ORDNANCE SURVEY GB

OS OPEN RIVERS™ – TECHNICAL SPECIFICATION

OFFICIAL
Ver 2.3

Ordnance Survey

Version history

Version	Date	Description
1.0	03/2015	Initial release.
2.0	10/2016	Minor updates.
2.1	07/2019	Minor updates.
2.2	05/2021	Introduction of vector tiles.
2.3	04/2023	GeoPackage format attribute name changes. Formatting and content improvements.

Purpose of this document

This document provides information about and insight into the OS Open Rivers product and its potential applications. For information on the contents and structure of OS Open Rivers, please refer to the Overview.

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Contents

1. Introduction

OS Open Rivers provides a two-dimensional, topologically-structured link-and-node network of Great Britain's watercourses. A link represents the approximate central alignment of a watercourse. Links have been digitised in the direction of water flow. Attribution indicates the flow direction and name of each watercourse.

OS Open Rivers is a generalised product which is automatically derived from Ordnance Survey large-scale data. Generalisation is the process of reducing the scale and complexity of map detail whilst maintaining the important elements and characteristics of the features.

1.1 Available formats

OS Open Rivers is supplied in the following formats:

- Geography Markup Language (GML): A national vector dataset in GML 3.2.1 Simple Features Profile – level 0.
- Shapefile: A national vector dataset in Esri shapefile (.shp) format.
- GeoPackage: A national vector GeoPackage (.gpkg) file.
- Vector tiles: A national vector tiles file in MBTiles format.

1.2 Identifiers

Each feature has a unique identifier. The identifier property name, which holds the feature's unique identifier, differs for each format:

- GML: *gml:identifier* property.
- Esri shapefile: *identifier* property.
- GeoPackage: *id* property.

Note: The identifier is not persistent between product versions; there is therefore no change-history information for features.

1.3 Adherence to standards

OS Open Rivers is based on the INSPIRE Data Specification on Hydrography, which itself is based on the ISO/TC 211 family of open standards.

1.3.1 Extension of the INSPIRE specification

OS Open Rivers extends the INSPIRE specification by extending the INSPIRE WatercourseLink feature type with a number of additional properties.

1.3.2 UML diagram and table conventions

The data structure is described by Unified Modelling 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 are used in the diagrams and tables to distinguish the INSPIRE specification from the additional properties that have been added in the Ordnance Survey specification.

In the UML diagrams, classes from the INSPIRE data specification are grey, whereas classes in the Ordnance Survey specification are orange. All code lists are blue and enumerations are green (see Figure 1. below) The accompanying tables use orange for feature types, blue for code lists, and green for enumerations.

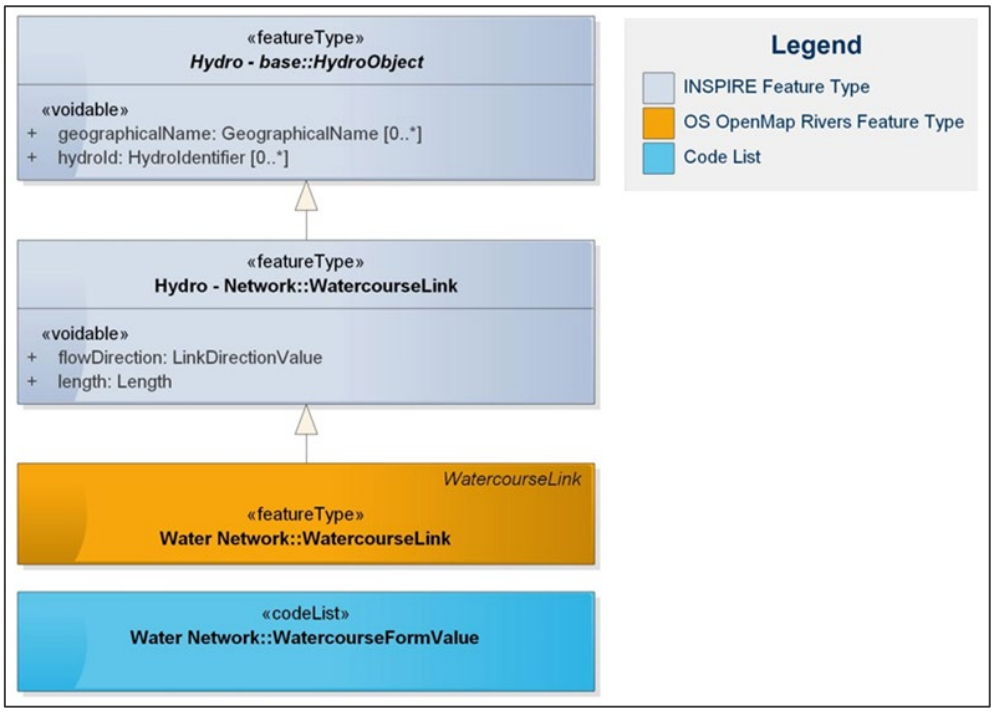

Figure 1: UML class diagram outlining the colour conventions specified in this Technical Specification

