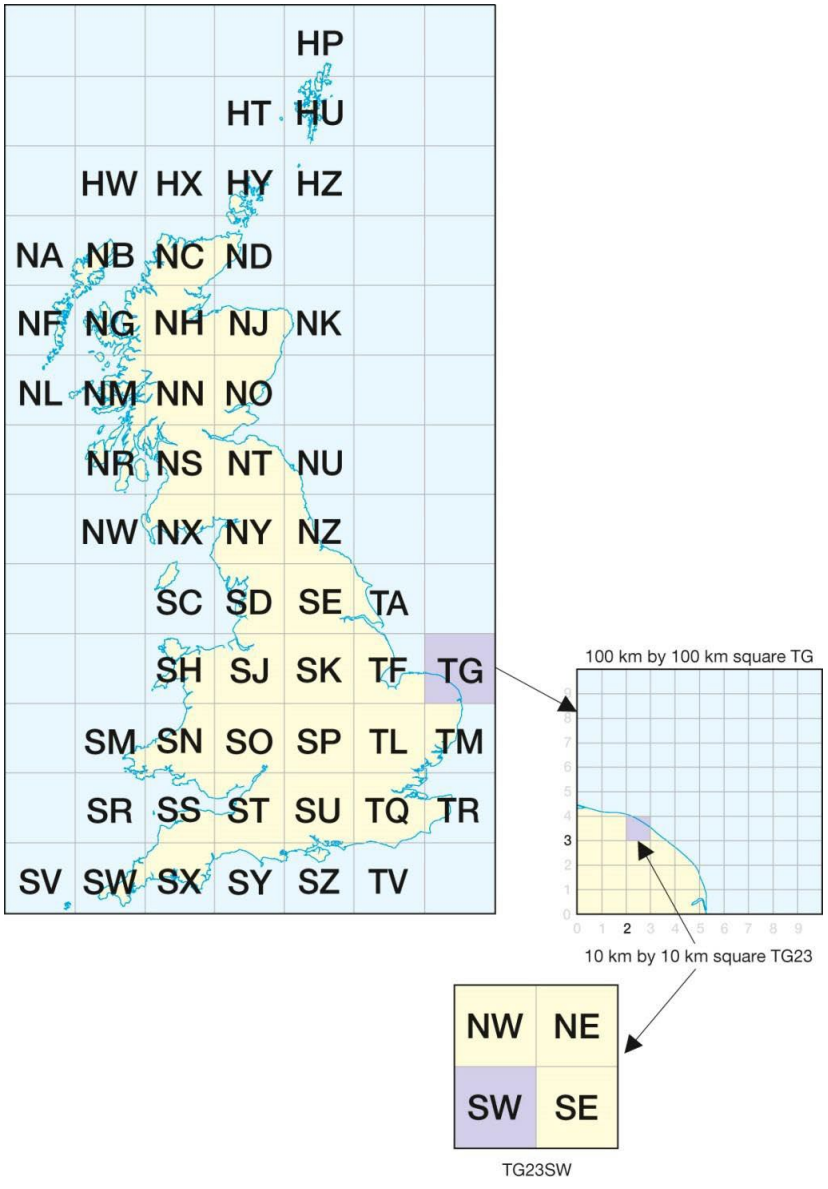
4. The National Grid

OS Terrain 5 is supplied as a whole set of Great Britain divided into 5km-by-5km tiles. These tiles are identified by quoting the National Grid reference of the south-west corner of the area they cover.

Ordnance Survey divides Great Britain into squares 100km-by-100km. Each of these squares has a unique two-letter reference, for example, TG in the diagram below.

To describe a 10km-by-10km tile, first add a two-digit reference to the 100km-by-100km square reference, with the easting first followed by the northing: for example, TG23. Then identify which quadrant of that grid square is required and add SW, SE, NW, or NE to the reference, for example, TG23SW.

For additional information on how to use the National Grid, visit the Ordnance Survey website (http://www.ordnancesurvey.co.uk).



Annex A: Glossary

Glossary term	Definition
accuracy	The closeness of the results of observations, computations or estimates to the true values or the values accepted as being true. Accuracy relates to the exactness of the result and is the exactness of the operation by which the result is obtained.
American Standard Code for Information Interchange (ASCII)	A 7-bit code for encoding a standard character set.
area	A spatial extent defined by circumscribing lines that form a closed perimeter that does not intersect itself.
attribute	An attribute is a property of an entity, usually used to refer to a non-spatial qualification of a spatially referenced entity. For example, a name or descriptive code indicating what an entity represents or how it should be portrayed.
attribute code	An alphanumeric identifier for an attribute type.
boundary	Boundaries define the areas of the various national and local government authorities and some European authorities.
chain	A closed loop of links bounding a polygon.
code	An alphanumeric attribute code used in digital map data to describe each feature in terms either of the object surveyed or its representation on the map (or both).
coding	Allocation of a feature code to a feature being created from constituent construction data – points and/or segments; with optional linking to an existing feature of the same feature code.
contour	A line connecting points of equal elevation.
coordinate pair	A coordinate pair is an easting and a northing.
coordinates	Pairs of numbers expressing horizontal distances along original axes. Alternatively, triplets of numbers measuring horizontal and vertical distances. Row and column numbers of pixels from raw imagery are not considered coordinates for the purpose of the standard.
data format	A specification that defines the order in which data is stored or a description of the way data is held in a file or record.
data model	An abstraction of the real world that incorporates only those properties thought to be relevant to the application or applications at hand. The data model would normally define specific groups of entities and their attributes, and the relationship between these entities. A data model is independent of a computer system and its associated data structures. A map is one example of an analogue data model.
data structure	The defined logical arrangement of data as used by a system for data management; a representation of a data model in computer form.

