Hedge Reference Layer Agreement

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This Agreement is made between:

(1) Ordnance Survey Limited, a company registered in England and Wales (company registration number 09121572) whose registered address is at Explorer House, Adanac Drive, SOUTHAMPTON, SO16 0AS (**OS**); and

(2) The Secretary of State for Environment, Food and Rural Affairs acting through the Rural Payments Agency whose principal place of business is at North Gate House, 21-23 Valpy Street, Reading, RG1 1AF (**Customer**).

Background:

A OS is the national mapping agency of Great Britain. OS licenses a range of mapping products to businesses, local and central government bodies, and consumers subject to Crown copyright.

B Customer is an executive agency of the Department for Environment, Food and Rural Affairs (Defra), and is the paying agency for the EU's Common Agricultural Policy schemes in England, and any replacement or successor scheme for the UK, following the UK's withdrawal from the EU (**CAP**).

C As part of its role in administering the CAP, the Customer requires information on the size and location of Hedges.

D This Agreement governs the terms on which OS licenses the Hedge Reference Layer to the Customer.

Agreed Terms:

1 Definitions & interpretations

1.1 The definitions and rules of interpretation in this Clause apply in this Agreement.

Expression	Meaning
Agreement	means this agreement including its schedules.
Annual Fee	means £245,000.00, adjusted in accordance with Clause 5.1.2.
Commencement Date	means 1 January 2021.
Confidential Information	means any information that is marked or identified as confidential, or that would reasonably be considered to be confidential in nature, that relates to the affairs of a Party and is acquired by the other Party in anticipation of or as a result of this Agreement.
Consumer Prices Index	means the Consumer Prices Index as published by the Office for National Statistics from time to time, or failing such publication, such other index as the parties may agree most closely resembles such index.
Contract Year	means a period of 12 months (or such shorter period if this Agreement is terminated earlier), commencing on the Commencement Date and each anniversary of the Commencement Date.
Defra	means the Department for Environment, Food and Rural Affairs whose principal place of business is at Seacole Building, 2 Marsham Street, London, SW1P 4DF.
Defra Network	means all Crown bodies sponsored by Defra (including, but not limited to, Executive Agencies and Non-Departmental Public Bodies).
EIR	means the *Environmental Information Regulations 2004*.
FOIA	means the *Freedom of Information Act 2000*.
Forestry England	means the government executive agency responsible for the protection and expansion of the woods and forests of England and Scotland, whose principal place of business is 620 Bristol Business Park, Coldharbour Lane, Bristol, BS16 1EJ.
Hedge Reference Layer	means the product known as the Hedge Reference Layer, licensed by OS to the Customer in accordance with this Agreement, as updated from time to time in accordance with the Product Specification.
IPR	means copyright, patents, trademarks, design rights, database rights, trade secrets, know how, rights of confidence and all other similar rights anywhere in the world whether or not registered and including applications for registration of any of them.
Land Management System	means the GIS system known as the Land Management System on which Defra will digest the Hedge Reference Layer.
Natural England	means the government's adviser on the natural environment, whose principal place of business is at 4th Floor, Foss House, Kings Pool, 1-2 Peasholme Green, York, YO1 7PX.
Product Specification	means the Hedge Reference Layer Product Specification set out at Schedule 1.
PSGA	means the Public Sector Geospatial Agreement, entered into between OS and the Minister for the Cabinet Office acting through the Geospatial Commission on 31 March 2020;
PSGA Member Licence	means the PSGA Member Licence between the relevant public sector organisation and OS, pursuant to the PSGA.
Public Body Licensed Use terms	means the terms set out in Appendix 1 (Licensed Use Public Body) to the PSGA Member Licence, together with the Ancillary Rights (as defined in the PSGA Member Licence), as such terms may be varied or replaced from time to time.
Quarter	means a period of 3 months commencing on 1 January, 1 April, 1 July and 1 October respectively and Quarterly shall be construed accordingly.

Updates means updates, revisions and modifications to the Hedge Reference Layer that OS provides (or provides access to) from time to time, in accordance with the Product Specification.

1.2 In this Agreement, unless the context otherwise requires:

1.2.1 words in the singular include the plural and vice versa; and

1.2.2 references to: a) a Clause are to a clause of these terms and conditions; and b) a statute or statutory provision include any amendment, extension or re-enactment of such statute or provision.

1.3 Clause and schedule headings do not affect the interpretation of this Agreement.

1.4 The Schedules to this Agreement, together with any documents referred to in them, form an integral part of this Agreement and any reference to this Agreement means this Agreement together with the Schedules and all documents referred to in them, and such amendments in writing as may subsequently be agreed between the Parties.

1.5 Reference to the Parties shall be deemed to refer to both OS and the Customer. Reference to a Party shall be deemed to refer to either OS or the Customer as the context so permits.

2 Term

2.1 This Agreement shall be deemed to have commenced on the Commencement Date and shall continue, unless otherwise terminated in accordance with this Agreement, for an initial period of 5 years from the Commencement Date. The Parties may by, mutual written agreement, extend the Agreement for a further 2 years beyond the expiry of the initial period.

2.2 This Agreement shall terminate in the event that the Customer's PSGA Member Licence expires or terminates, and is not immediately replaced with a licence (granting similar licensed use rights for the Customer) for OS MasterMap Topography Layer covering all of England. To be clear, in such a scenario, the Parties will negotiate in good faith the terms (including as to price) under which the Customer will be entitled to use the Hedge Reference Layer.

3 OS Obligations

3.1 OS will maintain, update, and make available to the Customer, the Hedge Reference Layer in accordance with the Product Specification.

3.2 In the event that, in addition to the Hedge Reference Layer, the Customer wishes OS to create, deliver and maintain additional data layers (including for example, single trees and/or stone walls), OS will enter into good faith negotiations with the Customer to amend this Agreement to cover such additional requirement and appropriate fees.

4 Customer Obligations

The Parties acknowledge that

4.1 For each delivery of data, Customer will notify OS within 14 days of receipt should any of the data not conform to the Product Specification. Where no notification of non-conformance is received in accordance with this Clause, the data will be deemed to conform to the Product Specification.

4.2 Customer will provide such reasonable assistance (including timely responses to all questions raised) as is requested by OS to enable OS to maintain, update and make available to the Customer the Hedge Reference Layer.

5 Payment

5.1 Customer shall pay to OS the Annual Fee, for the maintenance, update and licensing of the Hedge Reference Layer, on 1 January 2021 and then on 1 January for each subsequent year.

5.2 The Annual Fee shall be increased on an annual basis, with effect from each anniversary of the Commencement Date, in line with the percentage increase in the Consumer Prices Index in the preceding 12 month period. The first such increase shall take effect at the beginning of the second Contract Year, and shall be based on the latest available figure for the percentage increase in the Consumer Prices Index published for the 12 month period at the beginning of the last month of the previous Contract Year (the **CPI Percentage**). Accordingly, the Annual Fee for each Contract Year will be determined by increasing the Annual Fee for the previous Contract Year by the applicable CPI Percentage.

5.3 The Annual Fee shall be payable within thirty (30) days of submission of an invoice by OS and is exclusive of VAT, which will be payable in addition at the applicable rate.

6 Licensing and IPR

6.1 Customer acknowledges that OS, and / or its licensor the Crown, will own all or any copyright and database right (and any other IPR) that may subsist in the Hedge Reference Layer (including any Updates), together with any data captured or created in order to create and deliver the Hedge Reference Layer.

6.2 Until the expiry or earlier termination of this Agreement, OS will license the Hedge Reference Layer to the Customer on terms equivalent to the Public Body Licensed Use terms (including any rights to sub-license, e.g. to sub-contractors), as if the Hedge Reference Layer (and any Updates) comprised Licensed Data. The Customer agrees to comply with all relevant obligations and restrictions contained in the PSGA Member Licence (including, to be clear, provisions relating to deletion or destruction of data under clause 9.4 thereof) insofar as they are relevant to the licensing of the Hedge Reference Layer.

6.3 Subject to Clause 6.4, OS agrees that it will license (but not supply) the Hedge Reference Layer to all members of the Defra Network who are party to the use of Defra's Land Management System. Access is currently restricted to the Customer, Defra, Natural England and Forestry Commission, although may be extended to other organisations during the duration of this Agreement.

6.4 The licence from OS referred to in Clause 6.3 is conditional on the relevant organisation (including, for the avoidance of doubt, Defra, Natural England and Forestry Commission):

6.4.1 remaining party to a PSGA Member Licence or a replacement licence (granting similar licensed use rights for OS MasterMap Topography Layer covering all of England),

6.4.2 remaining part of the Department of the Environment, Food and Rural Affairs, and

6.4.3 first having entered into a licence with OS agreeing to comply with relevant obligations and restrictions (which will be broadly similar to the PSGA Member Licence, including any rights to sub-license the Hedge Reference Layer).

6.5 There is no assignment of OS's Intellectual Property Rights. All rights not expressly granted to the Customer under this Agreement are reserved to OS.

7 Profit Sharing

7.1 OS shall pay the Customer a royalty of 50% of the invoiced value (excluding VAT) (**Royalty**) of licensing fees in respect of the Hedge Reference Layer (including any geographic subsets thereof) payable by customers other than the Customer. For the avoidance of doubt, no Royalties shall be payable in relation to:

7.1.1 any licensing fees which relate to period following the expiry or termination of this Agreement; or

7.1.2 of any products created using data contained in, or a subset of the features and/or attributes contained in, the Hedge Reference Layer.

7.2 Following the end of each Quarter, OS shall report to the Customer in respect of invoiced sales of the Hedge Reference Layer in accordance with Clause 7.3 (the **Royalty Report**) and the Customer shall invoice OS for the Royalty payable. The Royalty shall be paid by OS within 30 days of receipt of the Customer's invoice. For the avoidance of doubt, OS will not be obliged to deliver a Royalty Report in relation to a Quarter if there have been no invoiced sales in such Quarter, but shall instead provide a nil return which can be delivered by way of email.

7.3 The Royalty Report shall include:

7.3.1 the Quarter for which the Royalties were calculated;

7.3.2 the amount of Royalties due and payable;

7.3.3 the number of new customers OS has signed in the Quarter; and

7.3.4 any other particulars the Customer may reasonably require.

7.4 OS will provide such information as the Customer shall reasonably request to evidence any profit share calculation.

7.5 Where, following termination or expiry of this Agreement, the Customer agrees to continue to license the Hedge Reference Layer, the Parties may negotiate an element of gainshare for the period of the extended licence.

8 Warranties and Liability

8.1 OS shall ensure that the Hedge Reference Layer (and any Update) substantially conforms to the Product Specification. If within 14 days of receipt of the Hedge Reference Layer (or any Update), the Customer finds that the Hedge Reference Layer (or Update) does not so conform and notifies OS in writing, then OS will rectify any problem which exists provided that it has not been caused by any modification, variation or addition not performed or authorised by OS, and has not been caused by any computer software or equipment which is incompatible with the Hedge Reference Layer (or Update). Such supply of substitute data shall be the Customer's sole and exclusive remedy and OS's sole and exclusive liability for supplying Hedge Reference Layer (or Update) data which do not conform to the Product Specification.

8.2 Nothing in this Agreement shall exclude or limit either Party's liability for:

8.2.1 death or personal injury to the extent it results from its negligence, or that of its employees or agents; or

8.2.2 fraud or fraudulent misrepresentation.

8.3 Neither Party will be liable to the other in contract, tort (including negligence) or otherwise for any loss of profits, loss of business or loss of contracts (in each case whether direct or indirect) or for any special, indirect or consequential losses or damages, provided that neither this Clause 8.3 nor any other provision of this Agreement shall prevent OS from recovering from the Customer all amounts lawfully due in respect of all infringements and breaches of Intellectual Property Rights or relating to OS's Confidential Information by the Customer or any other party which has obtained OS data from the Customer.

8.4 Subject to Clauses 8.2 and 8.3, neither Party's total aggregate liability for all claims made (whether in contract, tort (including negligence) or otherwise) under or in connection with this Agreement will at any time exceed the amount of £1,225,000.00.

9 Termination and Expiry

9.1 General termination rights

Either Party may terminate this Agreement at any time by giving the other Party notice in writing if:

9.1.1 the other Party is in material breach of any term of this Agreement and such breach is either incapable of being remedied or is not remedied within 30 days of a written request to do so;

9.1.2 the other Party is in persistent breach of this Agreement; or

9.1.3 the other Party ceases to carry on business (and does not transfer this Agreement in accordance with Clause 10.2).