1.3.3 Lexical conventions

- Class names are conceptually meaningful names (singular noun) in UpperCamelCase.
- Class names end in *Value* where the class is assigned the stereotype <<CodeList>> or <<Enumeration>>.
- Property names (attributes and associations) are in lowerCamelCase.

1.3.4 Stereotypes

The following stereotypes are used on UML elements:

Stereotype	UML element	Description
Application schema	Package	Parent package containing sub-packages and elements that comprise part of the modular specification.
FeatureType	Class	A spatial object type [ISO 19136].
Type	Class	A structured data type with identity.
CodeList	Class	A controlled set of values for a free text data type that may be extended.
Voidable	Property	A property that is required but is either not currently captured (unknown) or is partially populated (unpopulated).

1.3.5 Relationships and associations

There are four key types of relationship that can be defined between classes, only the following two exist in OS Open Rivers (see Figure 2 below):

1. **Generalisation/specialisation** – This is used to denote either:

    a. An extension relationship - The target class represents the same real-world phenomenon. It has the same name as the class it extends. It simply includes additional properties.

    OR

    b. A sub-typing relationship - The target class defines a specialised sub-type of a parent feature, for example, a TransportNetwork is a sub-type of a generic Network class.

2. **Directed association** – This is used to denote relationships between features. These relationships are by reference only (that is, they are implemented by a property whose value is the identifier of the related feature or object). The directed end is assigned a name that describes the relationship and a multiplicity.

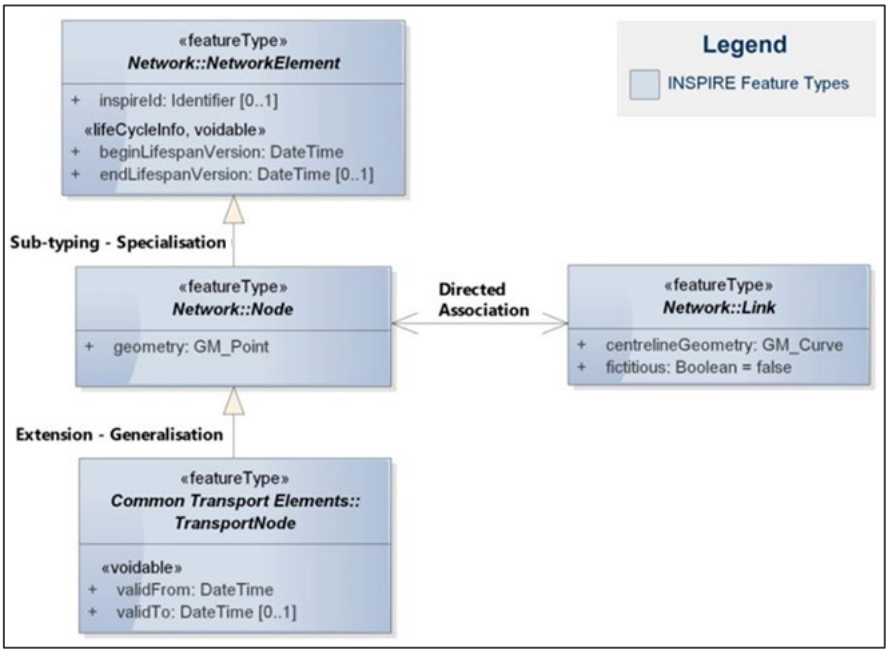

Figure 1: UML class diagram illustrating the key types of relationships in OS Open Rivers.

2. OS Open Rivers structure

2.1 Product structure

OS Open Rivers consists of two core features:

1. **WatercourseLink** – A feature which represents all or part of a watercourse.

2. **HydroNode** – A feature which represents a river's source, end, or where three or more links meet at a junction, and places where the real-world related attribution recorded changes, for example, a watercourse becoming tidal.

