Environmental Options Report

M6 Junction 33 Link Road

For Initial Public Consultation

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1 Introduction

1.1 Background

1.1.1 Lancaster City Council's published Local Plan identifies potential housing and employment land to the south of Lancaster on the west of the A6 highway. Lancaster University are proceeding with plans to construct a new Health and Innovation Campus next to their existing site on the east of the A6. The A6 corridor linking South Lancaster with Lancaster city centre will become an increasingly important link between Bailrigg Garden Village, Lancaster University and Lancaster City centre.

1.1.2 As the expansion of Lancaster University and Bailrigg Garden Village begin to take effect, the options for travel along the A6 highway corridor will become restricted as more demand is placed on the existing road network. Access to Lancaster/the university from the M6 Junction 33 by road can only be achieved by travelling through Galgate, which creates road traffic congestion and in turn has an impact on air quality in the village.

1.1.3 The existing A6 is constrained in traffic movement terms where it passes through Galgate, in particular at the signal controlled junction with Salford Road/Stoney Lane. Lancashire County Council and Lancaster City Council consider that there are minimal opportunities to implement sustainable and active travel along the A6 corridor for future needs owing to the narrowness of the carriageway and the built up nature of Galgate. There is also low potential to increase the capacity of the A6 junctions where it meets side roads.

1.1.4 The District of Lancaster Highways and Transport Masterplan sets Lancashire County Council's aspiration for transportation in Lancaster city and specifically for the area of south Lancaster. At page 30 under 'Our transport Vision' the District of Lancaster Highways and Transport Masterplan highlights a broad route from M6 Junction 33 which corresponds with a new travel pattern around Galgate village towards the city (the Link Road) and also variously discusses a

new travel corridor with emphasis on bus service along it through Bailrigg Garden Village.

1.1.5 There are four interconnected projects proposed for Lancaster and South Lancaster areas as follows:

1. An improved bus network for the city of Lancaster including removal of the one-way gyratory in the city centre;
2. A new cycling and walking superhighway linking the city centre with South Lancaster;
3. A direct link to the motorway for South Lancaster; and,
4. Access to Bailrigg Garden Village via a new bridge under the West Coast Main Line from the A6.

1.1.6 This project is planned to create a direct link from the M6 motorway into the future Bailrigg Garden Village area avoiding Galgate village - the road network within Bailrigg Garden Village will be built separately and is not part of the proposal for the link road to/from the M6 motorway. However, the proposal will include the formation of a bridge under the West Coast Main Line railway to connect to Bailrigg Garden Village.

1.2 Scheme Aim and Objectives

1.2.1 The aim in highways terms is to provide a more effective south link between Lancaster and the M6 motorway. The first benefit of doing so will be ensure the removal of a large amount of existing and future through traffic from Galgate village centre to remove the Air Quality Management Area (AQMA). The second benefit would accommodate road provision for new public transport and active travel together by making a more direct link between Junction 33 and Lancaster. The Scheme objectives are as follows:

