Registration
Learning and Development

An Insight into Ordnance Survey Maps

May 2011

ORDNANCE SURVEY MAPS

CONTENTS

This booklet is designed to give you an insight into the work of the Ordnance Survey and how their work affects the Agency. This is important because PART 1, Section 6(a) of the Land Registration (Scotland) Act states-

"THE KEEPER SHALL MAKE UP AND MAINTAIN A TITLE SHEET OF AN INTEREST IN LAND IN THE REGISTER BY ENTERING THEREIN A DESCRIPTION OF THE LAND WHICH SHALL CONSIST OF OR INCLUDE A DESCRIPTION OF IT BASED ON THE ORDNANCE MAP."

THE DEVELOPMENT OF THE ORDNANCE SURVEY

The Board of Ordnance initiated a national mapping programme in 1791 when Great Britain feared the possibility of invasion from Europe following the French Revolution, thus the Ordnance Survey was born. However the Ordnance Survey owes its formation more to Major-General William Roy, renowned surveyor, engineer and archaeologists of the time, rather than the Ordnance Board.

In his earlier years, Major-General William Roy had been responsible for the production of a military map of Scotland.

After the Duke of Cumberland defeated the Young Pretender at the Battle of Culloden and during the "pacification" of the Highlands, Cumberland and his staff found themselves severely handicapped by the poor quality of the existing maps of the area. Thus Roy was detailed to survey and map the area at a scale of 1 inch to 1000 yards which satisfied the military need to show the routes of communication and the terrain of the countryside clearly and accurately. Roy's original hand drawn map is now on show in the British Museum.

In 1765 Roy was appointed Surveyor General of Coasts and Engineer for making and directing military survey in Great Britain. Over the next twenty years he expressed the need for the establishment of a National Survey. However, it was not until after the end of the American War in 1783 that Roy's recommendations regarding the National Survey were given serious consideration.

Cassini de Thury, the French astronomer suggested that Greenwich and Paris Observatories should be connected by triangulation, the framework upon which all scientific survey is built. Roy was commissioned by the Royal Society to measure a base line on Hounslow Heath (now Heathrow Airport) and complete the triangulation of the Observatories. For this task George III presented the Royal Society a theodolite with a 3-foot diameter circle. This triangulation would form the basis of the triangulation for the national survey in 1791.

Sadly Major-General Roy's dream of a national mapping organisation was not to take shape, until one year after his death in 1790 at the age of 64.

The first action of the Ordnance Survey, the payment of which is recorded in the account book of the Board of Ordnance for 1791 was to acquire a new theodolite, which was purchased on the order of the 3rd Duke of Richmond. Following the re-measurement of the Hounslow Heath base line, the new theodolite, together with that originally used by Roy, was used to extend the triangulation until it covered the whole of Great Britain.

It was not until eight years later in 1800 that the Ordnance Survey really began to make its mark. With increasing risk of invasion from France, the entire Ordnance Survey staff were put to work along the south coast of England to produce military maps. The result of which was that on 1 January 1801 the first Ordnance Survey map of Kent at one inch to one mile scale was published, not by the Ordnance Survey however but by William Faden of London for the Board of Ordnance.

By 1805 when the threat of a French invasion had subsided the Ordnance Survey settled down to a more formal programme of map publication. The first of its numbered, regular map series was produced at a scale of one inch to one mile - this scale would become Ordnance Survey "flagship" scale.

In 1825, the Director General of the Ordnance Survey, Thomas Colby, took nearly all the staff of the Ordnance Survey to Ireland to carry out a survey in connection with land taxation. For this purpose Colby introduced the six inch to one mile scale map. The six-inch scale Irish Maps proved so useful that in 1840 this scale was adopted for those areas of northern Britain still unsurveyed at the time.

In 1842 a dispute of scales begun. The search for useful and sensible scales was complicated by changing needs as life outside the Ordnance Survey changed. The one-inch map was not suitable for detailed requirements of the Title Survey, or for engineers laying out new railway lines, nor was the sixth inch map adequate for use in the implementation of Land Registration and Poor Law legislation. In 1863
a discussion was finally made the one inch scale map was to be used as a general topographical map, the twenty-five inch (1/2500) scale map for cultivated areas, the six-inch (1/10,560) scale map for mountain and moor land area and final the ten feet to the mile (1/500) scale map for built up areas with a population of 4,000 or more.

An important aspect of Ordnance Survey maps is the representation of relief in the form of contours, bench marks, and spot heights. The first national "geodetic" levelling had begun in 1841 with a datum fixed to a tide pole in Victoria Dock, Liverpool. By 1912 it became clear that a more precisely measured levelling programme was required to meet advancing needs, and so new tide gauge were opened at Newlyn in Cornwall, Dunbar near Edinburgh, and Felixstowe in Suffolk, and a network of fundamental bench marks, set on solid rock, selected after advice from Geological Survey, was established to replace the old insecure network. Levelling, like all other aspects of Ordnance Survey's work, was to be interrupted by the Great War.

The war also delayed implementation of fundamental changes to Ordnance Survey's methods of marketing and selling its maps. Prior to 1914 Ordnance Survey's main interest centred on the sciences associated with map-making: mathematics, astronomy, and invention of instruments to do a job which had never been done so meticulously before.

Having made "the best maps in the world" (a traditional and rarely challenged claim). Ordnance Survey barely gave thought as to how best to sell them. In 1914, the Director General, Sir Charles Close, decided to break into the market-place and start selling maps in a big way. This period saw the explosion of rambling, cycling and motoring as leisure pursuits, and Close was quick to see that there was a potential for huge map scales among travellers and holiday-makers.

The war in Europe intervened however, and the future plans for marketing maps for leisure use had to be put on hold as Ordnance Survey put on its military hat and went into production of maps for the war effort. Many staff were posted overseas as surveyors, draughtsmen and printers, and in the following four years the Ordnance Survey churned out over 30 million maps for the forces, and provided expert training and equipment for the armies at home and abroad.

The war over, Close returned to the idea of selling maps, especially small-scale maps, to the public, and a fresh new wave of map covers and advertising slogans were launched from Southampton.

After the First World War the government forced severe reductions in staff numbers and widened the time between revisions of essential large-scale mapping, with the effect that map revision fell into arrears and innovative ideas were not taken forward through lack of resources. On reflection, this was to reveal itself as a major blunder which would take many years to rectify.

By the late 1930's it became clear that Ordnance Survey were not equipped to supply accurate and up-to-date maps that were required for the implementation of new legislation on Land registration (1925), town planning (1925), land drainage (1926), slum clearance (1930) and land valuation.

A committee was set up under the chairmanship of Sir J.C. (later Lord) Davidson in 1935 to consider how to restore the effectiveness of a national survey.

The problems they faced were that the control systems was in many respects inadequate, some of the triangulation marks were buried and could not be recovered and buildings carrying Ordnance Survey triangulation mark had disappeared. In 1936 Major-General M N MacLeod took the decision before publication of the Davidson Committee Report (1938) to re-triangulate Great Britain in preparation of the Committee's recommendations, a task which was in fact to take from 1936 to 1962 (interrupted by Second World War)to fully complete. In 1938 the Davidson Committee published its report, the major recommendations were:

(1) The recasting of 1:2500 scale (Twenty-five inches to one mile) map series on national instead of county lines using a national projection rather than separate county projections.

(2) That a National Grid be superimposed on all large and small scale maps to provide one reference system for the whole country.

(3) That the International metre be adopted as the unit on which the system be based. (This was a very far-sighted recommendation at that time.)

(4) That there would be a system of continuous revision for large scale maps.

(5) That the 1:1250 or 50" to I mile scale to be adopted for urban areas.

(6) That house numbers would be shown.

These recommendations were not immediately implemented because of the outbreak of the Second World War. As the war progressed the country suffered increasing damage from the air. In post-war Britain, the need for up-to-date mapping was realised and along with implementation of some of the Davidson Committees recommendations. In 1944 the Government agreed that after the war all major towns of Great Britain should be surveyed at the scale of 1/1250, the remainder of the country at 1/2500 and mountain/ moorland areas at a revised six-inch on National lines instead of County sheet lines. With metrication, the six-inch scale has now become 1/10000 The Government also gave their full backing to the remainder of the Davidson Committee's recommendations.

The first National Grid 1/1250 scale map was produced in 1947, the 1/10560 in 1946 and the 1/2500 in 1948, both of which were compiled from County Series sheets. All the maps now carried Ordnance Survey National Grid on their face. The maps were now constricted on a national projection (Transverse Mercator Projection) and were indexed to the National Grid. The grid provided the first truly national map referencing system where any place could be given precise location reference number for a wide range of maps and services.

The main task of the Ordnance Survey since then has been the resurvey of Great Britain on a National Grid base which was finally completed in 1983. Initially the methods employed were not vastly different from those used in original 19th century survey, but gradually as new equipment and instruments became available more economic methods have been introduced. New instruments such as Electronic Distance measuring theodolites to replace chaining, more sophisticated theodolites and above all the general use of aerial photography were used to speed up the survey process considerably, another task being the continuous revision necessary to overcome the faults of the previous county series system. Therefore a more systematic approach to keeping abreast of changes on the ground was introduced. Therefore a network of small survey offices, known as Continuous Revision sections was set up across the country.

These offices were organised into six regions -Scottish, Northern, East Midland, West Midland, South Western and South Eastern.

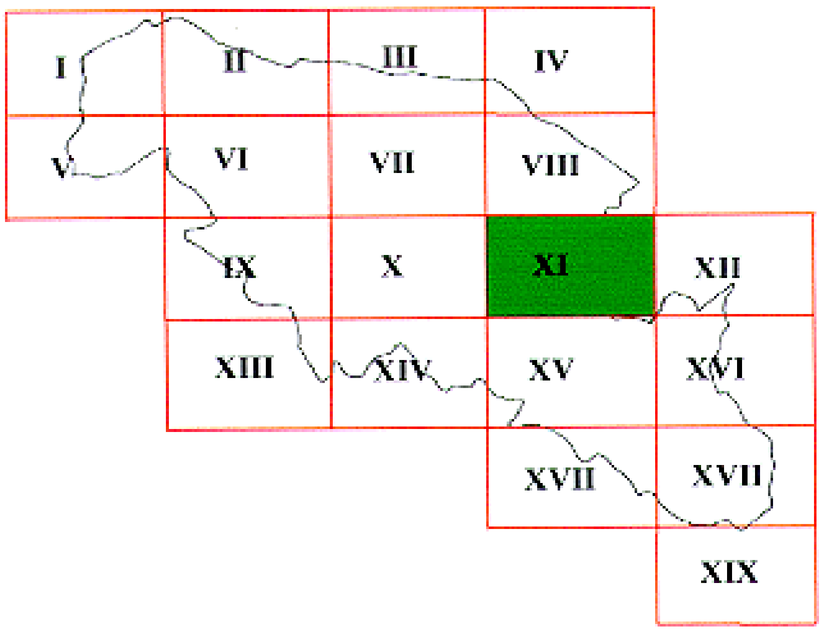
In 1971 Ordnance Survey began making digital maps. At this time digital technology was purely used as a production tool for making traditional maps on paper.

1983 saw the end of 192 years of direct military involvement in the management of the Ordnance Survey. Today it's an independent government department and Executive Agency reporting to the Secretary of State for Environment and is Great Britain's national mapping agency. Internationally it is regarded as a world leader in its field, which covers the production, maintenance computer data, geographical information and marketing.

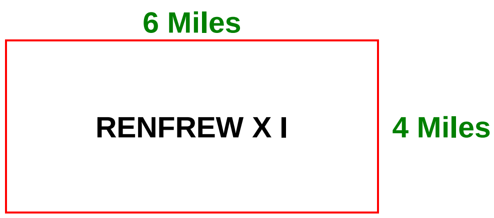
The national topographic database is stored at the Ordnance Survey's headquarters in Southampton. It is effectively a seamless map of Great Britain replacing the need to separately maintain around 23,0000 paper maps. In the field staff use hand held computers to survey and record information, with a system know as Probable Revision and integrated Survey Module (PRISM). Before visiting a site the surveyor load the necessary map data files onto his computer from the database at Southampton, on site the changes can be made directly onto the map data fields, and finally when returning from site the updated data can be sent back to the main database at Southampton and processed overnight. Therefore new information will be available for use the day after surveying. The information from the database can be accessed directly through a country-wide network of Superplan Agents as copies or as computer data on disc.