This product is based upon the INSPIRE Data Specification on Hydrography. The result is a product that inherits attribution from INSPIRE. An overview of the product's structure can be found in Figure 3 below, which highlights the inherited INSPIRE feature types and attribution. Properties of the INSPIRE specification which are voidable are not included in Figure 3 or the tables that follow. For information on the INSPIRE properties which are not included in this product, please see the INSPIRE Data Specification on Hydrography.

Note: GML attribute naming is used in the main text of this guide. GeoPackage and vector tile attribute naming is very similar to GML as there are no character-length limitations in the GeoPackage or MBTiles formats. However, shapefile attribute naming is limited to 11 characters. Attribute mappings between the formats are provided in Section 4.1 (GML and shapefile), Section 5.1 (GML and GeoPackage), and Section 6.2. (GML and vector tiles).

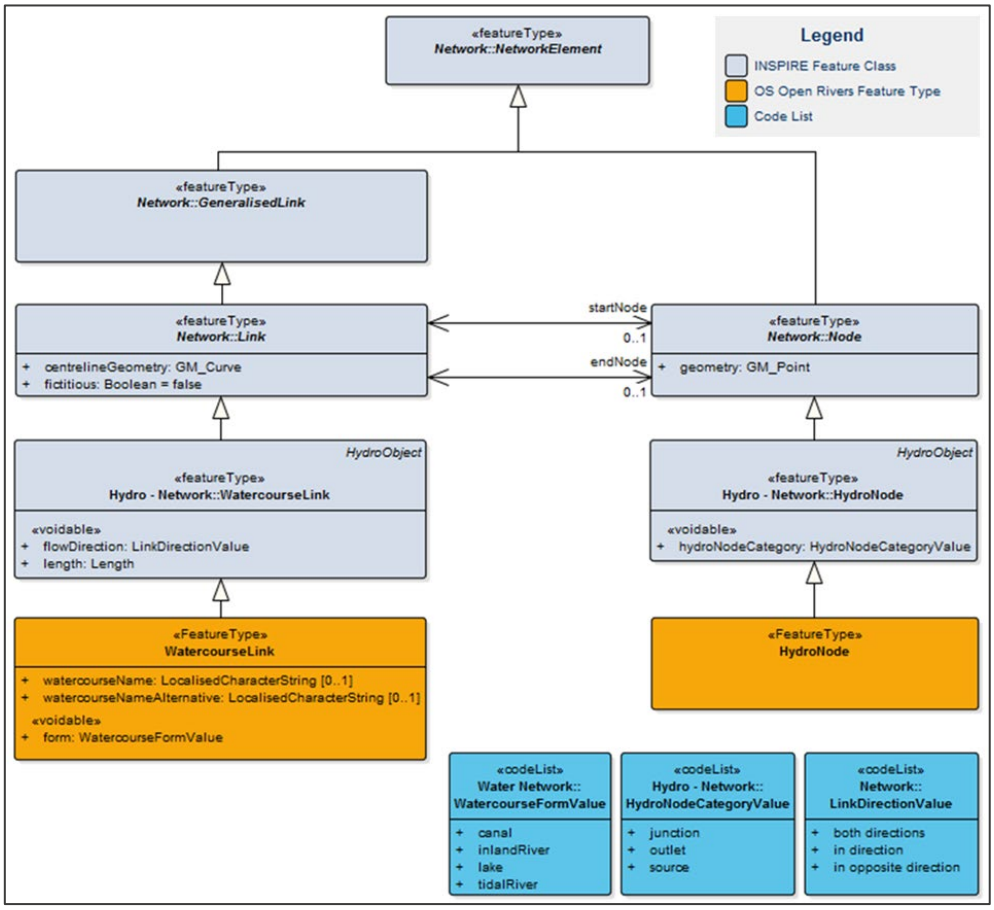

Figure 2: UML class diagram illustrating the data structure of OS Open Rivers and how it has been extended from the INSPIRE Data Specification on Hydrography.

2.2 Features

This section describes the two features available in the OS Open Rivers product and provides the following information about each attribute and association:

- **Name and Definition** – The name of the attribute and what it describes.
- **Attribute Type** – The nature of the attribute, for example, a numeric value or a logical indicator.
- **Multiplicity** – If the element is expected to be populated in the data, and if so, the number of times. An attribute may be optional or mandatory, and may have multiple occurrences. For example:
  - '1' – There must be a value.
  - '2' – There must be two values.
  - 'n' – There may be one or more values.
  - '0' – Population is optional.