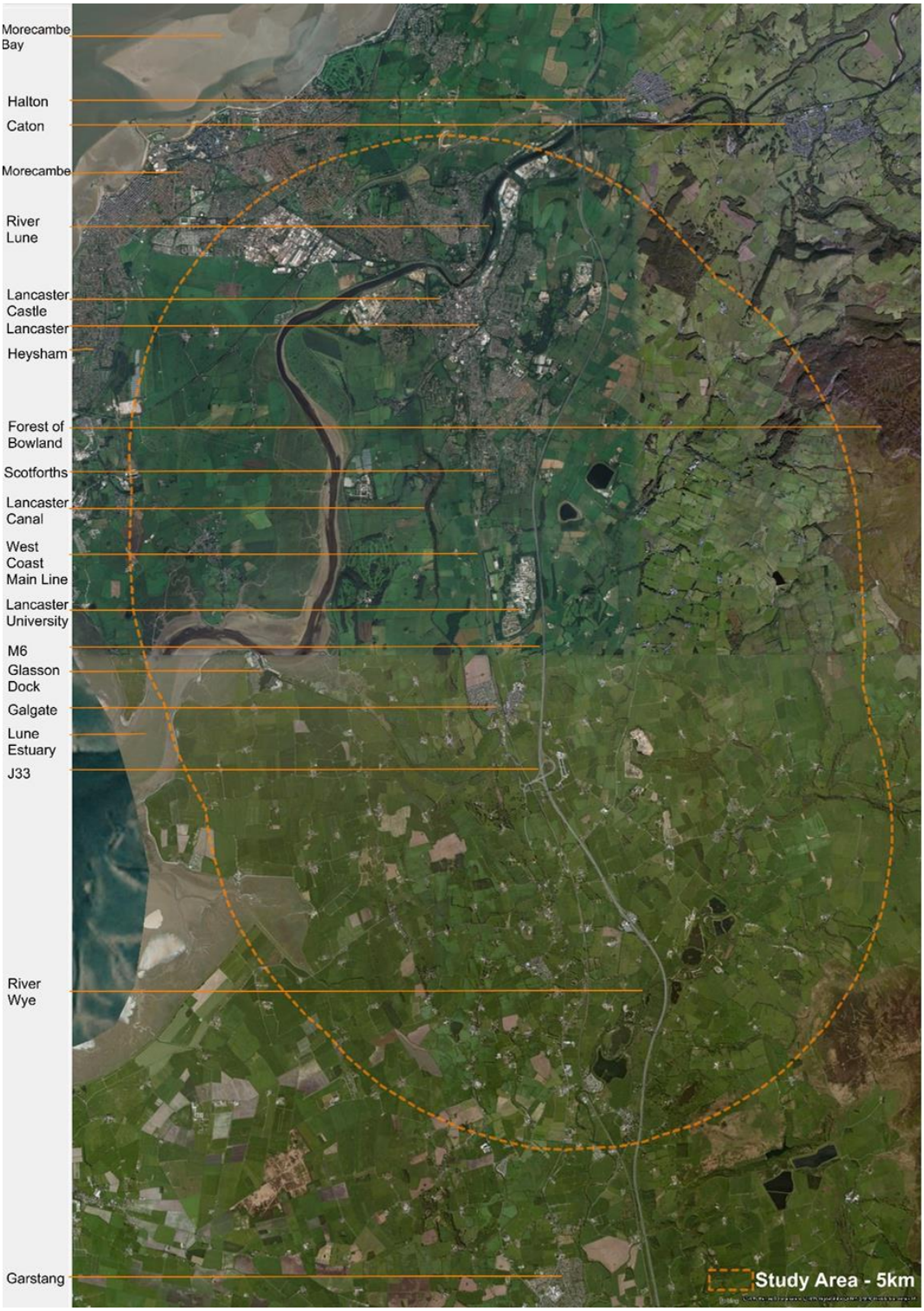
- Improve the M6 Junction 33;

- Form a connection to Bailrigg Garden Village; and,
- Relieve congestion in Galgate (centred on the main crossroads in the village) to remove the Air Quality Management Area.

1.3 Study Area

1.3.1 The search for a highways and transportation solution for the south of Lancaster has a number of key stages to understand and avoid environmental constraints to test against the engineering solution. This has required the setting of a Study Area, which is a zone of 5km from the centre of the Bailrigg Garden Village and M6 Junction 33 as illustrated below.

Figure 1 - Study Area



2 Environmental Objectives and Constraints

2.1 Summary of Topic Areas

2.1.1 In this study, environmental baseline data have been gathered in relation to the following environmental topics:

- Ecology/Biodiversity;
- Population and Human Health (including air quality, noise, road safety and effects on travellers);
- Climate Change;
- Ground Conditions/Landuse;
- Water (Resources and Flooding);
- Cultural Heritage (including architectural and archaeological);
- Landscape.

