ORDNANCE SURVEY GB

OS MASTERMAP WATER NETWORK LAYER – TECHNICAL SPECIFICATION

OFFICIAL
Ver 1.2

Ordnance Survey

Version history

Version	Date	Description
1.1	06/2015	Minor updates.
1.2	01/2022	Introduction of vector tiles and GeoPackage formats to the product. Minor formatting updates to the document.

Purpose of this document

This document provides information about and insight into the OS MasterMap Water Network Layer product and its potential applications. For information on the contents and structure of OS MasterMap Water Network Layer, please refer to the Overview and Getting Started Guide.

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1. Introduction

OS MasterMap Water Network Layer provides a three-dimensional structured link and node network of Great Britain's watercourses. A link represents the approximate central alignment of a watercourse and includes inland rivers, streams, tidal water, lakes, lochs and canals; links are attributed with additional information, including flow direction and primary flow paths. Where watercourses are obscured or underground, connectivity is provided where Ordnance Survey capture processes or accepted sources can infer the connection.

The OS MasterMap Water Network Layer product is in geometric sympathy with the underlying topographic features that comprise OS MasterMap Topography Layer (Figure 1). Polygons and lines representing the water area and its banks are not supplied in this product but will continue to be maintained and supplied as part of the OS MasterMap Topography Layer product.

Figure 1: Example extract from OS MasterMap Water Network Layer showing WatercourseLink and HydroNode features.

1.1 Identifiers

Ordnance Survey provides persistent managed identifiers as TOIDs. TOIDs are strings of up to twenty characters, starting with 'osgb'; the remaining characters are digits (0 to 9). In an INSPIRE encoded dataset such as this, each feature carries its identifier in three ways, as described below:

- **gml:id:** Required by Geography Markup Language (GML). This matches the pattern in other OS MasterMap products.

- **gml:identifier:** Recommended by INSPIRE and the UK INSPIRE project. This formats the TOID into a persistent URI, using *http://data.os.uk/id/* as a namespace, instead of 'osgb'. This does not mean that the water network features are available as linked data.

- **net:inspireId:** The localId is set to the TOID (without 'osgb'), and the namespace set as above. The INSPIRE identifier model does not fit with SF0; it does fit with level 1.

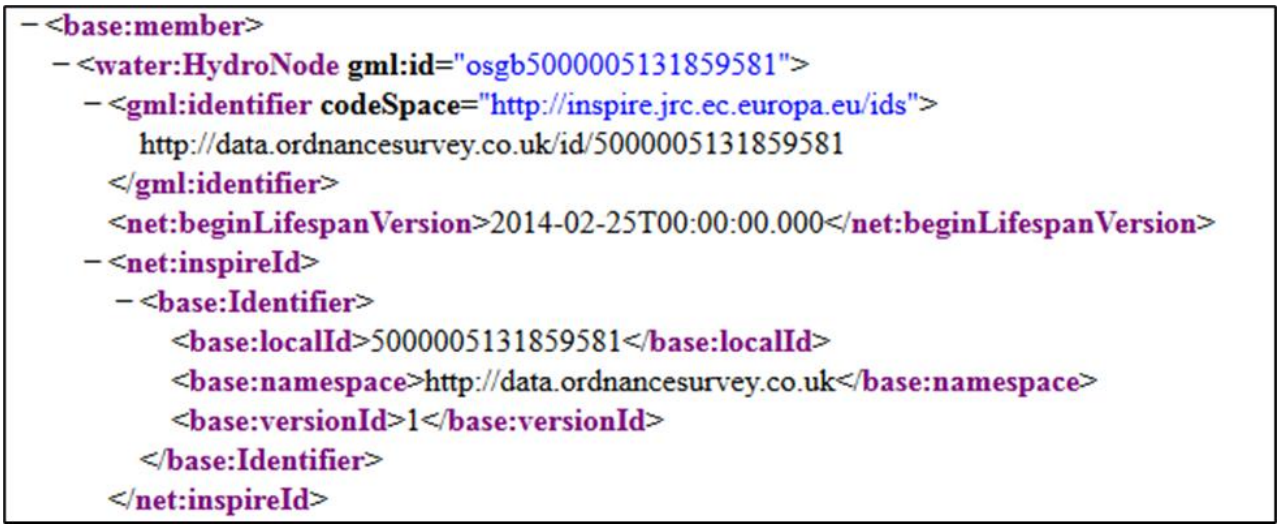

Figure 2: An example of a feature in an INSPIRE encoded dataset carrying its identifier in three ways.

The feature version is encoded as the versionId within the INSPIRE Identifier.

1.2 Available formats for the product

OS MasterMap Water Network Layer will be supplied in Geography Markup Language (GML) 3.2.1, GeoPackage and vector tiles formats.

1.3 Adherence to standards

OS MasterMap Water Network Layer is based on the INSPIRE Hydrography Data Specification, which itself is based on the ISO TC211 family of open standards.

1.3.1 Extending INSPIRE specification

OS MasterMap Water Network Layer extends the INSPIRE specification.

1.3.2 UML diagram and table conventions

The data structure is described below by means of unified modeling language (UML) class diagrams and accompanying tables containing text. The UML diagrams conform to the approach specified in ISO 19103 Conceptual schema language and ISO 19109 Rules for application schema, as adopted by INSPIRE.

Colour conventions have been used in the diagrams and tables to distinguish the INSPIRE specification from the additional properties that have been added in this specification. In the UML diagram, classes from the INSPIRE Data Specifications are coloured grey, whereas classes in the Ordnance Survey product specification are coloured orange. All code lists are coloured blue, enumerations are coloured green and data types are coloured purple, which can be seen in Figure 3. The tables which follow in this Technical Specification use orange for a feature type, blue for a code list, green for enumerations and purple for data types.

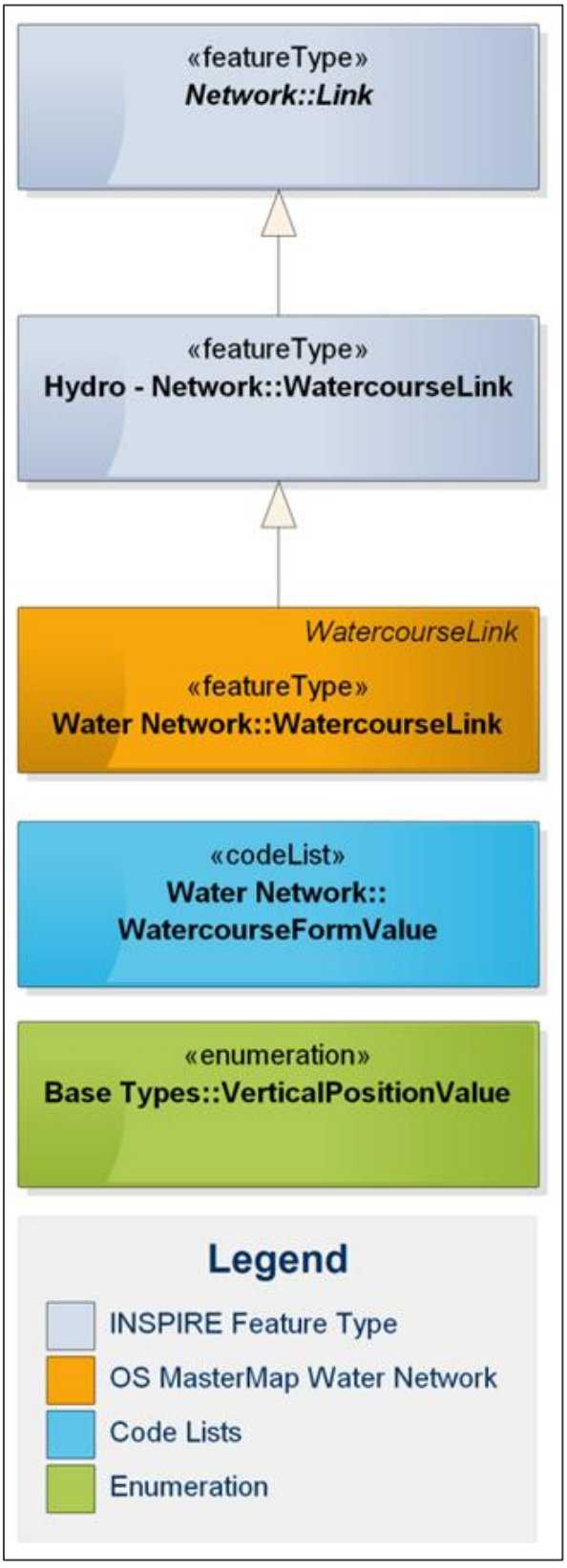

Figure 3: A UML diagram using the colour conventions specified in this Technical Specification.