  These values may be used in combination.

- **Association** – An association identifies the relationship between features. These relationships are by reference only and the value will be the identifier of the referenced feature.

2.2.1 WatercourseLink

The WatercourseLink feature is a generalised representation of the watercourse alignment. WatercourseLink features are split where their real-world related attribution changes or where they meet to form a junction.

«featureType» WatercourseLink	
Definition: A segment that forms part of a watercourse.	
Attribute: flowDirection «voidable»	
Definition: Direction of water flow in the segment relative to digitisation of segment geometry.	
Type: LinkDirectionValue	Multiplicity: [1]
Attribute: length «voidable»	
Definition: Length of network segment.	
Type: Length	Multiplicity: [1]
Attribute: centrelineGeometry	
Definition: The geometry that represents the centreline of the link.	
Type: GM_Curve	Multiplicity: [1]
Attribute: fictitious	
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]
Attribute: form «voidable»	
Definition: Classification of the type of watercourse that is formed by the WatercourseLink.	
Type: WatercourseFormValue	Multiplicity: [1]
Attribute: watercourseName	
Definition: Recognised name assigned to the watercourse. *Note 1: The language used to define the name shall also be 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, this attribute will be the Welsh or Gaelic version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Attribute: watercourseNameAlternative	

Definition: An alternative name of the main watercourse the link is part of. *Note 1: The language used to define the name shall also be 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, this attribute will be the English version.*	
Type: LocalisedCharacterString	Multiplicity: [0..1]
Association Role: startNode	
Definition: The HydroNode coincident with the first vertex for this WatercourseLink.	
Multiplicity: [0..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: [0..1]	

2.2.2 HydroNode

HydroNode features are added at the start and end of every WatercourseLink feature. They can represent the source of a watercourse, the end of a watercourse, a junction along a watercourse, or a change of real-world related attribution.

«featureType» HydroNode	
Definition: A feature at the end of one or more WatercourseLink features that indicates either the confluence or two or more watercourses and/or a change in the attribution of the WatercourseLink features.	
Attribute: hydroNodeCategory «voidable»	
Definition: Nature of the HydroNode.	
Type: HydroNodeCategoryValue	Multiplicity: [1]
Attribute: geometry	
Definition: The location of the HydroNode.	
Type: GM_Point	Multiplicity: [1]

2.3 Code lists

A code list is a controlled set of values for an attribute. This section identifies the code lists used within OS Open Rivers and describes their values.

2.3.1 LinkDirectionValue

The WatercourseLink feature is attributed with a *flowDirection* with a data type of *LinkDirectionValue*. The following table lists the codes which are used to populate this field and gives a description for each code.

Note: This code list is inherited from INSPIRE and is not extendable.

Code list: LinkDirectionValue List of values for directions relative to a link http://inspire.ec.europa.eu/codelist/LinkDirectionValue/	
Code	**Description**
both directions	In both directions.
in direction	In the direction of the link.
in opposite direction	In the opposite direction of the link.

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.

2.3.2 WatercourseFormValue

The WatercourseLink feature is attributed with a *form* with a data type of *WatercourseFormValue*. The following table lists the codes which are used to populate this field and gives a description for each code.

Code list: WatercourseFormValue Classification value defining the type of WatercourseLink	
Code	**Description**
canal	A manmade watercourse originally created for inland navigation.
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.
tidalRiver	Tidal river or stream (that is, below Normal Tidal Limit).

2.3.3 HydroNodeCategoryValue

The HydroNode feature is attributed with a *hydroNodeCategory* with a data type of *hydroNodeCategoryValue*. The following table lists the codes which are used to populate this field and gives a description for each code.

Note: The code list has been inherited from INSPIRE and is not extendable.

Code list: HydroNodeCategoryValue Classification value defining the type of hydrographic node http://inspire.ec.europa.eu/codelist/HydroNodeCategoryValue/	
Code	**Description**
junction	A split in the network to indicate where three or more watercourses 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, sinks 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.

Where the hydroNodeCategory has not been identified, this attribute is set to null and a *nilReason* of *inapplicable* is given. This will indicate where an attribute of the watercourse changes which requires a watercourseLink to split, for example, watercourseName. In the Esri shapefile, these are given the attribute value of *pseudo*.

3. GML overview

This section describes the GML format for OS Open Rivers. We recommend that you read this section in conjunction with the Open Geospatial Consortium (OGC) document, OpenGIS® Geography Markup Language (GML) Encoding.

