

ORDNANCE SURVEY

OS MasterMap Highways Playbook

Simple ways to tackle common questions

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* Please note that the USRN not currently populated in Scotland

Tips for success

- Focus on the core job that you ultimately trying to get done.
 - What other products will help to get the job done.
 - Don't over complicate the job.
1. Start by doing a data backup.
 2. Translate the data using our FME workbenches.
 3. Follow these easy steps to success!



Scenario 1: Connecting to address data

OS MasterMap Highways contains USRN as a unique reference for each street.

- This is really important as this provides a better link to addressing than the TOID information in the AddressBase Premium cross reference table.
- This also gives more accurate results to users planning and using services by allowing them to link more effectively to a road.
- This improves a users ability to identify properties, for use in routing; planning services such as waste management; calculating routes to school; reviewing service location and provision; identifying those affected by street works.

Use cases

- Identify delivery / collection addresses
- Optimising waste collection
- Metering
- Service review and optimisation



Q » How do I connect addresses to a road?

A » AddressBase will give you a basic answer, but OSMM Highways can tell you much more...

By linking across the relational mode using the unique keys in the data you can link the Roadlink geometry to AddressBase data.

This will give a more reliable match than using the Cross Reference table in AddressBase as it is based upon gazetteer data.

You will need:

TOID

relates to tables of restrictions and other information

in RoadLink and Road tables

USRN*

relates maintenance and reinstatement

in Streets table

What you will need

Data

- Roads Specification
 - Roadlink
 - RoadLink_FormsPartof *
 - Roadlink TOID

And to go one step further

- Road
- Street

* = SQL wildcard this will display all columns in the data in the query result. As an alternative you can list only the columns you need separated by a comma e.g. column1, column2, column 3....

Software

- **Translation software** is required to convert data from GML into chosen format. FME workbenches are available on GitHub to help with this.
- **Data storage** – once translated the data will need to be stored in a format compatible with your systems, this may be on your file system as a shape file, geopackage or tab file or in a database.
- **GIS or web application** to manipulate and display your results.

Steps to success: Connecting to address data

Step 1 – Using your preferred method translate the GML for Roadlink, Road and Street into a format of your choosing.

Step 2 – To join the RoadLink geometry to addresses in AddressBase the USRN* can be used as a cross reference. In the technical specification the USRN of the Street the RoadLink forms part is held in the RoadLink table. However some translators will split this out into a separate table to avoid duplication into a RoadLink_FormsPartOf.

Step 3 – Either in your database or GIS query select the RoadLink you want to find the addresses for. In the example I want to select all properties along the A3026

```
SELECT * FROM highways_nov.roadlink as r, as a WHERE r.roadclassificationnumber = 'A3026'
```

Step 4 – Next is to link to RoadLink_FormsPartOf on TOID in both tables.

```
SELECT * FROM highways_nov.roadlink as r, highways_nov.roadlink_formspartof as a WHERE  
r.roadclassificationnumber = 'A3026' AND r.toid = a.toid
```

Step 5 – This will return a list of RoadLinks with a reference to both the Street and Road it forms part of. As the USRN is a reference to the Street we can exclude Road from our query. In the GML formsPartOf includes these references, some translators may join these in one field or create a separate column.

GML Example: `<highway:formsPartOf xlink:role="Road" xlink:href="#osgb4000000003222248"/>`

Step 6 – The final step is to link to either AddressBase Plus or Premium using the USRN. (AddressBase does not contain the USRN).

* USRN not currently populated in Scotland

The results

Remember...

- USRN in AddressBase is an integer
- To remain INSPIRE compliant, OSMM Highways needs to have the USRN integer value prefixed by 'USRN'

Solution

1. Create a look-up table to combine value from AddressBase with a character field with usrn added

	usrn	usrn_bt
0	84205769	usrn84205769

or

2. Concatenate the 2 fields within your SQL query something like

CONCAT('usrn', usrn)

Completed SQL query

```
SELECT * FROM highways_nov.roadlink as r,
highways_nov.roadlink_formspartof as a WHERE
r.roadclassificationnumber = 'A3026' AND r.toid = a.toid
AND a.reftype = 'Street';
```

