

A06.3

Constructing a land use data set from public domain information

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1 Introduction

The original aim of the National Land Information Service in the UK was to disseminate information on land and property ownership, value and use. Significant progress has been made by the Land Registry in achieving this aim for ownership and value information but information on land use remains elusive. Data collected during Phase One of the National Land Use Database (Previously Developed Land) project appeared briefly on the web site but even after the current update of that data set is complete, development land accounts for a tiny fraction of total land area. Yet there are other public sector data sets that contain useful land use descriptions and, if combined geographically, may form the basis of a land use map at the land parcel level. This paper presents the findings of a research project that investigated the potential for creating a land use data set for an urban area by combining public domain data sets that contain land use descriptors.

2 Data sets

There are five national data sets in the public domain that classify urban land use in some way. All but one are address-based and describe use at the land parcel, building or occupied unit level. Land Use Changes Statistics (LUCS) are aggregated to national, regional and county level before they are released into the public domain, even though they are collected by the OS at the land parcel and building level. For this reason, LUCS are not considered further in this section.

2.1 National Non-Domestic Rating and Council Tax Databases

An important source of information on land use for non-domestic property can be obtained from the National Non-Domestic Rating (NNDR) list compiled by the Valuation Office Agency (VOA). As well as valuation data the list records primary and secondary descriptions for each rateable hereditament. These descriptors can be quite specific – examples include car park, hotel, camping site, school, cinema, surgery, cemetery, etc. Residential property can be identified using the Council Tax (CT) list.

2.2 MasterMap

MasterMap is the Ordnance Survey's new large-scale topographic view of the real world where nine themes represent groups of features which are further classified into descriptive groups and descriptive terms. Topographic features that were represented using lines and points in MasterMap's predecessor, LandLine, have been reformatted so that, where relevant, polygons represent real-world features such as buildings, land parcels, fields, lakes and parks. These polygons provide a basis for defining and classifying parcel-level land use data.

2.3 Planning information

Local planning authorities record planning applications and land use data as part of their development control function. However, the availability of these data to the public, particularly in electronic form, is very patchy. But where planning data are available they are potentially very useful. Bristol City Council undertook a survey in 1999 of the land use of each property in commercial district centres (commercial

centres outside the city centre retail and business districts). If these data were regularly maintained they would offer a useful supplementary source of commercial land use information.

2.4 The National Land and Property Gazetteer (NLPG)

The NLPG is an aggregation of local LPGs compiled by local authorities. Although the NLPG does not contain land use descriptors, it is nevertheless of vital importance in terms of linking databases together. The NLPG land parcel-referencing standard, BS7666 (BSI 1993), provides a national standard address specification for land and property and offers a means of linking land-use related information held in address-based data sets. A BS7666-compliant LPG was fundamental to the database linkages carried out as part of this research project. The standard is based on the concept of a land parcel unit known as a Basic Land and Property Unit (BLPU), defined as a contiguous area of land in uniform property rights or, in the absence of such ownership evidence or where required for administration purposes, inferred from physical features, occupation or use. Each BLPU has a unique reference number (UPRN), a spatial reference (national grid coordinates) and one or more Land and Property Identifiers (LPI). The LPI is basically the address of the BLPU in a standard format that includes Primary and Secondary Addressable Objects (PAOs and SAOs). A PAO is the name given to an addressable object that can be addressed without reference to another addressable object, for example a building name or street number. A SAO is given to any addressable object that is addressed by reference to a PAO, for example "First Floor". Many early local LPGs were point-based but BS7666 now provides for the capture of boundary extents for each BLPU. An extent is made up of one or more polygons.

3 Land use classification schemes

This section reviews land use classification schemes currently in use for databases that either define land use as their primary function or include land use descriptors within their database schemes in support of their primary function.

3.1 National Land Use Database (NLUD)

Version 4 of the NLUD classification, presented in table 1 (together with cross-referencing between all of the classification schemes considered in this section) bisects the definition of land use into two dimensions; land use and land cover. Land use is defined as the activity or socio-economic function for which the land is used and land cover is defined as the physical nature or form of the land surface.

3.2 MasterMap

There are seven feature types in MasterMap:

- Topographic areas
- Topographic lines
- Boundary lines
- Topographic points
- Cartographic symbols
- Cartographic text
- Departed features (change-only update supply only)

These features are described by placing them into one of 21 descriptive groups and, optionally, further described using a descriptive term. A theme is a set of features that can be collectively selected for supply by users. They are not part of the formal feature classification but allow users to select a group of features which are often requested and used together. A feature can be a member of any number of theme but must be a member of at least one.

3.3 Town and Country Planning (Use Classes) Order

The Town and Country Planning (Use Classes) Order 1987 (HMSO, 1987) specifies classes of use of buildings or other land for the purposes of section 22(2)(f) of the Town and Country Planning Act 1971 as amended. The (Use Classes) Order (UCO) is not a national data set but a classification scheme for statutory town and county planning functions. Certain uses that require specific planning permission or licences to be granted by each local planning authority are omitted from the Order.

