

Linking utility assets to OS MasterMap[®] Integrated Transport Network[™]

**An investigation into linking Assets from a Utility
company to OS MasterMap Integrated Transport
Network (ITN).**

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1 Introduction

The concept of associating data using a common reference has many business benefits, which are not limited to providing a definitive referencing system for companies to integrate their asset data and all other forms of associated information using OS MasterMap Integrated Transport Network (ITN) as the common denominator. This project attempts to link a company's asset data to definitive location referenced through unique identifiers. This helps to deliver a high level of data integrity which is necessary for making critical business decisions. An important advantage of this project is that the methodology would enable the company to easily associate data from external sources and share the location of its assets with relevant bodies in a reliable way, thus conforming to the principles of the digital national framework (DNF).

This report presents the results of an investigation into the feasibility of linking a utility company's assets to OS MasterMap Integrated Transport Network in particular and OS MasterMap as a whole. The report also outlines the methodology used to link assets to ITN and local street gazetteer (LSG) data, and the constraints of the process. The procedure was undertaken using off-the-shelf software and a logical process to provide proof that the procedure would enable any utility company to successfully integrate their assets with OS MasterMap and thus the real world.

The aim of this report is to outline a methodology that would provide a set of reference tables that allow the referencing of a particular asset through the following: the topographic area(s) it falls on; the nearest LSG elementary street unit (ESU); the nearest ITN RoadLink and the Address Layer 2 (AL2) features that reference the identified ITN RoadLink.

A key element of the project was to investigate the technical feasibility and constraints of linking the assets to ITN, the topographic and Address layers of OS MasterMap through the use of unique identifiers called topographic object identifiers (TOIDs). TOIDs are given to all features within OS MasterMap and can be used to represent real world change through versioning. Every TOID has a life-cycle which controls its maintenance and use; this control combined with its uniqueness allows the TOID to be used as a base for data association.

Asset data from East Sussex and Kent counties was chosen as a sample area of data on which to perform the integration with ITN and OS MasterMap, because it was felt that this area provided a good urban and rural mix.

1.1 Integrated Transport Network

ITN is the geographic reference for Great Britain's transport network. It provides a definitive road network from motorways to alley ways. It also provides detailed road routing information (RRI) from one-way streets to bridge heights and weight restrictions.

The data in ITN is grouped into two main themes: the Road network consisting of the road links and road nodes; and the road routing information which provides features that may affect a driver's choice of route, for example, one way road, time, height and vehicle-type restrictions.

ITN is a topologically structured network that is flexible and can be used as a precise foundation for road routing, the coordination of street works and emergency planning. The attempt to link assets to the ITN network in this project stems from the fact that it is a linear network which is topological structured and would provide comprehensive and definitive information for asset management. The use of unique identifiers (TOIDs) associated with each link and node provides a reference for traffic-flow analysis at crucial junctions and allows organisations to attach their own data. This makes the data flexible and intelligent.

1.2 Topography Layer

The OS MasterMap Topography Layer is a large-scale digital database of the detailed surface features on the landscape, with relative positions and elevations of every town, manor, parish, or tract of land mapped to minute detail. This highly accurate, flexible resource covers some 400 million man-made and natural features, from fields to pillar boxes, each with its own unique identifier or TOID for easy reference.

The Topography Layer helps with planning and asset management by enabling users to visualize the context of any feature or site, to pinpoint individual properties and precise sites when a high level of detail is required, and to assess the impact of a proposed development effectively and efficiently. It provides a base upon which to accurately position and record company assets, and to deliver valuable time savings for customers needing to quickly define large areas for data capture. The polygon structure can help users select areas with a single click instead of being restricted within outlines of non-polygonised datasets.

1.3 Address Layer 2

The OS MasterMap Address Layer 2 provides precise coordinates for more than 26 million residential and commercial properties in Great Britain, it is the most accurate and up-to-date link between any property address and its location on the map. Address Layer 2 originates from the Royal Mail's postcode address file (PAF[®]). Ordnance Survey uses on-the-ground GPS survey, aerial imagery and various other techniques to establish precise coordinates for each address and match this to the property on the map; effectively joining up postal and topographic geography, creating a fixed link between the property and its address.

Address Layer 2 is a fundamental tool in asset management. It meets the needs of businesses providing essential doorstep services such as gas, water, electricity and telecommunications; and the need to relate a customer or property to the support infrastructures in the street. Utility providers are able to quickly identify customers affected by interrupted services by correlating faulty infrastructure with properties supported by those infrastructures. Fire, ambulance and police services are able to instantly identify an address location to increase their response times in emergency situations.

1.4 Local street gazetteer

The LSG is the reference system used created and maintained by local highway authorities in the notification process and the coordination of street works. Under legislation, each local highway authority in England and Wales is required to create and maintain its own LSG and associated street data (ASD).

There are three levels of the LSG, with each successive level adding more detail. The level 1 specification of the LSG provides each street with a unique reference number (USRN); and defines the start and end coordinates of a street along with associated information such as its name, town, locality and administrative area. The level 2 specification is similar to the level 1 specification but it also provides coordinates to intermediate points between the start and end coordinates of the street. These intermediate points split the streets into different sections called Elementary Street Units (ESU). The level 3 specification provides level 1 and 2 attributes including additional points or vertices relating to the geometry of the street as defined by its ESUs.

For more information on the content and specification of the NSG please refer to the NSG website which can be found in the reference section of this document.

1.5 Description of the assets

The asset data provided for use in this study was obtained from a regional water company and contained the following assets with the table names outlined below in bold. The geometries of the different assets are shown in brackets while the diagrams below depict how they were displayed in the geographical information system (GIS) used for this project. The geographical coordinates and attributes of the assets were provided in these tables. Attributes such as installation date, locality and operational status were included in the tables.

- i. **NewSewjunct (point)**: These include point sewer junction assets such as junctions, end nodes, boundary nodes, capped ends and main changes. They are represented as point features in the GIS.