Example output

toid	osgb4000000023325840
localid	4000000023325840
roadclassification	A Road
roadclassificationnumber	A3026
formofway	Single Carriageway
operationalstate	Open
primaryroute	FALSE
routehierarchy	A Road
trunkroad	FALSE
roadname1_name	Ludgershall Road
directionality	bothDirections
toid-2	osgb4000000023325840
formspartof	usrn18500987
reftype	Street

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With an output similar to this depending on which columns you choose to return

toid	osgb5000005111833223
roadclassification	A Road
roadclassificationnumber	A3026
formofway	Traffic Island Link
primaryroute	FALSE
routehierarchy	A Road
trunkroad	FALSE
roadname1_name	Tidworth Road
formspartof	usrn18500939
reftype	Street
rm_organisation_name	
la_organisation	
department_name	
legal_name	
sub_building_name	FLAT 4
building_name	HARCOURT HOUSE
building_number	
sao_start_number	
sao_start_suffix	
sao_end_number	
sao_end_suffix	
sao_text	FLAT 4
alt_language_sao_text	
pao_start_number	
pao_start_suffix	
pao_end_number	
pao_end_suffix	
pao_text	HARCOURT HOUSE
alt_language_pao_text	
street_description	TIDWORTH ROAD
alt_language_street_description	
dependent_thoroughfare	
thoroughfare	TIDWORTH ROAD
welsh_dependent_thoroughfare	
welsh_thoroughfare	
double_dependent_locality	
dependent_locality	LUDGERSHALL
locality	
welsh_dependent_locality	
welsh_double_dependent_locality	
town_name	LUDGERSHALL
administrative_area	WILTSHIRE
post_town	ANDOVER
welsh_post_town	
postcode	SP11 9QD
postcode_locator	SP11 9QD
postcode_type	S
delivery_point_suffix	2J
addressbase_postal	D
po_box_number	
ward_code	E05008368
parish_code	E04011760

Additional steps: You can enhance this output even further by considering Road and Street features.

Road feature – this represents a collection of RoadLinks that share the same name or classification number and can be used to create a list of all RoadLink TOIDs for a feature and then linked to a USRN.

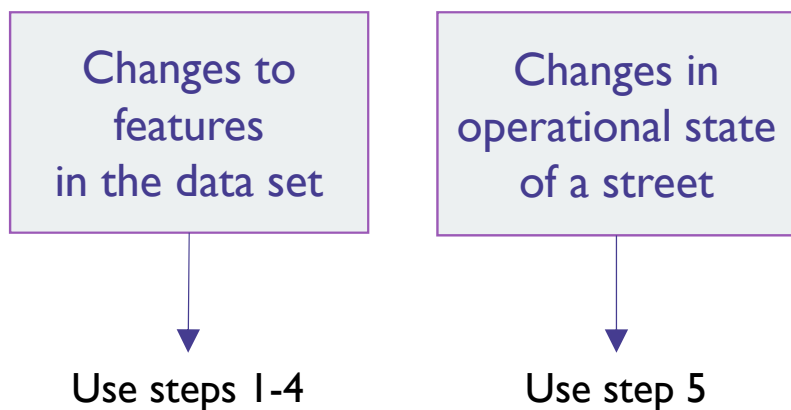
Street feature - Additional information on the street is contained in the Street record and can be linked to the RoadLink using the RoadLink_FormsPartOf reference.

Additional information includes:

- **Street Type:** The type of Gazetteer record for which the USRN relates
- **Operational State:** indicates whether the Street is proposed, under construction, open, or closed (permanently or temporarily)
- **Responsible Authority:** reference to the authority who performs an administrative function – notably naming and numbering
- **Local name:** Unofficial local name associated to the highway

Scenario 2: Identifying change in the network

There are 2 types of change that may be of interest for multiple use cases.