3.4 Land Use Change Statistics (LUCS)

LUCS record land use in one of 24 categories which are grouped into 10 land use groups and which can be aggregated into two divisions, urban and rural. A land use change is recorded as part of the OS map revision process when the current land use category of a parcel (identified by a centroid) changes or when new features appear, such as the demolition of a single dwelling and replacement by one or more new dwellings. If a change in land use is not physically apparent on OS large-scale mapping (such as a conversion from office to retail) then LUCS would not record this, although the local planning authority would. The classification does not explicitly distinguish between land use and land cover as the NLUD classification now does.

3.5 National Non-Domestic Rating (NNDR) and Council Tax lists

The VOA collect land use data in support of the compilation of the NNDR and CT lists. Land use data are collected because rateable value will vary depending on what a property is used for. Each rateable hereditament (a definable geographical unit comprising a single use and capable of separate occupation) is assigned a use code and description. These codes and descriptions are a rich source of land use information. There is no land use coding in the CT list, only the fact that the property is residential can be deduced.

4 Methodology

The approach adopted for this project involved combining existing data sets that include land use descriptors to create an urban land database that was capable of displaying land use geographically using a GIS. The study area chosen for this project encompassed the BS1 and BS8 postcode sectors of Bristol. This area includes a mixture of residential and commercial land uses and covers the main retail and business districts of the city, as well as district commercial centres which include residential, retail, office, industrial and leisure land uses. To be of greatest use to surveyors, land use needs to be recorded and published at the land parcel level. For this reason LUCS were not considered as part of the method adopted here. The data sets that were used have been described above and they are

- NNDR and CT lists from the VOA
- MasterMap from the OS
- Planning use information from BCC

These data sets are in the public domain at the level of individual land and property units. NNDR and CT lists are compiled and maintained by the VOA and every fortnight each Billing Authority (for the purposes of collection of commercial and residential property taxes, local authorities are responsible for billing) downloads extracts of the NNDR and CT lists for their area.

A major problem with parcel-based land and property-based data sets in the UK at the moment is that data recorded for the same property cannot be linked automatically because the data sets often do not match in terms of address fields or in terms of the basic land and property units that they describe. Therefore, in order to create a land use database from existing data sets, a means of linking them together was required. Bristol City Council has created a LPG and this was used to link the data sets. The Bristol LPG was originally created by combining land and property data sets from several different sources, including the VOA, the Land Registry and the Electoral Register. The LPG is also based on BLPU extents rather than seed points. Therefore, BLPU were used as the basis for defining the extent of atomic units of land use.

The next stage was to link the BLPUs to the NNDR and CT records in the study area. Each BLPU represents a separately identifiable occupied unit of land and property. If a property tax is due on that unit then there will be a CT or NNDR list entry for it. Unfortunately, the VOA does not currently use BS7666 for describing the location of taxable properties. Were this the case then the link between the Bristol LPG (which is BS7666-compliant) and NNDR and CT records would be straightforward to establish. As it is not the case an alternative means of establishing this link had to be found. As already stated, when Bristol City Council originally created the LPG, VOA data were used to help identify BLPUs. The cross-reference database that was generated when BLPUs in the Bristol LPG were derived from VOA NNDR and CT records was used to link the databases together.

The OS supplied MasterMap for Bristol and this was clipped to the study area using the BS1 / BS8 postcode sector boundaries.

5 Results and discussion

2,474 NNDR records matched against the total of 29,750 BLPUs in the study area. Clearly not all types of commercial property classified in the NNDR list will exist in the study area. The majority, unsurprisingly, are shops and offices, but there are also a significant number of leisure properties, such as pubs and restaurants, as well as workshops and stores. With regard to residential land use 11,286 CT records matched against the 29,750 BLPUs. The NNDR and CT data were then matched against the orders and groups defined in the land use dimension of version 4 of the NLUD Classification using the cross-references defined in table 1. Table 2 shows the results.

The NNDR and CT data succeeded in identifying properties that were classified in nine out of the total of 22 land use groups. Potentially the NNDR and CT data could have helped identify properties in 15 of 22 groups but it was not possible to achieve this in the study area chosen. There were 29,750 BLPUs in the study area, so 13,760 matches represents a match-rate between the NNDR and CT lists and the Bristol LPG of 46%. Three reasons can be offered to explain why is this so low. First, non-rateable BLPUs appear in the LPG, including land, and these will, by definition, not be recorded in the rating list. Second, NLUD Phase 1 land and property are not included. Finally, and most significantly, when the Bristol LPG was created in 1999, BLPUs were sourced from local authority databases (such as the electoral register) as well as the NNDR and CT lists. For this study only those BLPUs sourced from the NNDR and CT lists could be used. Numerically, there were 345,313 records in the cross-reference database used to create the BLPUs from multiple sources. 50% of these records were sourced from the CT list and 5% were sourced from the NNDR list. The remaining 45% were sourced from local authority databases.