2. Product structure

OS MasterMap Water Network Layer is a topological network representing the watercourses within Great Britain. The product is made up of five feature types:

- **WatercourseLink:** Features that represent the approximate central alignment of a watercourse, including rivers, lakes and canals. They can represent part of a watercourse or a whole watercourse.
- **HydroNode:** Features that represent a river's source, end, a junction where three or more links meet, and places where the real-world related attribution changes, for example, the point where a watercourse becomes tidal.
- **WatercourseSeparatedCrossing:** Features to indicate the relationships between watercourses that intersect at different levels.
- **WatercourseLinkSet:** Features to represent sets of links, for example, named rivers or watercourses within a catchment area.
- **WatercourseInteraction:** Features that represent events along the water network, for example, weirs and mooring points.

Only two feature types are supplied in the current release of the product: WatercourseLink and HydroNode (Figure 4). This technical specification will cover all five of the feature types which make up the product as all five feature types are referenced in the product schema, which is the controlling specification for the product.

All the feature instances, of whichever feature type, are provided as a single FeatureCollection.

OS MasterMap Water Network Layer has been built with the INSPIRE Hydro – Network Specification as a basis, which results in the product inheriting attribution from INSPIRE. An overview of the product structure can be found in Figure 4, which highlights the inherited INSPIRE feature types and attribution. Properties of the INSPIRE specification which are voidable and are not being populated in the product have not been included in the class diagrams or the following tables. For information on the INSPIRE properties which are not included in this product, please see the INSPIRE Data Specification on Hydrography – Network application schema (https://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_HY_v3.1.pdf).

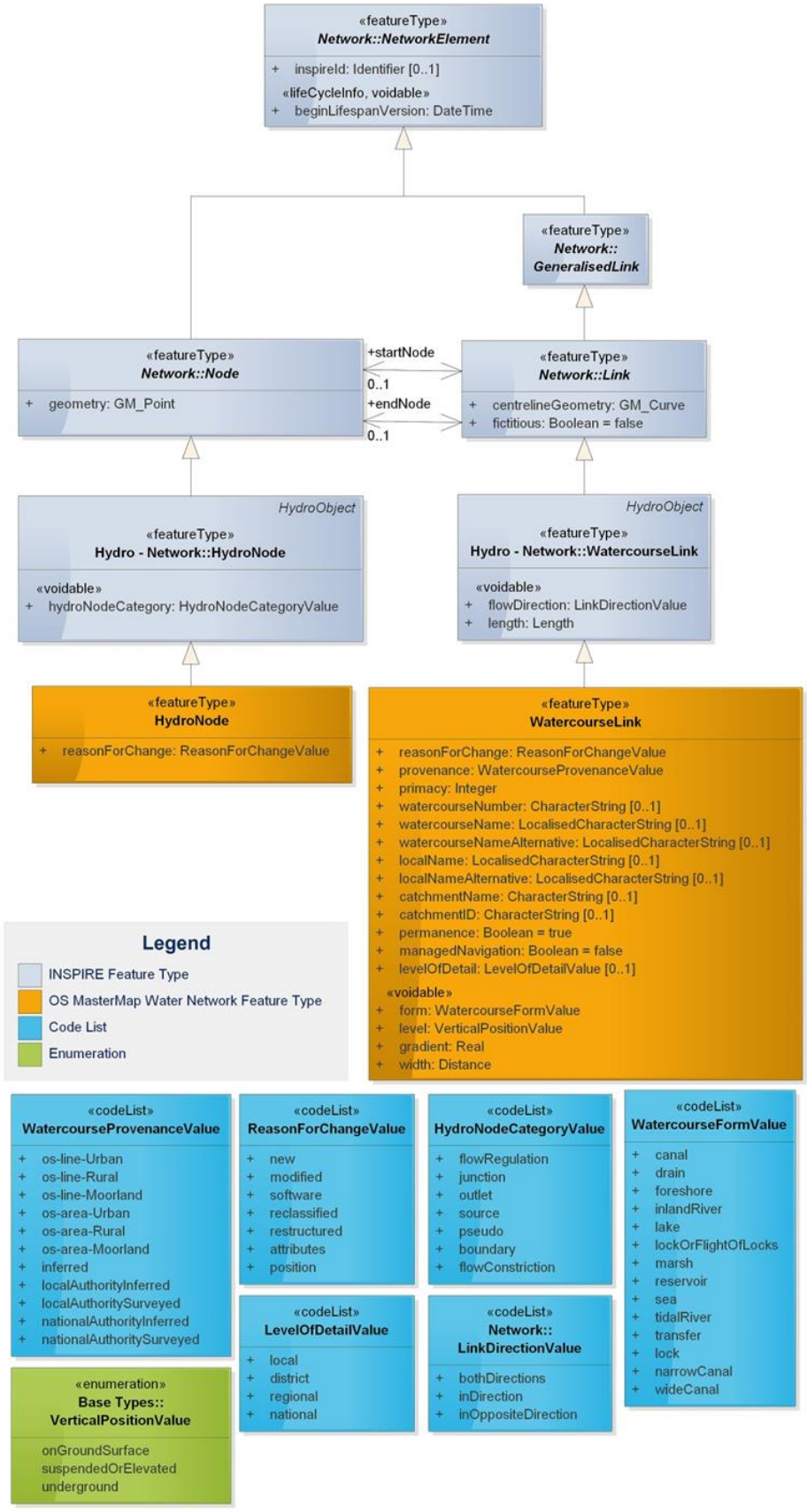

Figure 4: UML diagram showing the data structure of OS MasterMap Water Network Layer in the current release.