Glossary term	Definition
eastings	See rectangular coordinates.
entity	Something about which data is stored in a databank or database. For example, boundary and name. The data may consist of relationships, attributes, positional and shape information and so on. Often synonymous with feature.
Extensible Markup Language (XML)	This is a markup language written in a textual data format designed to encode documents and data structures for transfer over the Internet. It was developed by the World Wide Web Consortium (W3C). XML schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content, and semantics of XML documents.
Extensible Stylesheet Language Transformations (XSLT)	This is a language for transforming XML documents into objects that can be presented in a format that is more easily read by the user, such as HTML for web pages or plain text.
feature	An item of detail within a map that can be a point and/or symbol, text, or line.
feature identifier	A unique code to identify an individual feature. A specified part of a record containing a unit of data, such as the date of digitising. The unit of data may be a data element or a data item.
feature record	The logical information, both spatial and attribute, describing a feature or entity.
geographical information system (GIS)	A system for capturing, storing, checking, integrating, analysing, and displaying data that is spatially referenced to the Earth. This is normally considered to involve a spatially referenced computer database and appropriate applications software.
Geography Markup Language (GML)	GML was developed by the Open Geospatial Consortium (OGC), a global organisation of developers and users that aims to maximise the benefit of geographic information. GML is a spatially enabled dialect of XML schema.
layer	A subset of digital map data selected on a basis other than position. For example, one layer might consist of all features relating to counties and another to wards. Also known as a level.
level	A level corresponds to a single type of administrative unit, for example, a ward or a district, and is conceptual in form. See also layer.
line	A series of connected coordinated points forming a simple feature with homogeneous attribution.
line feature	The spatial abstraction of an object in one dimension. Lines may intersect with other lines. They are defined as a series of two or more coordinate pairs and may be curved or straight. Curved lines consist of a series of very short straight-line segments. As an object abstraction, a line has no width.
line segment	A vector connecting two coordinated points.
link or edge	Links are the representation of line features. They are made up of one or more consecutive non-intersecting link segments with common attributes

Glossary term	Definition
	between two terminating nodes. Links have no connection with other links except at the start or end, via common (shared) terminating nodes (points). All links contain their terminating coordinates. Links may form the boundaries of polygons and may be shared between polygons.
map scale	The ratio between the extent of a feature on the map and its extent on the ground, normally expressed as a representative fraction, such as 1:1,250 or 1:10 000.
name	The proper name or label of an object (real world) or feature (object abstraction). The descriptive name might consist of one or more text strings or be an attribute of the object or object abstraction.
National Grid	A unique referencing system that can be applied to all Ordnance Survey maps of Great Britain (GB) at all scales. It is used by Ordnance Survey on all post-war mapping to provide an unambiguous spatial reference in Great Britain for any place or entity, whatever the map scale. The National Grid is defined by the OSGB36 spheroid.
Northings	See rectangular coordinates.
object	A collection of entities which form a higher-level entity within a specific data model.
object (real world)	A recognisable discrete part of the real world.
origin	The zero point in a system of rectangular coordinates.
point and line data	A form of vector data designed for map production in which all map features are designated as points, lines, or text. Point and line data does not carry the topological relationships between features.
polygon	Polygons are a representation of areas. A polygon is defined as a closed line or perimeter completely enclosing a contiguous space and is made up of one or more links. At least one node occurs on the perimeter of a polygon where the bounding link completes the enclosure of the area. There may be many nodes connecting the bounding links of a polygon. Links may be shared between polygons. Polygons may wholly contain other polygons or be contained within other polygons.
polygon boundary	The link(s) which enclose a polygon, projected into the horizontal plane. A chain.
record	A set of related data fields grouped for processing.
rectangular coordinates	Also known as X-Y coordinates and as eastings and northings. These are two-dimensional coordinates that measure the position of any point relative to an arbitrary origin on a plane surface (for example, a map projection).
resolution	A measure of the ability to detect quantities. High resolution implies a high degree of discrimination but has no implication as to accuracy. For example, in a collection of data in which the coordinates are rounded to the nearest metre, resolution is 1metre, but the accuracy may be ± 5metres or worse.
segment	A chord defined by two consecutive coordinates in a line string.

Glossary term	Definition
shapefile	This is a data format developed by Esri to describe features such as points, lines, and polygons to enable spatial analysis. A shapefile consists of several files designed to hold information essential for the transfer of this data between software products which are capable of reading shapefiles.
spatial data	Data that includes a reference to a two- or three-dimensional position in space as one of its attributes. It is used as a synonym for geometric data.
spot height	A point on the Earth's surface for which the height, above a reference datum, is known and which has been fixed by observation.
String	A set of items which can be arranged into a sequence according to a rule. A sequence of coordinate pairs or triplets making up a line or a link.
structured data	Data within which collections of features (of any type) form objects. Topographically structured data also contains topological information, defining the relationships between features and objects.
Topography	The study of the physical features of the Earth. A topographic map's principal purpose is to portray and identify the features of the Earth.
Topology	The study of the properties of a geometric figure that are not dependant on position, such as connectivity and relationships between lines, nodes, and polygons.
Vector	A straight line joining two data points.
vector data	Positional data in the form of coordinates of the ends of line segments, points, text positions and so on.