- ii. **NewSewjunct (polyline)**: These are also sewer junction assets such as end nodes, capped ends and junctions. However, they have a different geometry because they are represented as linear features in the GIS.



- iii. **NewMkwmain (polyline)**: These are pipeline assets which form part of a larger network. The attribute data provided for these pipes include the diameter and material of the pipes and also the type of water they transport.



- iv. **NewSewmain (polyline)**: These are also pipeline assets which are part of the larger pipe network. They include the following: Supply, trunk, mains, transmission, distribution and private pipes. The attribute data for these assets included information such as the pipe length, pipe material and their strategic importance in the network.



2 Methodology

The procedure to link the Assets to ITN was done in incremental stages which used a variety of steps which are explained in the following sub chapters. The different stages were based on linking the assets to the different layers in OS MasterMap and the LSG. The successful linking of the assets depended on being able to link the unique identifiers of each particular asset to different OS MasterMap features.

The different stages of the procedure are outlined below.

Stage 1

The first stage of the project was to create identifiers that would uniquely identify each asset and then create a spatial link between the assets and the topographic area(s) they fall in. There will also be a requirement to identify the different surface types the assets fall within.

Stage 2

This stage of the project is divided into two parts. The first part would involve translating the LSG data into a form suitable to be used in a GIS by adding geometry and making it a structured dataset. The second part would match each ESU in the LSG to the nearest ITN RoadLink.

Stage 3

After the first two stages are completed, the next stage would be to link the topographic areas identified in the first stage to the ITN RoadLinks referred to in stage two.

Stage 4

The final stage would involve identifying the AL2 points that reference the identified ITN RoadLinks in stage two.

2.1 Linking assets to the Topography Layer

The first step taken in the procedure was to link the assets to the Topography Layer spatially.

To achieve this, a short process was developed with software code; this process could also have been manually done in a GIS but using a piece of code to automate this step made the overall procedure faster and more efficient.

To simplify the process, the tables containing information about the topographic areas in the two counties were merged into one. A unique identifier was then created for each asset and the four asset tables were updated (see figure 1). The reason for doing this is because the object identifiers generated by the GIS software are only unique for a particular asset table; so to identify a particular asset uniquely from all the different asset types a unique identifier had to be created. The process was then run on each asset table and the table containing all the topographic areas. The process is explained in greater detail in the following paragraphs.

MKWMANID *	OBJECTID	GID	MATERIAL	DIAMETER	MAINTYPE	OPERATIONIA	WATERTYPE	STRATEGICH	NOTES	DGNZONE	LENGTH	MI_PRIX	COUNTY
Mk1	109017	82440	PE	125		EX	Treated			TN12 6	147.914833	9506	Kent County
Mk2	109076	82432	CI	101.6		AB	Treated			TN12 6	120.965669	9506	Kent County
Mk3	109077	82433	PE	125		EX	Treated			TN12 6	188.511583	9506	Kent County
Mk4	109078	82434	CI	101.6		AB	Treated			TN12 6	36.808797	9506	Kent County
Mk5	109073	82429	CI	101.6		AB	Treated			TN12 6	47.640722	9506	Kent County
Mk6	109018	82441	CI	101.6		AB	Treated			TN12 6	47.277378	9506	Kent County
Mk7	109072	82428	CI	101.6		AB	Treated			TN12 6	27.105049	9506	Kent County
Mk8	109610	255086	PE	125		EX	Treated			TN12 6	9.365426	9506	Kent County
Mk9	109014	82427	PE	125		EX	Treated			TN12 6	7.018032	9506	Kent County
Mk10	109015	82438	CI	101.6		AB	Treated			TN12 6	30.784272	9506	Kent County
Mk11	109079	82436	PE	125		EX	Treated			TN12 6	24.017358	9506	Kent County
Mk12	109609	255081	PE	125		EX	Treated			TN12 6	4.121477	9506	Kent County
Mk13	109016	82439	CI	101.6		AB	Treated			TN12 6	65.194594	9506	Kent County
Mk14	109608	255080	PE	125		EX	Treated			TN12 6	2.441311	9506	Kent County
Mk15	109080	82437	PE	125		EX	Treated			TN12 6	3.217805	9506	Kent County
Mk16	109074	82430	CI	101.6		AB	Treated			TN12 6	53.912023	9506	Kent County
Mk17	109075	82431	PE	125		EX	Treated			TN12 6	37.692688	9506	Kent County
Mk18	109084	82487	PE	125		EX	Treated			TN12 6	33.351369	9506	Kent County
Mk19	109060	82483	HPPEP	180	DIS	EX	Treated			TN12 6	0.559017	9506	Kent County
Mk20	109059	82481	HPPE	180		EX	Treated			TN12 6	2.345519	9506	Kent County
Mk21	109566	209811	HPPEP	180	DIS	EX	Treated			TN12 6	82.500098	9506	Kent County
Mk22	109091	82506	PE	125		EX	Treated			TN12 6	641.919516	9506	Kent County
Mk23	109088	82496	HPPEP	180	DIS	EX	Treated			TN12 6	107.608585	9506	Kent County
Mk24	109089	82497	CI	101.6		AB	Treated			TN12 6	266.985857	9506	Kent County

Figure 1: Asset Table with new column containing unique identifiers highlighted.

The process loops through an asset table, and on each iteration selects the asset object of a particular asset and then does a spatial intersection with the objects in the table containing all the topographic areas. This spatial intersection forms a many-to-many (M: M) between the assets and the topographic areas they intersect.

Then all the topographic areas which the asset intersects with are then selected into a different table including the attribute information of the topographic features. Then the process writes out each asset and all the topography features it intersects with into an output file. The process also writes out the descriptive group and type of every selected topographic area.

The next step taken was to import into the GIS the output files obtained from the process for each asset type and then create a cross-reference table between the asset tables and the Topography Layer (see Figure 2). To create the cross-reference table, the three asset tables were merged into one table with three columns; the first for all the unique asset identifiers, the second for the TOIDs of the topographic area(s) they intersect and the final column contained the TOID version numbers.