THE COUNTY SERIES MAP SYSTEM

The County Series system was in use up to **1945**. Each diagram was surveyed as a single unit and each county had an independent **COUNTY DIAGRAM** on which was superimposed a grid system. The example below is the **Renfrew County Diagram**. For each rectangle so formed by the grid a map was produced which covered an area **6 miles by 4 miles**.

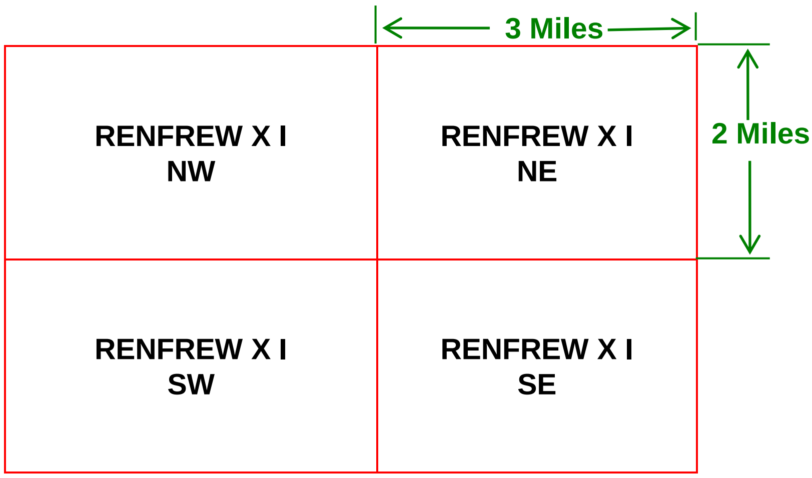


Each rectangle is identified by the County prefix (i.e. Renfrew) and a Roman numeral when it is published as a map at the scale of 6" to 1 mile or 1:10560 i.e. Renfrew XI.



Obviously the bigger or smaller the county the more or less rectangles of this size are formed

Each **6" to 1 mile** map could be, but not always, sub divided into four quarters and where known as **Quarter 6" maps**. That is to say maps still at the 6" to 1 mile scale which were one quarter the size of the original map. The quarter being separately numbered by the addition of the suffix **NE, NW, SE or SW**



To arrive at the largest scale surveyed under the County Series system a full 6" map was broken down into smaller units covering an area of **1 1/2 miles by 1 mile** at a scale of **25" to 1 mile or 1:2500**. There are 16 of these maps to a full 6" map.

RENFREW XI

1	**2**	**3**	**4**
5	**6**	**7**	**8**
9	**10**	**11**	**12**
13	**14**	**15**	**16**

The reference for the map coloured green on the above diagram above will be **Renfrew XI 10**.

BREAKDOWN OF THE COUNTY SERIES SYSTEM

COUNTY DIAGRAM

I	II	III	IV	
V	VI	VII	VIII	
	IX	X	XI	XII
	XII	XIV	XV	XVI
			XVII	XVIII
				XIX

RENFREW XI Scale 1:10560 Full 6"

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

RENFREW XI SE
Scale 1:10560 Quarter 6"

9	10
13	14

RENFREW XI 10
Scale 1:2500 25"

As previously stated this system was in use up until 1945. The County Series system was replaced by the National Grid system because of the recommendation of the DAVIDSON COMMITTEE which met between 1935 - 1939.

Its replacement was recommended because of the disadvantages of the County Series system which included -

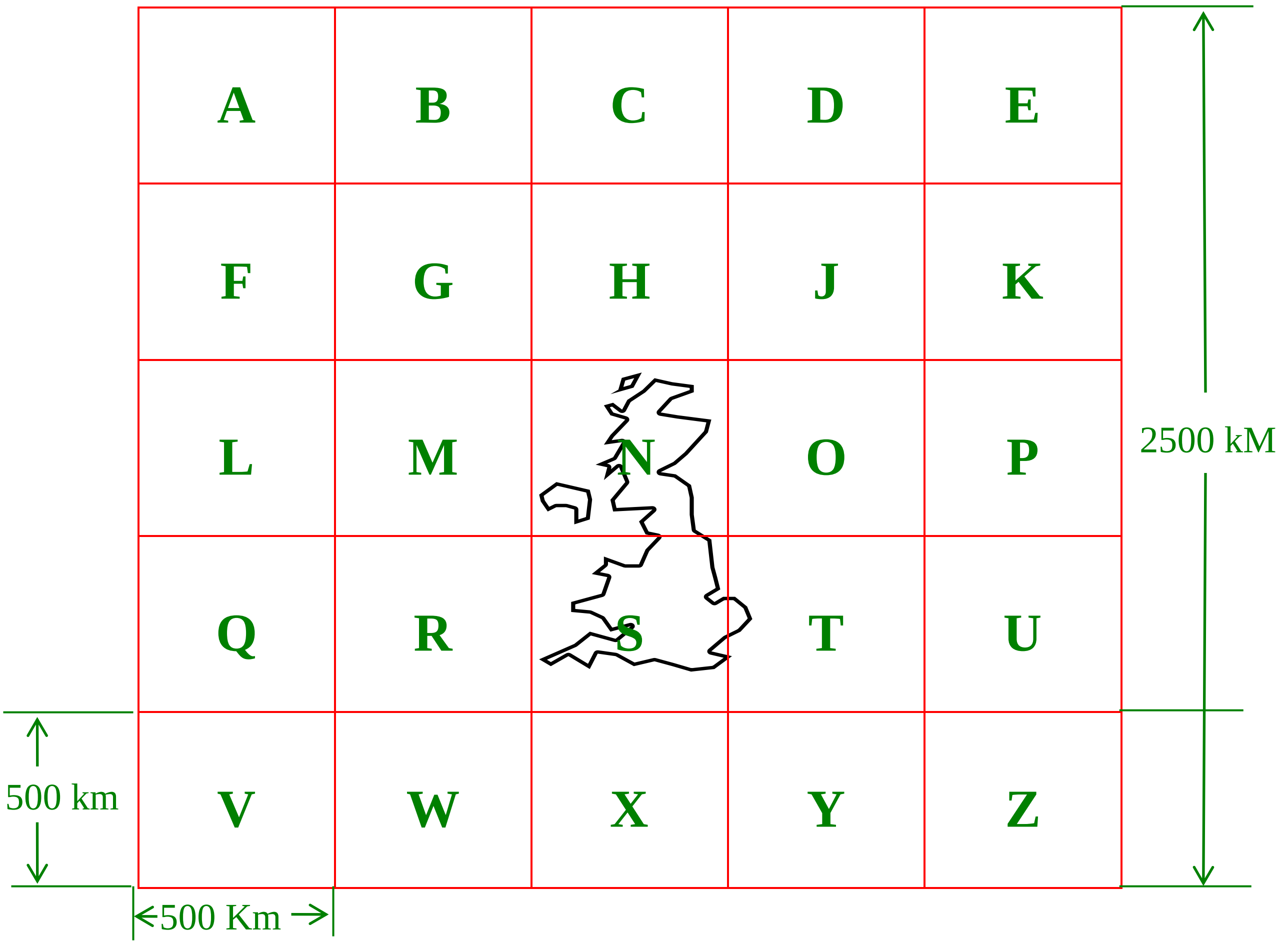
- Distortion at county edges making adjoining maps incompatible. Most counties at the 1/2500 scale surveys were carried out using a number of different map projections each with their own central meridians. The result was that although the greater part of the country was mapped at 1:2500 scale, it did not form a national survey but rather a number of county surveys which did not fit together at their boundaries.
- Largest scale was 1:2500 which was proving to be inadequate for recent legalization namely the Land Registration Act (1925) and the Town and Country Planning Acts (1925)
- No house numbers were shown.
- No systematic revision for updating new development each map was updated every 10 to 20 years.
- Due to each county having its own meridian there was no national referencing system

The recommendations of the Davidson Committee included -

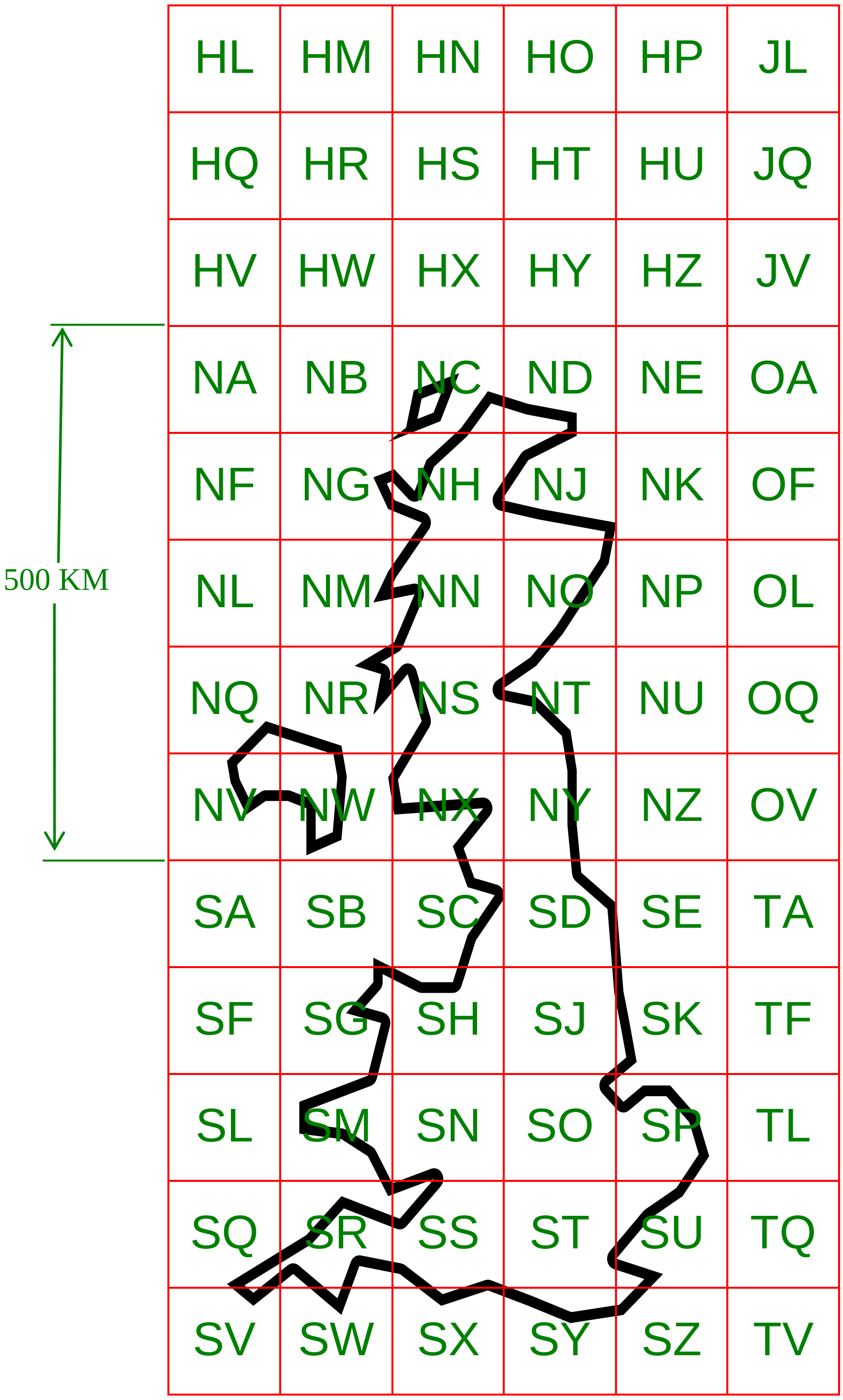
- The recasting of 1:2500 scale (Twenty-five inches to one mile) map series on national instead of county lines using a national projection rather than separate county projections.
- That a National Grid be superimposed on all large and small scale maps to provided one reference system for the whole country.
- That the International metre be adopted as the unit on which the system be based. (This was a very far-sighted recommendation at that time.)
- That there would be a system of continuous revision for large scale maps.
- That the 1:1250 or 50" to 1 mile scale to be adopted for urban areas.
- That house numbers would be shown.