9.2 Either Party shall be entitled to terminate this Agreement by giving to the other party not less than 6 months' written notice, such notice to expire on an anniversary of the Commencement Date.

9.3 Effects of termination or expiry of this Agreement

In the event of termination or expiry of this Agreement:

9.3.1 any accrued rights and remedies will not be affected; and

9.3.2 the provisions of this Agreement intended to survive termination or expiry shall continue in full force and effect, notwithstanding such termination or expiry.

10 Assignment

10.1 Except as provided in this Agreement, or as otherwise agreed from time to time, neither Party may assign, subcontract or sublicense their rights and obligations under this Agreement without the prior written consent of the other Party, such consent not to be unreasonably withheld.

10.2 Each Party is entitled to assign, transfer, novate, sub-contract or sublicense the benefits and obligations of this Agreement to any government body or nominated subcontractor or, in the event of the transfer of all or any of such Party's activities or functions to any other entity, to the entity to which those activities or functions have been transferred. The other Party agrees to the assumption of those obligations under this Agreement by that entity and, if required, shall enter into an agreement to this effect.

11 Freedom of Information/Environmental Information Regulations

11.1 The Parties shall both during and following expiry or termination of this Agreement use all reasonable endeavours to assist each other in complying with their respective obligations under the FOIA and EIR relating to this Agreement. In particular, where either Party receives a request for information relating to this Agreement pursuant to the FOIA and/or the EIR, such Party will notify the other and, where practicable, take into account the other's views prior to responding to the request.

12 Confidentiality

12.1 The Parties agree:

12.1.1 to use Confidential information of the other only for the purposes of discussions between the Parties relating to this Agreement, and for performing obligations and exercising rights granted under this Agreement;

12.1.2 to keep all Confidential Information secure, and to disclose it only to those persons who need to know such Confidential Information;

12.1.3 to notify the other without delay of any unauthorised use, copying or disclosure of the other's Confidential Information of which it becomes aware and provide all reasonable assistance to the other to stop such unauthorised use, copying and/or disclosure; and

12.1.4 except as required by law or by governmental or regulatory requirements (which, for the avoidance of doubt, shall include any requirements for disclosure under the FOIA and/or the EIR), not to disclose Confidential Information to any third parties unless expressly permitted under this Clause 12 or with the other's prior written consent.

12.2 The obligations in this Clause 12 do not apply to any information which is in the public domain (other than through the breach of any obligation of confidentiality) or which a Party can demonstrate was previously known to it (unless acquired directly from the other Party or in breach of any obligation of confidentiality) or was independently developed by it without the use of any Confidential Information.

13 Entire Agreement

13.1 This Agreement constitutes the whole agreement between the Parties and supersedes any previous arrangement, understanding or agreement between them relating to the subject matter of this Agreement.

14 Variation

14.1 No variation of this Agreement shall be effective unless it is in writing and signed by the Parties (or their authorised representatives).

15 Governance

15.1 The Parties will work together in a collaborative approach to the management of this Agreement.

15.2 The Parties' nominated representatives will meet regularly, to discuss progress of the Agreement, and to raise and discuss how best to resolve any issues which have arisen.

16 Force Majeure

16.1 Neither Party will be responsible for any delay or failure in carrying out obligations under this Agreement if the delay or failure is caused by circumstances beyond the reasonable control of the affected Party. In such circumstances the affected Party will notify the other of any such likelihood as soon as possible. The affected Party shall be allowed a reasonable extension of time to carry out its obligations in these circumstances. In the event that such circumstances materially impact the affected Party's performance of its obligations under this Agreement for a continuous period in excess of 90 days, the non-affected Party shall be entitled to terminate this Agreement by giving notice in writing to the other.

17 Notices

17.1 A notice given to a Party under or in connection with this Agreement shall be in writing (including email, provided that the email is not returned to the sender undelivered) and sent to the Party at the address (or email address) given in this Agreement or as otherwise notified in writing to the other Party.

18 Dispute Resolution

18.1 Both Parties (including their respective technical teams) shall work together in an open and transparent manner to achieve the objectives of this Agreement.

18.2 The Parties agree to use all reasonable endeavours to settle any disputes by discussion between them.

18.3 If there is any dispute relating to the terms of this Agreement the same shall be referred to a Director of OS and either a Director or the Head of Commercial of the Customer.

19 Legal Status

19.1 This Agreement will be governed by and construed in accordance with English law and the Parties submit to the exclusive jurisdiction of the courts of England and Wales.

20 Signing

Signed for and on behalf of **Ordnance Survey Limited**

[redacted]

Signature .....

Name .....

Title .....

Date .....

Having read and understood this Agreement signed for and on behalf of **Rural Payments Agency**

[redacted]

Signature .....

Name .....

Title .....

Date .....

[redacted]

Schedule 1 Product Specification

Department for Environment Food & Rural Affairs

Hedge Reference Layer

Landscape Features Reference Layer Product Specification

Date: November 2020

APPROVED

Contents

1 Document Control – Intentionally Blank

2 Introduction

2.1 Purpose

This document defines the product specification for the Landscape Feature (LF) Reference Layer being delivered by the Ordnance Survey (OS).

The LF Reference Layer is a dataset that represents landscape features captured using remote sensing techniques. The purpose of this specification is to define that representation plus the technical details for the reference dataset structure, data format and delivery.

This document does not define the data capture method and data capture rules, neither does it define all the business rules applied when using the reference dataset for claim control and administration within RPA's IT systems.

The specification will provide the CAP Delivery Programme with the detail needed to design the ingestion, usage and maintenance of the LF Reference Layer within Rural Payments.

2.2 LF Scope

The LF Reference Layer dataset is to cover the area of England, and within that only features covered by the land parcels within RPA's Land Management System (LMS) are required. The LMS is subject to continual revision by the RPA.

RPA will supply an annual refresh of the LMS[1] to Ordnance Survey in July. This refresh may contain extensions and subtractions to the LMS. The Reference Layer will then be expanded into any additional LMS areas as and when suitable imagery is available. Areas removed due to subtractions from the LMS will be deleted from the Reference Layer at the next update of the LF Reference Layer.

This document details the current requirements for topographic features bounding or within rural land and is designed to accommodate future RPA requirements with the minimum of changes.

2.3 Document Ownership and Distribution

This document is owned by the GI Technical Team within the RPA Design Directorate. The document is for use by RPA staff and third-party suppliers. The document, or any part of it, must not be supplied or communicated to any individual or organisation without the prior written permission of the owner.

[1] This data set will come from the LMS table LMS_OWNER_REFERENCE_PARCELS

2.4 Assumptions, Dependencies and Constraints

The document describes the derivation of a technical geospatial data product. It is not written for the layman and thus assumes that users of this document are knowledgeable in:

- Geographic Information Systems
- Topographic mapping
- Earth Observation concepts

3 Data Creation

3.1 Feature Classification

The sources for feature classification are four band (RGB and near-infrared) aerial imagery, digital surface models (DSM) and digital terrain models (DTM), as well as OS MasterMap Topography Layer topographic lines. This data is processed using object-based image analysis software to derive an automatic classification of the underlying topographic line features by landscape feature type.

In simple terms the process for creating an LF Reference Layer is shown in the following diagram:

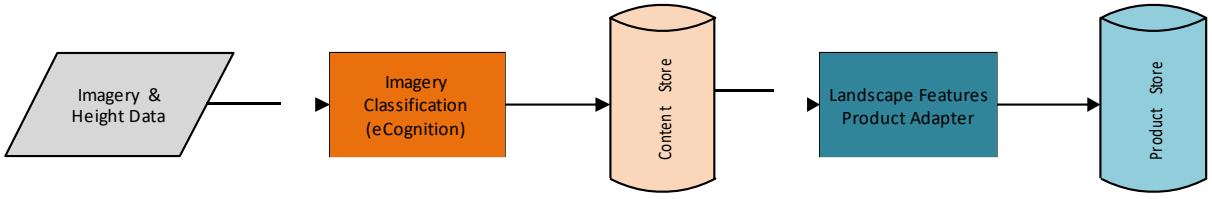


Figure 1 Overview of LF Reference Layer Creation

3.2 Geometry

The Reference Layer will only deliver features that are coincident with a defined subset of relevant OS MasterMap® Topography Layer topographic line features (Annex C). All the required landscape features that are coincident with these line features will be delivered.

As a result of the feature classification, the topographic line geometry is broken up (where applicable) into the required landscape feature types. The geometry supplied in the LF Reference Layer is coincident with the underlying topographic line.

3.3 Attributes

In the extraction and creation of the LF Reference Layer, attribution is generated from the associated parent topographic line and from the feature classification process.

4 Reference Layer Features

4.1 Representation

The initial focus of the LF Layer is hedges and so the features delivered will be represented by polylines. A polyline is an ordered set of points that are interpolated linearly. A polyline must not intersect itself or contain repeated points.

All reference Landscape Features will be classified against the underlying OS MasterMap® Topography Layer topographic line feature type. Within the OS MasterMap® Topography Layer these topographic line features, represent topographic information and inferred topographic area boundaries such as polygon closing links – a subset of obstructing features is used to identify landscape features that meet the LF Reference Layer requirement. The criteria for selection is included in Annex C – Obstructing, Woodland and Boundary Features.

The guiding principle is that the OS MasterMap Topography Layer topographic lines will have been updated from the imagery used to identify landscape features before those features are classified. However, it is recognised that to ensure that as much data as possible can be delivered in the LF Reference Layer, in some instances imagery will be used in advance of the Topo update programme when completing areas missing from the initial supply.

The feature derivation process generates line segments associated to topographic line segments and is not related to any polygon delivery. Figure 2 shows an example of imagery overlaid with the MasterMap topographic line. Figure 3 shows how the topographic line has been classified into hedge and wooded strip features.

The following rules will be applied to each parent topographic line in isolation in order to derive the features to be delivered rather than considering merged topographic line features. Where the geometry of a topographic line is wholly classified as a suitable landscape feature then the entirety of the topographic line will be supplied (there is no minimum length of topographic line that may be supplied if it is part of a landscape feature).

Figure 2 Example of aerial imagery showing Topographic Line depicting a landscape feature

Figure 3 Example of topographic line classified as Hedge (light green) and Wooded Strip (dark green)

4.2 Landscape Features Derivation Rules

4.2.1 Measurement of Features

All measurements referred to in the landscape feature derivation rules below refer to the measurements of the coincidence of the landscape feature identified from remote sensing and the length of the alignment along an underlying OS MasterMap topographic line.

4.2.2 Hedges

Hedges are defined as a row of shrubs which may also contain trees where the continuous canopy length of the trees is less than 50.0 metres and identified as associated with an OS MasterMap Topography Layer topographic line.

Hedge features will rarely have an average height above 3.5 metres. Above 3.5 metres features will generally be identified as tree canopy.

A hedge feature must be a minimum of 4.0 metres in length, unless the parent cross-referenced topographic line is wholly attributed as a hedge, in which case the feature will be the same length as the topographic line even if that is less than 4.0 metres.

When forming part of the topographic line the minimum feature length is 4.0 metres.
Individual trees and sections of tree canopy under 5om in length within a hedge feature (i.e. touching the feature) will not be delivered as separate features and will be included / fused in the hedge feature.

There is no minimum height for a hedge feature, however, features below 1m in height will not generally be depicted in the output due to the limitation of the data capture process.

There is no minimum width for a hedge feature, however, features below 1m in width will not generally be depicted in the output due to the limitation of the data capture process.

There is no maximum width for a hedge feature

Any gaps of less than 5.0 metres are ignored and subsumed into the hedge feature.

4.2.3 Wooded Strip

A Wooded Strip is defined as a continuous row of vegetation canopy, generally with an average height above 3.5 metres, with a length of 50.0 metres or more and identified as associated with an OS MasterMap Topography Layer topographic line.

Any gaps of less than 5.0 metres are ignored and subsumed into the wooded strip feature

4.2.4 Tree Canopy

Tree Canopy is defined as instances of vegetation canopy, generally with an average height above 3.5 metres, not adjacent or touching a hedge feature, with a canopy length equal to or greater than 4.0 metres and less than 50.0 metres, and identified as associated with an OS MasterMap Topography Layer topographic line.

Any gaps of less than 2.0 metres are ignored and subsumed into the tree canopy feature.