OID	ASSETID *	TOID *	VERSION *
0	SM1	1000001762427394	13
1	SM1	1000001762427316	7
2	SM1	1000001762427319	3
3	SM1	1000001762564772	4
4	SM1	1000001762564544	2
5	SM1	1000001762564597	3
6	SM1	1000001762564842	2
7	SM1	1000001762564489	3
8	SM1	1000001762564822	3
9	SM1	1000001762564490	2
10	SM1	1000001762564757	2
11	SM1	1000001762564862	2
12	SM1	1000002091126561	4
13	SM1	1000002091126562	7
14	SM1	1000002091126555	5
15	SM1	1000002091126559	3

Figure 2: Cross-Reference Table between Assets and Topographic areas.

To improve performance and the speed with which attributes can be searched and queried; spatial indexes were created on all columns in the cross-reference table between the topographic areas and the assets. Spatial indexes were also created on the TOID and TOID Version columns in the topographic area table, and also on the unique asset identifier and TOID columns in the output tables. Spatial indexes can be built in a spatial database or using an indexing tool in a GIS.

The final step of this stage was achieved using the relate tool available in a GIS. The Relate tool allows you to associate different types of datasets together by giving access to the different tables through a common field (see figure 3). It is employed in this procedure because a M: M relationship exists between the assets and the Topography Layer features. Relates are bi-directional, therefore both tables involved will be able to use the relate regardless of which table owns the relate. For example, if a relate is created on Table A for Table B, the Relate will be listed under Table A, but Table B will be able to use it to access records in Table A. Relates can also be done in a spatial database using primary and secondary keys on both tables to base the relate on. The GIS used in this project was ESRI Arc Map® 9.2, however the data relation can be done in any other GIS.

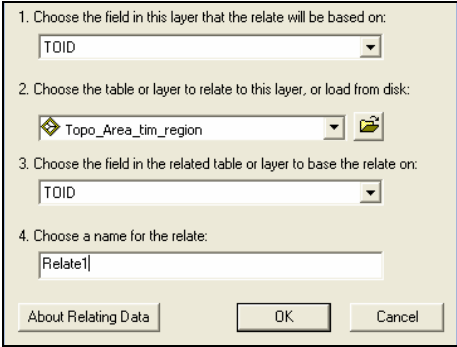


Figure 3: Relate Tool dialog box.

The output table obtained from the intersection of assets and the Topography Layer is related to the cross-reference table and the Topography Layer table is also related to the cross-reference table. The TOID field is used as the field to base the relate on as it is common to all tables. The related tables allow the identification of all topography areas that an asset falls into and also all the assets that fall into a particular topographic area (see Figure 4).

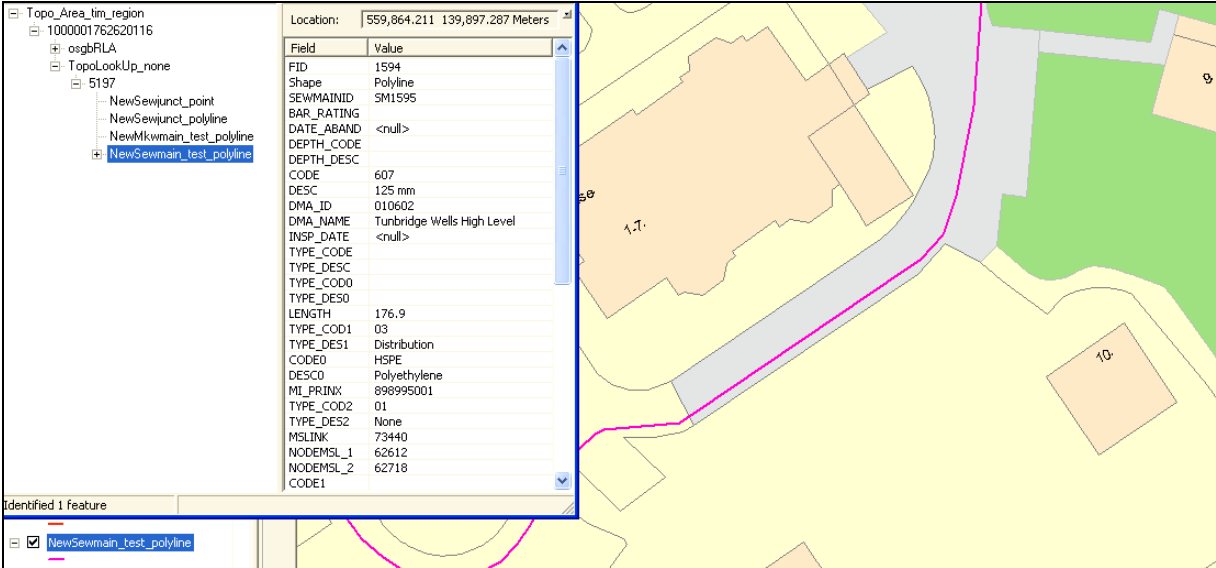


Figure 4: Related tables show the link from a topographic area to the asset which intersects it.

The table below shows the percentages of topographic areas in which the different assets intersect.

Percentages of the topographic areas intersected by assets.