THE RESULT WAS THE NATIONAL GRID SYSTEM

THE NATIONAL GRID SYSTEM



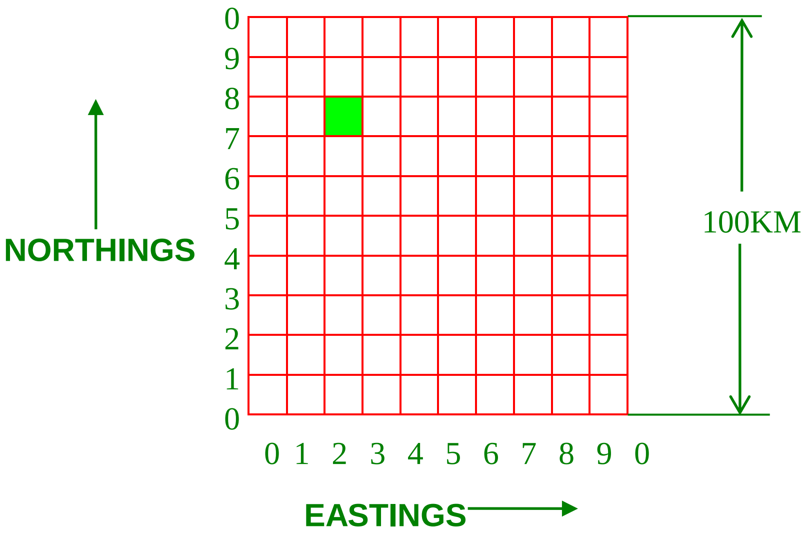
The National Grid reference system for Great Britain coincided with an existing larger military grid system with **500 kilometre** squares. This system used letter references for each square. The Ordnance Survey adopted the same lettering system to provide identical referencing on both Ordnance Survey and military maps.



Each **500km** square, i.e. **N** was broken down into **25 x 100km** squares. Each **100km** square was given an additional letter reference, i.e. **NA, NE, NU, NZ**. The only letter not being used from the alphabet being the letter I.

NS is a square with sides of **100km** and can be further broken down into **100 x 10km** squares. These **10km** square maps are published at scale of **1:25000** that is approximately **2½" to the mile.**

MAP REFERENCE - NS



To find the reference for the **10km** square coloured green on map reference **NS** we would have to know the principles which apply to all National Grid maps which are:-

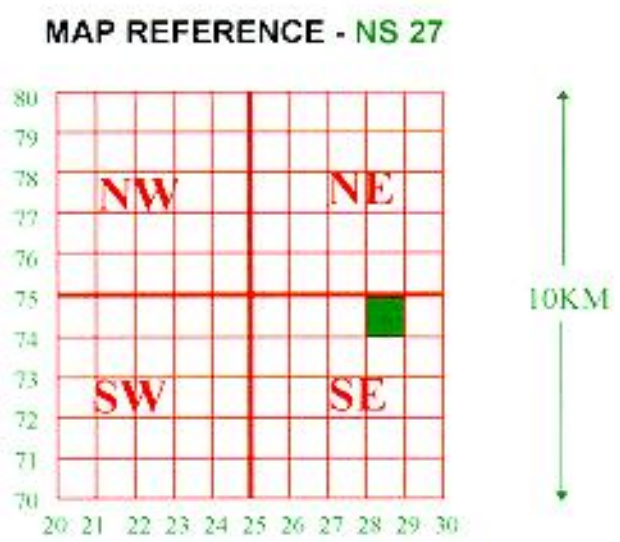
1. The reference is always to the **SOUTH WEST** corner of the square concerned.

2. The first number reference is taken from left to right along the horizontal axis and is known as an **EASTING**. In this case it is a number - **2**

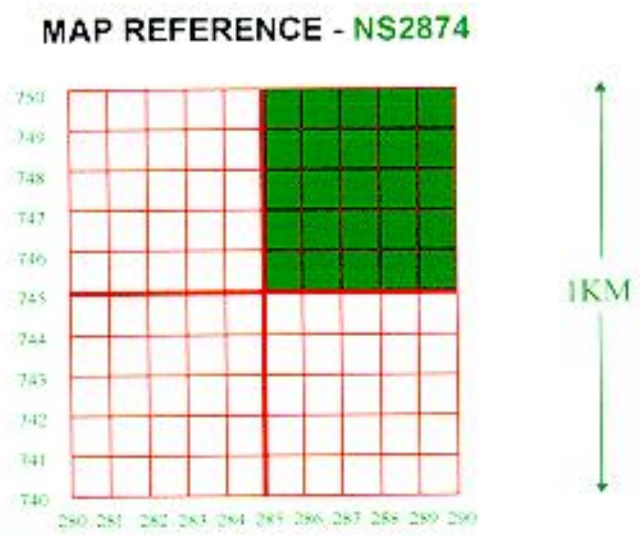
3. The second number reference is taken from bottom to top along the vertical axis and is known as a **NORTHING**. In this case it is a number- **7**

Therefore the reference for the **10km** square coloured green on the above diagram is **NS27**

Each **10km** square is further broken down into four quadrants - **NS27NE**, **SE, NW and SW** these are published at **1:10000** scale which is approximately **6" to 1 mile**. This is the largest scale published for mountain and moorland areas of the country.

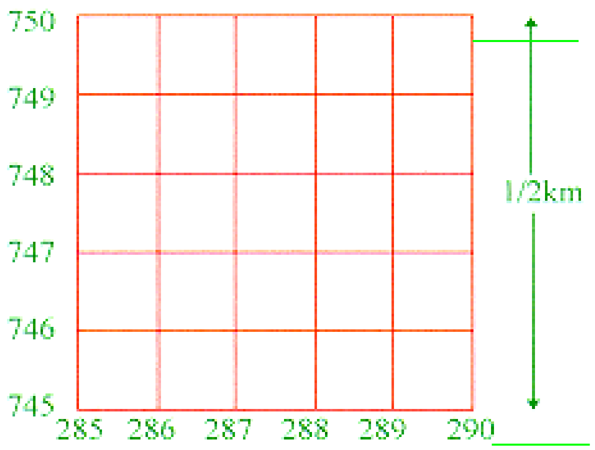


As well as being split into four quadrants **NS27** can be split into **100 x 1km** squares. The grid reference for the **1km** square coloured green on the diagram above will be **NS2874**. The reference is arrived at using the same Eastings and Northings principle as before and this results in a four figure grid reference. A **1km** square map is published at a scale of **1:2500** or approximately **25" to 1 mile**. These maps are normally published as **2 x 1km** sheets and are known as double sheets. Maps published at this scale are usually for rural areas.



Furthermore each **1km** square can be broken down into four quadrants, i.e. **NS2874NE, SE, NW and SW** covering a **½km** square. A **½km** square map is published at a scale of **1:1250** or approximately **50" to 1 mile**. This is the largest scale published and is mostly used for urban areas.

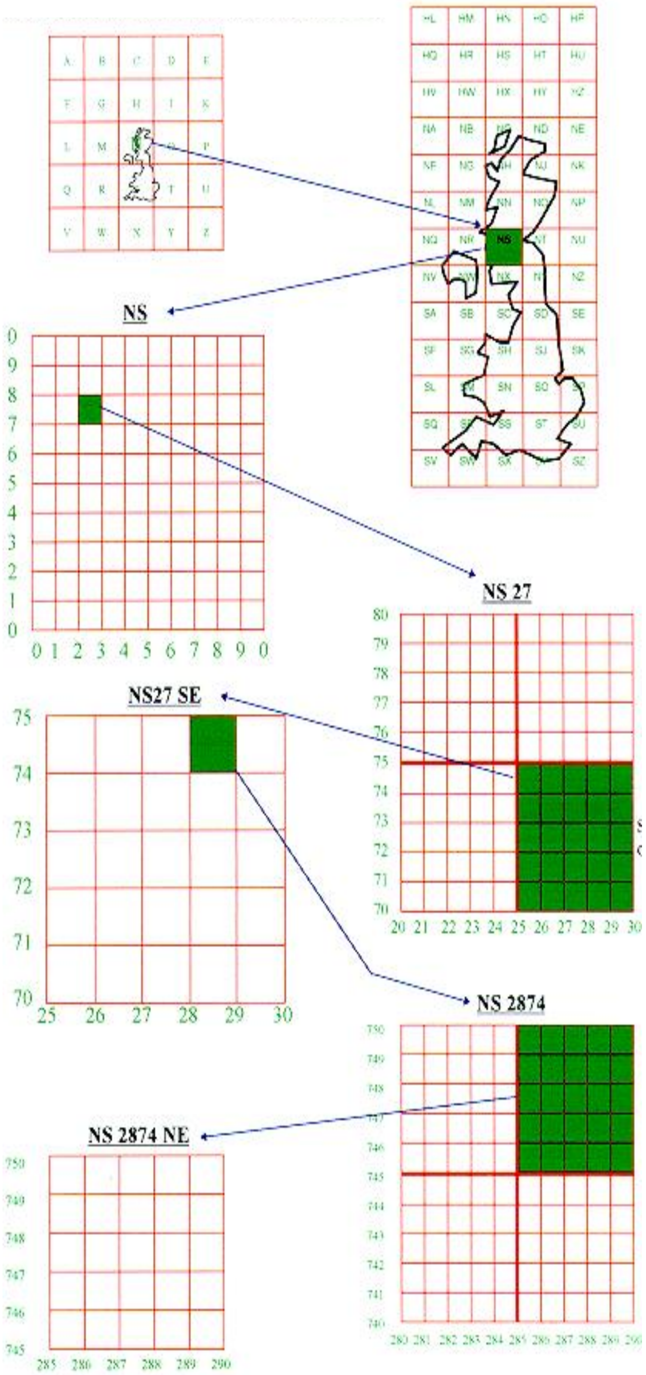
MAP REFERENCE - NS 2874 NE



It is possible to produce a 12 or more figure National Grid reference that can pinpoint an exact spot on the ground if necessary. However for Land Registry purposes we need never go beyond the reference as shown in the above diagram.

REMEMBER that if you are ever in doubt about which sheet is to the North, South, East or West of the one you are using then this information is shown on the respective side of each published sheet.

BREAKDOWN OF THE NATIONAL GRID



Scale 21/2" to 1 mile or1: 25000

Scale 6" to 1 mile or 1:10.000

Scale 25" to 1 mile or 1:2500

Scale 50" to1mile or 1:1250

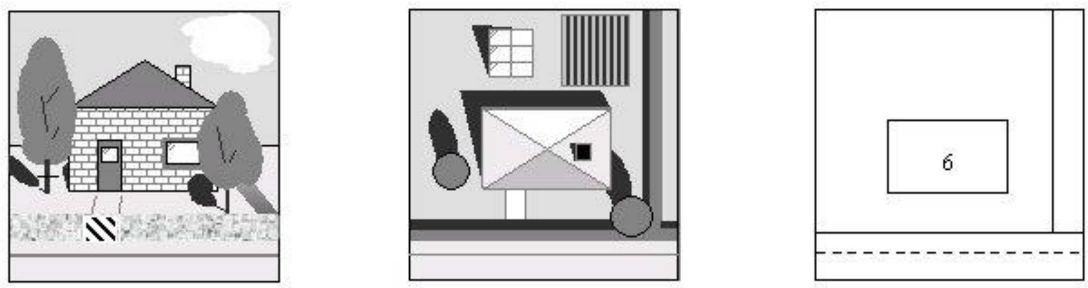
An Introduction to OS Large Scale Mapping

What is a Map?

A map is a scaled representation of a portion of the Earth's surface as if viewed from above. It transforms the three-dimensional 'real world' in which we live into the two-dimensional working environment of the cartographer, surveyor and you the map user. At best it is a compromise, struggling to maintain all the 'true ground' characteristics of scale, shape, orientation and area. It depicts both naturally occurring and man-made 'topographical' or surface features, their relative positions and extents.

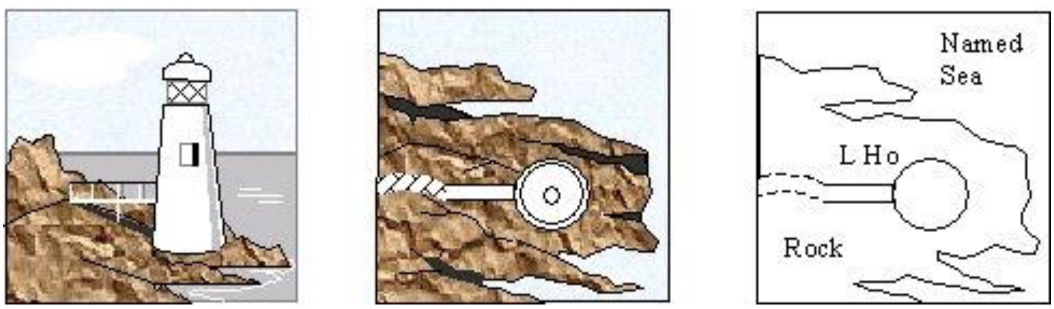
As humans we are familiar with our everyday environment and the relationship between features - the ground beneath our feet, the sky above our heads and the townscape or countryside built up through a combination of buildings, fields, trees, hills, streams, roads and power lines - stretching outwards towards the horizon, and infinity. Elevate our position, changing perspective to that of a bird's eye view and not surprisingly, we often become disorientated and confused. We are not familiar with this particular view of our world, where rooflines define buildings, parallel lines delineate roads, railways and canals, and vegetation and shadows mask the definition of seemingly familiar outlines.