Use cases

- Identify which features change and how that affects other information related to it
- Identify physical change to the road network
- Identify roads under construction and affects on service provision



Steps to success: Identifying change in operational state of a street

- Common attribute is across all features
- Gives the reason why a feature has changed using these values

You will need:

Code List: ChangeValue

Code	Description
New	New feature has been added
Modified Geometry	The geometry of the feature has been altered
Modified Attributes	One or more attribute properties have been altered
Modified Geometry and Attributes	Geometry and attribution properties have been altered

Considerations when adding your own data to OS MasterMap Highways

1. Back-up your data
2. Use feature validation data set (FVDS) to check which features are affected and how (TOID value and UPDATE, INSERT or DELETION)
3. Connect data to either TOID or USRN as this are persistent with a finite life cycle.
4. Further useful information
 - BeginLifespanVersion – gives date of when the object was inserted or changed in the data
 - Validfrom – data when the custodian entered the data into LSG (Street records)

Things to note: Data captured against OS MasterMap ITN Layer is easily transferred over to OS MasterMap Highways

- TOIDS are persistent across both products and have not changed
- Data linked to ITN using TOID should link to Highways
- FVDS can be used to identify where a reference may have changed

Steps to success: Identifying change in the operational state of a street

- Operational State – indicates the construction status of the street *see values on next slide
- Streets – all values are permitted, default is open
- RoadLink – Operational status defaults to open, although may occasionally be under construction
- Special designations table – provides additional information and can be linked directly to Street by USRN.

Code List: OperationalStateValue

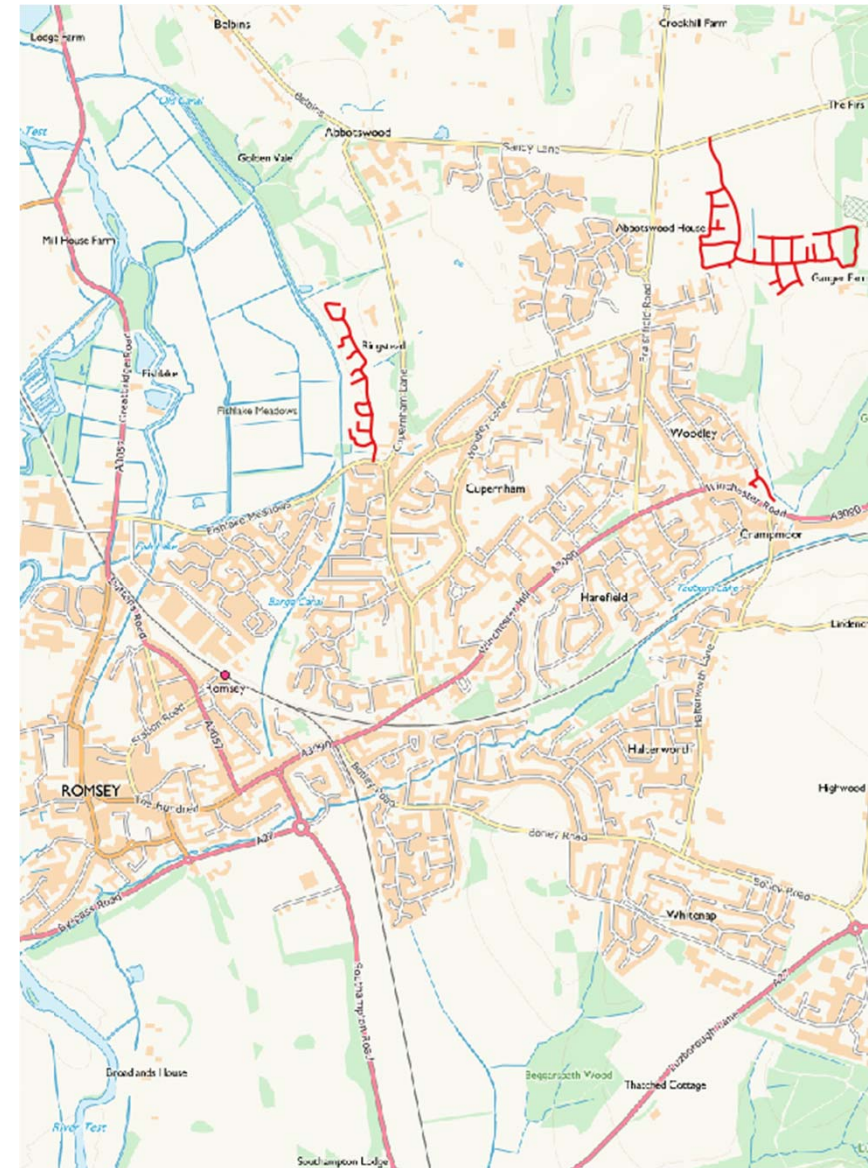
Code	Description
Prospective	Plans have been submitted for development but construction has not commenced.
Under Construction	Construction has commenced but the road cannot be used.
Open	Open
Temporarily Closed	<p>The way has been temporarily closed for a specified reason under Road Traffic Regulation Act 1984 Section 14 1(b):</p> <ul style="list-style-type: none">• Streetworks• likelihood of danger to public• Litter clearing or cleaning (duty imposed by section 89(1)(a) or (2) of the Environmental Protection Act 1990 (litter clearing and cleaning) to be discharged) <p>Note: The operationalState shall only be set to Temporarily Closed when the duration of the closure is intended to last more than 4 weeks.</p>
Permanently Closed	<p>A Street that has been permanently blocked up according to a Stopping Up Order</p> <p>Constraint: If the Street operationalState = Permanently Closed then the endLifespanVersion shall be set.</p>