NewSewmain – Pipe network assets

Descriptive group	Total count	Percentage
Road or track	8 006	48.139
Roadside	4 700	28.260
General surface	2 792	16.788
Natural environment	606	3.644
Building	122	0.734
Natural environment; road or track	64	0.385
Path	226	1.359
Inland water	39	0.235
Structure	14	0.084
Inland water		0.000
Unclassified	15	0.090
Building; road or track	5	0.030
Rail	31	0.186
Natural environment; rail	9	0.054
Structure; path	2	0.012
Total	16 631	100.000

NewMkwmain – Pipe network assets

Descriptive group	Total count	Percentage
Road or track	2 574	39.418
Roadside	2 025	31.011
General surface	1 375	21.057
Natural environment	402	6.156
Building	40	0.613
Natural environment; road or track	61	0.934
Path	14	0.214
Inland water	31	0.475
Structure	7	0.107
Inland water	1	0.015
Unclassified		0.000
Building; road or track		0.000
Rail		0.000
Natural environment; rail		0.000
Total	6 530	100.000

NewSewjunct(point) – Network junction assets

Descriptive group	Total count	Percentage
Road or track	1 860	47.741
Roadside	1 215	31.186
General surface	544	13.963
Natural environment	145	3.722
Building	46	1.181
Natural environment; road or track	9	0.231
Path	53	1.360
Inland water	7	0.180
Structure	8	0.205
Inland water		0.000
Unclassified	6	0.154
Building; road or track	1	0.026

Rail	1	0.026
Natural environment; rail	1	0.026
Total	3 896	100.000

NewSewjunct (polyline) – Network junction assets

Descriptive Group	Total count	Percentage
Road or track	117	60.309
Roadside	44	22.680
General surface	24	12.371
Natural environment	7	3.608
Building		0.000
Natural environment; road or track	1	0.515
Path	1	0.515
Inland water		0.000
Structure		0.000
Inland water		0.000
Unclassified		0.000
Building; road or track		0.000
Rail		0.000
Natural environment; rail		0.000
Total	194	100.000

Table 1: Percentages of the topographic areas intersected by assets.

2.2 Linking LSG data to ITN

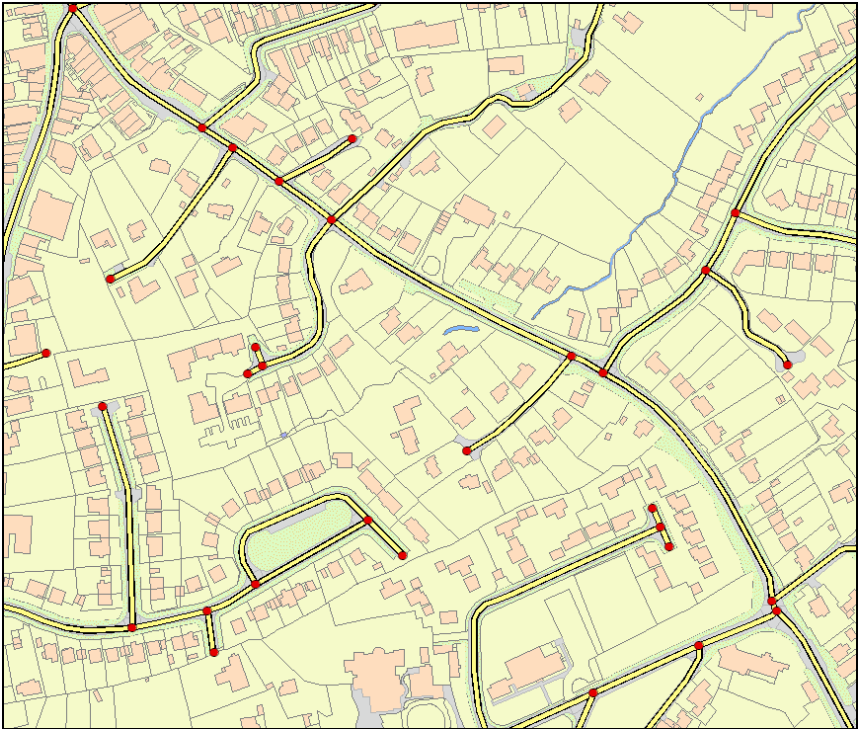
The second stage of the project involved linking level 3 LSG data (see Figure 5) to a structured ITN dataset for the study area. To ensure this stage of the project is successful the LSG data needed to be in a structured format with geometry that can be imported into a GIS or spatial database. Also to ensure the process linking the two datasets work, there needed to be a table for the elementary street units and another table for streets which includes a unique street reference number (USRN).



Figure 5: Translated local street gazetteer data.

The process was run on the ESU table to match the elementary street units and their nodes to the ITN RoadLinks and nodes (see Figure 6). This process which was developed with software code, matches the LSG's elementary street unit nodes to the ITN nodes by buffering the nodes and then finding the nearest ITN nodes that fall into the buffers created.

The process is done using several stages of matching which is based on using a 2 m buffer in the first instance, then a 5 m buffer if the 2 m buffer does not locate any ITN node. Once a node has been found it identifies the associated RoadLink and also if the node is the start or end node of that particular RoadLink.



 ITN Road Node  ITN RoadLink

Figure 6: Image showing ITN RoadLinks and Nodes on top of OS MasterMap Topography Layer.

The process used a one-to-one relationship (1:1) to match an ESU to an ITN RoadLink if it found only one RoadLink during the matching process. However if it finds that the ESU node matches several ITN road nodes and thus several ITN RoadLinks then it uses a one-to-many (1: M) relationship. In the case of the 1: M relationship the process uses the Dijkstra algorithm; this is a shortest-path algorithm that can be used to navigate along multiple ITN RoadLinks. The process also identifies a partial link between an ESU and RoadLink and this occurs when their start and end nodes do not match entirely together.

To find more details on the process used to link the LSG data to ITN please refer to the *Linking NSG to ITN report*.

The results of the process are outlined in the tables below. It can be noted that the assets in Kent did not match with almost a quarter of the ITN RoadLinks in the area; this is mainly due to fact that a high proportion of assets in Kent are intersecting with topographic areas other than road or tracks.

Match type	Number of RoadLinks
1:1 match	19 971
Multiple RoadLinks matched	2 698
Partial RoadLink matched	3 499
No RoadLink Matched	3 685

Table 2: Statistics of matching LSG data to ITN in East Sussex.

Match Type	Number of RoadLinks
1:1 match	27 238
Multiple RoadLinks matched	7 290
Partial RoadLink matched	8 051
No RoadLink Matched	14 041

Table 3: Statistics of matching LSG data to ITN in Kent.