4.2.5 Woodland Boundary

A Woodland Boundary is defined as a Landscape Feature that is adjacent to an area of woodland and identified as associated with an OS MasterMap Topography Layer topographic line.

Woodland areas are identified using OS MasterMap Topography Layer topographic areas with the attribution of:

Theme = Land;

Descriptive Group = Natural Environment;

Descriptive Term contains "Nonconiferous Trees" and/or "Coniferous Trees , and there are no other Descriptive Terms listed except for "Scrub"..

Topographic areas containing attribution of "Nonconiferous Trees (Scattered)" and/or "Coniferous Trees (Scattered)" are not considered to be woodland areas nor are any other areas of vegetation such as Orchard.

Features that are adjacent on one or both sides to an area of woodland will have the function attribute set to "Woodland Boundary". Identification of the correct form for these features is difficult as in most cases they will be covered by overhanging tree canopy. Therefore to improve overall accuracy they are always given a form attribute of "Wooded Strip" or "Tree Canopy" and are not given the form of "Hedge".

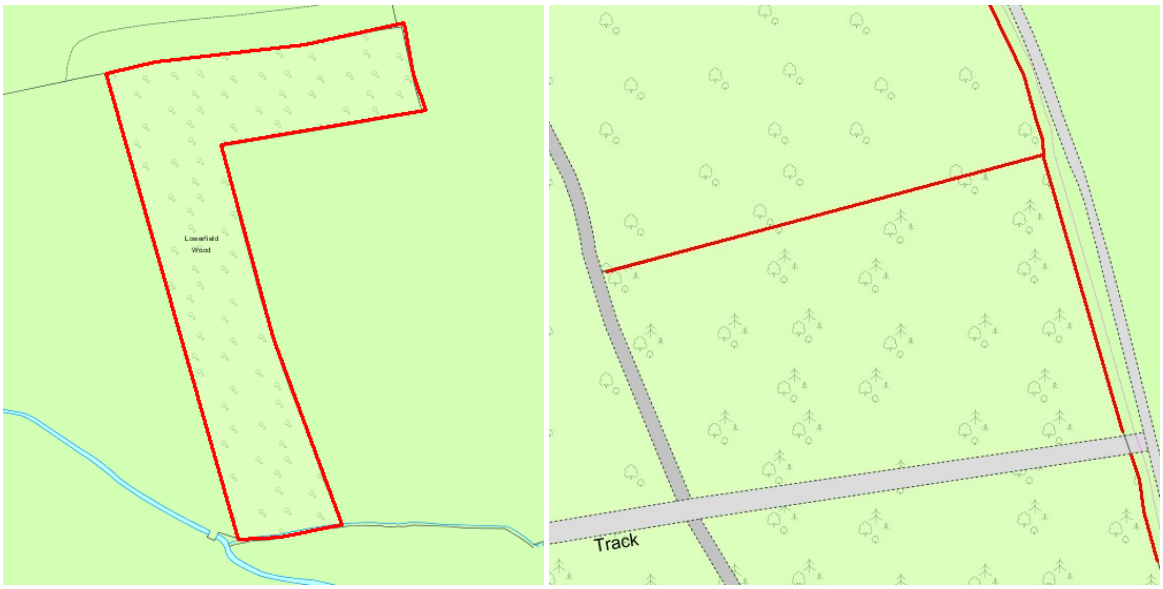


Figure 4 Examples of topographic line features (shown in red) that would be given the additional descriptive term of 'Woodland Boundary'

4.2.6 Gaps in Linear Landscape Features

Gaps in Hedge and Wooded Strip features are recognised as a gap when they are 5.0 metres or more in length. This figure was chosen as being well below the 20.0 metre maximum allowed under the Cross Compliance definition of hedges agreed with the Commission as suitable for this purpose but sufficiently large as not to require excessive data refreshing due to minor changes.

Gaps in Tree Canopy are recognised as a gap when they are 2.0 metres or more in length[2].

Below these minimum dimensions the 'gap' is fused into the adjacent feature following the rules in the table below.

Recognised gaps will be represented in the LF Reference Layer by the absence of a polyline in order to minimise data volumes.

There is a hierarchy of features that is used when determining how gaps between landscape features are processed, and when hedge features take precedence over tree canopy.

The Stage 1 Fusing occurs before the features are subsequently classified in to the appropriate LF Reference Layer type (e.g. "Hedge", "Tree Canopy" or "Wooded Strip") as determined in the decision tree below. The terms of "Hedge" and "Canopy" used in Table 1 Stage 1 Fusing Rules apply to the Content Store classification of features.

Gaps less than 2.0m are fused in Stage 1 of the generalisation process (as below);

Hedge	Gap < 2.0m	Hedge	→	Hedge	Hedge	Hedge
Hedge	Gap < 2.0m	Canopy	→	Hedge	Hedge	Canopy
Canopy	Gap < 2.0m	Hedge	→	Canopy	Hedge	Hedge
Canopy	Gap < 2.0m	Canopy	→	Canopy	Canopy	Canopy

Table 1 Stage 1 Fusing Rules

After features have been classified, the second stage of the generalisation process is to identify and fuse remaining gaps dependent upon the landscape feature classification (see below);

Hedge	Gap < 5.0m	Hedge	→	Hedge	Hedge	Hedge
Hedge	Gap >= 5.0m	Hedge	→	Hedge	Gap	Hedge
Wooded Strip	Gap < 5.0m	Wooded Strip	→	Wooded Strip	Wooded Strip	Wood Strip
Wooded Strip	Gap >= 5.0m	Wooded Strip	→	Wooded Strip	Gap	Wood Strip
Wooded Strip	Gap < 5.0m	Hedge	→	Wooded Strip	Hedge	Hedge
Wooded Strip	Gap >= 5.0m	Hedge	→	Wooded Strip	Gap	Hedge

[2] The reason this gap size differs from other features is to enable the feature type of 'Trees in Line' to be derived by the RPA when creating a Control Layer based on the Reference Layer. The definition of Trees in a Line is 'a line of trees with crown diameters of a minimum of 4.0m and where the gaps between tree crowns does not exceed 5.0m'.

Tree Canopy	Remaining gaps any size	Tree Canopy	→	Tree Canopy	Gap retained	Tree Canopy
Tree Canopy	Remaining gaps any size	Hedge	→	Tree Canopy	Gap retained	Hedge
Tree Canopy	Remaining gaps any size	Wooded Strip	→	Tree Canopy	Gap retained	Wooded Strip

Table 2 Stage 2 Fusing Rules

4.2.7 LF Reference Layer Feature Type Derivation Decision Tree

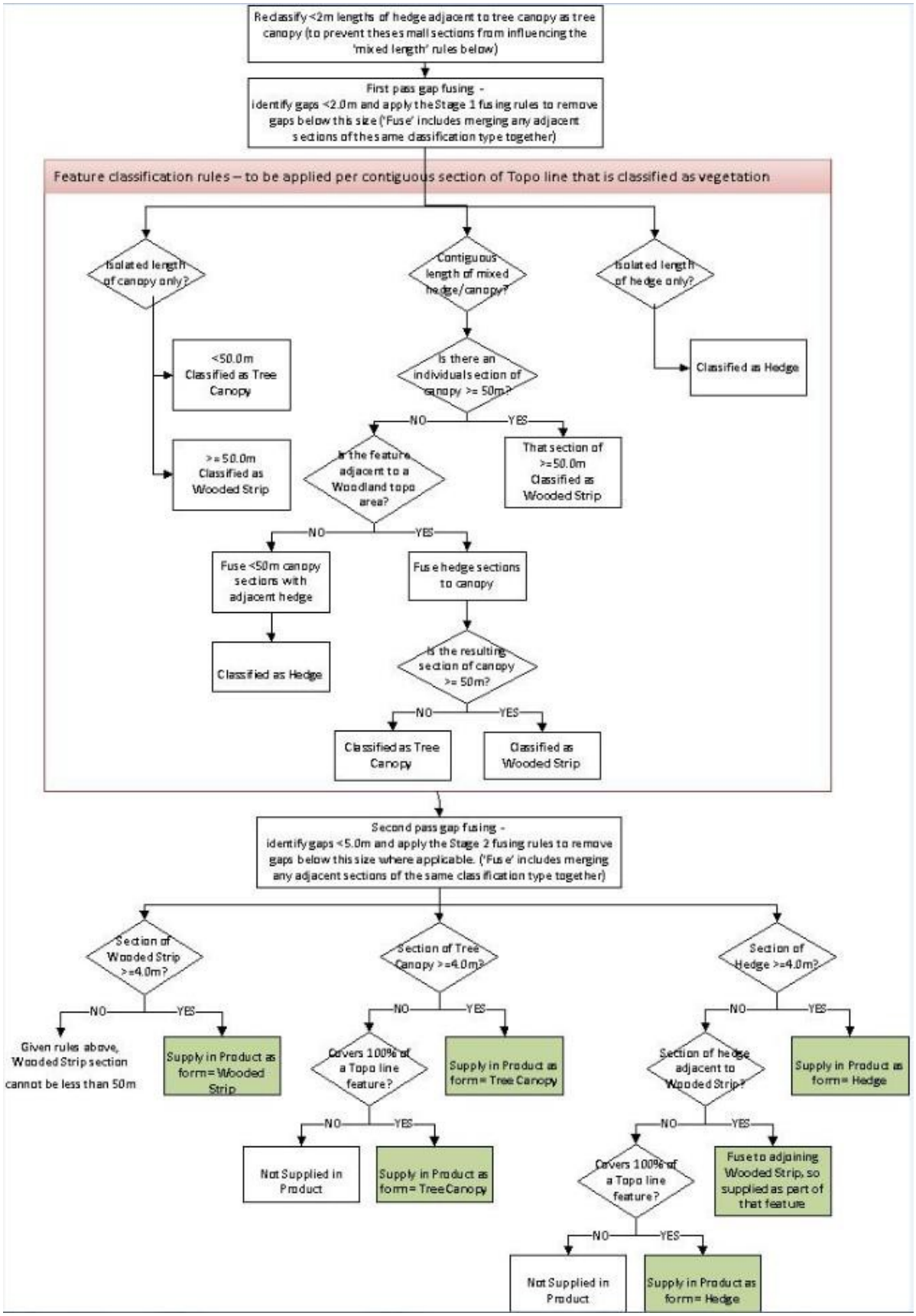
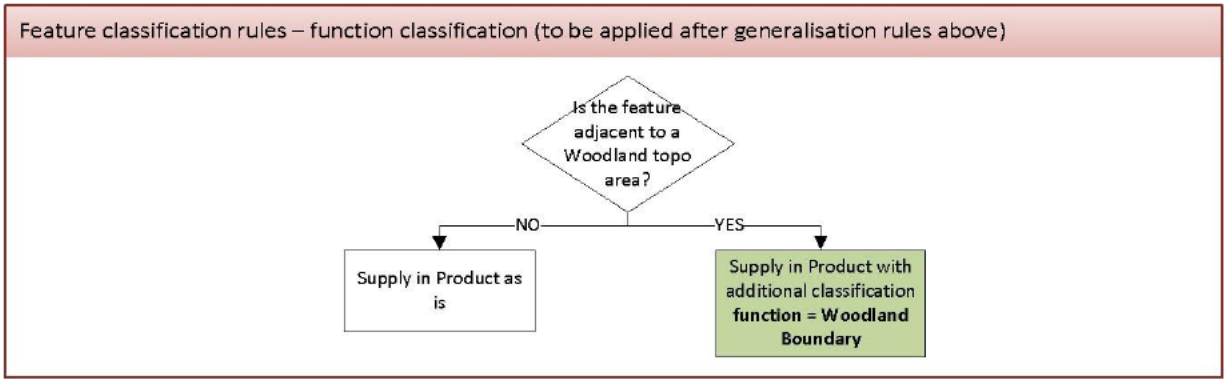

Reclassify <2m lengths of hedge adjacent to tree canopy as tree canopy (to prevent theses mall sections from influencing the 'mixed length' rules below)
First pass gap fusing - identify gaps <2.0m and apply the Stage 1 fusing rules to remove gaps below this size ('Fuse' includes merging any adjacent sections of the same classification type together)
Feature classification rules – to be applied per contiguous section of Topo line that is classified as vegetation
Isolated length of canopy only?
Contiguous length of mixed hedge/canopy?
Isolated length of hedge only?
<50.0m Classified as Tree Canopy
>=50.0m Classified as Wooded Strip
Is there an individual section of canopy >= 50m?
Classified as Hedge
NO
YES
Is the feature adjacent to a Woodland topo area?
That section of >=50.0m Classified as Wooded Strip
NO
YES
Fuse <50m canopy sections with adjacent hedge
Fuse hedge sections to canopy
Classified as Hedge
Is the resulting section of canopy >= 50m?
NO
YES
Classified as Tree Canopy
Classified as Wooded Strip
Second pass gap fusing - identify gaps <5.0m and apply the Stage 2 fusing rules to remove gaps below this size where applicable. ('Fuse' includes merging any adjacent sections of the same classification type together)
Section of Wooded Strip >=4.0m?
Section of Tree Canopy >=4.0m?
Section of Hedge >=4.0m?
NO
YES
Given rules above, Wooded Strip section cannot be less than 50m
Supply in Product as form= Wooded Strip
Covers 100% of a Topo line feature?
Supply in Product as form= Tree Canopy
Section of hedge adjacent to Wooded Strip?
Supply in Product as form= Hedge
Not Supplied in Product
Supply in Product as form= Tree Canopy
Covers 100% of a Topo line feature?
Fuse to adjoining Wooded Strip, so supplied as part of that feature
Not Supplied in Product
Supply in Product as form= Hedge

Figure 5 Decision tree showing logic of feature types

4.2.8 Woodland Boundary Classification Decision Tree



4.3 Positional Accuracy

The LF Reference Layer dataset will inherit the positional accuracy of the underlying topographic features from OS MasterMap Topography Layer.