Scenario 3: Highlighting roads under construction

This is a really easy one to complete...

1. Query the Streets table using this string

Query Streets table - "operationalstate_state" = 'Under Construction'



Scenario 4: Creating a map of winter gritting routes

- Special designations contains references to which streets are gritted.
- This information can be displayed against either the street geometry or road link.

Use cases

- Understanding which is the best route to use in winter avoiding untreated roads where possible
 - Emergency Services
 - Logistics



What you will need

Data

- Roads Specification
 - Roadlink
 - Street
 - StreetNetworkRef
- RAMI Specification
 - SpecialDesingation_Area
 - SpecialDesingation_Line
 - SpecialDesingation_Point
 - SpecialDesingation_NoGeom

Software

- **Translation software** is required to convert data from GML into chosen format. FME workbenches are available on GitHub to help with this.
- **Data storage** – once translated the data will need to be stored in a format compatible with your systems, this may be on your file system as a shape file, geopackage or tab file or in a database.
- **GIS or web application** to manipulate and display your results.

Steps to success: Connecting to address data

Step 1 – Information on Gritting routes is held in the Special Designation tables. This can be viewed with a simple query for example:

```
SELECT networkref, designation, description FROM highways_nov.specialdesignation_area where designation LIKE '%Winter%'
```

Step 2 – However as Special Designation is split into 4 tables depending on geometry type. The results can be merged into 1 table by querying all 4 with UNION ALL and dropping the geometry from the query output.

Step 3 – If you are working with a large data set it may be easier to create a new table of the results. (CREATE TABLE AS...)

Step 4 – The results can be linked using USRN to the Street table and use the geometry to display.

Step 5 – However you may want to add these to RoadLink as this includes classifications as well as road name and number.

Step 6 – This can be achieved by linking the USRN using the StreetNetworkRef table containing TOIDS

```
SELECT * FROM highways_nov.winter AS w, highways_nov.streetnetworkref AS r  
WHERE w.networkref = r.usrn;
```