2.1.2 There are a number of overarching objectives, which any proposed development would have to achieve in environmental terms and these are set out in the following table.

Table 2.1 – Overall Environmental Objectives and Constraints

Constraint	Environmental Objective
Biodiversity	• Protect and enhance biodiversity and green infrastructure • Protect and enhance sites designated for nature conservation
Population and Human Health	• Improve road safety and reduce the number of accidents and other incidents • Improve segregation of vulnerable road users from traffic • Reduce air, noise and light pollution from transport
Air quality	• Reduce air pollution impacts
Climate Change	• Reduce CO_2 emissions for both construction and operation
Ground Conditions	• Conserve soil and agricultural resources • Seek to remediate / avoid land contamination
Water resources and flooding	• Protect and enhance where possible, the water environment • Reduce risk of flooding and increase resilience to the effects of a changing climate • Conform with the design requirements of the DMRB
Landscape	• Protect and enhance the character and quality of the Study Area's landscapes and townscapes.
Cultural Heritage	• Protect and enhance the quality and distinctiveness of the Study Areas historic and cultural heritage.

2.2 Studies/appraisals – Stage 1 Constraints and Baseline

2.2.1 An options study was the starting point for appraising the existing environmental conditions. A Stage 1 study set out a process to identify appropriate baseline datasets to group information, which was measurable record of the existing environmental condition - and made an overview of existing information, which is available for each of the identified environmental topics across the map, based Study Area.

2.2.2 A review of adopted regional plans, policies and programmes and local plans was carried out for the Study Area.

2.2.3 An evaluation of the area involved identification, the mapping of environmental constrains and buffer zones around them. Each constraint was coloured and over-layered onto the map with green being acceptable and red being unacceptable/areas to potentially avoid. This assists the illustration of more favourable areas for a broad new road route corridor. In the search for a broad route corridor it is desirable to avoid as many environmental sensitive areas as possible but the avoidance of all environmental or engineering constraints may not be achievable and there will be a requirement of the solution to make a balance.

Table 2.2 – Overall Environmental Topics and Baseline Information Used to Inform the Study

Environmental Topic	Baseline Information
Ecology / Biodiversity	Special Protection Areas (SPA) and Potential SPA (pSPA) Special Areas of Conservation (SAC), Candidate SAC (cSAC) and Pre-Designated SAC (SCI) Ramsar Sites and Proposed Ramsar sites Sites of Special Scientific Interest (SSSI) Local Wildlife Sites Local Nature Reserves Local Nature Conservation Sites Sites of Importance for Nature Conservation Sites of Nature Conservation Importance Biological Heritage Sites International and Nationally Protected Species Limestone Pavement Orders Ancient / Veteran Trees Biodiversity Targets Marine Conservation Zones (MCZ)
Population and Human Health (including air, noise, road safety and effects on travellers)	Population (location and age structure) Location of major settlements and areas of population Working age population Unemployment Economic activity rates Key skills gaps in the regional / local workforce. Average property values Regional / localised data in relation to access services, housing and public transport infrastructure Location of strategic road network

Environmental Topic	Baseline Information
	Location of emergency services including police stations, fire stations and hospitals Health Surveys (England) Noise levels Open Access Land Woodland Parks / Forest Parks Index of multiple deprivation National Trails Air Quality Management Areas (AQMA) and proposed AQMA Clean Air Zones and Proposed Clean Air Zones
Climate Change	Regional variations in climate change Predicted changes to temperature and weather patterns
Ground Conditions / Landuse	Geological Conservation Review Geological SSSIs Geoparks Regionally Important Geological and Geomorphological Sites (RIGS) Recorded Mineral Sites Areas of Known Mining Instability Control of Major Hazard Sites Agricultural Land Classification Contaminated Land Register
Water (Resources and Flooding)	River Basin Management Plans Bathing Water Quality Marine Strategy Framework Directive Designated Shellfish Waters Drinking Water Protected Areas Safeguard Zones Groundwater Source Protection Zones Groundwater Vulnerability WFD Waterbody / Catchment Designation Flood Zones Surface Water Flood Risk Maps Reservoir Inundation Maps Main River Maps Areas benefiting from Flood Defences Flood Water Storage Areas Shoreline Management Plans Coastal Risk Maps
Cultural Heritage (including architectural and archaeological)	Non-designated assets (Historic Environment Records) World Heritage Sites Scheduled Monuments