Accuracy is defined in three ways:

Absolute accuracy – how closely the coordinates of a point in the dataset agree with the coordinates of the same point on the ground (in the British National Grid reference system).

Relative accuracy – positional consistency of a data point or feature in relation to other local data points or features within the same or another reference dataset.

Geometric fidelity – the 'trueness' of features to the shapes and alignments of the objects they represent - when testing the data according to the dataset specification against the 'real world' or reference dataset.

The following table represents the absolute and relative accuracy applicable to the scale at which the source product was surveyed.

Original Survey scale	99% confidence level	95% confidence level	RMSE[3]
1:1250			
Absolute Accuracy	0.9 m	0.8 m	0.5 m
Relative Accuracy	+/- 1.1 m (up to 60 m)	+/- 0.9 m (up to 60 m)	+/- 0.5 m (up to 60 m)
1:2500			
Absolute Accuracy	2.4 m	1.9 m	1.1 m
Relative Accuracy	+/- 2.5 m (up to 100 m)	+/- 1.9 m (up to 100 m)	+/- 1.0 (up to 100 m)
1:10 000			
Absolute Accuracy	8.8 m	7.1 m	4.1 m

[3] RMSE (root mean squared error) is the square root of the mean of the squares of the errors between the observations

Relative Accuracy	+/- 10.1 m (up to 500 m)	+/- 7.7 m (up to 500 m)	+/- 4.0 m (up to 500 m)

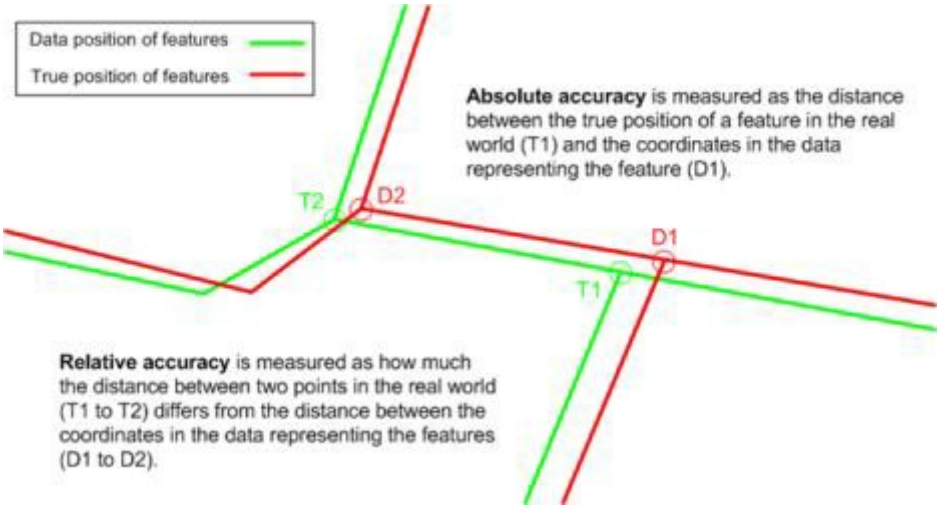


Figure 6 Diagram illustrating absolute and relative accuracy

4.4 Data Examples

The following examples show the application of the feature derivation rules (see section 4.2) on the Content Store (see Figure 1) in order to derive the LF Features to be delivered into the Reference Layer Product Store (see Figure 1).

OS will supply the LF Reference Layer, to which in turn RPA will apply their business rules to generate the LF Control Layer, which will be used to check what the farmer has declared. The RPA business rules for the definition of a hedge for the Hedge Reference Layer scheme is given in Annex A – Business Definition of a Hedge.

The key rules for how features within the Hedges Control Layer are derived from the LF Reference Layer are:

- Ignore gaps of less than 20m between features and fuse the features together
- Recognise features with a minimum length of 20m
- Apply eligibility rules for whether the feature is on or adjacent to arable land.

The following figures are illustrative only and do not provide an exhaustive list of scenarios.

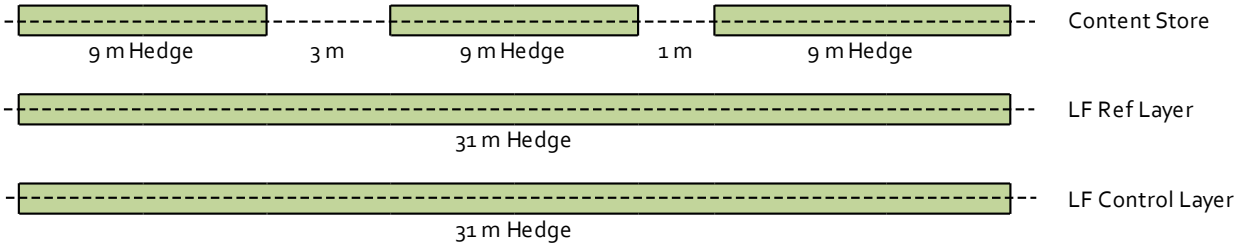


Figure 7 Example of hedgerow feature derivation along a topographic line (dashed line).

Figure 7 shows an example of 3m and 1 m gaps identified in the Content Store that are below the 5.0m minimum to be retained and are merged in to the adjoining hedgerow features for delivery in to the LF Reference Layer.

This data is then delivered into the Control Layer as the hedge feature is greater than 20m.

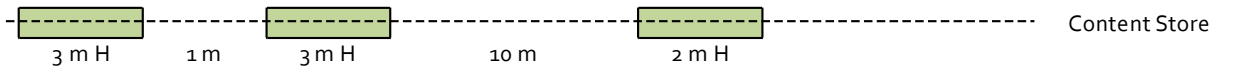


Figure 8 Example of hedgerow feature (H) derivation along a topographic line (dashed line).

Figure 8 shows a 1m gap in the Content Store which is ignored (below minimum gap size of 5.0m and therefore merged with the surrounding hedge features) and results in a 7m section of hedge in the Reference Layer. The 10m gap is larger than the 5m minimum gap size and so is recognised as a gap in the Reference Layer, however the 2m hedge in the Content Store does not meet the minimum size for a hedge feature and so is not delivered in to the Reference Layer.

For the Control Layer the 7m hedge section is below the minimum hedge size of 20m and so is not delivered.

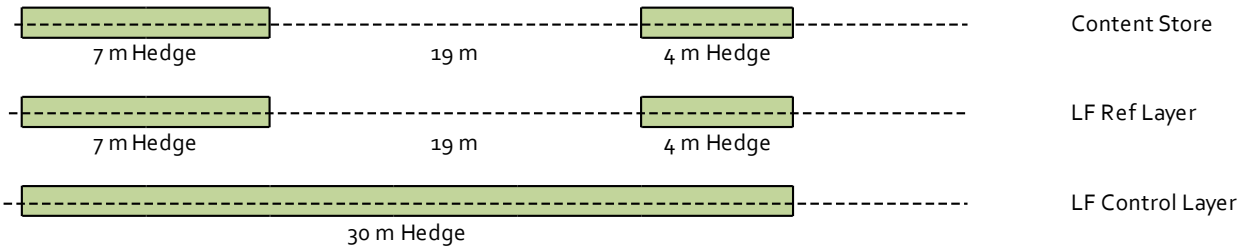


Figure 9 Example of hedgerow feature derivation along a topographic line (dashed line)

Figure 9 shows the 7m and 4m sections of hedge identified in the Content Store as being larger than the 4m feature minimum, and are therefore delivered into the Reference Layer along with the 19m gap.

The Control Layer comprises a 30m feature as the 19m gap is ignored for Control Layer purposes.

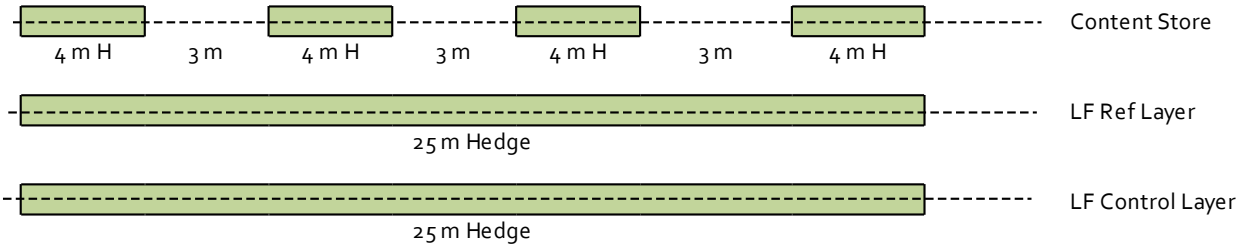


Figure 10 Example of hedgerow feature (H) derivation along a topographic line (dashed line)

Figure 10 shows the gaps in the Content Store are all below the minimum length for a gap to be recognised of 5m, and so the Reference Layer and Control Layer comprise one feature 25m long.

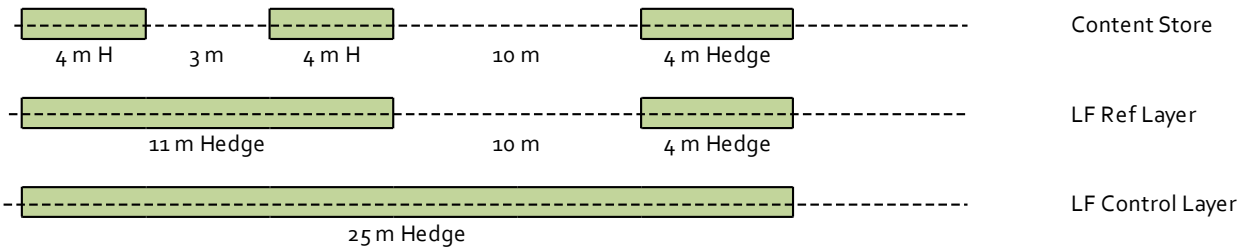


Figure 11 Example of hedgerow feature derivation along a topographic line (dashed line).

Figure 11 shows the 3m gap in the Content Store is below the 5m gap minimum for hedge features and so an 11m hedge feature is delivered to the Reference Layer, along with the 10m gap and 4m hedge feature.

For the Control Layer the 10m gap being less than the 20m maximum is ignored resulting in a feature 25m long.

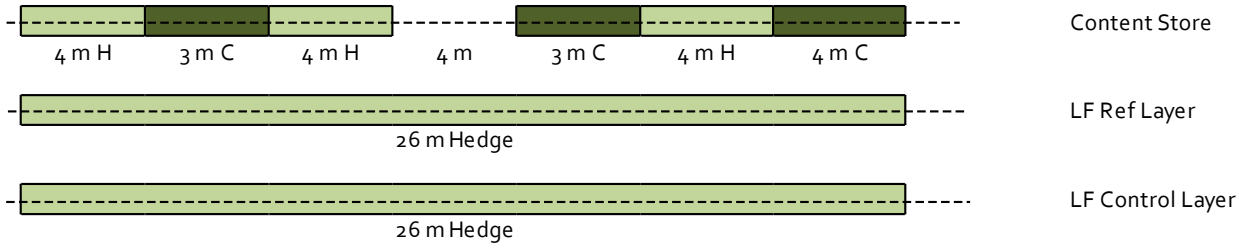


Figure 12 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line)

Figure 12 shows a mixed classification of objects from the Content Store of hedgerow (H) and canopy (C) features. The 3m and 4m sections of canopy adjoin eligible hedge features and are reclassified as a hedge feature and fused with the adjoining 4m sections of hedge –resulting in a 26m hedge feature in the Reference Layer as the gap is below 5m.