When the number of residential properties (11,286) is compared with the number of properties in the Council Tax list for BS1 and BS8 (13,347) the match rate is 85%. When the number of commercial properties (2,474) is compared with the number of hereditaments in the NNDR list for BS1 and BS8 (8,926) the match rate is 28%. This rather low match rate would be improved when land and property data sets adhere to BS7666 when referencing and addressing property. Identification of residential land use would seem to be more straightforward than commercial land use. Out of a sample of 260 properties from Bristol City Council's survey of land use in commercial district centres in the BS1 and BS8 postcode sectors, all but 12 land use descriptions matched those in the NNDR list described above. This was a very good match rate considering district centres contain secondary and often more transient commercial occupiers.

MasterMap feature types and descriptive groups and terms were used to identify land cover orders and groups as defined in the NLUD version 4 classification. Table 3 shows the results. Because there is a close correlation between NLUD land cover groups and MasterMap feature types, descriptive groups and terms, the success rate for identifying land cover from MasterMap is very high. For the study area 17 out of the 33 land cover groups were identified but potentially it would have been possible to have identified land cover for all 33 groups if the study area had contained land cover in all groups.

Figure 1 displays, using BLPU extents, residential land use derived from the CT and NNDR lists (the latter identifying institutional and communal accommodation). The largely residential BS8 in the west can now

easily be distinguished from the commercial heart of Bristol in BS1 in the east. Figure 2 shows the main commercial land uses. From this map it is possible to identify commercial centres in the study area. What cannot be displayed on two-dimensional land use maps are instances where mixed uses overlay one another, such as a ground floor shop with offices or flats above. Similar display problems also occur with developments like the Galleries shopping mall where a single BLPU overlays many sub-BLPUs within the mall that reference individual retail units. Interpretation of the land use map is simplified by displaying either individual or sub-sets of land use / cover layers interactively using a GIS. It is also preferable to zoom in to a larger geographical scale. Figure 3 shows the commercial centre of Clifton, firstly with residential switched off and then, in Figure 4, switched on. This shows how commercial and residential is juxtaposed in such urban areas.

Together, NNDR and CT data from the VOA and MasterMap from the OS are capable of populating a significant proportion of the urban land use and land cover groups as defined in the NLUD classification. Rating and council tax data contribute to the land use dimension and MasterMap contributes to the land cover dimension. These sources can be supplemented by local authority planning data. The land use and land cover dimensions of the NLUD classification make an important distinction in geographical terms that is similar to the distinction between MasterMap feature classification and NLPG – land cover is two-dimensional and land use is three-dimensional. Therefore, there needs to be some thought on how land use is represented geographically. The solution adopted in this study was to separate the NLUD land use and land cover groups into GIS map layers.

This research has shown that these VOA data sets can be geo-referenced using BLPUs as defined by a BS7666-compliant local land and property gazetteer. This is a process that can be extended nationally because the first release of the national land and property gazetteer used VOA data (with other data) to identify BLPUs. So long as the cross-references between the UPRNs in the NLPG and the codes for commercial and residential records in the NNDR and CT lists are maintained, national roll-out of land use data derived from VOA data is possible.

BLPUs typically relate to occupancy or ownership because that is the basis upon which property taxation is administered by local (billing) authorities and several other local authority systems work in support of other statutory functions such as planning, electoral registration and benefit payment. So BLPUs may not relate to the land cover mosaic (which, for example, may distinguish buildings from their curtilage). Instead each BLPU may encompass an entire occupied site (including several buildings) if they are all under the same ownership and used for a common purpose. BS7666 permits BLPU extents to be inferred from ownership evidence, physical features, occupation or use and BLPUs represent a practical basis on which to depict land use geographically.

It was suggested in earlier land use database research (Ordnance Survey 1996) that where multiple land uses exist on a single parcel of land, the primary and secondary uses should be recorded, but not subsidiary uses. For example, a case may arise where a ground floor shop is recorded as the primary use, residential flats on the first and second floors above are recorded as a secondary use but a workshop in the converted garage at the rear of the premises is ignored. This solution is unsatisfactory and reflects a map-based approach to the problem. The VOA will require three separate hereditaments to be identified for commercial and residential tax purposes and the local authority will require three separate units to be identified for planning purposes. An urban land use database should recognise and record all three uses. This is the approach adopted in this study and this is why the Bristol LPG, which recognises all land and property units regardless of their geographical overlay, was used to link the data sets together. The problem of simultaneously displaying all three land uses on a map is simplified by separating each land use into layers in a GIS database. Another means of identifying mixed land use within a single building or land parcel is to note multiple secondary addressable objects (SAOs) for a single primary addressable object (PAO).

6 Conclusions and recommendations

The aim of this research project was to evaluate the potential for using information derived from surveyor activity to assist in the creation of an urban land use database. There are several land use classification in existence in the UK and this project has examined those that classify land use at the land parcel, building or occupied unit level. The NLUD classification represents an attempt to unify them. This might be achieved initially through the use of cross-reference or 'look-up' tables and eventually through migration to a common standard land use classification. It can be seen how MasterMap contributes almost entirely to the Land Cover dimension in the NLUD version 4 classification. It is also possible to see the very close relationship between this version of NLUD and the LUCS classification. A standard classification will promote data sharing, allow integration of other data sets and aid understanding of data underlying land use statistics.