The next step taken was to create a cross-reference table between the ESUs and the ITN RoadLinks they matched with (see figure 7). This table consisted of the Elementary Street Unit's unique identifier and the RoadLink TOIDs that the above mentioned process matched it to. Then spatial indexes were built on the columns in the cross-reference table; and also on a table containing all the ESUs.

	OID	ESU *	TOID *
	0	00546886099771	4000000033194265
	1	00546925099723	4000000033195274
	2	00547012099639	4000000033195274
	3	00547039099606	4000000033194604
	4	00547042099913	4000000033194610
	5	00547076099547	4000000033195273
	6	00547077099571	4000000033194604
	7	00547096099658	4000000033197984
	8	00547111099593	4000000033194605
	9	00547121099641	4000000033197975
	10	00547127099694	4000000033194611
	11	00547131099499	4000000033194267
	12	00547131099499	4000000033197957
	13	00547131099499	4000000033197958
	14	00547131099499	4000000033197959
	15	00547155099914	4000000033194656

Figure 7: Cross-Reference Table between elementary street units and ITN RoadLinks.

These tables were then imported into the GIS and the relate tool was used to relate the ESU table to the ITN RoadLink table using the cross-reference table. The relate was done using the ESU identifier as the field to base the relate on.

2.3 Linking Topography Layer to ITN

This stage required the linking of the ITN data for the study area to the topographic areas identified in stage one. The ITN data was loaded into a personal database in a GIS. The next step was to relate the ITN RoadLinks to the assets through the topographic areas they intersected. To achieve this relationship the study used the *osgbRLA* table which is already included in the ITN dataset.

The *osgbRLA* table (see figure 8) is an in-built cross-reference table between the ITN RoadLinks and topographic areas. The use of this table eliminates the need to run further SQL queries to create a new cross reference table. The table consists of a list of the ITN RoadLink TOIDs and in the second column a list of the Topographic area TOIDs that are associated to each ITN RoadLink.

	OID *	RoadLink *	TopoArea *
▶	1	4000000030074648	1000002060648345
	2	4000000030074648	1000002060648344
	3	4000000030074648	1000002318351798
	4	4000000030074648	1000002318351811
	5	4000000030074648	1000002060649496
	6	4000000030074649	1000001825006306
	7	4000000030074649	1000001825006459
	8	4000000030074650	1000001824799470
	9	4000000030074650	1000002318467458
	10	4000000030074650	1000002318467476
	11	4000000030074651	1000002318011642
	12	4000000030074651	1000002318012910
	13	4000000030074651	1000002318012909
	14	4000000030074660	1000002091178488
	15	4000000030074661	1000001761299432

Figure 8: *osgbRLA*: Cross Reference Table between the ITN RoadLinks and Topographic areas

The Relate tool discussed on page 8 of this report was utilized again to relate the ITN RoadLink features to the *osgbRLA* table using the RoadLink TOID as the field to base the relate on. Then the Topographic areas which contain assets were also related to the *osgbRLA* using the topographic area TOID as the field on which to base the relate. To improve performance and the speed with which attributes can be searched and queried. Spatial indexes were created on all the TOID columns of the RoadLink and Topographic area Tables.

The *osgbRRL* is another in-built cross-reference table that can be used to link the individual RoadLinks to a Road feature within ITN (see figure 9). This is useful for identifying which road feature different individual RoadLinks are associated with.

The linkage of the LSG Elementary Street Units to ITN RoadLinks and the linkage of the ITN RoadLinks to topographic areas which are in turn linked to the assets which intersect them enables the identification of an asset by the RoadLinks which reference the topographical area it falls within (see Figure 10).

OID ^	Road ^	RoadLink ^
1	4000000030480988	4000000030078668
2	4000000030480988	4000000030117662
3	4000000030480988	4000000030117663
4	4000000030480988	4000000030186010
5	4000000030480988	4000000030186011
6	4000000030480988	4000000030294793
7	4000000030480988	4000000030294916
8	4000000030480988	4000000030294917
9	4000000030480988	4000000030443664
10	4000000030480988	4000000030443667
11	4000000030480988	4000000030916085
12	4000000030485123	4000000030075362
13	4000000030485123	4000000030088778
14	4000000030485123	4000000030117507
15	4000000030485123	4000000030389165

Figure 9: osgbRRL: Cross Reference Table between the ITN RoadLinks and Road features.