For the Control Layer the hedge feature is also 26m.

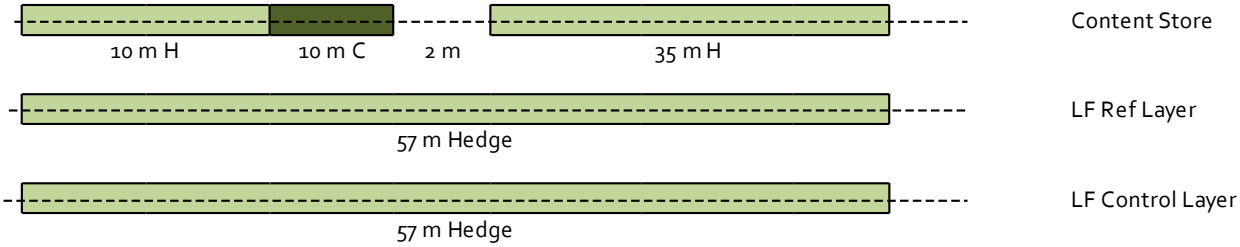


Figure 13 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line)

Figure 13 shows a mixed classification of objects from the Content Store of hedgerow (H) and canopy (C) features. The canopy feature is under 50m and therefore not large enough to be a Wooded Strip and is reclassified as hedgerow.

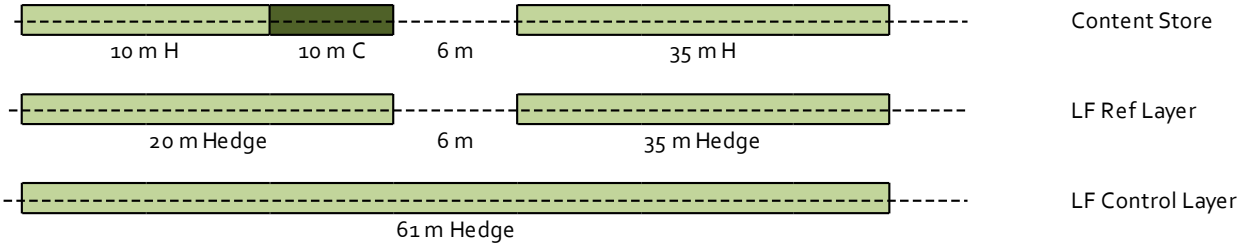


Figure 14 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line)

In Figure 14, the gap is over the minimum of 5m and is therefore retained in the Reference Layer.

In the Control Layer this gap is closed as it is under 20m.

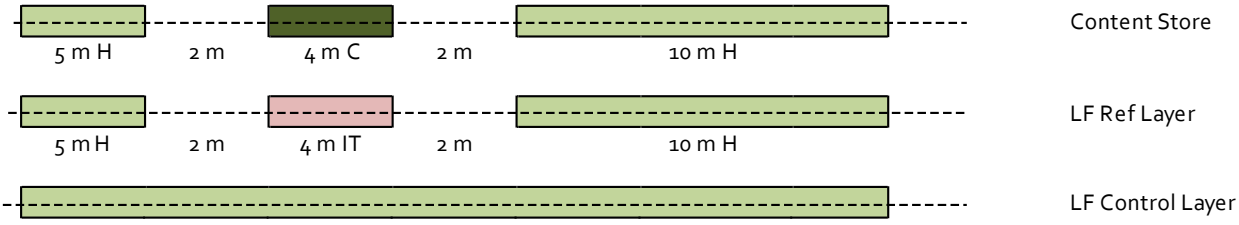


Figure 15 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line) including isolated trees (IT)

Figure 15 shows a mixed classification of objects from the Content Store of hedgerow (H) and canopy (C) features. As there is a 4m canopy object unattached to hedgerow features identified in the Content Store, and the gap between the canopy and hedgerow features is equal to the minimum 2m gap permitted for Tree Canopy, the canopy is classified as Tree Canopy (as it is equal to the minimum size for a Tree Canopy feature) in the Reference Layer and the gaps retained.

In the Control Layer these are merged into the hedgerow feature for payment purposes.

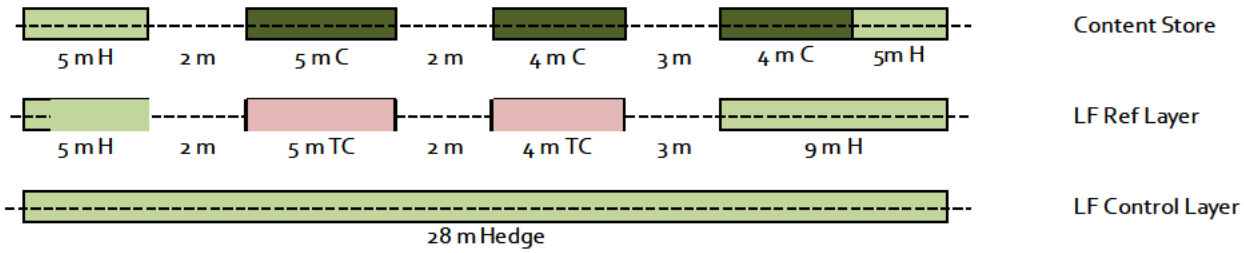


Figure 16 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line) including tree canopy (TC)

Figure 16 shows a similar scenario to Figure 15, but shows the delivery of multiple instances of Tree Canopy in the Reference Layer.

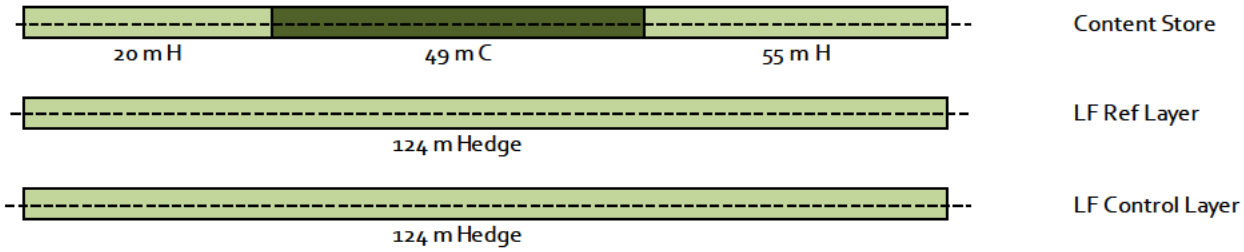


Figure 17 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line)

Figure 17 shows a mixed classification of objects from the Content Store of hedgerow (H) and canopy (C) features. The canopy feature is merged in to the adjoining hedge features and reclassified as hedge.

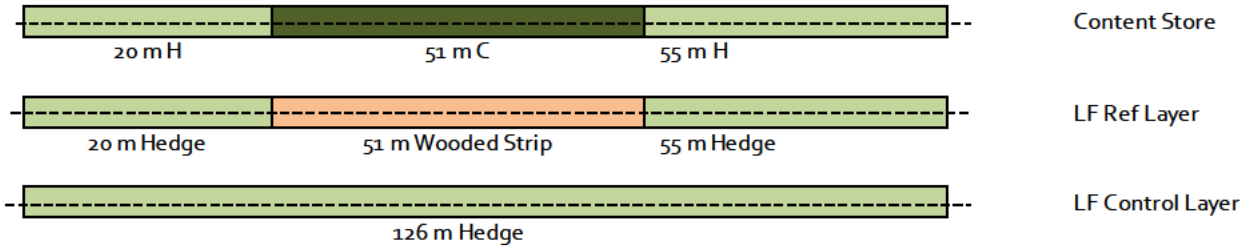


Figure 18 Example of hedgerow (H) and canopy (C) derivation along a topographic line (dashed line) including Wood Strip

Figure 18 shows a mixed classification of objects from the Content Store of hedgerow (H) and canopy (C) features. The canopy feature is above the minimum size of 50m to be classified as a Wood Strip and is delivered as such in the Reference Layer.

5 Feature Types and Attribution

The LF Reference Layer will contain a representation of physically-apparent real-world objects identified as associated with an OS MasterMap Topography Layer features.

There are three types of feature that can be used to represent geospatial information in the LF Reference Layer; they are:

TopographicLine - Features representing landscape objects and concepts that have a line-based geometry.

TopographicArea - Features representing landscape objects that have a polygon-based geometry. **TopographicPoint**

- Features representing topographic objects and other concepts that have a point-based geometry. Only features

represented by TopographicLines are being used within the scope of the current work.

5.1 Attribution

Each LF Reference Layer feature comes with a set of attribution. Attribution provides additional information about the feature. This information relates to the real-world object the feature represents or to the properties of the feature itself, for example, the form the feature belongs to is an attribute, as is the unique topographical identifier known as a TOID. The form is a property of the real-world object; the TOID is a property assigned to the feature.

More information on each of these attributes is given in Annex E - Attribute Definitions.

5.1.1 Feature referencing attributes

TOID

The unique identifier comprising a number and the four-letter prefix 'osgb'. The TOID will be treated as a text string rather than a number; the TOID must always be retained / stored in its entirety. TOID is implemented as gml: id.

5.1.2 Life-cycle metadata

Version

The version number of the landscape feature.

Version date

The date this version of the feature became the current version. This is the date on which the feature was changed in the database and is not the date when the real-world object it represents changed.

Reason for change

The reason why a new version (or new feature) has been created or changed. There will only be one reason per version.

5.1.3 Feature description attributes

There are six attributes common to all features that make up the descriptive attributes. These are date of imagery, parent TOID, parent version, method of capture, form and function.

Date of imagery

The date on which the imagery that was used to identify the feature was flown.

Parent TOID

A reference to the parent topographic line from whom the geometry has been extracted. It is a unique identifier comprising a number and the four-letter prefix 'osgb'. This reference permits the user to derive additional attribution from OS MasterMap Topography Layer.

Parent version

The version number of the topographic line feature from whom the geometry has been extracted.

Method of capture

The methodology used to capture the landscape feature, this is usually an automatic remote sensed approach but can include other entries.

Form

This is the classification attribute of a feature. It assigns a feature a category of real-world topographic or landscape objects.

Function

This attribute describes the function of the landscape features.

5.1.4 Geometric attributes

Polyline

A polyline is an ordered set of points forming a line feature.

Point

A pair of easting and northing coordinates in metres, defining a horizontal location in the British National Grid spatial reference system.

Polygon

A polygon is a single closed region defined by a set of lines that represent the boundaries.

6 LF Reference Layer Life Cycle

The decision on what size of change to a feature will deliver a change through to the Reference Layer is a balance between the desire to have a high level of detail in order to minimise the risk of audit criticism and allow other features to be delivered in future, versus the operational difficulties of handling the significant volume of data churn that having a small change size will generate. What is proposed below is considered to be a reasonable approach when considered against those factors.

Any feature that is changed by 5.0 metres or more in overall length is delivered as a change in the LF Reference Layer.

Features will be deleted when they drop below their minimum feature length, even if the length by which that feature has changed is below 5.0 metres For example, if a hedge was 6m in epoch 1 and then 3.5m in epoch 2, it will be deleted as it has fallen below the minimum size threshold.

This can also trigger changes to features that are less than 5m in cases where they touch a feature that has changed by 5 metres or more. If this type of cascaded change means that the cascaded feature is now under minimum size, it will be deleted or merged with the changed feature where applicable.
The following figures are illustrative only and do not provide an exhaustive list of scenarios.