Example 1



Terrestrial View   Aerial View   Equivalent Map Depiction

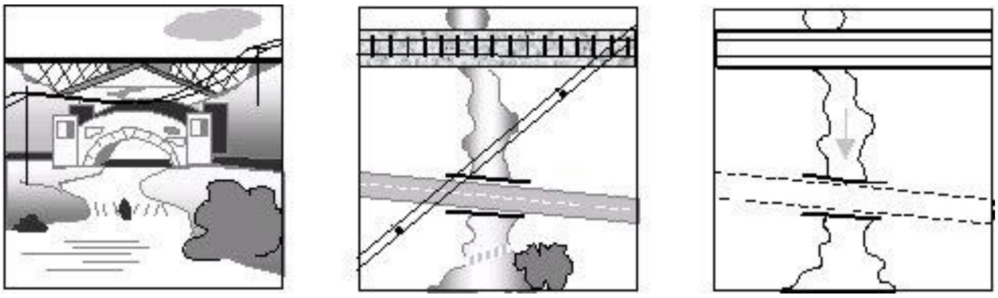
Example 2



The lighthouse is shown, along with the ramp and pathway, (assuming public access is permitted). The 'rock' classification is applied to indicate the nature of the ground and the descriptive abbreviation 'L Ho' added.

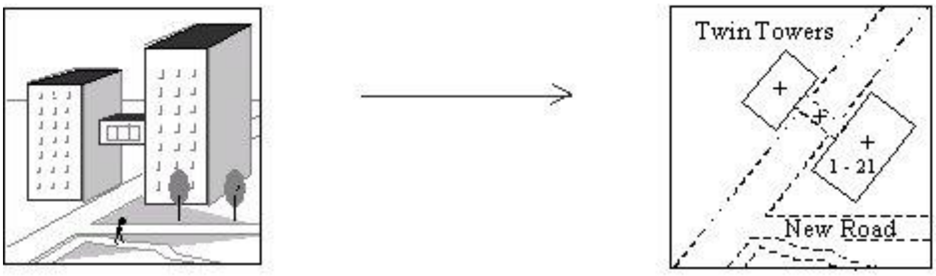
The nature of the light is also added in brackets, e.g. (flashing, white). The distinctive name for the Sea or promontory would also be added to enhance clarity of location along with tidal information.

Example 3



The rail and road bridges are shown crossing the river with no detail shown beneath. The rail line is depicted as a set of parallel solid lines and the road as a set of parallel broken or 'dashed' lines. The overhead power lines running along on single poles would not be shown, unless they constituted a significant map feature in a particularly remote area. A direction of flow arrow would be added to indicate the flow of the river.

Example 4



The buildings would be depicted as solid line detail (with attached seed to link additional GIS data) and the linking corridor would be shown as a broken line representing overhead detail. The limits of the metalling which forms the road and the made path surface would be shown by a dashed line. Any distinctive name for the roads, tower blocks and number ranges for individual properties within the blocks would be added.

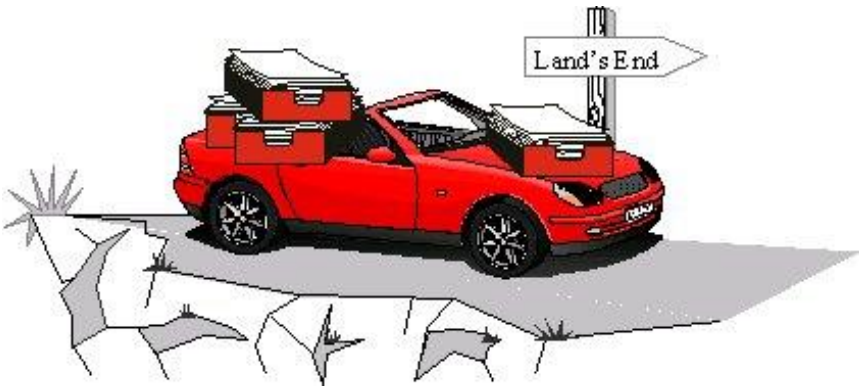
Scale of Mapping

At lower levels the definition of detail in an aerial photograph is clear and unambiguous, individual drain covers can be identified, the stone slabs that make up pathways, the plants in the allotment gardens, even the 'cats-eyes' in the road have a distinct form. If however we rise vertically, as in an air-balloon, the area covered by our field of view increases, whilst the definition of features on the ground diminishes.

The drain covers and cats-eyes merge into the fabric of the road, the path is barely discernible in the shadows of the houses and individual plots in the allotment have combined to yield one concentrated mass of vegetation. Rise even further and the definition of individual features becomes increasingly difficult, single properties merge into regimented rows of rooflines, outbuildings disappear and roads, pavements and paths appear like variegations in the resulting melange of shapes, shadows and colour, which represent the town.

Maps can accommodate such variations in extent and detail definition, by representing a portion of the earth's surface at a series of pre-determined scales. A scale is where one unit of measure on the map is declared to represent a corresponding measurement in the real world, e.g. 1 inch to 1 mile, or 1 to 2500 metres. Map scales are often expressed in the following way – 1/2500 or 1:2500. The scale selected depends very much on the purpose of the map.

To cover the full extent of Great Britain on one piece of A4 it would take a map scale in the order of 1:4,000,000. This map however would have little benefit to the tourist trying to navigate his way around Edinburgh during the Festival! Conversely, a series of 1:500 maps, whilst giving a very clear picture of Edinburgh, would hold little value to someone travelling from John O'Groats to Land's End. The number of maps needed to complete the journey would take up most of the space in the car!

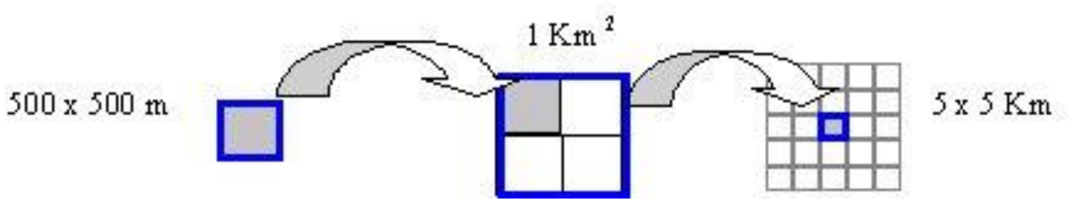


The Ordnance Survey (OS) established through an Act of Parliament (1791), maps Great Britain at three scales - known as the 'Basic Scales'. Other map-based products are derived from the information generated through the maintenance of this 'core' activity.

The three <u>Basic Scales</u> are described in the table below:

Scale	*Environment*	*Map sheet coverage*
1/1250	**Urban** – Cities, Major Conurbation's, Industrial Complexes, Large Towns.	500 x 500 m Referenced by Quadrant within Km, e.g. NS2187NW
1/2500	**Rural** – Small towns, Farms and farmland.	1 km x 1 km Referenced by Km, e.g. NS2187
1/10,000	**Mountain/moorland**.	5 km x 5 km Referenced by 1/25,000 Quadrant e.g. NS28NW

<u>Relationship between Scales:</u>



1/1250 **1/2500** **1/10,000**

<u>Examples:</u>

<u>1/1250</u>

1/2500

<u>1/10,000</u>

Detail depicted within each scale range is very much dependent on the ability of the surveyor to capture and represent distinct features, rather like the balloonist being able to distinguish one feature from another when viewed from his floating platform. Too many features, portrayed at a ridiculously small scale would clutter the map, making the final product unintelligible and impossible to use.

To avoid such confusion a series of rules were established by the Ordnance Survey to accompany each scale of mapping. The next section deals with this ‘Map Detail Specification’ as defined by the OS.

Rules governing the depiction of detail on OS large scale map products.

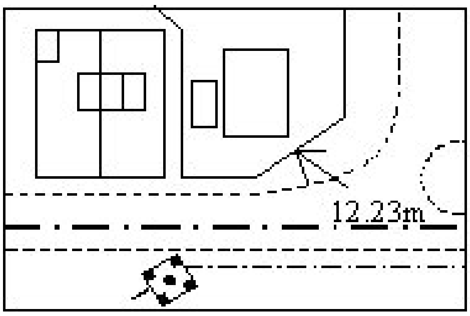
Explanation of abbreviations used in the following section:

[A] = applies to 1/1250
[B] = applies to 1/2500
[C] = applies to 1/10,000
[AB] = applies to 1/1250 and 1/2500
[ABC] = applies to 1/1250, 1/2500 and 1/10,000

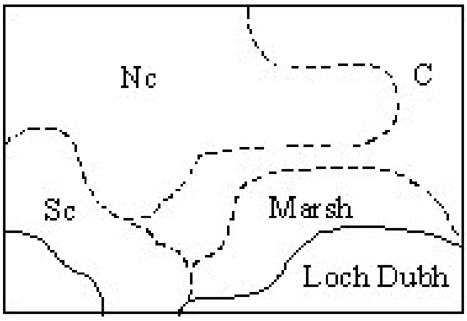
Where more than one ruling dimension is shown, the **first** will apply to 1/1250, the **(second)** to 1/2500 and the **(third)** to the 1/10,000 scale map detail, e.g. (**1.0m), (2.0m), (5.0m)**.

Permanent detail

This detail will include permanent ground features, natural or artificial, whose extent, shape and / or planimetric position can be defined to scale or by symbols. Solid lines represent features with heights in excess of 0.3m above ground surface level, and effectively constitute a restriction to free passage on foot. Broken or dashed lines will depict the edge of definite detail such as kerbs, metalling and pathways, which do not exceed 0.3m in height.

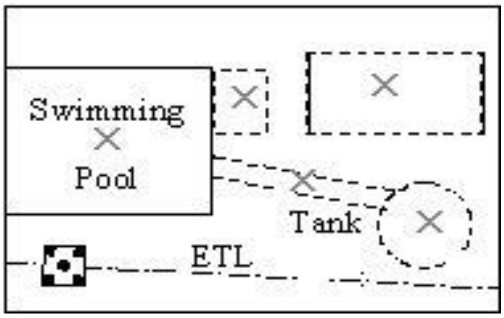


Indefinite detail



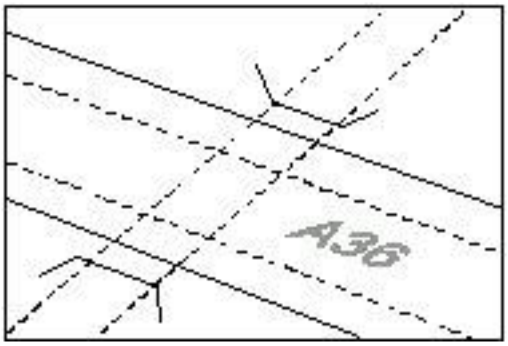
Represents detail of sufficient importance to be captured and added to the map, but has an outline which is either liable to change, or is not defined by any survey able feature; e.g. the edge of woodland, or area of marsh.

Overhead detail



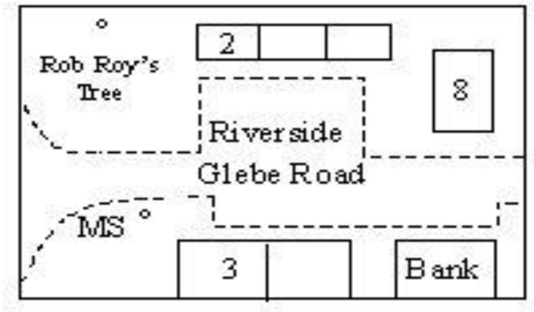
Overhead detail is detail, which exists above ground surface level; e.g. cantilevered buildings, balconies, overhanging roofs and buildings supported on pillars. Overhead detail is captured if it is of such a size and character as to constitute a useful map feature. Its outline will be depicted by the dashed line. The ‘5’ symbol is a seed and is used to define roofed areas. Overhead Electricity Transmission Lines carried on pylons or double poles will be shown and annotated ‘ETL’.