The results showed that there was potential for using NNDR and CT records to identify land use for urban areas in conjunction with MasterMap and LUCS data for identifying land cover. The NLPG creates a framework for identifying and mapping land uses on a national basis. It is important then that local LPGs are constructed in such a way that the data may also be used to inform a land use database. Compatibility between BLPUs, OS MasterMap polygons, NNDR and CT records is a crucial issue if we are to reap maximum benefit from economies of scale of land and property data collection. Given that the first version of the NLPG used the NNDR and CT lists to define BLPUs, there is an opportunity for the VOA to cross-reference their land use codes to BLPUs and thus define and maintain land use data at the national level. More thought could be given to the definition of SAOs within the BS7666 standard address format in order to distinguish atomic units of land use. In terms of display land cover is two-dimensional and land use is three-dimensional. Thought should be given as to how to represent the latter on a map. Ultimately three-dimensional mapping and GIS might offer a solution. In the meantime, separate GIS layers work relatively well.

Finally, with regard to update of a land use database, continuous update using existing sources rather than a survey / census or aerial photographic interpretation for urban land use is recommended. Land use could be updated regularly and land cover update could be undertaken less frequently and in association with MasterMap revision. Thematic delivery of land use data might offer early benefits to, say, residential land use studies, given the scarcity of development sites in certain parts of the country. Given that housing is the largest single land use and has the highest political profile, the successful match rate between CT records and BLPUs offers a powerful argument in favour of early roll-out of residential land use data.

References

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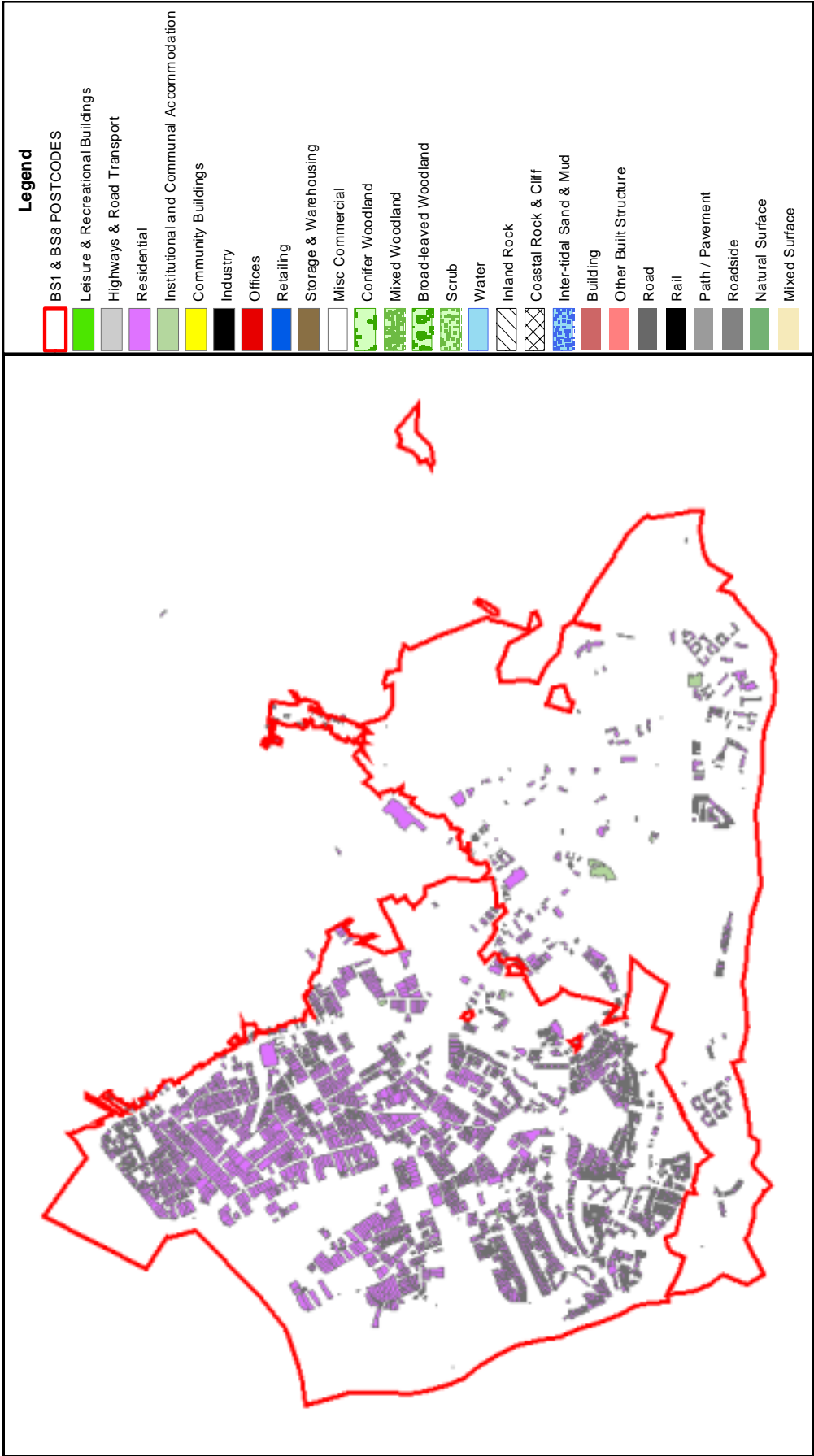