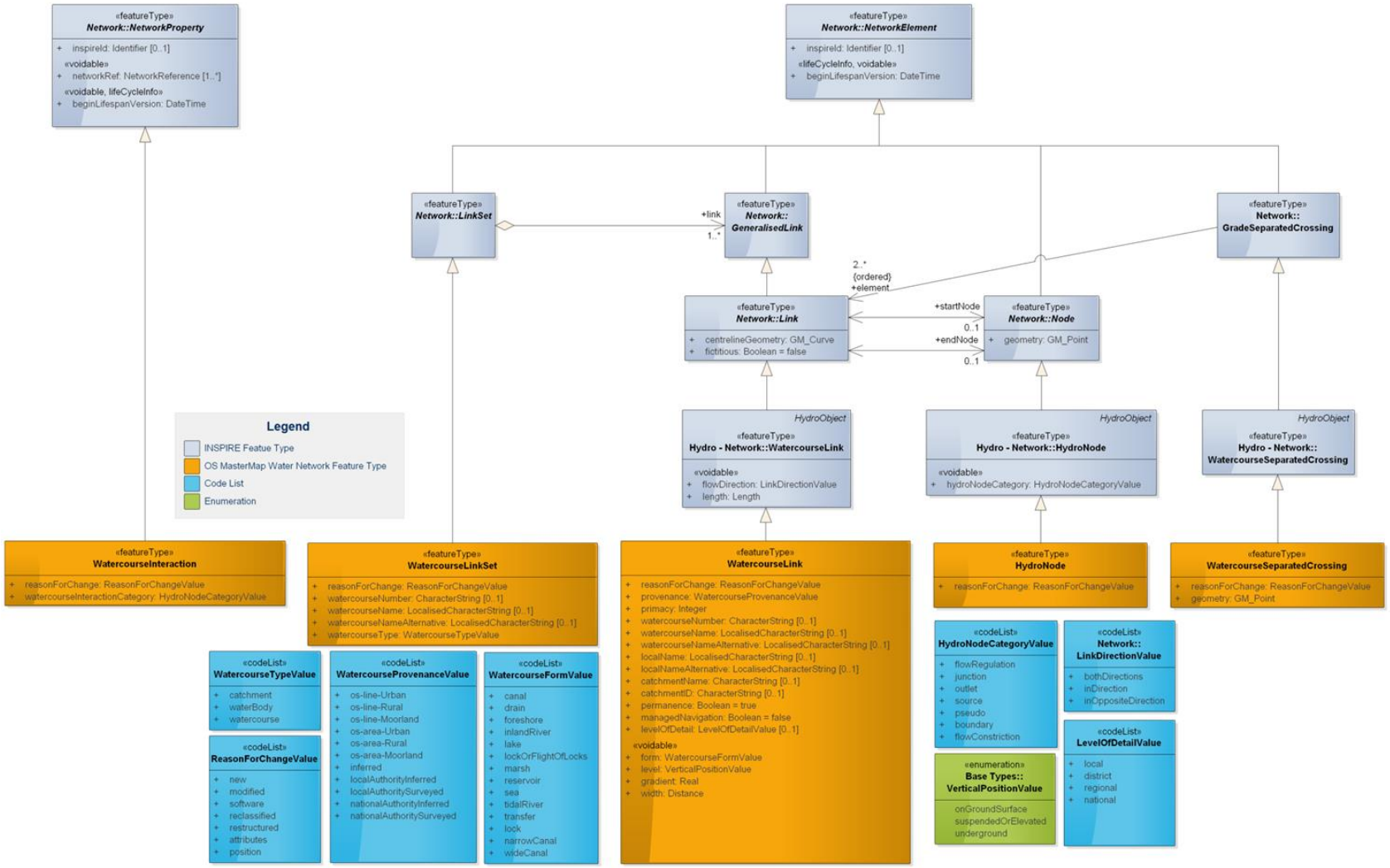

Figure 5: UML diagram of OS MasterMap Water Network Layer product structure referenced by the schema.

2.1 WatercourseLink

WatercourseLink features represent the alignments of watercourses and have, in the most part, been derived from Ordnance Survey detailed topographic data.

Where the classification or name changes along a watercourse, the network will be split and a HydroNode classified as 'Pseudo' will be created.

2.1.1 Attributes

«featureType» WatercourseLink	
Definition: A segment that represents part of a watercourse.	
Subtype of: WatercourseLink	
Attribute: centrelineGeometry	
Definition: The three-dimensional geometry that represents the general alignment of the watercourse.	
Type: GM_Curve	Multiplicity: [1]
Attribute: ficticious	
Definition: Indicator that the centreline geometry of the link is a straight line with no intermediate control points – unless the straight line represents the geography in the resolution of the data set appropriately.	
Type: Boolean	Multiplicity: [1]
Association Role: startNode	
Definition: The HydroNode coincident with the first vertex for this WatercourseLink.	
Multiplicity: [1]	
Association Role: endNode	
Definition: The HydroNode coincident with the last vertex for this WatercourseLink. On very rare occasions, the end HydroNode may be the same instance as the start HydroNode.	
Multiplicity: [1]	
Attribute: inspireId	
Definition: External object identifier of the spatial object. *Note 1: The localId contains the Ordnance Survey TOID.* *Note 2: An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.*	
Type: Identifier	Multiplicity: [0..1]

«featureType» WatercourseLink	
Attribute: versionId «lifeCycleInfo» «voidable»	
Definition: The identifier of the particular version of the spatial object, with a maximum length of 25 characters. If the specification of a spatial object type with an external object identifier includes life-cycle information, the version identifier is used to distinguish between the different versions of a spatial object. Within the set of all versions of a spatial object, the version identifier is unique.	
Type: CharacterString	Multiplicity: [0..1]
Attribute: beginLifespanVersion «lifeCycleInfo»	
Definition: Date and time at which this version of the spatial object was inserted or changed in the spatial data set. *Note: This is equivalent to 'versionDate' in other MasterMap products; at present, the time part is always set to zero.*	
Type: DateTime	Multiplicity: [1]
Attribute: reasonForChange	
Definition: The cause of the creation of the current version of the feature.	
Type: ReasonForChangeValue	Multiplicity: [1]
Attribute: form «voidable»	
Definition: The nature of the watercourse being represented by the feature.	
Type: WatercourseFormValue	Multiplicity: [1]
Attribute: level «voidable»	
Definition: A description of the relationship of the watercourse to ground level.	
Type: VerticalPositionValue	Multiplicity: [1]
Attribute: provenance	
Definition: The origin of the centrelineGeometry property.	
Type: WatercourseProvenanceValue	Multiplicity: [1]
Attribute: flowDirection «voidable»	
Definition: Direction of water flow in the segment relative to digitisation of segment geometry.	
Type: LinkDirectionValue	Multiplicity: [1]
Attribute: primacy	
Definition: Value indicating the relative importance of the WatercourseLink within any larger watercourse it is part of. *Note: Primary flow is indicated as 1; secondary (and all other levels of) flow is indicated as 2. Further levels are not currently indicated. The primary flow was originally calculated using a combination of attributes.*	
Type: Integer	Multiplicity: [1]

«featureType» WatercourseLink	
Attribute: watercourseNumber	
Definition: The code assigned by a responsible body that is used to identify the watercourse. The responsible bodies are Environment Agency for England, the Scottish Environmental Protection Agency for Scotland, and Natural Resources Wales for Wales. *Not currently populated.*	
Type: CharacterString	Multiplicity: [0..1]
Attribute: watercourseName	
Definition: The name of the watercourse that the WatercourseLink is part of. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla'). See also OS MasterMap Water Network Layer – January 2022 Product Notes.* *Note 2: Where a watercourse has a name in more than one language, then this attribute will be the Welsh or Gaelic version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: watercourseNameAlternative	
Definition: An alternative name of the watercourse that the WatercourseLink is part of. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla'). See also OS MasterMap Water Network Layer – January 2022 Product Notes.* *Note 2: Where a watercourse has a name in more than one language, then this attribute will be the English version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: localName	
Definition: A name that applies to part of a watercourse that is a sub-section of a larger named watercourse that the WatercourseLink is part of. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla'). See also OS MasterMap Water Network Layer – January 2022 Product Notes.* *Note 2: Where a watercourse has a local name in more than one language, then this name will be the Welsh or Gaelic version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: localNameAlternative	
Definition: An alternative name that applies to part of a watercourse that is a sub-section of a larger named watercourse that the WatercourseLink is part of. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla'). See also OS MasterMap Water Network Layer – January 2022 Product Notes.* *Note 2: Where a watercourse has a name in more than one language, then this attribute will be the English version.*	

«featureType» WatercourseLink	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: catchmentName	
Definition: The name of the catchment area where the WatercourseLink falls, assigned by a responsible body. The responsible bodies are Environment Agency for England, the Scottish Environmental Protection Agency for Scotland, and Natural Resources Wales for Wales.	
Type: CharacterString	Multiplicity: [0..1]
Attribute: catchmentID	
Definition: The code of the catchment area where the WatercourseLink falls, assigned by a responsible body. The responsible bodies are Environment Agency for England, the Scottish Environmental Protection Agency for Scotland, and Natural Resources Wales for Wales.	
Type: CharacterString	Multiplicity: [0..1]
Attribute: permanence	
Definition: A logical indicator that describes if the watercourse contains water year-round (in normal conditions) or only contains water intermittently. For example, a flood relief channel would have this set to 'False'.	
Type: Boolean	Multiplicity: [1]
Attribute: managedNavigation	
Definition: A logical indicator that describes whether the watercourse is managed for inland navigation by a member of The Association of Inland Navigation Authorities (AINA). *Note: All values are currently set to false, future releases of the product may include values set to true.*	
Type: Boolean	Multiplicity: [1]
Attribute: length	
Definition: Calculated two-dimensional length of network segment in metres. Value supplied to one decimal place.	
Type: Length	Multiplicity: [1]
Attribute: gradient «voidable»	
Definition: A calculated percentage value that indicates the rate of descent of the surface of the water. See Gradient for derivation. Where the gradient does not correlate with the flow, this value is not supplied and a "nilReason" of 'unknown' is given.	
Type: Real	Multiplicity: [1]

«featureType» WatercourseLink	
Attribute: width «voidable»	
Definition: The average width of the watercourse along the WatercourseLink expressed in metres. This value is void for WatercourseLink features derived from Ordnance Survey large-scales single line features. These values will be given a "nilReason" of 'unknown'.	
Type: Distance	Multiplicity: [1]
Attribute: levelOfDetail	
Definition: A calculated value indicating the relative cartographic importance of a WatercourseLink to aid selection and depiction when styling the data. See LevelOfDetail for derivation.	
Type: LevelOfDetailValue	Multiplicity: [0..1]

2.1.2 Code lists and enumeration

Code list: LinkDirectionValue

Code list: LinkDirectionValue List of values for flow relative to a WatercourseLink coordinate order http://inspire.ec.europa.eu/codelist/LinkDirectionValue/	
Value	**Description**
bothDirections	Water flows in both directions along the watercourse.
inDirection	Water flows in the same direction as the order of the coordinate vertices.
inOppositeDirection	Water flows in the opposite direction to the order of the coordinate vertices.