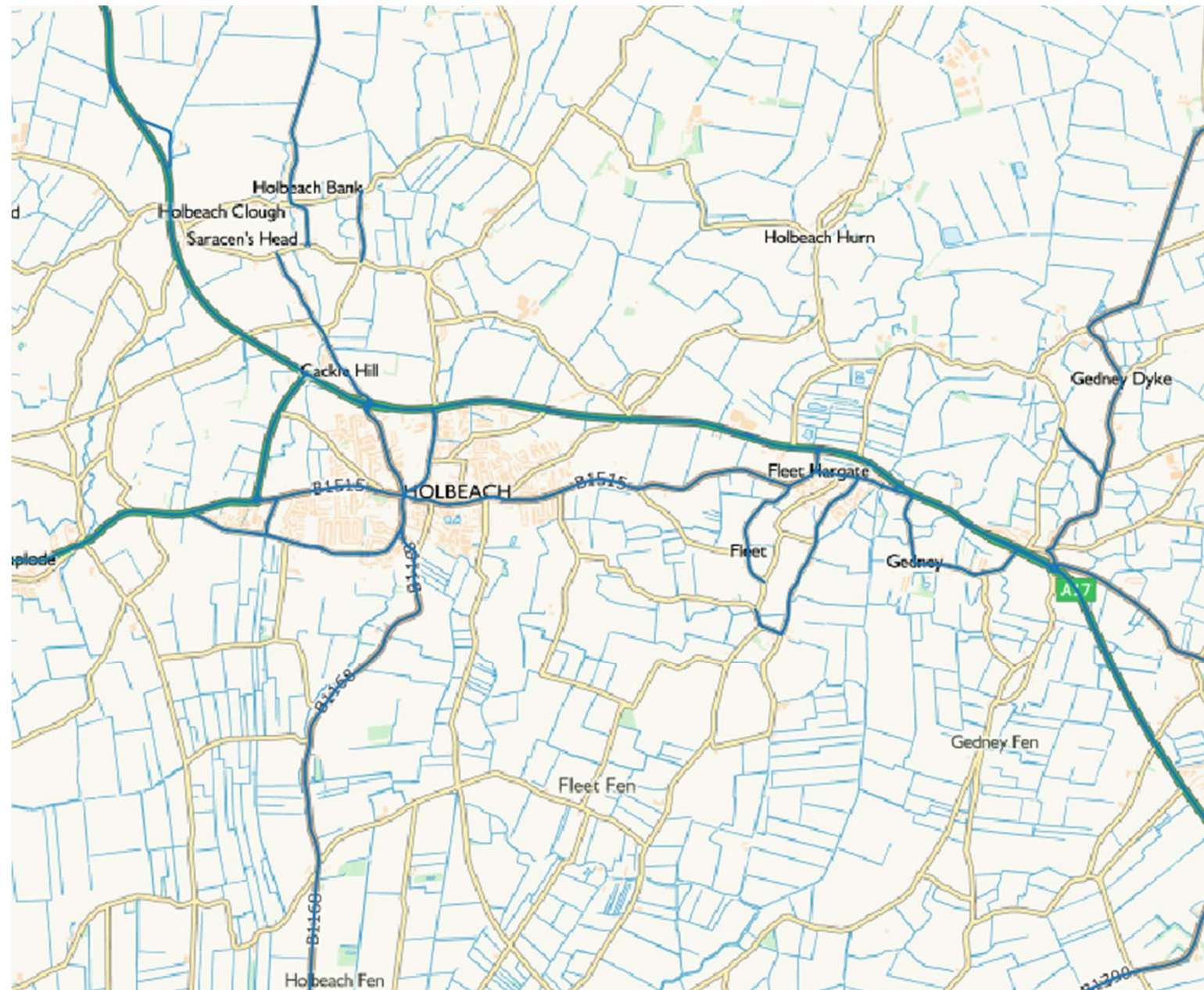
Step 7 – Use the TOID to then join the data to RoadLink, the example limits the information returned

```
SELECT w.designation, w.description, r.toid, r.roadclassification, r.formofway, r.geom FROM highways_nov.winter_toids  
AS w, highways_nov.roadlink AS r WHERE w.roadlink_toid = r.toid;
```

Step 8 – The output can then be displayed on a map or used as part of routable network to add a priority to roads that have been treated.

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With an output similar to this