Figure 1 – Land Use: Residential and Institutional Accommodation

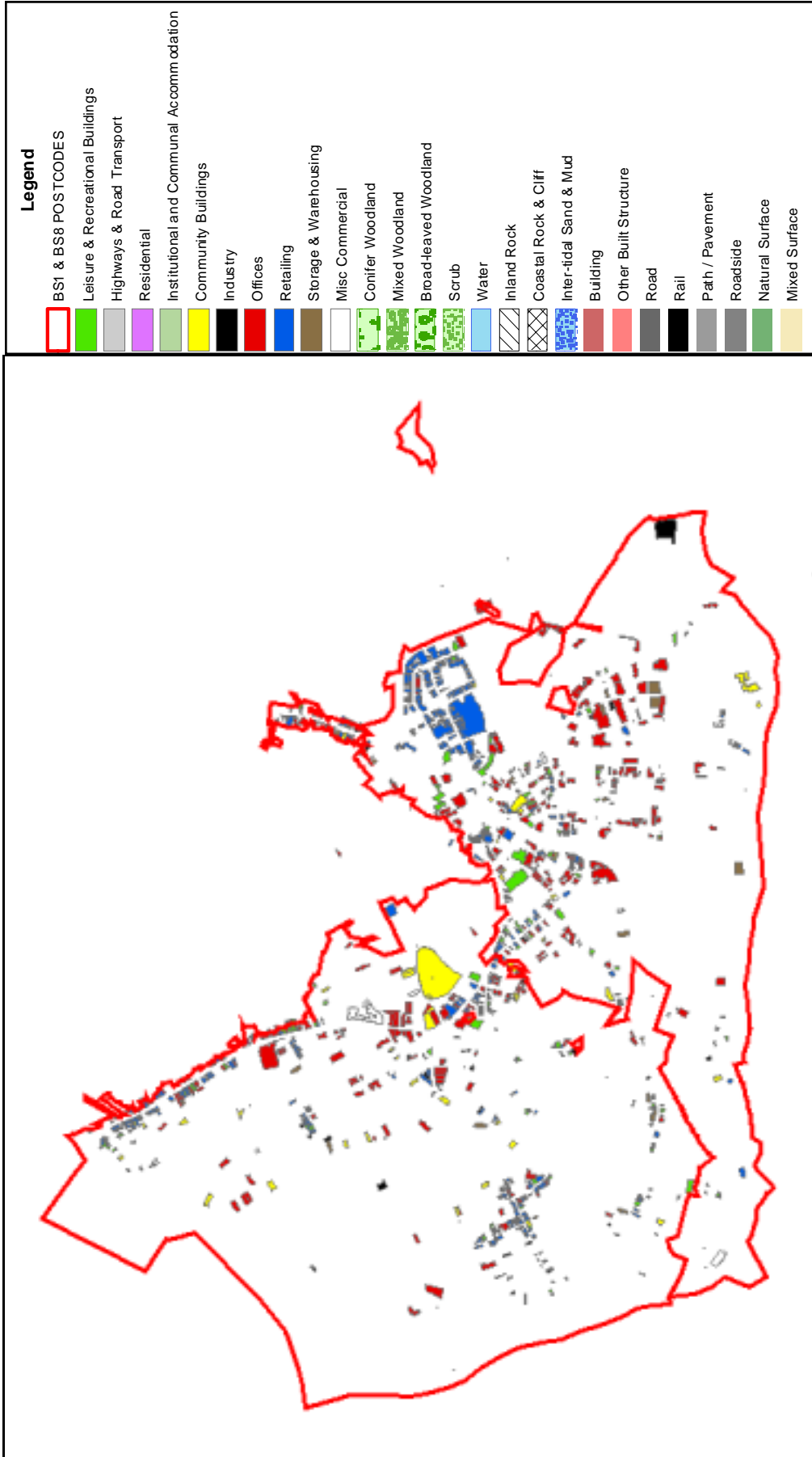


Figure 2 – Land Use: Offices, Retailing, Industry, Storage & Warehousing, Community Buildings, Leisure & Recreational Buildings