Underground detail



Underground detail is detail, which exists below ground surface level. The only underground detail normally captured and depicted is the outline of communications in tunnels and subways, or occasionally in complex forms of construction it may be necessary to depict additional underground detail to improve the clarity and ease interpretation of the depicted detail.

Names and Postal Numbers



The recognised names and of all features, areas and localities is captured. The form of spelling to be adopted is that which is most generally useful and acceptable in the locality concerned. The postal number of each property is captured, unless it is part of a sequence and can be implied. House names are captured for houses that have no postal numbers. Descriptive or distinctive names are captured for other buildings with no postal numbers.

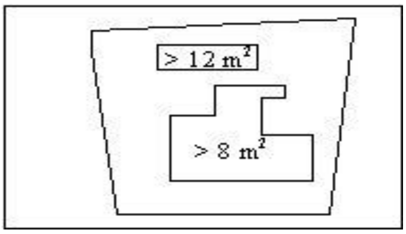
Detail at Ground Surface Level

OS detail depiction represents the real world at normal ground surface level, i.e. the intersection of buildings, walls, fences, kerbs, trees, etc., with the natural ground surface. Where more than one level of detail exists, e.g. shopping malls, ground surface level is defined as the upper level of through public communications.

Buildings

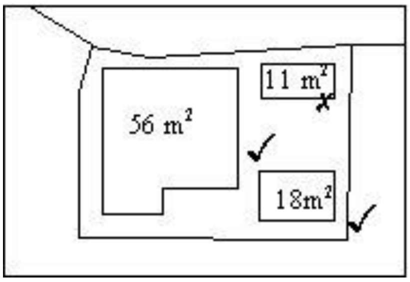
Specification

[AB] All permanent buildings and detail whose plan outline area is greater than 8.0 m^2 are captured and shown, unless they constitute outbuildings within a private garden when the minimum size is 12.0 m^2.



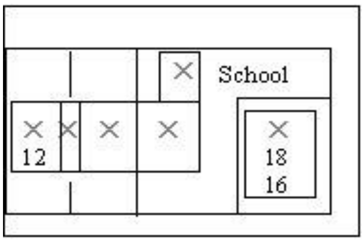
Smaller buildings and detail covering 4 m^2 or more whose smallest dimension is 1.0 (2.0) m or more, will be shown when the building is in such a detached position to be considered an important topographical feature. The main corners of buildings are always captured in their correct planimetric position.

Example

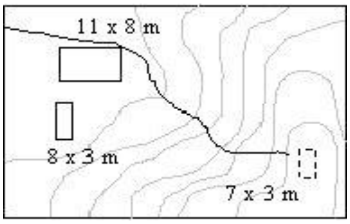


Structural divisions at ground surface level within buildings, which can be surveyed from the outside, are captured when they:

- Divide the building into separate properties at floor levels
- Separate completely different types of construction.

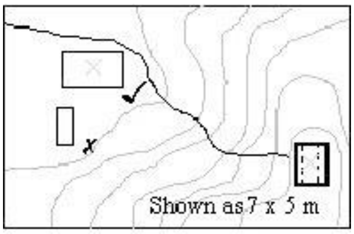


[C] Permanent buildings and objects with a minimum dimension of 5.0 m are captured.

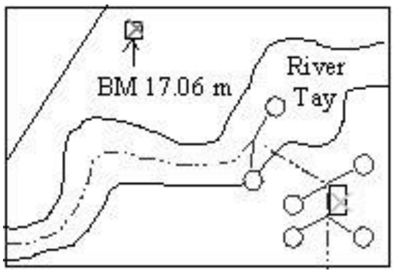


Smaller buildings and objects are shown if they are in such a detached position as to be considered an important topographical feature – they are exaggerated and shown at minimum size.

Open-sided buildings are shown as normal buildings by firm lines.



[ABC] Buildings and detail are always shown regardless of size, when the building or detail has been used for referencing an administrative boundary, or has a benchmark (BM) cut into one of its surfaces.

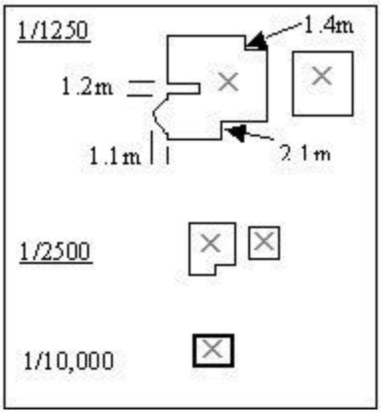


Small yards and shafts inside buildings are surveyed when they are accessible, extend to ground level and are more than 8.0m^2 in area

Juts and Recesses

[AB] Juts, porches, bay windows and recesses that form an integral part of a building are only captured when: -

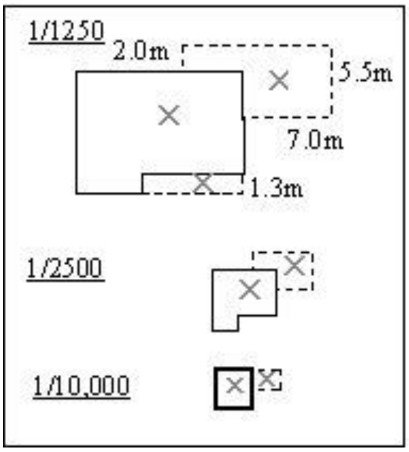
- their smallest dimension is not less than 1.0 (2.0) m or,
- where they abut on to a public thoroughfare or,
- contain a Bench Mark.



[C] Juts, recesses and spaces between buildings of less than 5.0 m are ignored.

Overhead Detail

[ABC] Overhead detail, balconies, roof projections, etc., are only shown if they measure greater than 1.0, (2.0), [5.0] m.

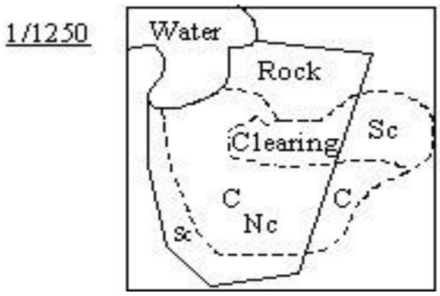


No detail is captured beneath overhead areas except:

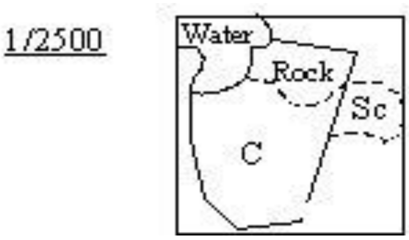
- Intersections of the outer walls of the building with the ground surface level
- Structural divisions
- In complex structures to clarify detail depiction.

Vegetation and Surface Features

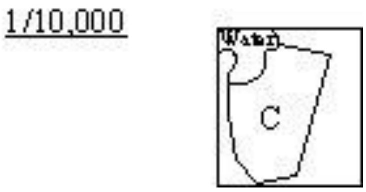
[ABC] Limits of vegetation and surface features are shown on the map provided they have a minimum area of, (0.1), [1.0] hectares (ha) and a minimum width of 5.0, (10.0), [10.0] m.



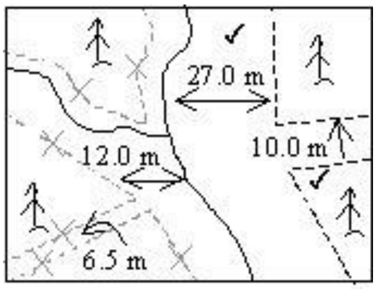
Where the limit of the vegetation is not coincident with a feature, e.g. fence or wall, the limits are treated as indefinite detail and shown by a sketched broken line.



Areas less than 0.25, (1.0), [1.0] ha will be classified in only one way and not subdivided. Clearings within woods will be shown if their extent is greater than 0.4, (0.4), [1.0] ha.



[C] The limits of clearings, rides and firebreaks will be shown if the break in vegetation is greater than 9.0 metres. Linear clearings bordering roads, streams, wall and fences will not be shown unless the edge of the clearing is more than 25 metres from the feature.



Slopes and Cliffs

[ABC] Artificial slopes that are permanent features and over 1.0, (1.0), [2.0] metres in height will be shown when they are:

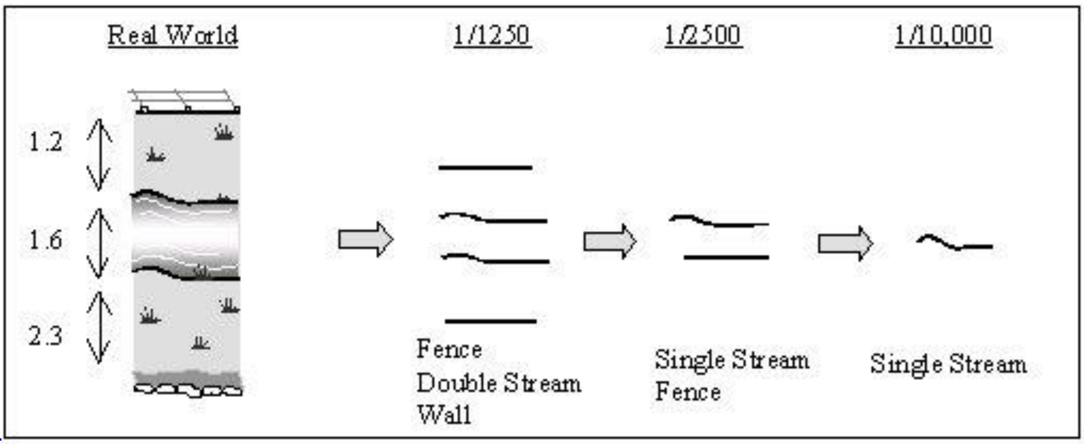
- Structured slops associated with features such as roads, railways, reservoirs and sports stadia; or,
- Constructed for some other specific purpose, e.g. noise reduction. Ornamental slopes will not be shown.

[ABC] The upper edges of cliffs will be shown by a solid line, the lower edges are treated as indefinite detail and depicted by a broken line. No intermediate cliff or rock faces are captured between the extreme upper and lower limits.

Parallel Features

0 **[ABC]** When features run parallel and close to one another, they will be shown separately if the distance between them is greater than 1.0, (2.0), [5.0] m. When conflicts arise the surveyor must decide which is the most important feature; with priority given to features which carry administrative boundaries, or define a property boundary.

Features to be withdrawn will not be terminated abruptly at the plan edge when a change of scale and depiction criteria occurs; instead the feature will be taken to a natural conclusion over the edge of the reduced scale map.



Detail in Private Gardens and Detail Depiction

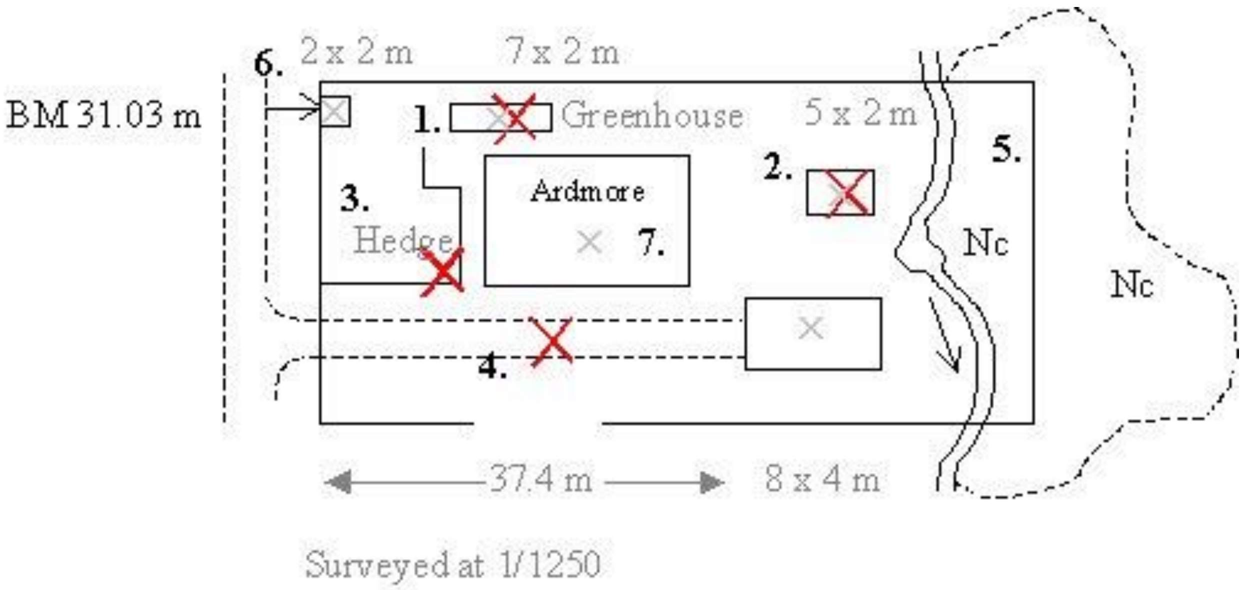
The final scale of the map has always dictated the type and density of detail to be shown. The cartographer has had to strike a balance between the amount of detail portrayed and the clarity of the resultant map. It is unlikely therefore that all the juts and recesses depicted on the 1/500 Solicitors plan will correspond to the OS large scale map. The map offers a generalised solution in areas of complex detail.