Where the flow direction has not been determined, this attribute is set to null and a 'nilReason' is given.

- Where the value of nilReason is set to 'unknown', then the flow direction is not known to Ordnance Survey. A correct value may exist, but the methods employed by Ordnance Survey to date have not facilitated capture.
- Where the value of nilReason is set to 'missing', then the flow can be considered indiscernible. Ordnance Survey has attempted to identify the flow on the ground, but no flow has been determined.

Code list: WatercourseFormValue

codeList: WatercourseFormValue Classification value defining the type of WatercourseLink.	
Value	**Description**
Canal	A manmade watercourse originally created for inland navigation.
Drain	A manmade watercourse whose primary purpose is the removal of excess water from a localised area. This attribute is not fully populated in this release of the data; however, it will be added to in future data updates.
Foreshore	A watercourse that flows without a well-defined channel over the foreshore (the area between the high and low water marks).
inlandRiver	A river or stream that is not influenced by normal tidal action.
Lake	A large area of non-tidal water without an obvious flow that is enclosed by land.
lockOrFlightOfLocks	An enclosure in a canal or navigable river with a movable gate and sluices at either end. Designed to allow vessels to move between sections of canal or navigable river at different levels by filling or draining the enclosure. This attribute is not fully populated in this release of the data; however, it will be added to in future data updates. Where watercourses flow through Locks, they are included but may be attributed with a more general term.
Marsh	An area of ground that is predominantly waterlogged by freshwater throughout the year with no identifiable specific alignment for the flow. For the water network, they are captured only where water flows into and out of the marsh and connects to other watercourses.
Reservoir	An area of non-tidal water used for storing water that may be used for irrigation, water supply, power generation or flood control. The area has been created artificially either fully or in part. This attribute is not fully populated in this release of the data; however, it will be added to in future data updates. Where watercourses flow through Reservoirs they are included but may be attributed with a more general term.
Sea	Tidal water where the influence of inland watercourses is negligible, for example, a wide estuary or the open sea. They are usually included to provide connections for watercourses running into estuaries.
tidalRiver	Watercourses that are subject to the effect of normal tidal action. These exist between the Normal Tidal Limit and Point B (an intangible line where the level of a river meets the level of the sea).
Transfer	A manmade watercourse whose primary purpose is to move water from one location to another (using gravity and / or pumping) typically for water supply or power generation.

Where the WatercourseForm has not been determined, this attribute is set to 'null' and the value of nilReason is set to ‘unknown’.

Note: A correct value will exist, but the methods employed by Ordnance Survey to date have not facilitated capture.

Code list: WatercourseProvenanceValue

codeList: WatercourseProvenanceValue The source and / or technique used to create the WatercourseLink feature	
Value	**Description**
OS-line-Urban	The WatercourseLink is based upon Topographic line features representing watercourses within Ordnance Survey basic scale data, where the line feature was originally captured to an accuracy of 0.5m RMSE. See Topographic line and area features for more information.
OS-line-Rural	The WatercourseLink is based upon Topographic line features representing watercourses within Ordnance Survey basic scale data, where the line feature was originally captured to an accuracy of 1.1m RMSE. See Topographic Line and Area features for more information.
OS-line-Moorland	The WatercourseLink is based upon Topographic line features representing watercourses within Ordnance Survey basic scale data, where the line feature was originally captured to an accuracy of 4.1m RMSE. See Topographic Line and Area features for more information.
OS-area-Urban	The WatercourseLink is based upon Topographic area features representing watercourses within Ordnance Survey basic scale data, where the area feature was originally captured to an accuracy of 0.5m RMSE. See Topographic Line and Area features for more information.
OS-area-Rural	The WatercourseLink is based upon Topographic area features representing watercourses within Ordnance Survey basic scale data, where the area feature was originally captured to an accuracy of 1.1m RMSE. See Topographic Line and Area features for more information.
OS-area-Moorland	The WatercourseLink is based upon Topographic area features representing watercourses within Ordnance Survey basic scale data, where the area feature was originally captured to an accuracy of 4.1m RMSE. See Topographic Line and Area features for more information.
Inferred	A WatercourseLink where the alignment has been added by deduction from existing Ordnance Survey Topographic features or terrain data to provide an indicative connection between other WatercourseLink features.
localAuthorityInferred	A WatercourseLink provided by a local authority that has not been measured or otherwise confirmed on the ground, but which has been added to provide an indicative connection between other WatercourseLink features.
localAuthoritySurveyed	A WatercourseLink provided by a local authority that has been measured or otherwise confirmed on the ground.
nationalAuthorityInferred	A WatercourseLink provided by an accepted national authority that has not been measured or otherwise confirmed on the ground, but which has been added to provide an indicative connection between other WatercourseLink features.
nationalAuthoritySurveyed	A WatercourseLink provided by an accepted national authority that has been measured or otherwise confirmed on the ground.

A feature may have been obtained from more than one source; where this is the case, the following priority order is used to assign the provenance value:

1. OS-line or OS-area
2. localAuthoritySurveyed or nationalAuthoritySurveyed
3. localAuthorityInferred or nationalAuthorityInferred
4. inferred

Code List: LevelOfDetailValue

This attribute is currently set to a single value of 'Local', pending future developments in creating an attribute set in sympathy with OS Open Rivers data.

Code list: LevelOfDetailValue A calculated value indicating the relative cartographic importance of a WatercourseLink to aid selection and depiction when styling the data.	
Value	**Description**
Local	A watercourse which is important mainly at a local level, recommended for representation only at scales of 1:20 000 and larger.
District	***Not in this release of the product.*** *A watercourse which is important at a local and district level, recommended for representation only at scales of 1:50 000 and larger.*
Regional	***Not in this release of the product.*** *A watercourse which is important at a local, district and regional level, recommended for representation at scales of 1:250 000 and larger.*
National	***Not in this release of the product.*** *A watercourse which is important at a national level, recommended for representation at all scales.*

Code list: ReasonForChangeValue

Code list: ReasonForChangeValue	
Value	**Description**
New	This is a new feature in the database.
Modified	The feature has been edited by an operator, i.e. the geometry of a feature is changed following real-world change.
Software	Feature has been adjusted by an automatic software process. Includes geometric adjustment, cleaning and reversing direction of digitising.
Reclassified	The classifying attributes of a feature have changed
Restructured	New feature(s) have been created from parts of existing feature(s). Applied to features where a feature is split into two or more features, or when two or more features are joined together.
Attributes	Applied to features that have attributes other than the classifying ones changed.
Position	Correction of position of feature, not related to real-world change.

Enumeration: VerticalPositionValue

Enumeration: VerticalPositionValue The relative vertical position of a feature.	
Value	**Description**
onGroundSurface	The feature is on ground level.
suspendedOrElevated	The feature is suspended or elevated.
Underground	The feature is underground.

Where the VerticalPosition has not been determined, this attribute is empty, with a nilReason explicitly stated as 'unknown'. A correct value does exist, but the methods employed by Ordnance Survey to date have not facilitated capture.

2.2 HydroNode

HydroNode features explicitly represent the starts, ends and junctions of watercourses, and places where certain attribution changes. They only exist at the end points of the WatercourseLink features. HydroNode positions are provided in 3D. The vertical coordinate has been sourced from Ordnance Survey terrain data.