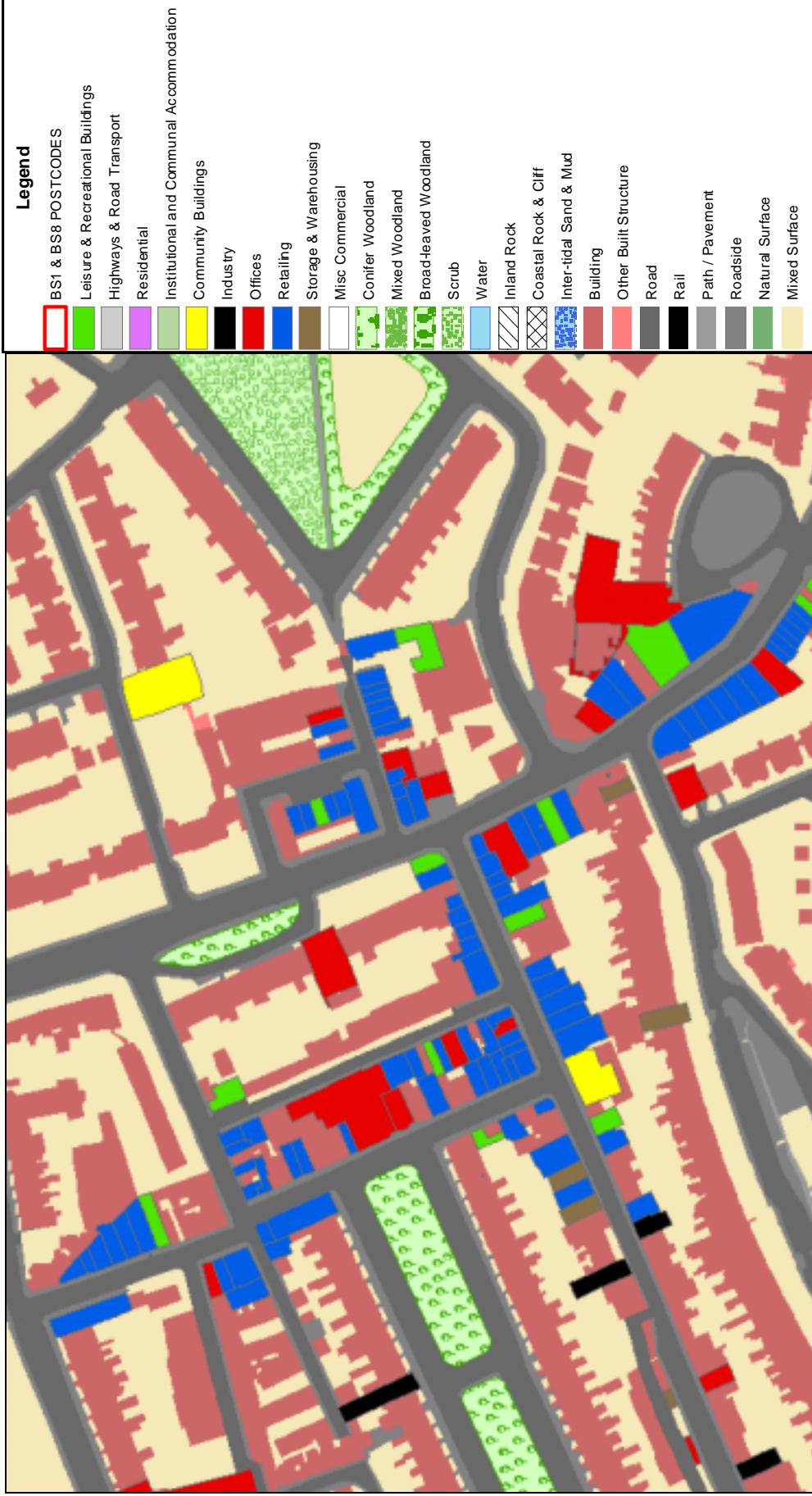


Figure 3 – Land Use: Clifton centre without residential land use displayed

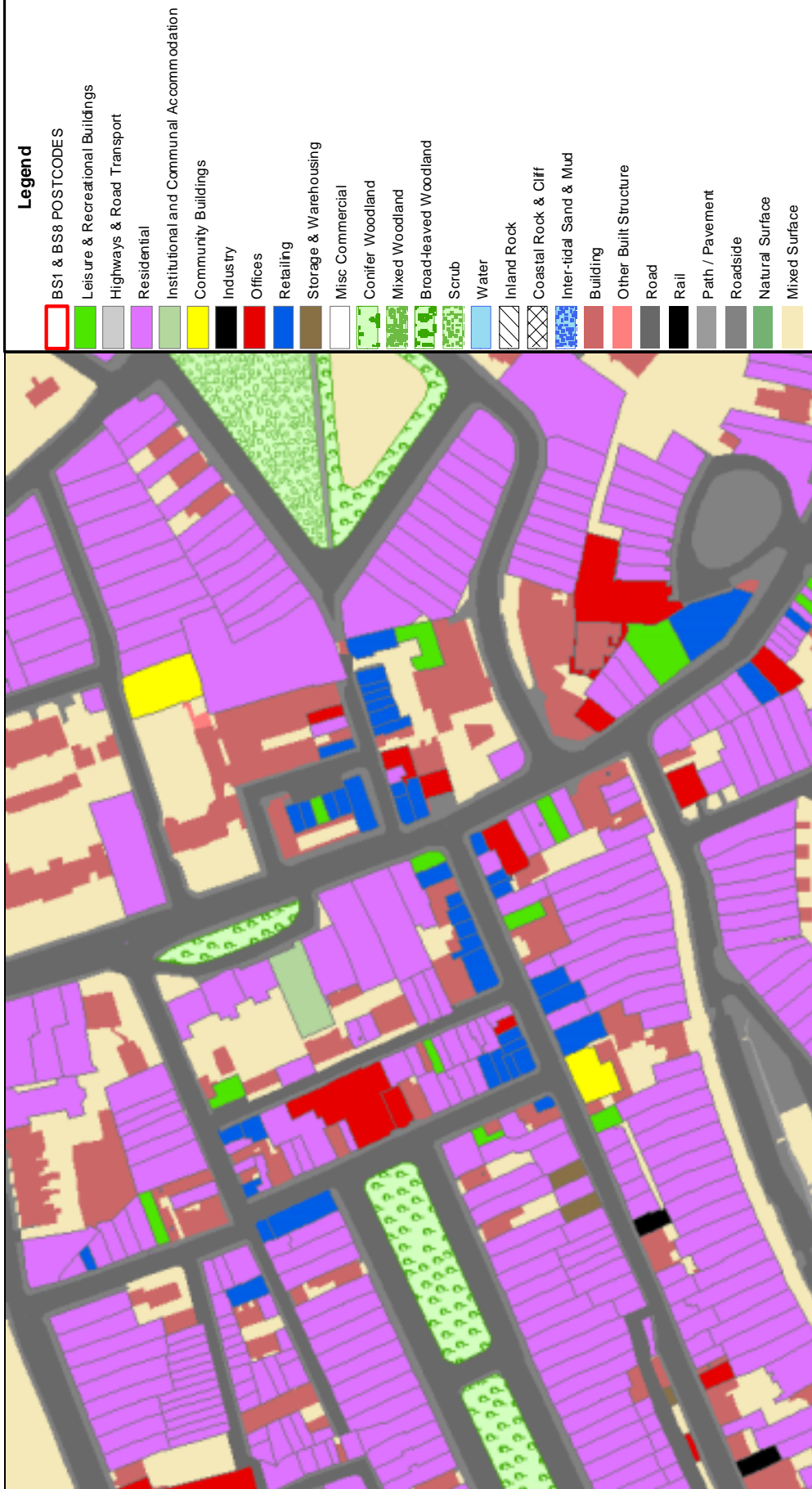


Figure 4 – Land Use: Clifton centre with residential land use displayed

NLUUD v4		NLUUD v3.3	LUCS	UCO	MasterMap	VOA Code
Order	Group	Sub-Group			Descriptive Group	Descriptive Term
LAND USE						
1. Agriculture	1.1 Agriculture		6.1			IM6
	1.2 Agricultural Building		6.2			
2. Forestry, Open Land & Water	2.1 Forestry / Woodland		7.1			
	2.2 Open Land					
	2.3 Water (LANDCOVER, 4.1)					
3. Minerals & Landfill	3.1 Mineral Workings & Quarries		6.1	8.1		FC, IM, IM1, IM4
	3.2 Landfill Waste Disposal		6.2	8.2		IM4
4. Recreation	4.1 Outdoor Recreation		7.2	9.1		CC, CC1, LS-LS5, LS7
	4.1.1 Outdoor Recreation		7.3			LI, LI1, LS6, LT-LT3, CC2, CL, CLI, CR, CRI, LC2, LC3
	4.1.2 Allotment		7.1	4.2	D2	NT, NT2
	4.2 Leisure & Recreational Buildings					
5. Transport & Utilities	5.1 Highways & Road Transport		8.1	2.1		CP, CPI, NT3