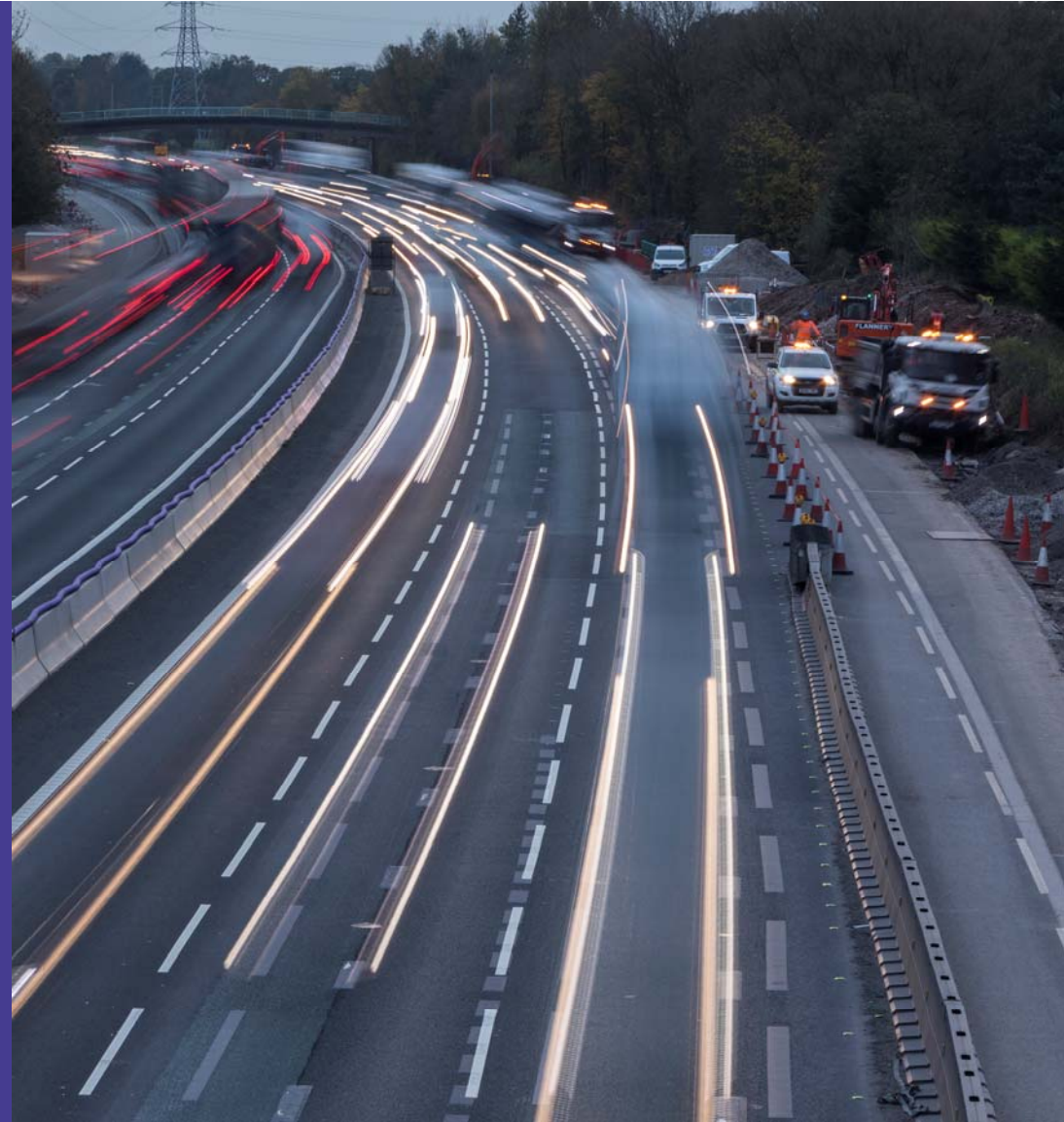


Tips for success: Cleaning Geometry created with FME

- When FME writes to some databases it writes the geometry as geometry and not point, line or area.
- This creates a problem for some software reading the metadata as it does not fully understand the data type.
- This can be resolved by cleaning the metadata table – In PostGIS use

`SELECT Populate_Geometry_Columns()`

- Or by pre-creating the table and in the FME writer set table handling to either 'Use Existing' or 'Create If Needed'.
- An SQL script can be used within FME to create the table if necessary



Scenario 5: Adding road names and numbers to a map

Sources

- RoadLine – includes name, number and alternative name
- Road – includes designated name and who has designated it
- Street – designated name, descriptor and local name

What are the differences?

Street contains designated name given by name and numbering authority. Where matched this will be in the name field on the road link.

Roadlink name comes from name plate from survey this will be alternative on matched streets and name on unmatched

Use cases

- Adding street names to map
- Directions for routing
- Gazetteer searching and identifying the correct street



What you will need

Data

- Roads Specification
 - Roadlink
 - Road
 - Street

Software

- **Translation software** is required to convert data from GML into chosen format. FME workbenches are available on GitHub to help with this.
- **Data storage** – once translated the data will need to be stored in a format compatible with your systems, this may be on your file system as a shape file, geopackage or tab file or in a database.
- **GIS or web application** to manipulate and display your results.