2.2.1 Attributes

«featureType» HydroNode	
Definition: A feature at the end of one or more WatercourseLink features that indicates the confluence of two or more watercourses and / or a change in attribution of the connected WatercourseLink features. Subtype of: HydroNode	
Attribute: reasonForChange	
Definition: The cause of the creation of the current version of the feature.	
Type: ReasonForChangeValue	Multiplicity: [1]
Attribute: geometry	
Definition: The location of the HydroNode.	
Type: GM_Point	Multiplicity: [1]
Attribute: inspireId	
Definition: External object identifier of the spatial object. *Note 1: The localId contains the Ordnance Survey TOID.* *Note 2: An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.*	
Attribute: versionId «lifeCycleInfo»	
Definition: The identifier of the particular version of the spatial object, with a maximum length of 25 characters. If the specification of a spatial object type with an external object identifier includes life-cycle information, the version identifier is used to distinguish between the different versions of a spatial object. Within the set of all versions of a spatial object, the version identifier is unique.	
Type: CharacterString	Multiplicity: [0..1]
Attribute: beginLifespanVersion «lifeCycleInfo»	
Definition: Date and time at which this version of the spatial object was inserted or changed in the spatial data set. *Note: This is equivalent to 'versionDate' in other OS MasterMap products.*	
Type: DateTime	Multiplicity: [1]
Attribute: hydroNodeCategory «voidable»	
Definition: Nature of the HydroNode.	
Type: HydroNodeCategoryValue	Multiplicity: [1]

2.2.2 Code lists

Code list: HydroNodeCategoryValue

Code list: HydroNodeCategoryValue Classification value defining the type of hydrographic node.	
Value	**Description**
flowConstriction	A split in the network captured to indicate a hydrographic point of interest or facility, or a man-made object that affects the network flow. This attribute is not manifested in this release of the data; however, it will be utilised in future data updates.
flowRegulation	A split in the network captured to indicate a man-made object that is used to regulate the network flow. This value is not currently supplied.
junction	A split in the network to indicate where three or more WatercourseLink features meet at the same level, for example, confluences or bifurcations.
Outlet	The end terminal of a set of one or more interconnected links that does not have any downstream flow, for example, where a watercourse sinks into the ground or the point where a river enters the sea.
Source	The start terminal of a set of one or more interconnected links that has downstream flow, for example, springs or collects.
Pseudo	A location where the real-world attribution of a watercourse changes that requires a WatercourseLink to be split.
boundary	HydroNode used to connect different networks. *Note: Can be used to connect cross border networks or adjacent networks together. Differs from source / outlet in that in the real world there is an adjacent link that is not present in the dataset supplied.*

Where the hydroNodeCategory has not been determined, this attribute is set to null and the value of nilReason is set to 'unknown'.

3. Feature types for future release

The following three feature types (WatercourseSeparatedCrossing, WatercourseLinkSet and WatercourseInteraction) are not currently populated in the current version of OS MasterMap Water Network Layer; however, they are referenced in the product's schema which is the controlling specification for the product. The intention is to add these three feature types into future versions of the product.

3.1 WatercourseSeparatedCrossing

Note: Not currently populated in this release of OS MasterMap Water Network Layer.

A feature used to indicate the relationship between watercourses that pass over one another without interaction. The WatercourseLink features are not broken at these locations (Figure 6), and the WaterCourseSeparatedCrossing feature is used to describe the vertical sequence of WatercourseLink features.

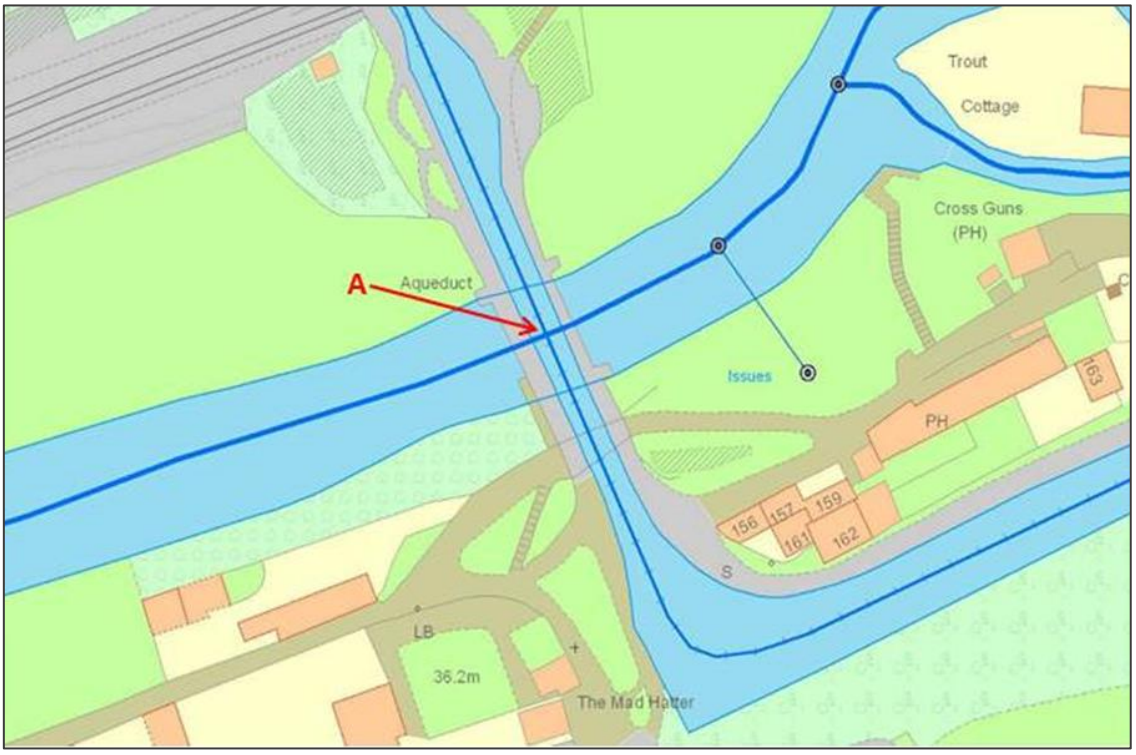

Figure 6: An example of where a watercourseSeparatedCrossing feature would exist.

«featureType» WatercourseSeparatedCrossing	
Definition: A feature that indicates two or more watercourses which pass over one another at different physical levels.	
Subtype of: WatercourseSeparatedCrossing	
Association Role: element	
Definition: Sequence of crossing links. The order reflects their elevation; the first WatercourseLink is the lower WatercourseLink.	
Multiplicity: 2..*	
Attribute: reasonForChange	
Definition: Reason for the current version to be created	
Type: ReasonForChangeValue	Multiplicity: [1]
Attribute: geometry	
Definition: Point where two or more WatercourseLink features intersect.	
Type: GM_Point	Multiplicity: [1]

3.2 WatercourseLinkSet

Note: Not currently populated in this release of OS MasterMap Water Network Layer.

This spatial object type is included for future use to record sets of links that when combined create a recognisable identifiable watercourse, for example, a named river or a canal.

«featureType» WatercourseLinkSet	
Definition: A feature recording a set of watercourse links representing an identifiable watercourse.	
Subtype of: LinkSet	
Attribute: reasonForChange	
Definition: The cause of the creation of the current version of the feature.	
Type: ReasonForChangeValue	Multiplicity: [1]
Attribute: watercourseNumber	
Definition: Official code assigned to identify the watercourse. This is an official identification code assigned by a responsible authority, such as the Environment Agency (EA) or the Scottish Environmental Protection Agency (SEPA).	
Type: CharacterString	Multiplicity: [0..1]
Attribute: watercourseName	

«featureType» WatercourseLinkSet	
Definition: The name of the watercourse that the WatercourseLinkSet is representing. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla')".* *Note 2: Where a watercourse has a name in more than one language, then this attribute will be the Welsh or Gaelic version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: watercourseNameAlternative	
Definition: An alternative name of the watercourse that the WatercourseLinkSet is representing. *Note 1: Where a feature has more than one name, the language of each name is provided as a three-digit ISO 639-2 code ('eng', 'cym', 'gla')".* *Note 2: Where a watercourse has a name in more than one language, then this attribute will be the English version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: watercourseType	
Definition: The type of watercourse that the WatercourseLinkSet represents.	
Type: WatercourseTypeValue	Multiplicity: [1]

Code list: WatercourseTypeValue

codeList: WatercourseTypeValue Classification value defining the type of Watercourse.	
Value	**Description**
catchment	The area drained by a watercourse and its tributaries that enters the sea, a lake or a sink where no further flow is identified. Supplied by the Environment Agency for England, the Scottish Environmental Protection Agency for Scotland, and Natural Resources Wales for Wales.
waterBody	A water body defined under the Water Framework Directive (WFD).
watercourse	A watercourse with an accepted proper name in common use.