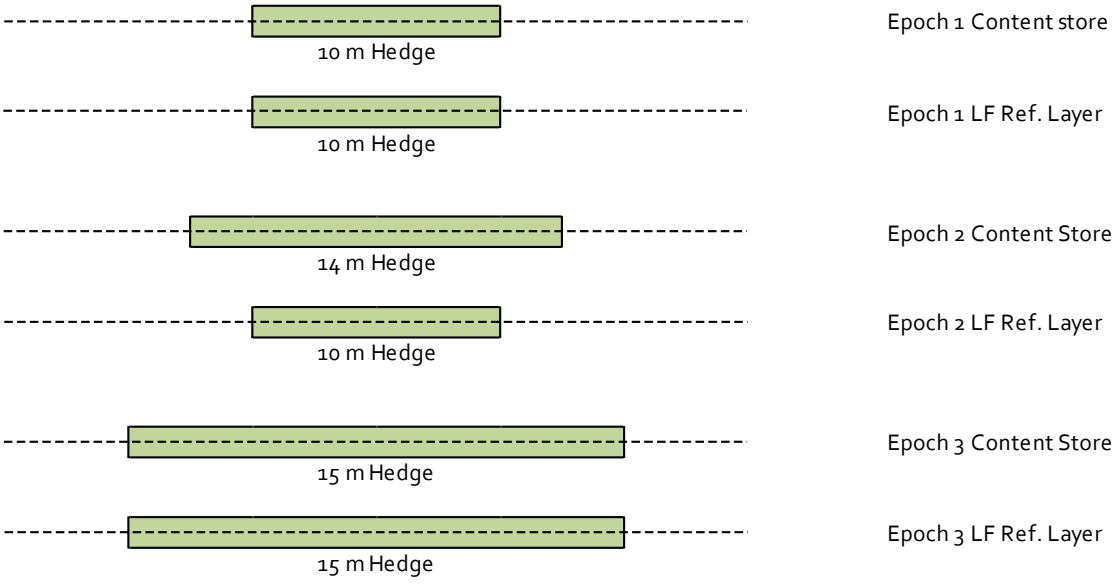
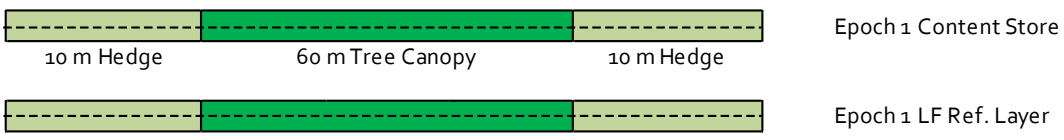


Figure 19 Diagram showing minimum of 5 metre change triggering resupply of hedge feature



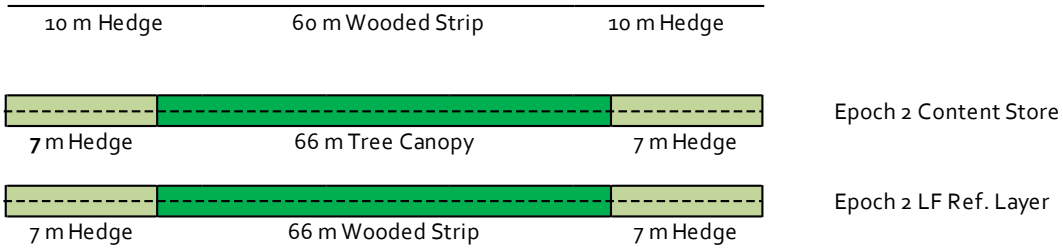


Figure 20 Diagram showing change to Wooded Strip over 5 metres

In Figure 20, if the change to the Wooded Strip had resulted in the 7m Hedge features being below the 4m minimum size, then those features would be fused into the Wooded Strip feature as per the rules in the decision tree.

6.1 Feature Life-Cycle

The LF Reference Layer adopts a similar feature lifecycle approach to that used for OS MasterMap Topography layer.

6.1.1 Creation of line features

When a new linear real-world hedgerow object is identified from the Content Store, a new line feature is created to represent it where it is coincident with an underlying topographic line. The creation of a new topographic line will not result in the delivery of a new landscape feature until the topographic line has been classified from imagery.

If a landscape feature is reclassified to another landscape feature type then a new landscape feature is created and the previous feature is deleted. The unique identifier (TOID) of the landscape feature does not persist.

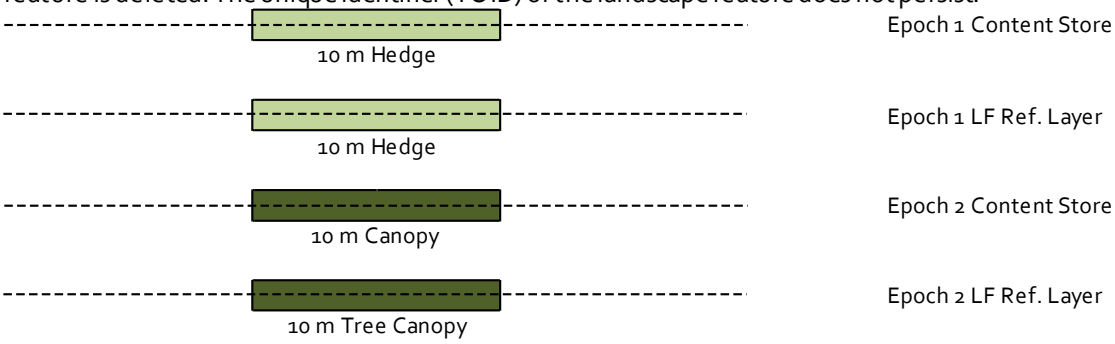


Figure 21 Creation of a new feature due to change in classificationFigure 21 shows a landscape feature was classified as a 10m section of hedge with a TOID of 'osgb123' in epoch 1. In the second epoch the feature has now been classified as a canopy feature. This will result in the deletion of TOID = 'osgb123' and the creation of a new tree canopy feature TOID = 'osgb789' with a reasonForChange of 'New'. The TOID does not therefore persist between reclassifications of feature type.

If real world geometry change has occurred as part of this reclassification then the new reclassified feature would reflect this new geometry change.

In Figure 21, if the Epoch 2 analysis had shown a canopy feature 12m in size, then the new canopy feature would be 12m in length as well as a new TOID and classification. The minimum change trigger of 5m is not applicable when reclassifying a feature.

A new feature will be created when the underlying reference topographic line is geometrically altered.

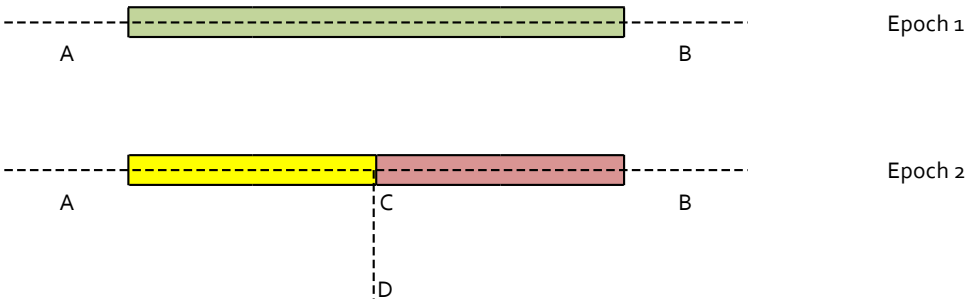


Figure 22 Modification of underlying topographic line (dashed line)Figure 22 shows a landscape feature TOID = 'osgb123' coincident with a topographic line from A to B, as delivered in Epoch 1. In Epoch 2 the underlying topographic line has been changed with the insertion of the link C to D, splitting the original line into A to C and C to B.

This will result in the deletion of TOID = 'osgb123' and the creation of two new features (represented by the yellow and red polygons in the figure). The original TOID will be applied to one of the two new features and the creation of a new TOID for the remaining new feature. The reasonForChange on TOID = 'osgb123' will be 'Modified', and for the newly created TOID will be 'New'.

6.1.2 Deletion of line features

When a real-world object is no longer present in the real world, the corresponding line feature is deleted from the Ordnance Survey Product Store. These will be published as features for deletion in the appropriate COU product supply.

A landscape feature will be deleted when:

- The feature is no longer present on the imagery (e.g. removal of a hedge and replacement with a fence). The reasonForChange will be 'End of Life'.
- The associated topographic line is deleted as part of OS update process. The reasonForChange will be 'End of Life'.
- Subsequent epoch of imagery classification means that the landscape feature has merged with adjoining features. The reasonForChange will be 'End of Life'.
- Changes to adjoining landscape features cause the feature to drop below its minimum size. The reasonForChange will be 'End of Life'.
- The feature is no longer within the product extent (e.g. because of a change to the RLR that is being used to define the extent). The reasonForChange will be 'Departed'.

6.1.3 Modification of line features due to real-world change

A line feature may be modified due to changes to the real-world object, or due to changes in adjacent real-world objects. The original feature may be retained if a portion of its geometry remains and one or more new features may be created to reflect the change.

A landscape feature will be modified when:

- The geometry of the associated topographic line is updated as part of the OS update process and the landscape feature persists along the new alignment. The reasonForChange will be 'Modified'.
- The associated topographic line is updated as part of the OS update process and the topographic features TOID and/or Version is changed but the geometry of the landscape feature is unchanged. The reasonForChange will be 'Attributes'.
- A landscape feature is updated as a result of classification from newer imagery that detects a change to the extent of the feature (or adjoining feature in the case of cascaded change). The reasonForChange will be 'Modified'.

- A landscape feature is updated as a result of a change to the descriptive attributes of the LF feature (given the rules that apply when the various attributes in the LF Layer are updated, this will only apply when the Function attribute changes). The reasonForChange will be 'Reclassified'.

6.1.4 Modification of line features due to error correction

When a line feature is changed solely to correct a classification or cartographic error, the feature will be retained, unless the resulting topological changes with adjacent features make this inappropriate.

7 Initial Supply and Update Service

There are two periods contractually for the delivery of the LF Reference Layer.

- Initial Supply : the LF Reference Layer for the Priority Area (and as much of the remainder of the LF Reference Layer as is expedient) – this was delivered in 2015

- Update Service: from 1 January 2016, the Update Service has delivered and will continue to deliver the balance of the Priority areas not delivered in the Initial Supply and those areas required to complete coverage of the RLR. This service will also deliver real-world change updates to the LF Reference Layer.

Data will be delivered in GML 3.2.1 and processed by RPA using Snowflake's GO Loader. This software will load initial supply and process subsequent updates.

7.1.1.1 Initial Supply of LF Reference Layer

The Initial Supply of the LF Reference Layer was from existing imagery (2011-2015).

To ensure that as much data as possible can be delivered in the LF Reference Layer, it was recognised that in some instances imagery will be used to create the LF Reference Layer in advance of the Topo update programme. The 2015 imagery filled some gaps in the priority area coverage and will also refresh existing imagery content.

7.1.1.2 Update Service to the LF Reference Layer

From 1st Jan 2016 the Update Service has delivered updates to the LF Reference Layer and deliver the balance of the Priority areas not delivered in the Initial Supply.

To ensure that as much data as possible can be delivered in the LF Reference Layer, it is recognised that in some instances imagery will be used to create the LF Reference Layer in advance of the Topo update programme when completing areas missing from the initial supply. Once the LF Reference Layer is complete in coverage, subsequent updates will be made following OS MasterMap Topography Layer updates.

Updates will be supplied to the LF Reference Layer on a 12-weekly basis.

7.1.1.3 Change Only Update Mechanism for Delivery of LF Reference Layer

Change Only Update is the mechanism by which the LF Layer will be delivered. The first instalment of the LF Reference Layer that will be delivered to the customer no later than 28 August, will be in initial supply format, subsequent deliveries will be in change only update format. A change only update contains new features, new versions of changed features and deleted features.

8 Dataset Specification

8.1 Format

The LF Reference Layer will be provided in GML format version 3.2.1.

8.2 LF Reference Layer Metadata

This metadata file will be supplied with each product supply.

Metadata should conform to ISO 19115 and be UK GEMINI discovery level metadata. The following is a detailed description of the metadata:

Title: The name by which the data resource is known.

Unique Resource Identifier: A unique string or number used to identify the data resource

Dataset Reference Date: Identifies the type of event (creation/publication/revision) associated with a data resource date

Frequency of Update: The frequency with which revisions and updates are made to the data resource after its initial completion.

Topic category: Main theme(s) of the data resource.

Keyword: Keywords taken from a controlled vocabulary summarising the subject of the data resource.

Dataset Language: The language(s) used within the data resource.

Abstract: A brief description of the data resource.

Conformity: Degree of conformity with the product specification or user requirement being evaluated against data resource.

Specification: Citation (title) of the product specification or user requirement against which data resource is evaluated.

Lineage: Information about the source data used in the construction of the data resource.

Spatial resolution: Denominator of the representative fraction on the source map(s) and/or the ground sample distance.