	5.1.1 Highways & Road Transport					FR
	5.1.2 Car Park		8.2			FD, NT1
	5.2.1 Railway		8.3	2.2		FE, FG, FT, FW, NC
	5.2.2 Airport		8.4	2.2		CH-CH3, MR, MR1
	5.2.3 Dock		8.5	2.2		EM, EM1, LC, LC1, MH-MH2, TH
6. Residential	5.3 Utilities		11.5	2.3		EL, EL1, EP, EPI, EU, EU1
	6.1 Residential		9.1	1.1	C3	MC
	6.2 Institutional & Communal Accommodation		9.1	1.1		CG1, CG2, IF-IF3, IM2, IM3, IM5
	7.1 Community Buildings		9.2	1.2	C1, C2	CO, ML, MP, MPI, TO
7. Community Services	7.1.1 Institutional Building		10.1	4.1	D1	CA, CA1, CG, CL, CLI, CM, CR, CRI, CS-CS7
	7.1.2 Educational Building		10.2	4.1		CW-CW3
	7.1.3 Religious Building		10.3	4.1		
8. Industry & Commerce	8.1 Industry		11.1	3.1	B1, B2	
	8.2 Offices		11.2	3.2		
	8.3 Retailing		11.3	3.3	A1, A3	
9. Vacant, Previously Developed Land	8.4 Storage & Warehousing		11.4	3.4	B8	
	9.1 Vacant Land Previously Developed		12.1	5.1		
	9.2 Derelict Land & Buildings		12.2	5.1		
	10.1 Defence		12.3	5.2		
	10.1.1 Defence		13	10.1		TD
LAND COVER						