3.3 WatercourseInteraction

Note: Not currently populated in this release of OS MasterMap Water Network Layer.

A feature that allows the supply of additional information related to the network in addition to the attribution and geometry of WatercourseLink features. For example, where a watercourse passes under a bridge or over a weir.

«featureType» WatercourseInteraction	
Definition: A feature that describes an event along a watercourse related to the water network that cannot be indicated by the attribution or geometry of the WatercourseLink or HydroNode feature(s).	
Subtype of: NetworkProperty	
Attribute: reasonForChange	
Definition: Reason for the current version to be created.	
Type: ReasonForChangeValue	Multiplicity: [1]
Attribute: watercourseInteractionCategory	
Definition: Not currently populated in OS MasterMap Water Network Layer.	
Type: HydroNodeCategoryValue	Multiplicity: [1]

Interactions can be either PointReference (for interactions less than 2m in length) or LinearReference (for interactions more than 2m in length), which is illustrated in Figure 7. These record the position along a specified WatercourseLink for a point interaction, or the start and end position along one or more links for a linear interaction.

Interactions can be recorded with an offset indicating which side of the WatercourseLink the interaction is and a distance.

Data type: LinearReference

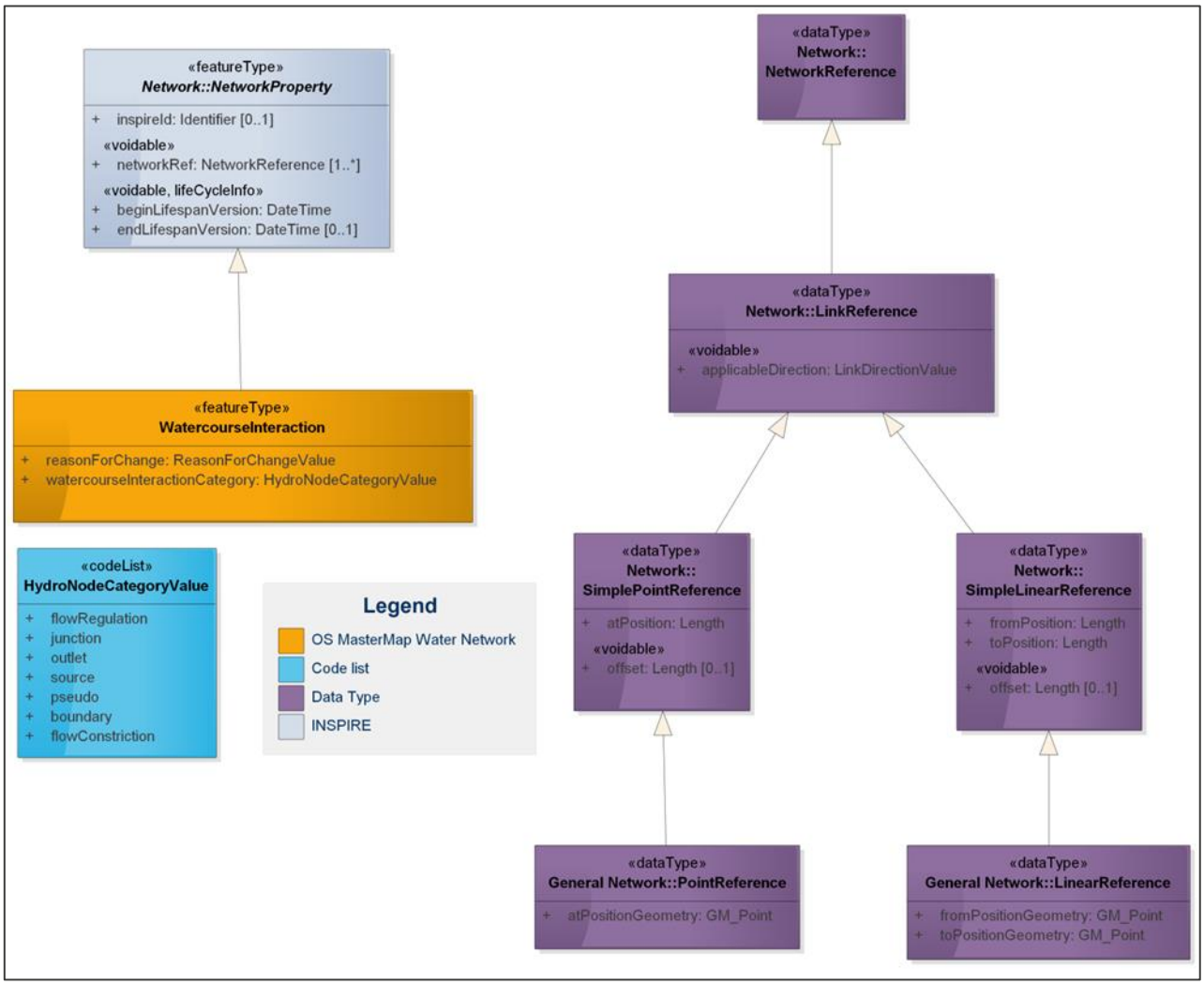

Figure 7: Schema for linear referencing.

The linearReference data type will be used where required to record interaction over a length of a WatercourseLink. For example, in Figure 8, linear interactions could be used to record where the water network passes under the bridge for a distance at A, over a weir at B or has an associated fish pass at an offset at C.

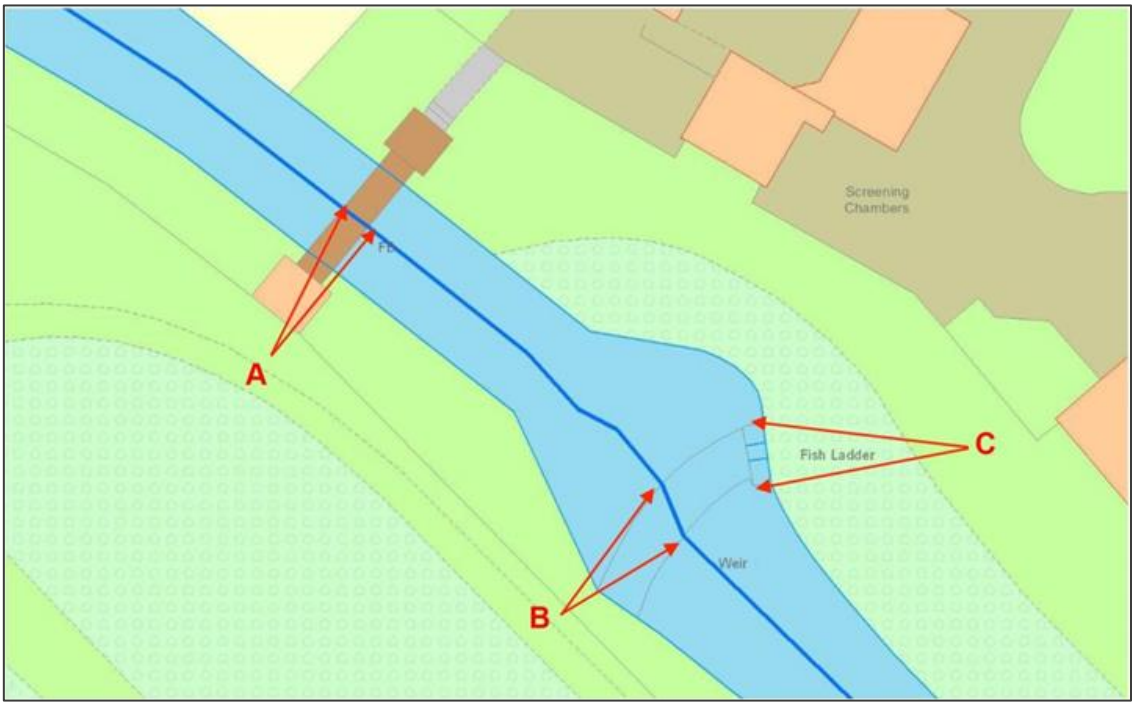

Figure 8: Examples of watercourseInteractions which could be modelled through linear referencing.

Where a linear interaction applies to two or more links, then each part of the interaction is recorded by means of more than one networkReference property.