Steps to success: Adding road names and numbers to a map

Step 1 - Local name contains other names the authority may know a street by.

Step 2 - The GML and may contain multiple values for each e.g.

`<highway:roadName xml:lang="cym">Ffordd Conway</highway:roadName>`

`<highway:roadName xml:lang="eng">Conway Road</highway:roadName>`

Step 3 - Note a language field is also present to indicate the language of the name, e.g. English, Welsh or Gallic. These can either be held as one or split into multiple fields.

Step 4 - Once translated the road names can be added to either roadlink or street geometry using the labelling tools within your chosen software.

Step 5 - You may want to combine names across tables, for instance display the local name with road name on the roadlink

There are a number of ways to do this

1. Construct a query in your labelling tool
2. Append local name from street to roadlink
3. Create new table of roadlinks with the columns containing the labels

primaryroute	r
routehierarchy	Local Road
trunkroad	f
roadname1_name	Ffordd Conway
roadname2_name	Conway Road
roadname1_language	cym
roadname2_language	eng
directionality	bothDirections
startnode	osgb40000000012468572
endnode	osgb40000000012520731

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Sample code for creating name table

```
CREATE TABLE schema.local_names AS
SELECT
r.roadclassification, r.formofway, r.roadname1_name, r.roadname2_name, s.localname1, s.localname2, r.geom
FROM
schema.roadlink AS r, schema.street AS s, schema.streetnetworkref AS n
WHERE
(r.toid = n.roadlink_toid)
AND
(s.usrn = n.usrn);
```

Scenario 6: Merging tables and dropping geometry... ...make the data easier to use

- Maintenance, Reinstatement and Special Designation can have different geometry (point, line or area) or no geometry.
- In a non-spatial database this is not a problem and they can easily be merged into one.
- A spatial database will not allow mixed geometry types.
- It is suggested to create a new table, dropping the geometry.
- Link to geometry can then be preserved if required.

What you will need

Data

- RAMI Specification
 - Maintenance
 - Reinstatement
 - Special Designation

Software

- **Translation software** is required to convert data from GML into chosen format. FME workbenches are available on GitHub to help with this.
- **Data storage** – once translated the data will need to be stored in a format compatible with your systems, this may be on your file system as a shape file, geopackage or tab file or in a database.
- **GIS or web application** to manipulate and display your results.

Steps to success: Merging tables and dropping geometry

Step 1 - Create table statement with UNION ALL

```
CREATE TABLE highways_nov.maintenance AS
SELECT id, maintenanceresponsibility, partialreference, highwayauthorityname, highwayauthorityid,
maintenanceauthorityname, maintenanceauthorityid, referencetostreetusrn, locationdescription FROM
highways_nov.maintenance_line
UNION ALL
SELECT id, maintenanceresponsibility, partialreference, highwayauthorityname, highwayauthorityid,
maintenanceauthorityname, maintenanceauthorityid, referencetostreetusrn, locationdescription FROM
highways_nov.maintenance_area
UNION ALL
SELECT id, maintenanceresponsibility, partialreference, highwayauthorityname, highwayauthorityid,
maintenanceauthorityname, maintenanceauthorityid, referencetostreetusrn, locationdescription FROM
highways_nov.maintenance_point
UNION ALL
SELECT id, maintenanceresponsibility, partialreference, highwayauthorityname, highwayauthorityid,
maintenanceauthorityname, maintenanceauthorityid, referencetostreetusrn, locationdescription FROM
highways_nov.maintenance_nogeom
```

Scenario 7: Creating a routable network

OS MasterMap Highways contains the information need to build network data sets taking into consideration the features that control where we can drive such as one way streets, no entry etc..

The data can be used to create routes for emergency response, refuse collection or delivering goods. Adding the Path data set extends the network capabilities allowing you to generate walking routes and look at access to services such as schools and health practices.