The XML specifications on which the GML is based are available from the World Wide Web Consortium (W3C) website: https://www.w3.org/XML/.

Information about Unicode and UTF-8, the character encoding that we use, is available on the Unicode Consortium website: http://www.unicode.org/.

3.1 Schema overview and location

XML schemas are used to define and validate the format and content of the GML. The GML v3.2.1 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, *OSOpenRivers.xsd*, which is referenced by the data, is available on the OS Open page (https://www.ordnancesurvey.co.uk/xml/open/index.html) of the XML file resources section of our website.

It OS schema imports the INSPIRE Data Specification on Hydrography application schema, which in turn imports the GML 3.2.1 schemas. These in turn import schemas produced by the W3C, which are available from the W3C website at: http://www.w3.org/XML/1998/namespace.html.

All these schemas are defined in XML Schema Definition language (XSD), as defined by the W3C.

The OS application schema uses the XML namespaces detailed in the table below. A links to each definition is provided in the last column.

Prefix	Namespace identifier	Definition available at
gml	http://www.opengis.net/gml	http://schemas.opengis.net/gml/3.2.1/gml.xsd
xsi	http://www.w3.org/2001/XMLSchema-instance	Built into the XML schema: http://www.w3.org/TR/xmlschema-1/
xlink	http://www.w3.org/1999/xlink	http://www.w3.org/1999/xlink.xsd

3.2 Simple Features Profile – Level 0

OS Open Rivers conforms to GML 3.2.1 Simple Features Profile – Level 0.

GML is designed to support a wide variety of capabilities, ranging from simple contextual mapping, such as OS OpenMap, to products that include complex geometric property types and even spatial and temporal topology. The Simple Features Profile of GML 3.2.1 defines a restricted subset of GML, which allows for greater interoperability.

4. Esri shapefile overview

OS Open Rivers is supplied as an Esri shapefile. Shapefile is an open file format to store geometry and attribute information about spatial features.

4.1 Attribute mapping

The naming of attributes between GML and Esri shapefile is different; shapefiles limit attribute names to 11 characters, whereas GML has no limit. The tables that follow map the GML attribute name to its Esri shapefile equivalent for the WatercourseLink and HydroNode features.

Note: GML includes attributes which describes the geometry of the features; this is not applicable to shapefile as they are separated by their geometry. The use of an asterisk symbol (*) in the following tables indicates that a particular attribute is not mapped in that format, for example, centrelineGeometry has no shapefile equivalent.

4.1.1 WatercourseLink

GML attribute	Esri shapefile attribute
gml:identifier	identifier
flowDirection	flow
length	length
fictitious	fictitious
form	form
watercourseName	name1
watercourseNameAlternative	name2
startNode	startNode
endNode	endNode
centrelineGeometry	*

4.1.2 HydroNode

GML attribute	Esri shapefile attribute
gml:identifier	identifier
hydroNodeCategory	formOfNode
geometry	*

5. GeoPackage overview

The Open Geospatial Consortium (OGC) defines GeoPackage (*.gpkg) an open, non-proprietary, platform-independent, standards-based data format for geographic information systems (GIS). 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 offer users the following benefits:

- The single file is easy to transfer and offers a rich end-user experience.
- Attribute names are not limited in length, making the format user friendly.
- The file size limit is large at 140 TB.

  Note: A file size limit could be imposed by the file system to which the file is written.
- 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, which is available from the OS Open Rivers support page (https://www.ordnancesurvey.co.uk/business-government/tools-support/open-map-rivers-support) on the OS website. For further information on GeoPackage, please see the GeoPackage website (https://www.geopackage.org/).

OS Open Rivers is supplied as a national GeoPackage file.

5.1 Attribute mapping

The naming of attributes between GeoPackage and GML is very similar as both formats do not limit the number of characters for an attribute name. The following tables map the GML attribute name to its GeoPackage equivalent for the WatercourseLink and HydroNode features.

Note: GML includes attributes which describes the geometry of the features; this is not applicable to GeoPackage files as they are separated by their geometry. The use of an asterisk symbol (*) in the following tables indicates that a particular attribute is not mapped in that format, for example, centrelineGeometry has no GeoPackage equivalent.