Only the following features are captured in private gardens:

- Main dwelling house(s)
- Other permanent buildings > 12.0, (12.0) m^2 , [5.0 m min. dimension]
- Greenhouses and conservatories are not shown – irrespective of size
- Fences, hedges and walls forming the perimeter of the property
- Continuous topographical features, e.g. streams and woods that extend into the garden from outside
- Roads, tracks and drives > 100 m
- Under-size building/feature if used to mere a boundary or house a BM

The following examples show the conversion of detail from aerial view to final map depiction.

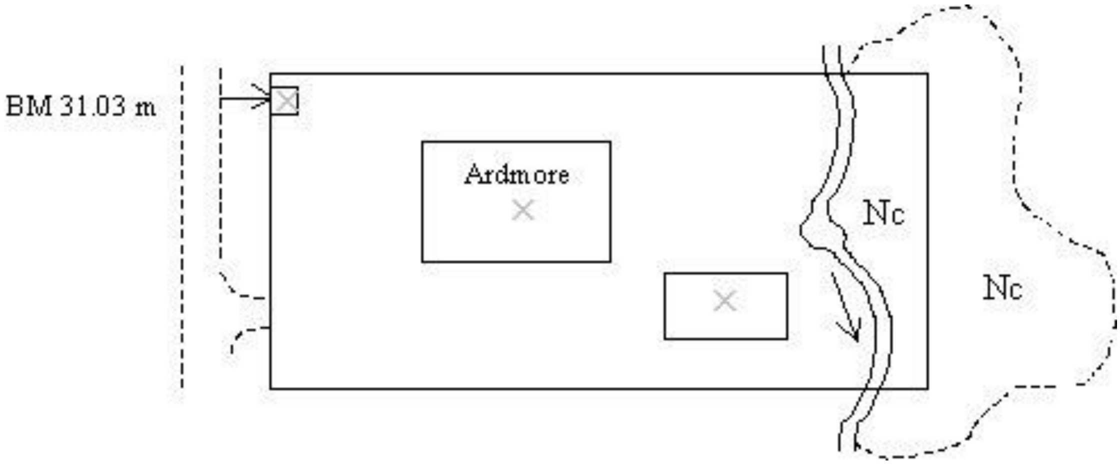
Example 1
Aerial View



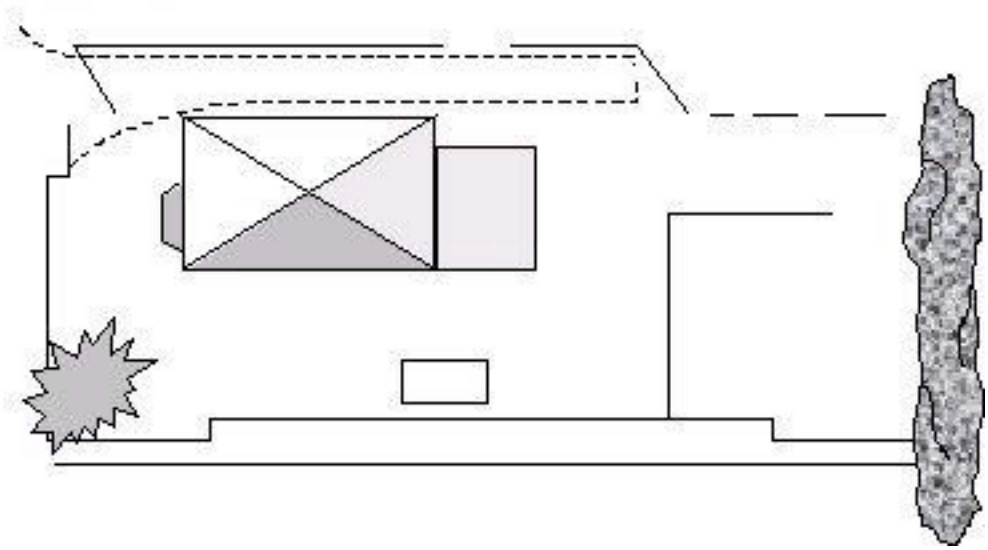
Explanation:

1. Greenhouses and conservatories are not shown irrespective of size.
2. The outbuilding (5 x 2 m = 10.0 m^2) falls below the 12.0m^2 minimum size for ‘other permanent buildings’ captured in private gardens.
3. Internal fences, walls and hedges are not shown.
4. Drives less than 100 m will not be shown.
5. The stream and area of non-coniferous vegetation are considered as continuing topographical features and are shown.
6. The small outbuilding (4.0 m^2) falls below the minimum specified size limit, but does carry a Benchmark and is therefore shown.
7. With no number, the house name is shown on the map.

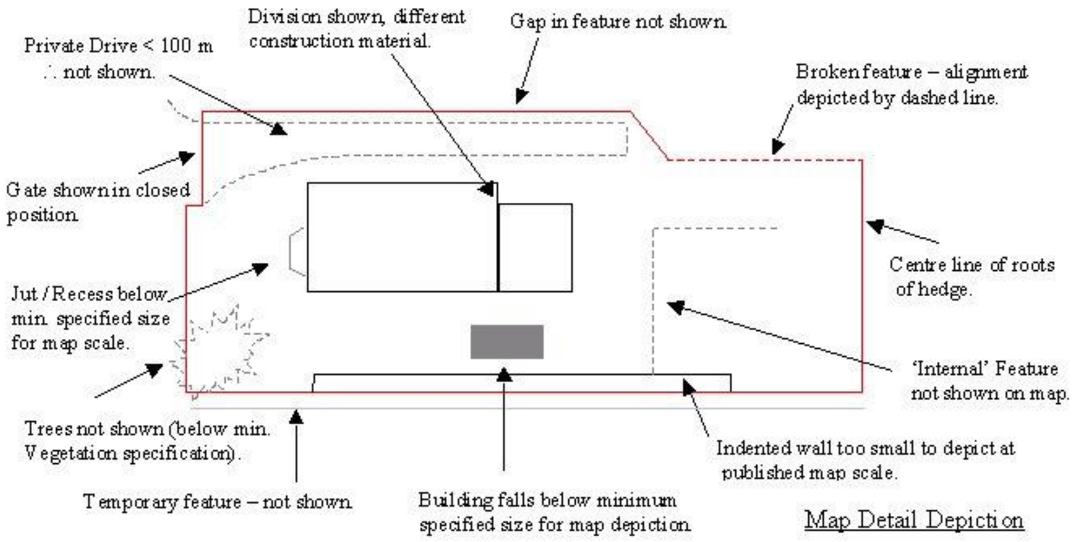
The final map depiction for the area would be as follows:-



Example 2
Aerial view



The final map depiction for this area would be as follows:-



Fences, Hedges and Walls

[ABC] Only permanent fencing will be captured and represented by a solid line. Minor breaks in linear features are ignored and the feature shown as a continuous line. Ring fences protecting single trees, temporary/protection fencing in afforested areas, crop rotation fences and those fences subdividing private gardens, will not be shown. The centre line of the roots of all hedges are represented by a solid line, irrespective of the width of the hedge, (unless it reaches minimum vegetation widths.) A wall less than 1.0, (2.0), [5.0] m wide is represented by its centre line. A wall greater than those dimensions will be represented by a double line drawn to scale.

Paths

[AB] Made paths are those surfaces that are paved or metalled. Their alignment (edges) are shown by the dashed line unless coincident with a solid feature, in which case the solid line style takes preference.

[C] Paths are depicted by a single dashed line representing the centre of the alignment.

[ABC] Unmade paths are neither paved nor metalled, and are identified by evidence of continuous disturbance to the ground. They must also have definite 'start' and 'end' points, such as from a car park to a viewpoint on a hill.

Roads

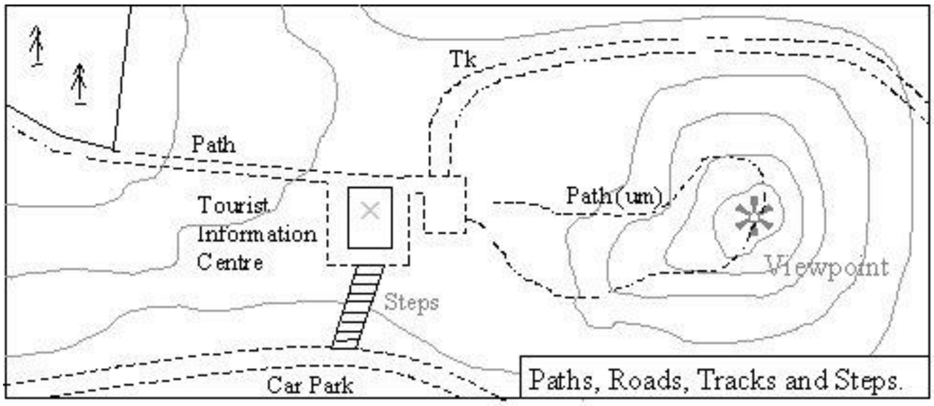
[AB] Defined as a metalled way for vehicles, the limits of roads are surveyed and depicted by dashed lines.

[C] Roads are captured to scale or shown at 5.0 m wide if less.

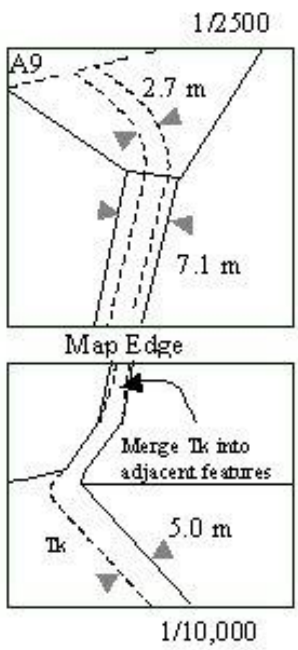
Steps

[ABC] Flights of steps with a minimum area of 2.0, (4.0), [100] m are captured, provided they form part of a public path or pavement.

Individual treads in a flight of steps are conventionally spaced at 1.0, (2.0), [5.0] m apart if their spacing is less than this.



Tracks



A track is defined as a permanent, unmetalled way, used by vehicles and should be 2.5, (2.5), [5.0] m wide. Tracks are annotated 'Tk'.

[AB] All public tracks are surveyed and depicted by dashed lines except where coincident with other features. Tracks joining metalled roads are closed at the edge of the metalling.

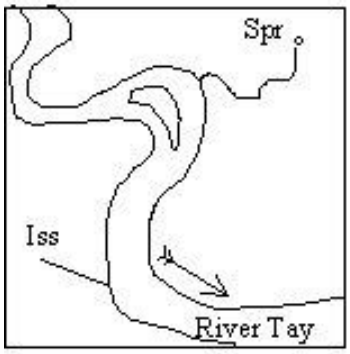
[C] Tracks that are fenced on one side will have the fence shown in its true alignment. Where a track runs between solid detail that is less than 10m apart, the dashed lines will be omitted.

Lakes, Ponds, Reservoirs and Water

[ABC] The outline of lakes and ponds (including islands) are shown at normal winter level. Reservoirs are shown at maximum holding level.

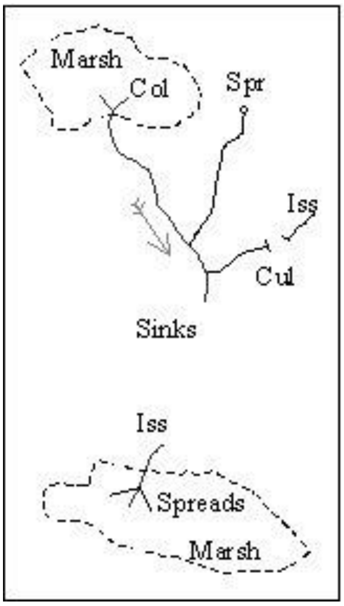
[C] Lakes and Lochs with a surface area > 25 ha will have their height added.