Extents of dataset based on Coordinates of Bounding Rectangle: In decimal degrees.

Spatial reference system: OSGB36/British National Grid (EPSG: 27700).

Responsible Party/Role: OS is an originator.

Role name: OS Customer Services.

Organization name: OS is responsible for the data resource.

Data format: Takes the form of the name of the format or formats the product is supplied in will include whether the data is the initial supply or COU.

Distributor contact details: OS contact details.

Dataset format: GML 3.2.1

Use Constraints: Description of the restrictions and legal prerequisites for using the data resource.

Limitations on Public Access: Description of the restrictions and legal prerequisites for accessing the data resource.

9 Data Delivery Requirements

9.1 Initial Supply

An initial supply (provided in 2015) is required that contains all Landscape Features for LMS parcels in England as defined by the data extract provided to OS on 20th January 2015. This initial supply was provided in 'chunks' and thus as new chunks are delivered features on the boundaries with previously delivered chunks may be revised.

9.2 Updates

Following the Initial Supply Change Only Updates (COU) will be supplied as the LF Reference Layer moves into the Update Service maintenance. A COU update will only contain new features, new versions of changed features and deleted features.

9.3 Delivery

During the Initial Supply phase the data will be supplied on DVD in 5km geo-chunked extents at intervals agreed in the Delivery Plan.

During the Update Service phase the data will be supplied on DVD in 5km geo-chunked extents at 12 week intervals.

With each data supply a summary text file will be supplied containing the following information:

- a delivery reference number / unique identifier;
- the delivery type: 'Initial supply' or 'COU update';
- for COU updates, the change-since date;
- the delivery data size: in Mb.

9.3.1 Feature Validation Data Set

A Feature Validation Data Set (FVDS) will be required with each delivery during the Initial Supply phase and with the 12 weekly COU updates during the Update Service.

9.3.2 Imagery Metadata File:

An imagery metadata file will be supplied with all deliveries of the LF Reference Layer during Initial Supply and Update phases.

The metadata file is a 1km National Grid reference of each 1km grid square in England (approx. 135,179 kms), with the flown date of the imagery that was used to create the Reference Layer. This is intended for use by the RPA as a reference dataset.

The format will be as follows;

TQ1234,2015-01-05

TQ1235,2015-01-05

Etc.

10 Data and Quality Measures

Starting from a structured framework of spatial data quality measures taken from ISO standards a document on LF Reference Layer Data Quality was produced and has been worked through in a number of workshops held in Southampton. Within the document a matrix of data quality elements and their applicability to the LF Reference Layer has been developed. This document was agreed between OS and the customer in December 2015.

11 Annex A – Business Definition of a Hedge

The following definition provided for context is that published to farmers for the purpose of declaring LF features. It does not therefore define the rules for producing the LF Reference Layer.

A 'hedge' is any hedgerow (a row of bushes) growing on or adjacent to (next to) arable land which forms part of a farmer's holding and has:

a continuous length of at least 20 metres, or is part of any such length, or

a continuous length of less than 20 metres where it meets (at an intersection or junction) another hedgerow at each end.

The hedge does not have to contain trees, but any trees growing in it form part of the hedge.

Hedges can include gaps, such as gateways. See the table below for more information.

Hedges on banks are eligible.

Width	There is no minimum or maximum width for a hedge.
Length	The minimum length for a hedge is 20 metres. Hedges can include gaps. There is no limit on how many gaps a hedge can have – as long as each individual gap is not more than 20 metres it will be treated as part of the hedge.
Height	There is no maximum or minimum height for a hedge. This means newly planted hedges can be used for Hedge Reference Layer (LF) if they are in the ground when the application is made.

12 Annex B - Reference Documents

Name	Reference	Version	Date
OS MasterMap Technical Specification	OS MasterMap Topography Layer User guide and technical specification	V2.0	08/2017

13 Annex C – Obstructing, Woodland and Boundary Features

OS MasterMap Topography Layer topographic line attributes that meet criteria for inclusion in LF Reference Layer (preliminary selection to be expanded as required in the OS Technical Specification).

13.1 Obstructing and boundary features

Only ground level obstructing features will be classified as landscape features.

Theme	Descriptive Group	Physical Presence
Land	General Feature	Obstructing
Land, Rail	General Feature	Obstructing
Land, Roads Tracks and Paths	General Feature	Obstructing
Land, Roads Tracks and Paths, Rail	General feature	Obstructing

The selection of descriptiveGroup = "General Feature" and physicalPresence = "Obstructing" will result in some ineligible features being chosen, the examples below show how undesirable features can be excluded from this selection.

Gates will be excluded from classification as eligible landscape features, where a topographic line attributed as Theme = "Roads Tracks and Paths" and "Land" and descriptiveGroup = "General Feature" and physicalPresence = "Obstructing" has a topographic area of with descriptiveGroup = "Road Or Track" or "General Surface" on either side of it.

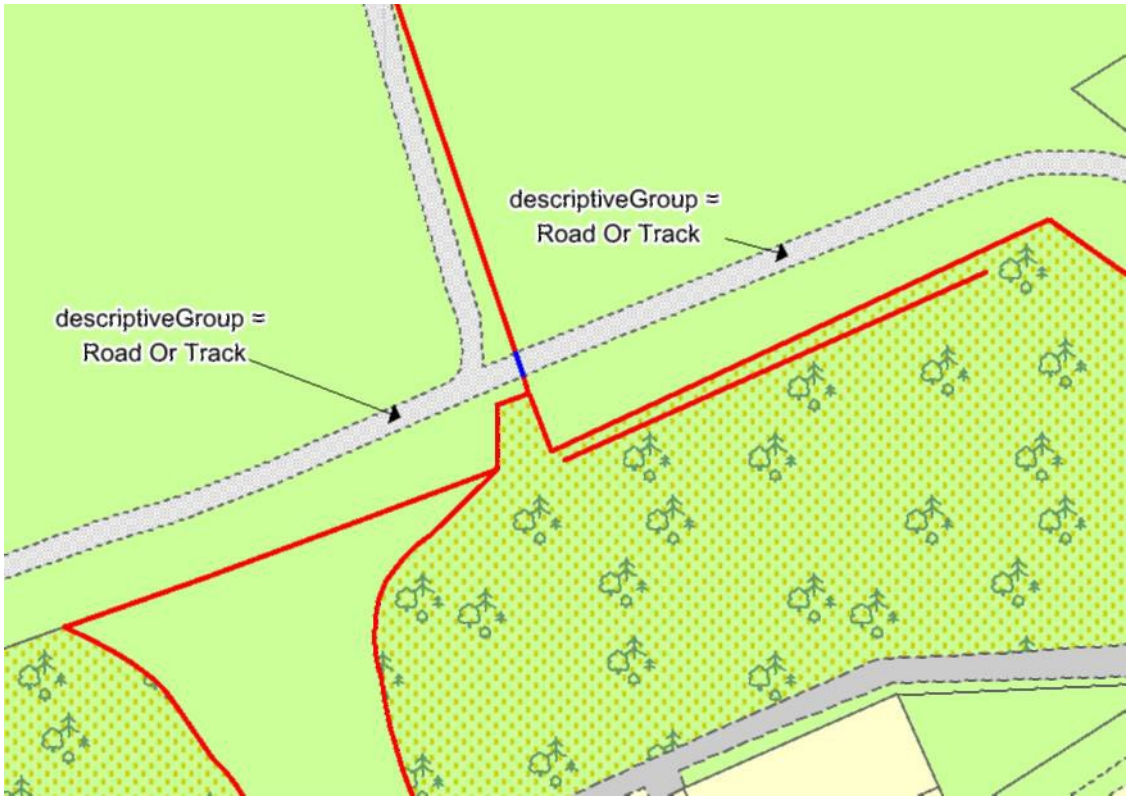


Figure 23 Identifying gates for exclusion

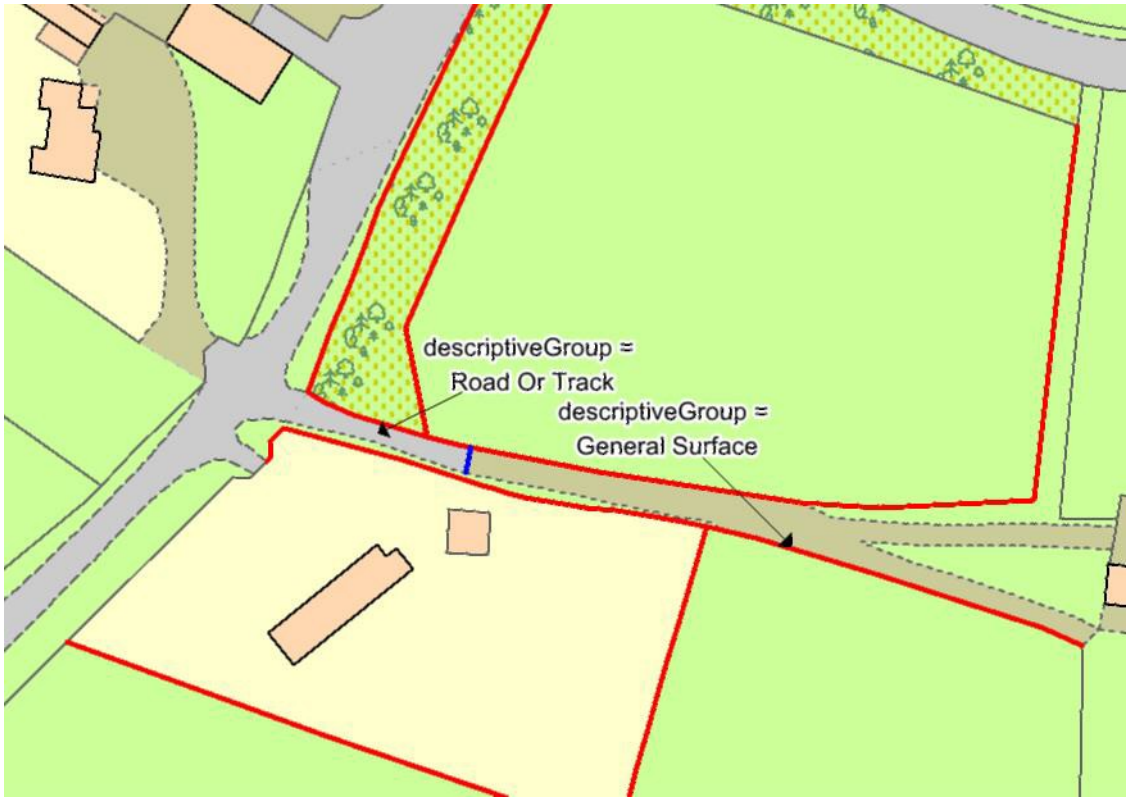


Figure 24 Identifying obstructing gates for exclusion

Figure 23 and Figure 24 show examples of physicalPresence = "Obstructing" features (in red) with gates (in blue). The gate is identifiable from the other obstructing features as it is flanked by topographic areas attributed with descriptiveGroup of either "Road Or Track" or "General Surface".