«dataType» LinearReference	
Definition: Reference to a part of a WatercourseLink along which a specific property applies.	
Subtype of: SimpleLinearReference	
Attribute: fromPositionGeometry	
Definition: Point geometry to explicitly locate the start location from which the property applies.	
Type: GM_Point	Multiplicity: [1]
Attribute: toPositionGeometry	
Definition: Point geometry to explicitly locate the end location to which the property applies.	
Type: GM_Point	Multiplicity: [1]

Data type: PointReference

The pointReference data types will be used to record interactions at points on the WatercourseLink (interactions with a length of less than 2 m). For example, in Figure 9, point interactions could be used to record the presence and position of features such as sluices (point A in Figure 9).

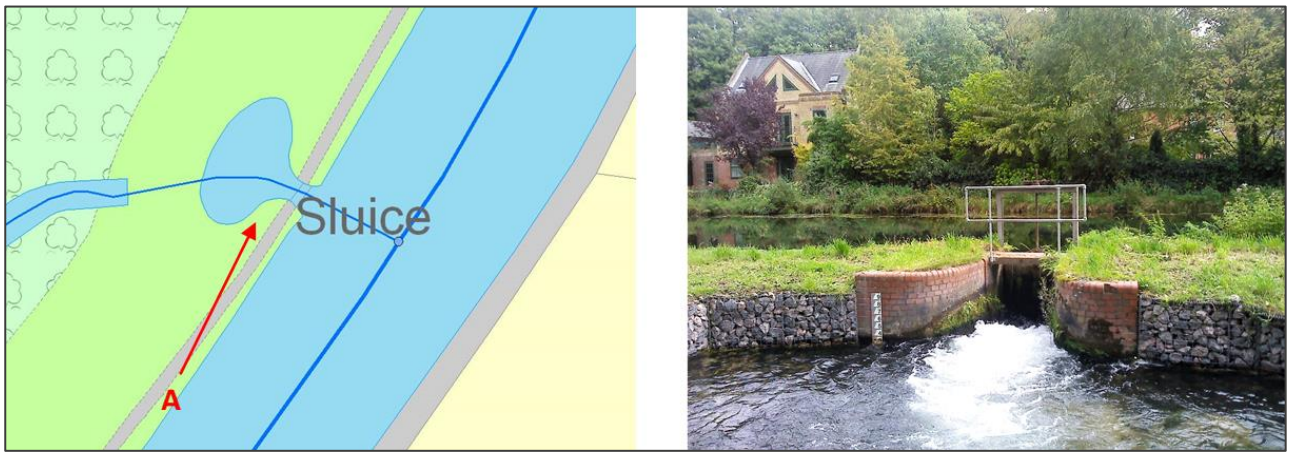

Figure 9: An example of a watercourseInteraction which could be modelled through point referencing.

«dataType» PointReference	
Definition: Reference to specific point on a WatercourseLink at which a specific property applies.	
Subtype of: SimplePointReference	
Attribute: atPositionGeometry	
Definition: Point geometry to explicitly locate where on the WatercourseLink the property applies.	
Type: GM_Point	Multiplicity: [1]

4. GML overview

4.1 Simple Features – Level 1

The Geography Markup Language (GML) data conforms to GML Simple Features Profile Level 1. In this release of the product, the only thing that does not conform to level 0 is the inspireId.

The geometries that we use are OGC 'simple': points, and line strings with linear interpolation.

4.2 Schemas

XML schemas are used to define and validate the format and content of the GML. The GML 3.2.1 specification provides a set of schemas that define the GML feature constructs and geometric types. These are designed to be used as a basis for building application-specific schemas, which define the data content.

The Ordnance Survey application schema *waterNetwork.xsd*, which is referenced by the data, is available on our website. It imports the INSPIRE Hydrography networks application schema, which in turn imports the GML 3.2.1 schemas. These in turn import schemas produced by the W3C. The data contains elements and attributes from a range of namespaces:

Table 1: The XML namespaces used by the application schema and their definitions.

Namespace identifier	Short form prefix	Application schema
http://namespaces.os.uk/mastermap/waterNetwork/1.0	water	OS MasterMap Water Network Layer
urn:x-inspire:specification:gmlas:HydroNetwork:3.0	hy-n	INSPIRE Hydrography networks
urn:x-inspire:specification:gmlas:Network:3.2	net	INSPIRE generic network
urn:x-inspire:specification:gmlas:BaseTypes:3.2	base	INSPIRE base types
http://www.opengis.net/gml/3.2	gml	OGC GML 3.2.1
http://www.w3.org/1999/xlink	xlink	W3C XML Linking
http://www.w3.org/2001/XMLSchema-instance	xsi	W3C XML Schema instance

5. GeoPackage overview

OS MasterMap Water Network Layer is supplied as a single GeoPackage for the whole of Great Britain. GeoPackage (*.gpkg) is an open, non-proprietary, platform-independent, standards-based data format for geographic information systems (GIS), as defined by the Open Geospatial Consortium (OGC). It is designed to be a lightweight format that can contain large amounts of varied and complex data in a single, easy to distribute and ready to use file. GeoPackage is natively supported by numerous software applications.

GeoPackage offers users the following benefits:

• The single file is easy to transfer and offers the end-user a rich experience.

• Attribute names are not limited in length, making the format user-friendly.

• The file size limit is very large at 140 TB[1]

• It supports raster, vector and database formats, making it a highly versatile solution.

• It is an OGC standard.

• In most cases, it is a plug-and-play format.

For information on how to open, use and understand a GeoPackage dataset, please refer to our 'Getting Started with GeoPackage' guide (https://www.ordnancesurvey.co.uk/documents/getting-started-with-geopackage.pdf), which is available on the OS website. Further detailed information on GeoPackage can be taken from the GeoPackage website (https://www.geopackage.org/).

5.1 Attribute naming differences between GML and GeoPackage formats

The naming of attributes between GeoPackage and the Geography Markup Language (GML) file is very similar as GeoPackage files are not limited in the number of characters for an attribute name. Therefore, the following tables map the GML attribute name to the attribute name in the GeoPackage files.

The GML contains an attribute which describes the geometry of the feature; this is not applicable for a GeoPackage file as they are separated by their geometry.

Please note that the use of an asterisk symbol (*) in the following tables indicates that a particular attribute is not mapped to GML.

[1] A file size limit might be imposed by the file system to which the file is written.

5.1.1 WatercourseLink

GML attribute	GeoPackage attribute
*	fid
gml_id	toid
identifier	identifier
centrelinegeometry	geometry
fictitious	fictitious
startNode	start_node
endNode	end_node
localId	local_id
versionId	version_id
beginLifespanVersion	begin_lifespan_version
reasonForChange	reason_for_change
form	form
level	level
provenance	provenance
flowDirection	flow_direction
primacy	primacy
watercourseNumber	watercourse_number
watercourseName	watercourse_name
watercourseNameLang	watercourse_name_lang
watercourseNameAlternative	watercourse_name_alternative
watercourseNameAlternativeLang	watercourse_name_alternative_lang
localName	local_name
localNameLang	local_name_lang
localNameAlternative	local_name_alternative
localNameAlternativeLang	local_name_alternative_lang
catchmentName	catchment_name
catchmentID	catchment_id
permanence	permanence
managedNavigation	managed_navigation
length	length

GML attribute	GeoPackage attribute
length_uom	length_uom
gradient	gradient
width	width
width_uom	width_uom
levelOfDetail	level_of_detail

5.1.2 HydroNode

GML attribute	GeoPackage attribute
*	fid
gml_id	toid
identifier	identifier
reasonForChange	reason_for_change
centrelinegeometry	geometry
localId	local_id
versionId	version_id
beginLifespanVersion	begin_lifespan_version
hydronodecategory	hydronode_category

6. Vector tiles overview

OS MasterMap Water Network Layer is supplied as a national vector tiles set in a single MBTiles file. This is a lightweight set of tiles that are efficient and fast to render in your software, and which provide high-resolution data and give a seamless experience when zooming in and out. The data is supplied in Web Mercator projection (ESPG:3857).

6.1 Vector tiles schema

The vector tiles schema is detailed in the following table. In the zoom levels columns within the table, the letter *N* indicates that the specified layer and attribute are not mapped within that zoom level, whereas the letter *Y* indicates that the specified later and attribute are mapped within that zoom level.