River and Streams



[ABC] Rivers and streams have both banks surveyed in their correct position if they are 1.0, (2.0), [5.0] m or more wide, or by a single line representing the centre of the feature if less.

The width considered is normal winter (but not spate) level. The direction of flow will be indicated by an arrow.



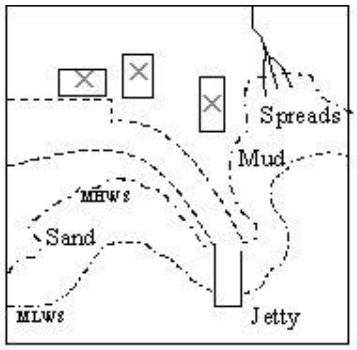
[AB] Terms associated with the source and discharge of rivers and streams are defined below:

- ‘Collects’ (Col) - where the source is a marsh or bog.
- ‘Spring’ (Spr) - where the source is a natural spring.
- ‘Issues’ (Iss) - where the source is an emission from an agricultural drain, or where a stream re-emerges from underground.
- ‘Sinks’ - where a stream disappears underground.
- ‘Spreads’ - where a stream spreads out over sand, shingle or in a marsh.
- ‘Cul’ - culvert/conduit carrying a stream or drain.

[C] The above terms are not used at 1/10,000 scale, unless exceptionally to clarify the course of water detail.

Tide Lines

[ABC] The lines of high and low water are captured, except where they pass beneath a permanent structure such as a jetty or landing stage supported on piles.



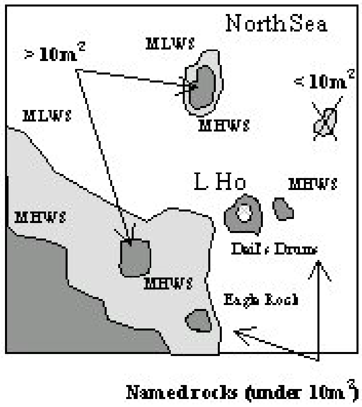
In Scotland the tide lines surveyed are those of the Mean Spring tides, annotated Mean High (or Low) Water Springs, i.e. MHWS / MLWS.

MLWS effectively defines the Extent of the Realm.

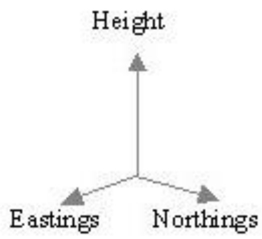
Offshore Islands and Rocks

[ABC] Offshore islands and Rock isolations are captured when:

- Minimum area > 10 m^2 at low water mark
- Where Buildings are present or a Name applies (irrespective of size).

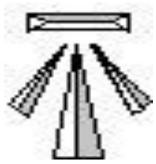


Depiction of Relief

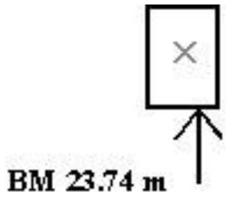


The third dimension (height) is represented on OS maps through a combination of line work, symbols and annotated values, all related to the OS National Height Datum at Newlyn in Cornwall.

[ABC] Heights are expressed in two common ways in all three scales:

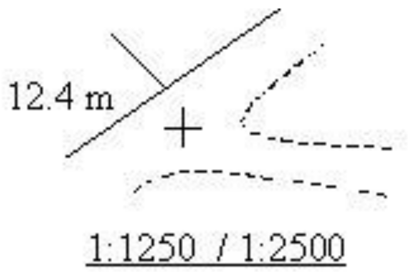


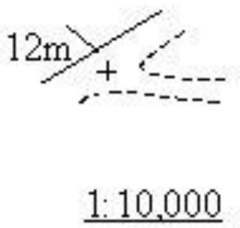
- Bench Marks (BM's) - are marks taking the form of a brass plate or cut arrowhead located on permanent features, e.g. living rock or building face. The horizontal bar represents the actual heighted point and BM's are represented on the map by an arrow symbol defining plan position, with the height expressed in metres, to two decimal places alongside.



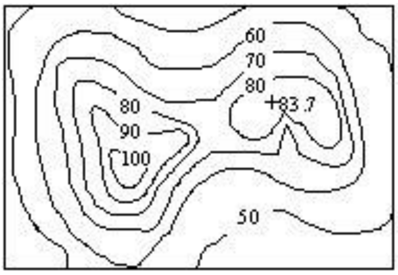
Note: When using Bench Marks to establish ground height it should be remembered that the horizontal bar of the cut shape is normally 0.3 – 0.5 m above the ground. In some instances however, the BM can be up to 2.0m above / below normal ground surface level.

- Spot Heights are not ground marked points, but are included in the map to indicate the nature of the terrain. To facilitate ease of location spot heights are in the centre of roads / tracks and located at road junctions, fence / wall junctions and at sharp changes in ground height. On the map they appear as a cross symbol with a height expressed in metres to one decimal place; on 1:10,000 maps all decimal values are rounded up / down to the nearest whole metre value.





[C] At 1:10,000 scale the general nature of the terrain is depicted by Contours, i.e. lines joining points of equal height above Ordnance Datum. These ‘form lines’ are captured photogrammetrically and are shown at 5.0 m intervals in lowland areas and 10.0 m intervals in more mountainous areas. Smaller ‘infill’ areas are surveyed on the ground by Spirit Levelling.



Remember, the closer the contours, the steeper the slope!

Currency and Maintenance of Large Scale Mapping

Maps are representations of the real world – like photographs they are ‘snap shots’ in time, recording the scene as the surveyor finds it on the day of the ground visit. When the sun slips behind a cloud and shadow envelops the landscape, or a car moves off along the road - the photographed scene changes irreversibly. The same is true in mapping. The day after the surveyor has visited a map site a wall can be knocked down (accidentally or as planned), a further house can be added to the developing estate, the river channel can overflow and migrate across the flood plain – and the map is rendered unrepresentative and ‘out of date’. To maintain the currency of the national mapping archive, the OS must monitor change and continually revise their mapping accordingly. It is rather like being a painter on the Forth Rail Bridge – no sooner have you completed one revision of the town or countryside ……. when it is time to return to the beginning and start all over again!

Change however by its very nature can be sporadic, regular cyclical map revisions are not enough. A revision may miss major new developments and the map could remain wholly unrepresentative of the true ‘ground’ situation for several years, at least until the next scheduled mapping visit. To overcome this problem the OS have developed an intelligence monitoring programme, which collates planning information from a wide variety of sources in conjunction with ‘change evidence’ gathered by surveyors on the ground.

A programme of detail capture has been developed to respond more readily to identify change, prioritising work loads by map scale and the amount, or nature of the detail outstanding.

The following section deals with both the maintenance and quality of the data, which constitutes the map detail, depicted on OS maps.

Units of Change

OS has historically quantified and recorded the amount of change taking place on any basic scale map by the number of house units of change. One house unit equates to the complete mapping of one new house and all its associated features, i.e. peripheral fencing, garage, drive, etc.
Other types of change are measured as parts, or multiples of the basic house unit.

A few examples are tabulated below:

Category	Type of Change / Feature description	House Unit (HU) value
1	A new house and associated features	1
1	A new house for which fences still have to be erected.	0.75
1	Property boundary fences	0.25
1	House names and numbers associated with a new house	1 per 5 names.
1	New Commercial, Industrial and Public Sector buildings	20 per hectare
1	Motorway and Dual Carriageway (incl. paths, fencing).	10 per 100 m.
1	All other roads, std. gauge railways and canals (incl. associated paths and fences.	5 per 100 m.
1	Survey of / changes in kerb lines, e.g. creation of parking bays.	1 per 100 m.
1	Demolition/deletion of any Category 1 feature	0.25 per HU value.

Maintenance of OS Maps

In order to keep the maps as up to date as possible the OS have adopted two approaches to the revision and maintenance of our large-scale map database.

Continuous revision

Continuous revision is the term used to describe the process currently applied in urban, rural and moorland areas to capture major changes to the landscape such as large housing developments, commercial developments and major road or railway construction. They are captured within six months of building completion or demolition. These changes are captured using either ground or aerial survey methods, or a combination of both.

Cyclic revision

Cyclic revision is the term used to describe the process of 'sweeping' through rural areas over a five year period and moorland areas over a ten year period, to capture general revision information which is of most significance to customers. Major changes to the landscape in these areas that occur between revision cycles are captured by the continuous revision process described above. Cyclic revision is undertaken primarily using aerial survey methods.

Quality of Land-Line data

The term 'quality' can mean different things to different users, one generally-accepted definition however is 'that it is a measure of performance against a pre-determined specification'.
The quality of Land-Line can be considered in terms of the following criteria:

Lineage

Great Britain was completely remapped between the years 1946 – 1983. These maps were produced by a number of different methods producing a range of accuracies within the overall published tolerances for each scale in question.

Land-Line was digitised from these published maps in a programme which commenced in 1971 and was completed in 1995. These digital maps have been constantly revised within a digital environment since their initial capture. The quality procedures used were formulated in collaboration with the National Joint Utilities Group, (NJUG).

Content and Completeness

This is a measure of the correspondence between the real world and the specified data content.
At initial digitising stage, all Land-Line tiles were rigorously checked to ensure that no features included on the source map were omitted with reference to the product specification.

Subsequent revision of the Land-Line tiles include local quality control procedures to ensure that all captured data conforms to the current specifications. Data 'cleaning and enhancement' processes have also been carried out to enhance the geometric fidelity of the data, e.g. closing 'closed' polygons, removing 'spikes' and redundant points in the data.

Currency / Revision Policy

All detail is not equal, ...… certainly not in the eyes of the OS! Real-world detail is sub-divided into four categories and each category is assigned a different priority with regard to its frequency of capture.

Category 1 change includes new housing development, roads, railways and major community, public sector and industrial developments.

Category 2 No Longer Exists

Category 3 change includes agricultural and horticultural buildings, quarries, field boundaries, forestry, tracks and paths and other rural features.

Category 4 change includes private garages, extensions and other minor alterations to existing buildings and features in Category 1. This category also covers street furniture and Mean High/Low Water.

Category 5 change includes archaeological information, changes to contours and Mean High Water when affected by changes to Category 1 and 3 features.

The following table shows each category of change, its revision category and frequency of change:

Change Category	*Area Classification*	*Revision Category*	*Revision Period*	*Comments*
1	Urban	Continuous	6 Months	95% surveyed and made available within 6 months of change occurring on ground.
1	Rural and/or Mountain and Moorland	Continuous	6 Months	Only after 1st Cyclic Revision, then same 95% rule as above, with exception of isolated houses (within 3 months).
3 & 4	Rural	Cyclic	5 Years	Collect all remaining Category 1 change and at least 85% of Category 3 change.
3 & 4	Mountain and Moorland	Cyclic	10 Years	All cyclic revision commenced in 1995.
5	Urban, rural, and Mountain and Moorland	Continuous and Cyclic	Same time as associated plan detail.	

Accuracy (or Geometric Accuracy)

There are three measures of accuracy that can be applied to a mapped feature:

- Accuracy of Shape (Geometric Fidelity)
- Relative Accuracy
- Absolute (Positional) Accuracy

Accuracy of Shape

The accuracy of feature representation depends on the scale of capture; its associated limitations and if any degree of generalisation has been used. The principle of accuracy of shape is ‘that any real world alignment must be accurately replicated in Land-Line’, for example:

- Features that are square, rectangular or straight in the real world must be square, rectangular or straight in Land-Line;
- Adjacent features must be correctly separated, orientated and aligned to each other;
- Subject to established tolerances and the limitations of the source survey scale, there should be no discrepancy between the measured and scaled distances between any two (well-defined) adjacent features.

Relative Accuracy

Relative accuracy is a measure of the positional accuracy of a data point in relation to other local points of detail, (see Table below). OS is continually sampling data and testing the accuracy of well-defined points of detail. Random samples are taken in different geographical areas for the various source survey scales and survey methods.