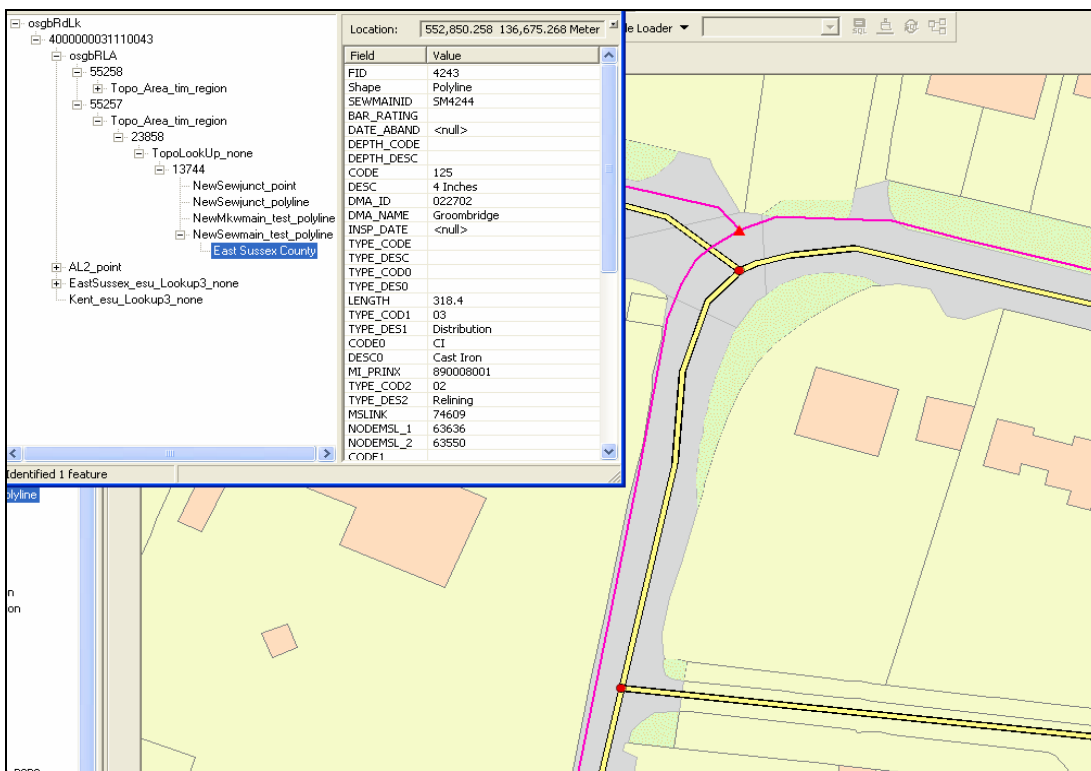


Figure 10: Related tables show the link from an ITN RoadLink to the nearest asset.

In the same manner an asset can be identified by the ESUs which reference the ITN RoadLinks that are linked to the topographic area it intersects (see figure 11).

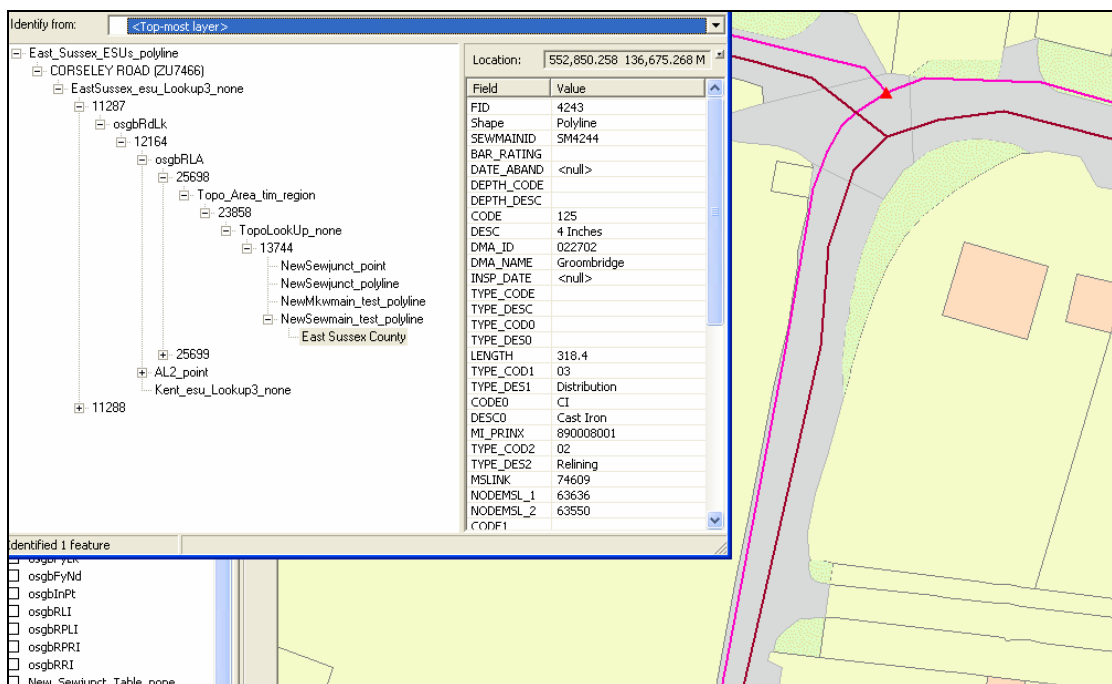


Figure 11: Related tables show the link from an LSG elementary street unit to the nearest asset.

2.4 Linking Address Layer 2 to ITN

The final stage in this project was to link Address Layer 2 to the ITN RoadLinks to identify the address that may be related to an asset. The steps taken at this stage are similar to those in the previous stage.

The Address Layer 2 data for the study area was imported into the GIS and spatial indexes were built on all the columns to increase the speed of matching between it and the ITN RoadLink table.

This next step which was linking the AL2 data to ITN was very straightforward due to the fact that all AL2 features provide a reference to the nearest ITN RoadLink to them. The relationship was done using the Relate tool and it was based on the OS_RL_TOID column in the AL2 table and the TOID column in the ITN RoadLink table.