		Zoom level							
Layer	**Attribute**	**0 to 8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
watercourse_link	toid	N	Y	Y	Y	Y	Y	Y	Y
	fictitious	N	Y	Y	Y	Y	Y	Y	Y
	form	N	Y	Y	Y	Y	Y	Y	Y
	level	N	Y	Y	Y	Y	Y	Y	Y
	provenance	N	Y	Y	Y	Y	Y	Y	Y
	flow_direction	N	Y	Y	Y	Y	Y	Y	Y
	primacy	N	Y	Y	Y	Y	Y	Y	Y
	watercourse_number	N	Y	Y	Y	Y	Y	Y	Y
	watercourse_name	N	Y	Y	Y	Y	Y	Y	Y
	watercourse_name_alternative	N	Y	Y	Y	Y	Y	Y	Y
	local_name	N	Y	Y	Y	Y	Y	Y	Y
	local_name_alternative	N	Y	Y	Y	Y	Y	Y	Y
	catchment_name	N	Y	Y	Y	Y	Y	Y	Y
	permanence	N	Y	Y	Y	Y	Y	Y	Y
	managed_navigation	N	Y	Y	Y	Y	Y	Y	Y
	length	N	Y	Y	Y	Y	Y	Y	Y
	length_uom	N	Y	Y	Y	Y	Y	Y	Y
	gradient	N	Y	Y	Y	Y	Y	Y	Y
	width	N	Y	Y	Y	Y	Y	Y	Y
	width_uom	N	Y	Y	Y	Y	Y	Y	Y
	level_of_detail	N	Y	Y	Y	Y	Y	Y	Y

		Zoom level							
Layer	**Attribute**	**0 to 8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
hydro_node	toid	N	Y	Y	Y	Y	Y	Y	Y
	hydonode_category	N	Y	Y	Y	Y	Y	Y	Y

6.2 Attribute naming differences between GML and vector tiles formats

The naming of attributes between vector tiles and the Geography Markup Language (GML) file is very similar as the vector tiles set within the MBTiles file is not limited in the number of characters for an attribute name. The following tables map the GML attribute name to the attribute name in the vector tiles.

6.2.1 WatercourseLink

GML attribute	Vector tiles attribute
gml_id	toid
fictitious	fictitious
form	form
level	level
provenance	provenance
flowDirection	flow_direction
primacy	primacy
watercourseNumber	watercourse_number
watercourseName	watercourse_name
watercourseNameAlternative	watercourse_name_alternative
localNameLang	local_name
localNameAlternative	local_name_alternative
catchmentName	catchment_name
Permanence	permanence
managedNavigation	managed_navigation
length	length
length_uom	length_uom
gradient	gradient
width	width

GML attribute	Vector tiles attribute
width_uom	width_uom
levelOfDetail	level_of_detail

6.2.2 HydroNode

GML attribute	Vector tiles attribute
gml_id	toid
hydronodecategory	hydronode_category

7. Data provenance

7.1 Data creation

Data was created from Ordnance Survey large-scale data with additional input from recognised bodies.

In OS MasterMap Topography Layer, watercourses with less than specified widths are captured as single line features for cartographic clarity purposes. These dimensions are 1m in urban areas, 2m in rural areas and 5m in mountain and moorland areas.

For watercourses captured as area features, algorithms were used to create a network, including generating topological connections if appropriate. Additional connecting geometry has been added to ensure topological connectivity where this can be deduced by inspection.

Watercourses represented by line features were used to generate network lines and these were extended both automatically and manually to indicate connectivity.

Manual improvement was undertaken where validation identified issues with flow and connectivity, and as a result of customer feedback.

7.2 Derived attributes

This section describes how attributes are derived from other information contained within Ordnance Survey large-scale data.

7.2.1 Width attribute

The width attribute is calculated to provide an average width of the Topographic Area feature(s) used to create the network links. There may be significant variation along the portion of the watercourse represented by a WatercourseLink with a single width attribute.

7.2.2 Topographic line and area features

The majority of links in the data were sourced from Ordnance Survey detailed topographic data. Different depictions within Ordnance Survey detailed topographic data are adopted for cartographic clarity purposes, and watercourses may be represented as lines or areas. Watercourses with less than specified widths are captured as single line features, while watercourses with greater than specified widths are captured as area features.

Table 2: Parameters used by OS for topographic line and area features on watercourses.

Locality	Width	Topographic representation	Width attribute
Urban	<1.0m	line	null
Urban	+>1.0m	area	calculated
Rural	<2.0m	line	null
Rural	+>2.0m	area	calculated
Mountain and moorland	<5.0m	line	null
Mountain and moorland	+>5.0m	area	calculated

Advances in data capture techniques mean that the cartographic constraints on capture as area features are now less pronounced. As a result, some features below the minimum widths in the table above may have been captured as areas.

7.2.3 LevelOfDetail

Definition: A calculated value indicating the relative cartographic importance of a WatercourseLink to aid selection and depiction when styling the data.

Currently, this has been populated with a single value pending the development of algorithms to create more usable attribution.

7.2.4 Primacy attribute

The Primacy attribute is derived by assessing a combination of the flow, width, gradient and length of the network WatercourseLink feature to identify the most likely course of the main flow of a watercourse at bifurcations.

7.2.5 Gradient attribute

Gradient is a calculated attribute that indicates the rate of descent of the surface of the water over the entire length of the WatercourseLink.

Gradient is expressed as a percentage or drop in metres per 100 metres of WatercourseLink length.

$$\text{Gradient} = \frac{\text{Height on first vertex} - \text{Height on last vertex}}{\text{Planar length of link}} * 100$$

For more detailed analysis of the WatercourseLink, height is provided on each vertex that can allow a user to calculate gradients within sections of the WatercourseLink.

7.3 Heighting the network

The water network was heighted by interpolation from a bare earth terrain comprising mass points and breaklines. The highest resolution height information available was used in this process. This terrain was captured by Ordnance Survey recently and is the basis for new products that include a height component.

The data used to height the network is of a resolution and quality that in some cases results in height attribution that contradicts the flow attribution. This is typically in areas with little change in elevation. In these cases, the calculated gradient attribute will not be supplied.

Future developments will reduce occurrences by improving the terrain data to reflect the influence of watercourses on the terrain surface.

Annex A: OS MasterMap Water Network Layer – January 2022 product notes

The following annex outlines observations made from product testing and observations which are of note to users of the product. Ordnance Survey is working towards fixing these errors for the next release.

Language qualifiers

The xml:lang attributes are not populated in the product. They are planned for population in a future product release where a feature has more than one name.

Name continuity

The names of watercourses in the product are not all continuous throughout their extent.

HydroNode categories

There are a number of errors with HydroNode features with the hydroNodeCategory value 'Source' and 'Outlet', where the flowDirection of the connected WatercourseLink is in the wrong direction or is unknown.

Geometry issues

There are a number of WatercourseLink features which self-intersect. The vast majority are at the mm level and were created by rounding processes. These will be fixed in a future release.

There are a small number of WatercourseLink features which are shorter in length than 1m.

There are a small number of WatercourseLink features which form a closed loop.

There are a number of double digitised WatercourseLink features across the product.

Annex B: Additional resources

- Further information about the product can be found on the OS MasterMap Water Network Layer product page on the OS website (http://os.uk/waternetwork).
- OS MasterMap Water Network Layer Overview (https://www.ordnancesurvey.co.uk/business-government/tools-support/mastermap-water-support)
- OS MasterMap Water Network Layer Getting Started Guide (https://www.ordnancesurvey.co.uk/business-government/tools-support/mastermap-water-support).

Loading the data (GeoPackage format)

The product's Getting Started Guide focuses solely on using the product in Geography Markup Language (GML) format. For guidance on using the product in GeoPackage format, please see the Getting Started with GeoPackage guide (https://www.ordnancesurvey.co.uk/documents/getting-started-with-geopackage.pdf), which is available on the OS website.

Loading the data (vector tiles format)

The product's Getting Started Guide focuses solely on using the product in GML format. For guidance on using the product in vector tiles format, please see the Getting Started with Vector Tiles guide (https://www.ordnancesurvey.co.uk/documents/user-guides/getting-started-with-vector-tiles-v1.0.pdf), which is available on the OS website.