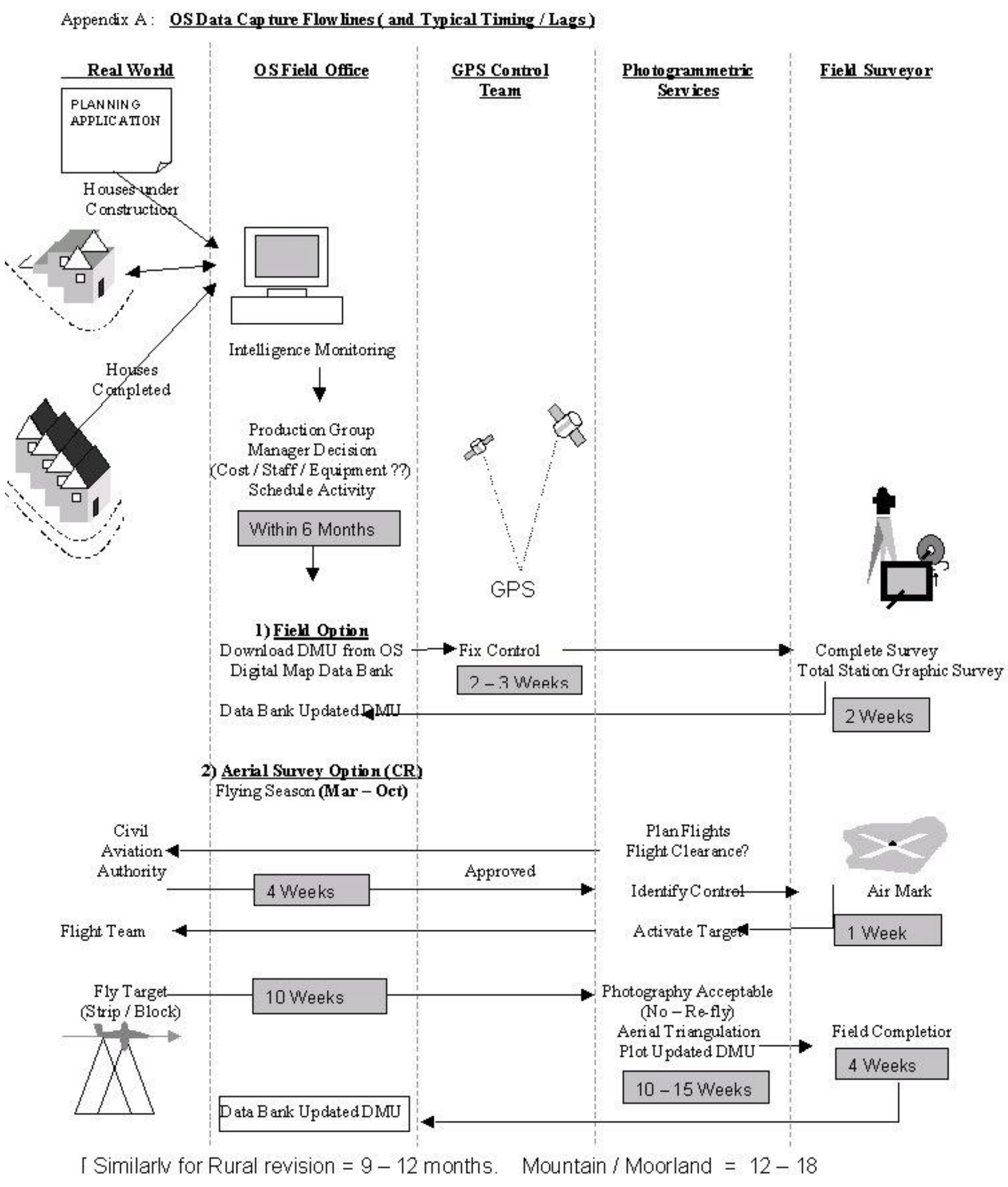
Absolute Accuracy

This is a measure of the positional accuracy of a point of detail compared to its ‘true’ national grid position and is determined by precise surveying techniques.

	Absolute accuracy, that is, compared to the National Grid [Root-mean-square error]	*Relative accuracy, that is, distances between points taken from the map [Expected standard error]*
Urban	<± 0.5 m	<± 0.4 m
Rural	* Either <± 1.1 or <± 2.8 m	* Either <± 0.9 or <± 1.2 m
Moorland	<± 4.1 m	<± 3.5 m

* Accuracy depends on survey methods used.

15.6.7 OS Data Capture Flow Lines (and typical timings)



DIGITAL MAPPING

Ordnance Survey first began making digital maps in 1971. At first, digital technology was used as a production tool for making traditional maps on paper. Increasingly, the digital data from which these maps have been made has found a market of its own, with the increase in demand the digitising process was accelerated and completed in 1995.

A digital map may be defined simply as a map in computer readable form. Conventional map detail (lines, points and text) is represented as strings of co-ordinates and is recorded on magnetic media. Once converted into this digital format, digital map data is suitable for use in a variety of applications.

A digital map can be displayed on a computer screen, merged with other graphical data, or plotted onto paper, film etc. It may be displayed or plotted at a wide range of scales and individual feature codes (layers) may be distinctively coloured or omitted, to customise plots and screen views.

OS DIGITAL MAP DATA PRODUCTS

Due to the many different users and their diverse needs of digital mapping the O.S. provide mapping data to its customers in varying formats and products. Some of the products produced by the O.S. are-

Land-line	Large scale topographical data.
Meridian	Mid scale vector digital map data.
Strategi	1/2500000 scale vector digital map.
Superplan data	Site centred large scale data
Base Data GB	1/625000 scale vector digital map

as well as map data the OS produce other products which can be used in conjunction with the map data for instance

Address point	Digitally coordinated postal address data.
Land-Form PANORAMA	1/50000 scale digital height data
Land-Form PROFILE	1/10000 scale digital height data

We in the Agency need only concern ourselves with the large scale digital Map data family known as the “Land-Line Data” product.

LAND-LINE DATA PRODUCT - is Ordnance Survey’s established series of authoritative large-scale maps in computer readable vector form.

BASIC PRINCIPLES

The basic principles of Land-line as stated by the Ordnance Survey are:-

- Land-Line views the real world as series of point, line and text ‘features’ making up a digital map.
- Each ‘feature’ has associated geometry; this may be a single point for a symbol representing a Mile Post alongside a road, or two pairs of co-ordinates, representing each end of a straight fence.
- Each feature is a free standing entity, the data contains no pointers to logically connect or relate any feature to any other feature.
- Each ‘feature’ is classified by means of a feature code (FC). e.g. a building outline is distinguished from a fence by the feature code assigned to each feature. These feature codes are allocated as the data is captured and interpreted from the source information. A building outline will be distinguished from a wall or fence and other kinds of features by the feature code assigned to it.

Real world features included in Land-line are classified into thirty feature codes, 22 of which are shown on the **Features** window on the DMS Drawing Tool, and six text categories which are also included in the Features window.

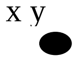
BASIC PRINCIPLES - EXPLAINED

Land-Line views areas of ground as a series of point, line and text **features** making up a digital map.

Features are made up of **X** and **Y** co-ordinates. All co-ordinates used in land line are 2 dimensional and are based on the Ordnance Survey national grid referencing system
i.e. Easting and northings

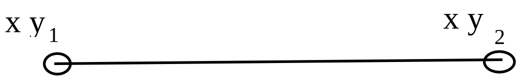
A **feature** could be -

(a) a single point for a symbol representing a mile post alongside a road.

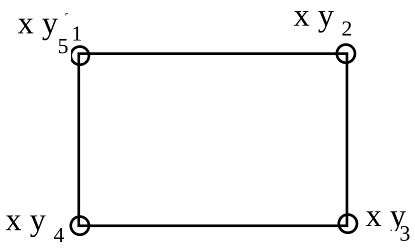


This single **feature** would have only one **X** and **Y** co-ordinate

(b) two sets of X and Y co-ordinates representing each end of the fence

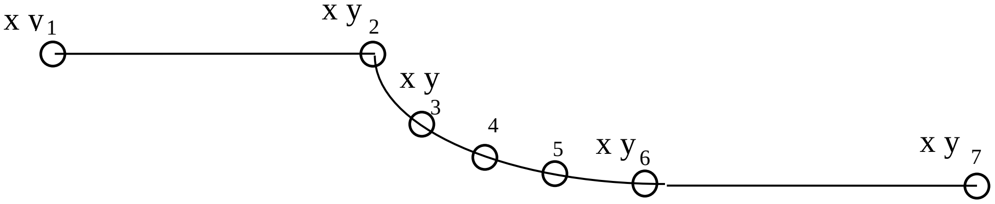


(c) or a string of **X** and **Y** co-ordinates representing say a rectangular house.



In a string of co-ordinates where the feature to be depicted is a polygon the last XY co-ordinate is the same as the first. The software has to be given instructions on where to draw the last line.

Curved features are established by digitising intermediate points along the regular arcs which make up any curve. If these curved features are joined to a straight line section then they will become part of them and are not isolated.



These **x** and **y** co-ordinates are called **Vector Points**

FEATURE CODES

Each **feature** is in turn classified by means of a Feature code (FC). These feature codes are allocated as the data is captured and interpreted from the source information.
E.g. a building outline is distinguished from a fence by the feature code assigned to each **feature**.

<u>MAINTENANCE SERVICE</u>

The Agency currently rents map data from the OS on an annual basis. This arrangement also includes a maintenance service which provides us with up to date replacement digital map files to reflect any physical change.

As development takes place on the ground it is surveyed and digitised. The extent of the change is measured in “Units of Change”. One unit is a house and its fences, or an equivalent amount of change reckoned in length of road, area of industrial buildings etc. When sufficient change has occurred on a map, the updated digital map file is supplied under the maintenance service.

OS allow customers to tailor this service to accommodate their own specific needs by specifying the “Update Threshold” and “Update Supply Interval” required.

- The “Update Threshold” specifies the number of “Units of Change” that can accrue on a map file before a new version of the map is re-supplied.
- The “Update Supply Interval” specifies the frequency of delivery of updated information.

Our current contract provides for a standard maintenance service which re-supplies us with new map files on a monthly basis after twenty units of change have accrued. The OS administer this service and review any change through utilising the house unit count for each map file.

ACCURACY AND THE O.S. MAP

A whole range of answers can be given to the simple question “How accurate is the map?” The varying attributes of Ordnance Survey maps are influenced by the surveying and production processes, by the projection employed for the national surveys as a whole, as well as by the detailed specifications for individual map series.

Absolute or Positional Accuracy

This is a measure which compares how closely the coordinates of a point in the National Grid agree with the ‘real’ coordinates of the same point on the ground.

Relative Accuracy

Compares the scaled distance between features (measured on the map) with the true distance. In general, relative accuracy is more important to map users than the positional.

Relative accuracy is normally expressed as a constant plus an amount proportional to the distance measured. The constant is related to survey practice- the accuracy of which measurements are taken and detail plotted.

The Accuracy of Shape

Is the one measure that represents the generalisation of mapping (for example whether a wall is represented by one line or two) How Features are generalised is a function of the survey and map specification. No statistic can be published

The figures given relate to well defined points - such as fence junctions or building corners. Clearly less well defined detail, such as hedges, vegetation boundaries and river banks will be less accurate.

The O.S. carry out tests to determine how accurate the map is and if the result is unacceptable corrective action of either resurveying or changing the processes used will be taken. However on anyone map sheet, different techniques may have been used to collect the detail thereon and so the accuracy may not be uniform.

If maps are printed, the process used upon which the map is printed can contribute significantly to the error. Paper is affected by humidity and temperature and most copiers (including microfilm processes) introduce distortions.

The following figures are given for guidance and relate to what O.S. know as "basic scale" information - i.e. the actual scale of survey for any given area. Accuracy factors for products derived from the basic scales will depend on the origin scale and the process used.

1:1250 scale maps and data

1:1250 scale maps and the data derived from them have all been created using instrumental control and as a result the geometric accuracy is high and consistent.

The relative accuracy can be taken as 0.2m. ±0.5% of the measured distance. In other words a true distance of 100m could be represented by a distance between 99.3m to 100.7m.

1:2500 scale maps and data

The 1:2500 scale mapping has been produced over time in a number of different ways that have resulted in different accuracy within the series.

Relative accuracy in most cases would be 0.5m ±1% of the measured distance. In other words a 100m line would be represented as being between 98.5m and 101.5m.

1:10000 scale maps and data

As for the 1:2500 scale mapping, 1:10000 scale maps and their data have been produced by a number of different processes. However, more generalisation has been carried out at this scale.
For this reason the relative error can be expected to be a maximum of 8m over any distance.