Use cases

- Emergency Service command & dispatch
- Routes to school
- Public transport planning
- Optimising waste collection
- Service review and optimisation

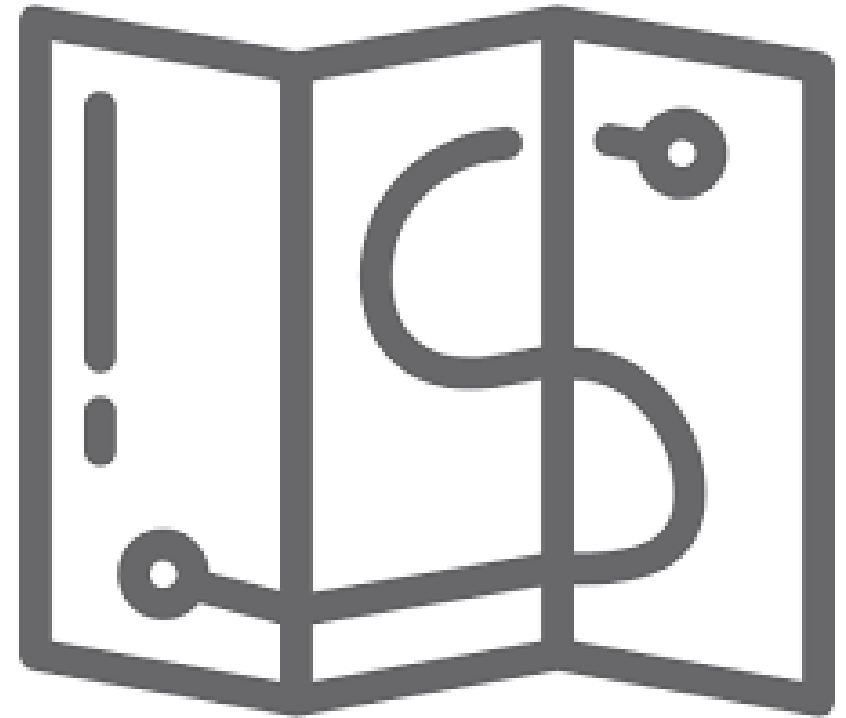


Tips for success:

Popular routing software packages

There are a number of options for use in routing and some systems will have this built in. The most popular across the Public Sector are:

- **RouteFinder** – Produced by a 3rd party to provide a routing engine for MapInfo Pro. Has a translator which supports Highways
- **Network Analyst** – The beta version in ArcGIS Pro provides support for Highways.
- **pgRouting** – An open source routing extension to PostGreSQL / PostGIS. Results can be displayed in any software that can support the database however QGIS has tools for this.
- **CadCorp MapModeller** – Has a built in routing engine with support for Highways.



What you will need

Data

- RAMI Specification
 - Roadlink
 - Roadnode
 - TurnRestrictions
 - AccessRestrictions
 - FerryLink
 - FerryNode
 - Hazards
 - Structures

And to go one step further

- Path Specification
- PathLink
- PathNode
- ConnectingLink
- ConnectingNode

Software

- **Translation software** is required to convert data from GML into chosen format. FME workbenches are available on GitHub to help with this.
- **Data storage** – once translated the data will need to be stored in a format compatible with your systems, this may be on your file system as a shape file, geopackage or tab file or in a database.
- **Routing application** to perform the routing analysis and display the results in a meaningful way.

Steps to success: Creating a routable network

Step 1 - Using your preferred method translate the GML, this will also depend on the routing application used, some have their own translators.

Step 2 - Build a routable network – your software will have tools to do this for incorporating the restrictions etc.

For pgRouting a useful guide can be found here - <https://github.com/mixedbredie/highways-for-pgrouting>

Step 3 - Add additional information to your network such as road speed

You will need:

TOID

relates to tables of restrictions and other information

in RoadLink and Road tables

USRN

relates maintenance and reinstatement

in Streets table

Additional steps: You can enhance this output even further with the addition of PathLinks to make a walking network

Path Specification

- PathLink
- PathNode
- ConnectingLink
- ConnectingNode

Add these to the RoadLinks to create a new data set and then use the same steps to create a network

Still to come...

- Conveyancing – including mapping PROW
- Statistical reporting