1. Agricultural Land	1.1 Field Crops	1.1	
	1.2 Fallow Land	1.2	
	1.3 Horticulture & Orchards	1.3	
	1.4 Improved Pasture	1.4	
	1.5 Field Margins	1.5	
2. Woodland	2.1 Conifer Woodland	2.1	4.3.3, 4.3.4
	2.2 Mixed Woodland	2.2	>1 desc term
	2.3 Broad-leaved Woodland	2.3	4.3.5, 4.3.8, 4.3.9, 4.3.10
	2.4 Undifferentiated Young Woodland	2.5	4.3.15
	2.5 Scrub	2.6	
	2.6 Felled Woodland	2.4	
	2.7 Land Cultivated for Afforestation	3.1	4.3.13
3. Unimproved Grassland & Heathland	3.1 Unimproved Grassland	7.2	
	3.2 Heathland	3.2	4.3.6
	3.3 Bracken	3.3	
4. Water	4.1 Water	4.2	5.1, 5.2
		7.4	5.1, 5.2
	4.1.1 Standing Water	4.3	
	4.1.2 Running Water	4.1	
5. Wetland	4.2 Sea / Estuary	4.4	
	5.1 Freshwater Marsh	4.5	
	5.2 Salt Marsh	4.6	
	5.3 Bog	4.6	
6. Rock & Coastal Land	6.1 Inland Rock	5.1	4.3.1, 4.3.2, 4.3.11, 4.3.12
	6.2 Coastal Rock and Cliffs	5.2	4.1.1, 4.1.2, 4.3.14
	6.3 Inter-tidal Sand & Mud	5.3	5.2.1
	6.4 Dunes	5.4	
7. Buildings & Structures	7.1 Building	1.1	
	7.2 Other Built Structure	1.2, 1.3, 1.4	
8. Developed Surfaces	8.1 Road	2.1	
	8.2 Rail	3.1	
	8.3 Path / Pavement	2.2	
	8.4 Roadside	2.3	
	8.5 Sealed Surface	4.3	
	8.6 Natural Surface	4.4, 4.5	
	8.7 Mixed Surface		

Table 1 – NLU Classification (showing relationship with other land use classification schemes)

Order	Groups	Number of matches
1. Agriculture	1.1 Agriculture	0*
	1.2 Agricultural Building	0*
2. Forestry, Open Land and Water	2.1 Forestry/Woodland	0
	2.2 Open Land	0
	2.3 Water	0
3. Minerals and Landfill	3.1 Mineral Workings and Quarries	0*
	3.2 Landfill Waste Disposal	0*
4. Recreation	4.1 Outdoor Recreation	0*
	4.2 Leisure and Recreational Buildings	186
5. Transport and Utilities	5.1 Highways and Road Transport	77
	5.2 Transport (other)	0
	5.3 Utilities	0*
6. Residential	6.1 Residential	11,286
	6.2 Institutional and Communal Accommodation	21
7. Community Services	7.1 Community Buildings	67
8. Industry and Commerce	8.1 Industry	74
	8.2 Offices	916
	8.3 Retailing	979
	8.4 Storage and Warehousing	116
	Miscellaneous Commercial	38
9. Vacant Previously Developed Land	9.1 Vacant Land previously developed	NLUD-Phase 1
	9.2 Derelict Land and Buildings	NLUD-Phase 1
Defence	10.1 Defence	0*
TOTAL		13,760

* indicates that VOA data does contain use codes and descriptions for these land use groups and sub-groups but none were found in this study area

Table 2 – NLUD (land use) groups and sub-groups matched against VOA data

Order	Groups	Number of matches
1. Agricultural Land	1.1 Field Crops	0*
	1.2 Fallow Land	0*
	1.3 Horticulture & Orchards	0*
	1.4 Improved Pasture	0*
	1.5 Field Margins	0*
2. Woodland	2.1 Conifer Woodland	1
	2.2 Mixed Woodland	11
	2.3 Broad-leaved Woodland	103
	2.4 Undifferentiated Young Woodland	7
	2.5 Scrub	135
	2.6 Felled Woodland	0*
	2.7 Land Cultivated for Afforestation	0*
3. Unimproved Grassland & Heathland	3.1 Unimproved Grassland	0*
	3.2 Heathland	0*
	3.3 Bracken	0*
4. Water	4.1 Water	70
	4.2 Sea / Estuary	0*
5. Wetland	5.1 Freshwater Marsh	0*
	5.2 Salt Marsh	0*
	5.3 Bog	0*
6. Rock & Coastal Land	6.1 Inland Rock	13
	6.2 Coastal Rock and Cliffs	349
	6.3 Inter-tidal Sand & Mud	99
	6.4 Dunes	0*
7. Buildings & Structures	7.1 Building	12360
	7.2 Other Built Structure	331
8. Developed Surfaces	8.1 Road	1911
	8.2 Rail	166
	8.3 Path / Pavement	206
	8.4 Roadside	1359
	8.5 Sealed Surface	0*
	8.6 Natural Surface	274
	8.7 Mixed Surface	14458
TOTAL		31,853

* indicates that WasteMap data does contain use codes and descriptions for these land use groups and sub-groups but none were found in this study area

Table 3 – NLUD (land cover) groups and sub-groups matched against MasterMap data