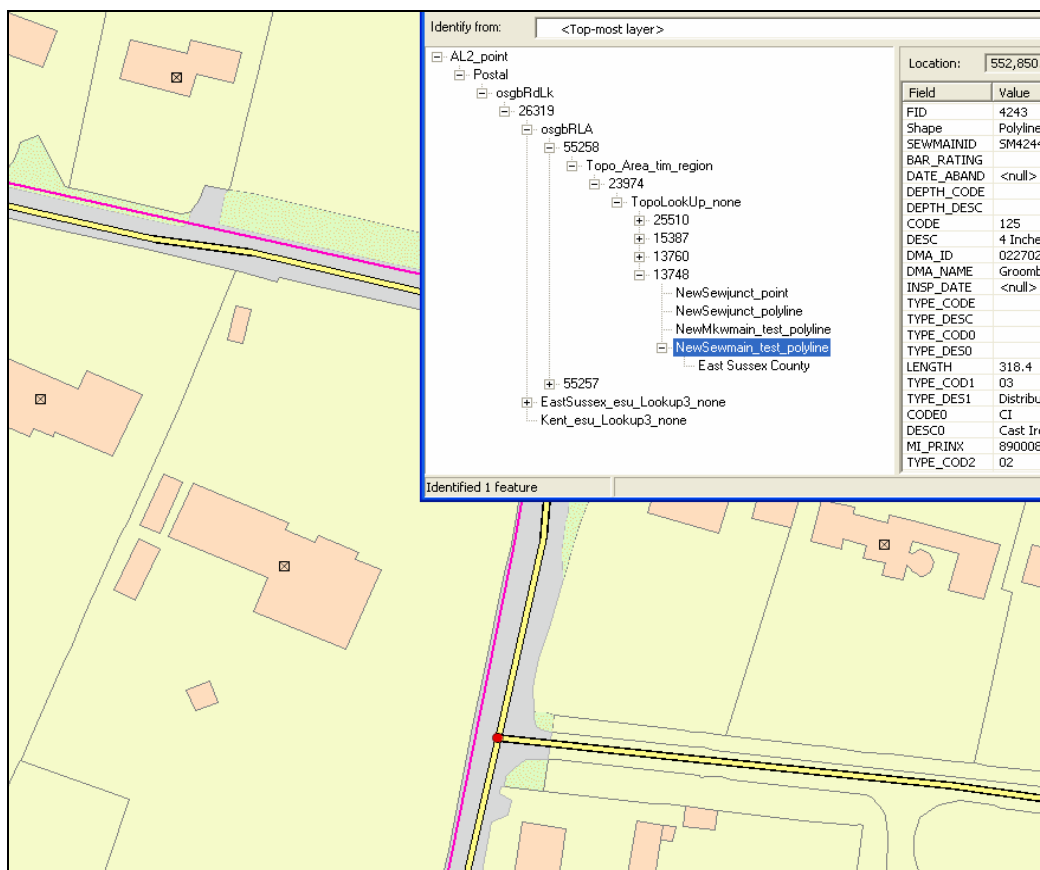


Figure 12: Related tables show the link from an Address Layer 2 feature to the nearest asset.

Linking of the AL2 dataset to the ITN RoadLinks table which is already linked to the topographic area in this way enables the identification of an asset by the address features which are nearest to it (see figure 12); and it also allows the identification of all the addresses that may be connected to a particular asset through the ITN RoadLink that references it.

2.5 Quality Assessment process

Quality assessment was undertaken to ensure that the linking of the different layers of OS MasterMap, namely ITN, AL2 and Topography Layer, actually provided a link to the right asset. This was done by selecting a random sample of the three different asset types and manually checking each one to see if the reference to a feature in any of the MasterMap layers is the actual TOID that should be referenced by that feature.

The asset was queried using the Identify tool found in a GIS; this lists all the features which relate to a particular asset in other tables/datasets. The TOIDs were then noted and compared to the TOIDs obtained by manually querying and visually checking the relevant OS MasterMap feature table to see if they match. There was a hundred per cent match between the TOIDs referenced by the asset and the actual OS MasterMap feature's TOID.

FID	Layer	Referenced TOID	Actual TOID	Matched
733	NewSewMain	1000001762860444	1000001762860444	Y
2468	NewSewMain	1000001762544041	1000001762544041	Y
903	NewSewMain	1000001762747932	1000001762747932	Y
1123	NewSewMain	1000001762757673	1000001762757673	Y

2374	NewSewMain	1000001762513159	1000001762513159	Y
2760	NewSewMain	1000001762395587	1000001762395587	Y
1389	NewSewMain	1000001762646670	1000001762646670	Y
2186	NewSewMain	1000001762503354	1000001762503354	Y
4401	NewSewMain	1000001762242230	1000001762242230	Y
356	NewSewJunct	1000001762862507	1000001762862507	Y
1951	NewSewJunct	1000001762560130	1000001762560130	Y
2862	NewSewJunct	1000001762291612	1000001762291612	Y
3105	NewSewJunct	1000001762503425	1000001762503425	Y
3582	NewSewJunct	1000001762561393	1000001762561393	Y
2723	NewSewJunct	1000002091225047	1000002091225047	Y
3000	NewSewJunct	1000001761022920	1000001761022920	Y
1148	NewSewJunct	1000001762488717	1000001762488717	Y
138	NewSewJunct	1000001762636599	1000001762636599	Y
174	NewSewJunct	1000002091177708	1000002091177708	Y
2906	NewSewJunct	1000002091481934	1000002091481934	Y
2489	NewMkwmain	1000001763264734	1000001763264734	Y
936	NewMkwmain	1000001763380473	1000001763380473	Y
1859	NewMkwmain	1000001761135612	1000001761135612	Y
653	NewMkwmain	1000001763431093	1000001763431093	Y
2191	NewMkwmain	1000001763375440	1000001763375440	Y
2830	NewMkwmain	1000001763265397	1000001763265397	Y
450	NewMkwmain	1000002091176231	1000002091176231	Y
1518	NewMkwmain	1000001763168331	1000001763168331	Y
2125	NewMkwmain	1000001763425430	1000001763425430	Y
2611	NewMkwmain	1000001763271417	1000001763271417	Y
2209	NewMkwmain	1000001763163303	1000001763163303	Y

Table 4: Section of QA table showing 100% match of Assets to the OS MasterMap features.

3 Known issues

There were some known issues identified during the procedure used while working on this project and these are discussed in the following paragraphs.

There were cases where assets intersected only polygons in other classes in the Topography Layer and did not intersect any road, track or path polygon (see figure 13). This meant that there was difficulty in identifying which ITN RoadLinks and ESUs they should reference. This is because polygons in other classes have no direct reference to ITN and the road network and thus a separate procedure would be needed to link these polygons to the road, track or path polygon they should reference.

This situation was especially true of assets in Kent which have a high percentage of not intersecting with the road, track or path polygons in the Topography Layer (see table 1). A high percentage of the assets in Kent fell within Roadside, Natural Environment and General surface polygons only.