5.1.1 WatercourseLink

GML attribute	GeoPackage attribute
gml:identifier	id
flowDirection	flow_direction
length	length
fictitious	fictitious
form	form
watercourseName	watercourse_name
watercourseNameAlternative	watercourse_name_alternative
startNode	start_node
endNode	end_node
centrelineGeometry	*

5.1.2 HydroNode

GML attribute	GeoPackage attribute
gml:identifier	id
hydroNodeCategory	hydro_node_category
geometry	*

5.2 GeoPackage format changes

In April 2023 there were significant changes to the naming patterns in the GeoPackage format. The formatting of most names changed from title case to snake case. The following tables map the previous names to those use after April 2023.

5.2.1 Attribute names

GeoPackage attribute name prior to April 2023	GeoPackage attribute name after April 2023
id	id
flowDirection	flow_direction
length	length
fictitious	fictitious
form	form
watercourseName	watercourse_name
watercourseNameAlternative	watercourse_name_alternative
startNode	start_node
endNode	end_node
hydroNodeCategory	hydro_node_category

5.2.2 Layer names

GeoPackage layer name prior to April 2023	GeoPackage layer name after April 2023
HydroNode	hydro_node
WatercourseLink	watercourse_link

5.2.3 Column names

GeoPackage column name prior to April 2023	GeoPackage column name after April 2023
geom	geometry

5.2.4 Constraints

GeoPackage constraint name prior to April 2023	GeoPackage constraint name after April 2023
HydroNode_pkey	hydro_node_pkey
WatercourseLink_pkey	watercourse_link_pkey

6. Vector tiles overview

OS Open Rivers is supplied as a national vector tileset in a single MBTiles file. This is a lightweight set of tiles that is efficient and fast to render in your software, provides high-resolution data and a seamless experience when zooming in and out. The data is supplied in Web Mercator projection (ESPG:3857).

6.1 Schema overview

The vector tiles schema, as well as the zoom level for each attribute, is detailed in the following table.

Note: In the Zoom levels columns, N (no) indicates that the specified layer and attribute does not display within that zoom level, whereas the Y (yes) indicates that the specified layer and attribute does display within that zoom level.

		Zoom levels						
Layer	**Attribute**	**0 to 8**	**9**	**10**	**11**	**12**	**13**	**14**
watercourse_link	id	N	Y	Y	Y	Y	Y	Y
	flow_direction	N	Y	Y	Y	Y	Y	Y
	length	N	Y	Y	Y	Y	Y	Y
	form	N	Y	Y	Y	Y	Y	Y
	watercourse_name	N	Y	Y	Y	Y	Y	Y
	watercourse_name_lang	N	Y	Y	Y	Y	Y	Y
	watercourse_name_alternative	N	Y	Y	Y	Y	Y	Y
	watercourse_name_alternative_lang	N	Y	Y	Y	Y	Y	Y
hydro_node	id	N	Y	Y	Y	Y	Y	Y
	hydronode_category	N	Y	Y	Y	Y	Y	Y

6.2 Attribute mapping

The naming of attributes between vector tiles and GML is very similar as the vector tiles (set within the MBTiles file) do not limit in the number of characters for attribute names. The following tables map the GML attribute name its vector tiles equivalent for the WatercourseLink and HydroNode features.

Note: The use of an asterisk symbol (*) in the following tables indicates that a particular attribute is not mapped in that format, for example, fictitious has no vector tile equivalent.

6.2.1 WatercourseLink

GML attribute	Vector tiles attribute
gml:identifier	id
flowDirection	flow_direction
length	length
fictitious	*
form	form
watercourseName	watercourse_name
*	watercourse_name_lang
watercourseNameAlternative	watercourse_name_alternative
*	watercourse_name_alternative_lang
startNode	*
endNode	*
centrelineGeometry	*

6.2.2 HydroNode

GML attribute	Vector tiles attribute
gml:identifier	id
hydroNodeCategory	hydro_node_category
geometry	*

Annex A: Related documentation

Guides

You can find additional information and documentation on the OS Open Rivers support page (https://www.ordnancesurvey.co.uk/business-government/tools-support/open-map-rivers-support) of the OS website.

We recommend you read the following guides:

- *OS Open Rivers – Overview.*
- *Getting Started with GeoPackage.*
- *Getting Started with Vector Tiles.*

Stylesheets

Predefined stylesheets for OS Open Rivers are available for download from the OS-Open-Rivers-stylesheets Github repository (https://github.com/OrdnanceSurvey/OS-Open-Rivers-stylesheets).

To download a zip containing all stylesheets, navigate to *Code* > *Download Zip*.