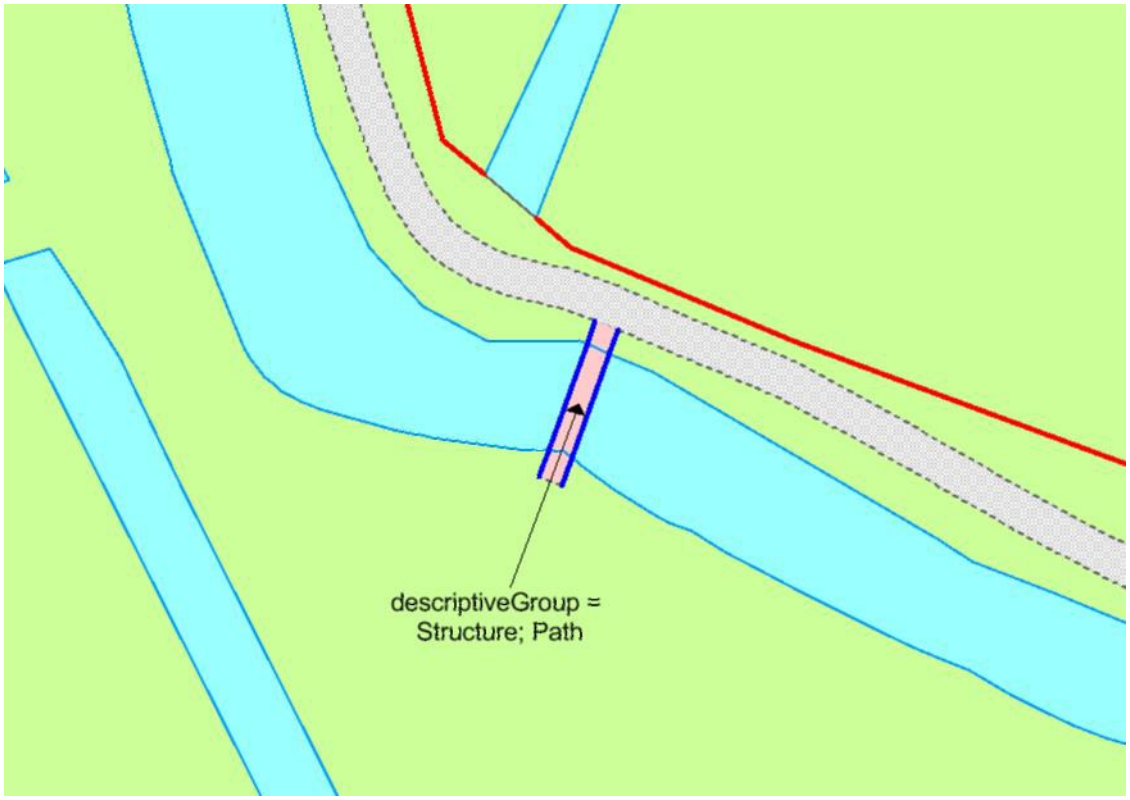


Figure 25 Identifying obstructing structures for exclusion

Figure 25 shows an example of physicalPresence = "Obstructing" features (in red) with an obstructing structure (in blue). The structure is identifiable from the other obstructing features as it is coincident with a topographic area as attributed with descriptiveGroup containing "Structure".

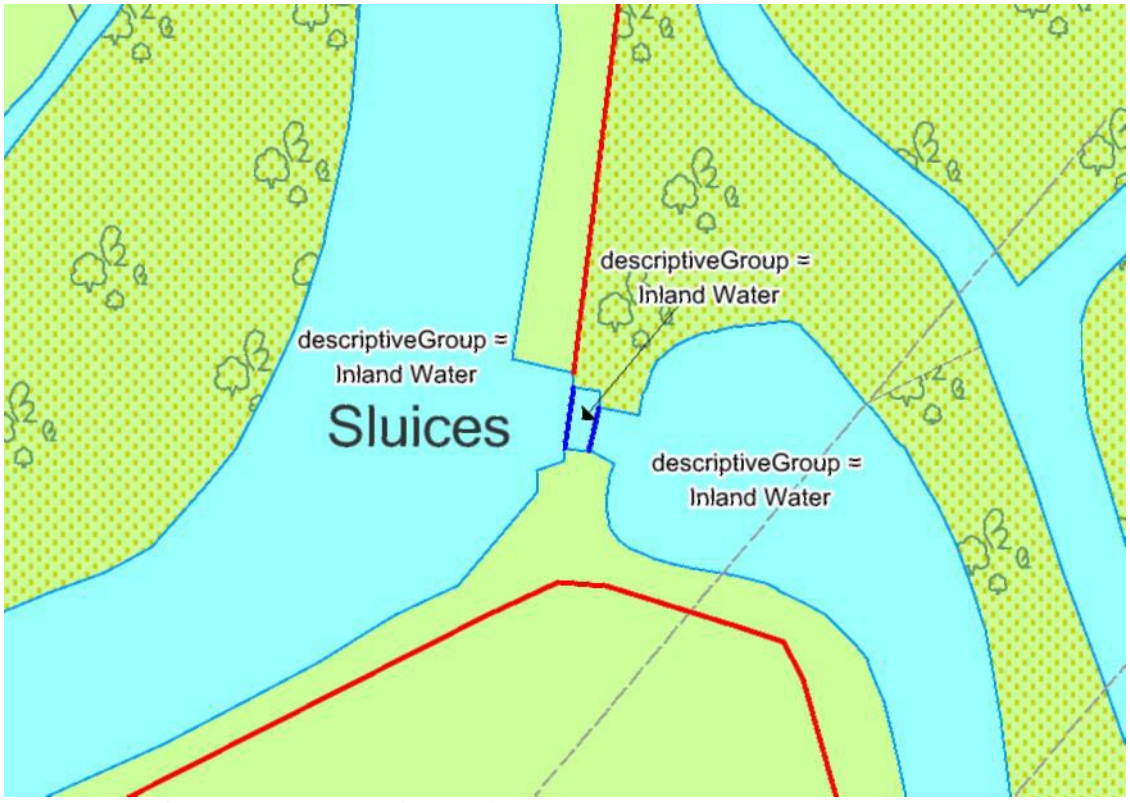


Figure 26 Identifying obstructing water features for exclusion

Figure 26 shows an example of physicalPresence = "Obstructing" features (in red) with an obstructing feature (in blue). The structure is identifiable from the other obstructing features as it is bounded on both sides with a topographic areas attributed with descriptiveGroup containing "Inland Water".

13.2 Woodland areas

Woodland areas are identified using OS MasterMap Topography Layer topographic areas with the attribution of:

Theme	Descriptive Group	Make	Descriptive Term
Land	Natural Environment	Natural	Nonconiferous Trees
Land	Natural Environment	Natural	Coniferous Trees
Land	Natural Environment	Natural	Coniferous Trees Nonconiferous Trees
Land	Natural Environment	Natural	Nonconiferous Trees Coniferous Trees
Land	Natural Environment	Natural	Scrub Nonconiferous Trees
Land	Natural Environment	Natural	Scrub Coniferous Trees
Land	Natural Environment	Natural	Nonconiferous Trees Scrub
Land	Natural Environment	Natural	Coniferous Trees Scrub
Land	Natural Environment	Natural	Scrub Nonconiferous Trees Coniferous Trees
Land	Natural Environment	Natural	Scrub Coniferous Trees Nonconiferous Trees
Land	Natural Environment	Natural	Nonconiferous Trees Scrub Coniferous Trees
Land	Natural Environment	Natural	Coniferous Trees Scrub Nonconiferous Trees

Land	Natural Environment	Natural	Nonconiferous Trees Coniferous Trees Scrub
Land	Natural Environment	Natural	Coniferous Trees Nonconiferous Trees Scrub

14 Annex D - Feature Attributes

This section defines the attributes associated with each LF Reference Layer feature type and shows the expected occurrence in the data of the attributes for each feature type. This is shown in UML notation, that is, if they are optional (0) and if they can be single (1) or multiple (*), with 'or' being represented by double dots (..).

14.1 TopographicLine

Attribute	Occurrence
TOID	1
version	1
form	1
function	0
dateOfImagery	1
versionDate	1
parentTOID	1
parentVersion	1
methodOfCapture	1
reasonForChange	1

14.2 TopographicPoint

Although the first release of the LF Reference Layer contains only polyline features the attribution of point features is modelled here.

Attribute	Occurrence
TOID	1

version	1
form	1
function	0..1
dateOfImagery	1
versionDate	1
parentTOID	1
parentVersion	1
methodOfCapture	1
reasonForChange	1

14.3 TopographicArea

Although the first release of the LF Reference Layer contains only polyline features the attribution of polygon features is modelled here.

Attribute	Occurrence
TOID	1
version	1
form	1
function	0..1
dateOfImagery	1
versionDate	1
parentTOID	1
parentVersion	1
methodOfCapture	1
reasonForChange	1

15 Annex E - Attribute Definitions

15.1 Attribute Data Types

Each attribute has one of the following data types. Each item of information in a complex attribute has one of the following data types.

Type	Description
Boolean	Value of 'true' or 'false'.
Date	Specifies a day within the Gregorian calendar in the format YYYY-MM-DD.
Integer	Any positive or negative whole number or zero.
Point	A pair of easting and northing coordinates in metres, defining a horizontal location in the British National Grid spatial reference system.
Polygon	A closed area defined by one outer boundary and zero or more inner boundaries. Each boundary is a closed ring of coordinate pairs, interpolated as for a polyline.
Polyline	An ordered set of points that are connected with a straight line between each pair
Real	A floating point number.
Rectangle	A rectangle defined in the British National Grid.
String	An ordered set of characters.
TOID	OS MasterMap unique feature identifier.

15.2 Simple attributes

A simple attribute is one that contains a single piece of information that may be qualified by associated information such as its units of measure. Geometric attributes are considered to be simple. The following simple attributes occur in LF features.

Attribute	Data Type	Purpose
dateOfImagery	Date	The date the imagery was flown from which the landscape feature was classified
form	String	This attribute gives the primary classification information about the feature.
function	String	This attribute gives further classification information about the feature.
methodOfCapture	String	Specifies the method by which the landscape feature was captured.

parentTOID	TOID	The unique reference number of the parent OS MasterMap feature that was classified as a landscape feature. This attribute comprises a number and the four-letter prefix 'osgb'.
parentVersion	Integer	The version number of the parent OS MasterMap feature. This uniquely identifies a specific version of a parent OS MasterMap feature with a given parentTOID value.
reasonForChange	String	The reason for a change made to a feature.
TOID	TOID	Unique identification reference number of the feature. The unique identifier comprising a number and the four-letter prefix 'osgb'. It is recommended that the TOID be treated as a text string rather than a number; the TOID should always be retained/stored in its entirety
version	Integer	The version number of the feature. This uniquely identifies a specific version of a feature with a given TOID.
versionDate	Date	The date on which this version of the feature became the current version. This is the date that the feature was changed in the database and is not the date of any associated real-world change This is the date the feature appeared in the product store.

15.3 Attribute values

Some attributes have a values defined from the prescribed lists below.

15.3.1 form

Value	Description
Hedge	A row of shrubs which may also contain trees
Tree Canopy	A tree canopy not adjacent or touching a hedge
Wooded Strip	A continuous row of tree canopy with a length >= 50 metres

15.3.2 function

Value	Description
Woodland Boundary	A landscape feature that is adjacent to an area of woodland.

15.3.3 methodOfCapture

Value	Description
Ground Survey	The feature was captured by an on the ground survey.
Automatic Remote Sensed	The feature was identified by the automatic imagery classification process.
Manual Remote Sensed	The feature was identified by visual inspection of imagery and height data.

15.3.4 reasonForChange

Value	Description
New	This is a new feature in the database.
Correction	Indicating correction to a LF feature This would be used when a change to a feature (either it's attribution or geometry) has happened as a result of fix to resolve a 'bug' in the product creation process (e.g. if an error was found in the query to identify features as having the function of 'Woodland Boundary')
Modified	The geometry of an LF feature has changed following real-world change[4].
Software	Feature has been adjusted by an automatic software process. Includes geometric adjustment, cleaning, squaring and reversing direction of digitising. This would be used when a change to a feature occurs because it is reprocessed following a change to the software rules (either in the eCogntion image classification or the Product Adaptor), but where there has been no change to the input imagery or to the Topo lines features.
Attributes	The descriptive attributes or geometry of the parent topographic line that the landscape feature references have changed, but the geometry of the LF Layer feature is unchanged.
Reclassified	The descriptive attributes of the LF feature have changed. Given the rules that apply when the various attributes in the LF Layer are updated, in practise this will apply when the Function attribute (Woodland Boundary) changes.
End Of Life	The lifecycle of the feature has ended.
Departed	The feature is no longer within the area of interest.

Where more than one change has taken place between deliveries then the following hierarchy (from highest to lowest) is used to determine which change type is populated.

[4] *This represents changes to point and lines not polygons.*

.1.1....1. New

.1.1....2. Correction

.1.1....3. Modified

.1.1....4. Software

.1.1....5. Reclassified

.1.1....6. Attributes

.1.1....7. End Of Life

.1.1....8. Departed

16 Annex F – Glossary

Obstructing Feature - Indicates that feature is normally more than 0.3 m high and forms an obstruction to passage on foot [from the Ordnance Survey MasterMap specification].

GML - The **Geography Markup Language** (**GML**) is the XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features. GML serves as a modeling language for geographic systems as well as an open interchange format for geographic transactions on the Internet.

Landscape features - Farmland landscape features are important components of the countryside and contribute to biodiversity by providing connections between farmland habitats. Field boundaries such as hedges, stone walls and grass banks, as well as farm ponds can be valuable wildlife habitats, enhance the landscape and, in some cases, may be of historic importance.

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