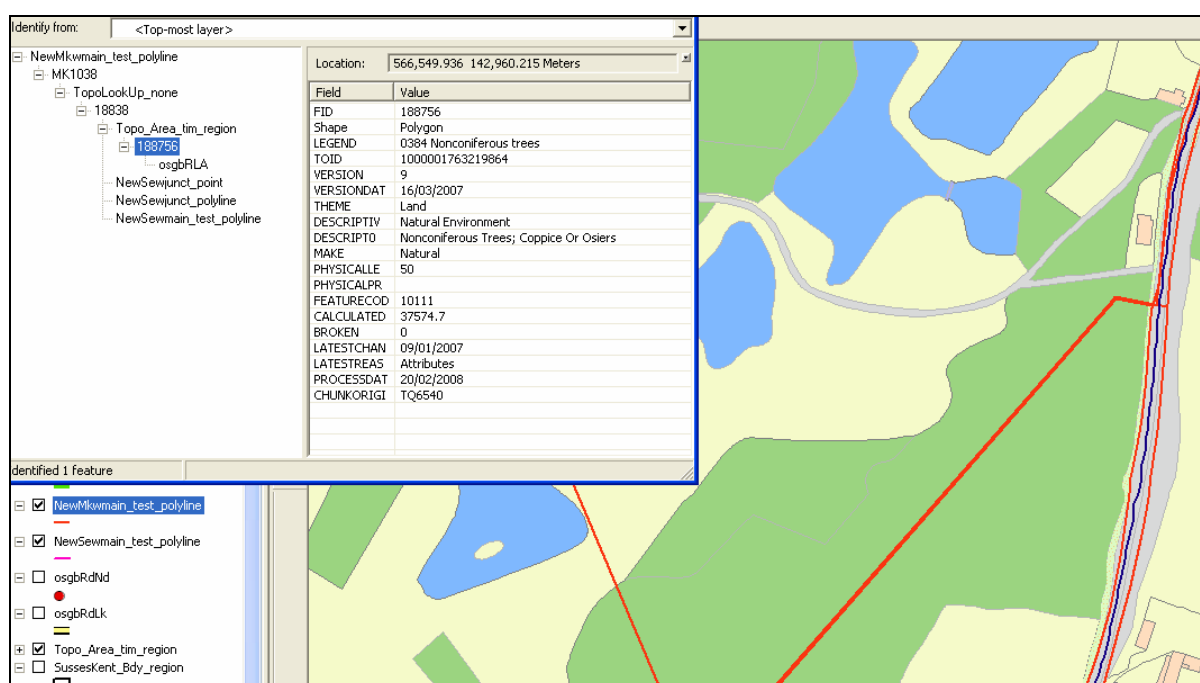


Figure 13: Related Tables show the link from an asset to the Natural environment polygon it intersects.

3.1 Data quality issues

Data quality may introduce a large number of errors into the process that may have a slight or severe impact thus impacting on the success of the methodology. The LSG data had some inconsistencies regarding the location of the start and end coordinates of some ESUs. These inconsistencies meant that these ESUs could not be successfully translated or matched with ITN RoadLinks.

The different structures of LSG and ITN examined during this study means that ITN provides more comprehensive dataset for linking buried assets to the real world than LSG because the LSG elementary street units stop at county boundaries while ITN is an unbroken national dataset.

It is also pertinent to note that the positional accuracy and relative accuracy of the assets needs to be very high as this would have a direct impact on the success rate of linking the assets to OS MasterMap and to ITN in particular.

4 Summary

The procedure and process outlined in this study are by no means conclusive and many improvements may be added to the procedure; for instance in the case of identifying assets which do not intersect with any road, track or path polygon, these could be identified by buffering them and then identifying the nearest ITN RoadLink or AL2 feature. Improvements such as this would improve the success of the procedure in matching all assets.

It is also pertinent to note that the automated processes used in this procedure would not yield a hundred per cent accuracy and there are many factors that can influence the success of this procedure such as inconsistencies in the LSG or asset data being processed. It is important to ensure there are robust quality assurance checks in place to identify these errors and provides a mean for handling them. This error handling procedures should recognise that it may be necessary for some records to be created or edited manually.

Using the specification given and the outlined methodology the procedure provided a 100% match for all the assets that fell within a road polygon on the Topography Layer and thus a 100% match to the associated ITN RoadLinks.

There was a 46.1% match between all the assets and the road polygons in the Topography Layer and a 29.3% match between the assets and the roadside polygons in the Topography Layer. This indicates that 75.4% of the assets intersected road and roadside polygons.

Future work could be carried out to link the assets that fell within the road side polygons by matching the roadside polygons to the roads they run alongside; however this was outside the specification of this study.

If the methodology is implemented properly, it provides a good basis for linking a company's buried assets to the real world and if implemented in a spatial database the whole procedure could be taken one step further by developing an application to automate it, and this way the OS MasterMap features linked to the assets could be updated regularly to reflect the ever changing geography around and above the assets.

In conclusion the methodology taken in the project has proved that it is feasible to link assets to ITN. This report has explained the methodology and highlighted the advantages of linking a company's buried assets to a definitive dataset by creating relates with ITN and other layers of OS MasterMap using the in-built references in OS MasterMap. Relating the data in this manner allows the organisation to link their assets to the road network, an address database and third party data, thus enabling the organisation to work with other organisations and government agencies within a common framework.

5 Dependencies

To gain a detailed understanding of some of the processes used in this methodology and also the structure of ITN and AL2 and the Topography Layer of OS MasterMap, readers should familiarise themselves with the documents listed below.

- 1 Linking National Street Gazetteer data to OS MasterMap Integrated Transport Network Layer report.
- 2 OS MasterMap Integrated Transport Network User Guide and technical specification.
- 3 OS MasterMap Address Layer and Address Layer 2 User Guide.
- 4 OS MasterMap Address Layer 2 technical specification.
- 5 OS MasterMap Topography Layer User Guide and technical specification.

6 References

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7 Glossary

ITN	Integrated Transport Network
DNF	Digital National Framework
LSG	Local street gazetteer
ESU	Elementary street unit
AL2	Address Layer2
TOID	Topographic Object Identifier
PAF	Postcode address file
ASD	Associated street data
USRN	Unique reference number
GIS	Geographical information system
M: M	Many-to-many
1: M	One-to-many
RRI	Road routing information