Environmental Topic	Baseline Information
	Historic Battlefields Parks and Gardens Listed Buildings Conservation Areas
Landscape	National Parks Country Parks Special Landscape Areas and Areas of Great Landscape Value Landscape / Seascape Character Assessments Areas of Outstanding Natural Beauty Heritage Coasts

2.3 Comparison of Constraints and Initial Scoring

2.3.1 A series of 'Tier 1' and 'Tier 2' criteria associated with each environmental objective and baseline datasets have been defined to help refine the Study Area and aid future consideration and assessment of any potential intervention in the context of the identified environmental issues. They were applied to the Study Area using GIS mapping techniques.

2.3.2 Tier 1 criteria are those, which are principally areas or features of International or National significance, or are of very high importance or rarity, with zero, very limited or limited potential for substitution. The best approach to the protection of such areas is generally to avoid the development of any infrastructure in such areas altogether as this would avoid direct impacts on the noted feature. As such, the approach to Tier 1 areas or features is to avoid these but it should be noted that circumstances might dictate that avoidance is not always possible.

2.3.3 Tier 2 criteria are often associated with Tier 1 and act as a 'buffer' to the Tier 1 criteria. The purpose of such buffer areas is to ensure that any potential indirect effects are avoided or reduced. The size of the buffer utilised is dependent upon the nature of the area or feature and follows where possible good practice. Tier 2 features are also areas or features that may be important in a local or regional context and which have limited potential for substitution. As with Tier 1,

avoidance of such features is the best form of protection, but it should again be noted that circumstances might dictate that avoidance is not always possible.

2.3.4 Outside of Tier 1 and Tier 2, areas / features are identified as being ‘Less Constrained’ and contain features of zero, low or medium importance or rarity at a local level. It is to be noted that these areas would still require consideration of environmental protection as a fundamental part of any intervention or Scheme.

2.3.5 This then provides us with route corridors, these were developed by a principal engineer who provided six potential routes these will be discussed in the next section.

3 Option Review

3.1 Existing Conditions

3.1.1 The existing transport links to and from Lancaster City centre/Junction 33 are orientated in a north-south direction, namely the A6, the M6 motorway, the Lancaster canal and the West Coast Main Line railway. The site for the proposed Bailrigg Garden Village is situated to the west of the West Coast Main Line railway. The existing built up area of Galgate and Lancaster University campus are further physical built constraints to development.

3.1.2 All potential route options propose the construction of a wider bridge under the West Coast Main Line to enable highway access to the Bailrigg Garden Village from the A6. The Western route options do not provide alteration works to Junction 33.

3.2 Link Road Route Options

Link Road

3.2.1 A link road is proposed so that access to M6 Junction 33 can be made without traffic passing through Galgate village. The main function of a new link road in all options will be to provide connection to Bailrigg Garden Village and remove the AQMA in Galgate. In Eastern and Central route options the link road will directly join into a revised Junction 33 so that the two parts of the junction function as a single junction.

3.2.2 There are two potential route options to the east of the M6 motorway. Two potential route options that create a more central alignment on land between Galgate/Ellel and the motorway. Two western route options that could create a route to the west of Galgate, to the West Coast Main Line railway (WCML) and the Lancaster Canal.

3.2.3 Six highway route options for the Junction 33 link to Bailrigg Garden Village were appraised in total as follows: Eastern 1; Eastern 2; Central 1; Central 2; Western 1; and Western 2.

3.2.4 All of the link road options put forward were appraised against land, environmental and planning constraints. The characteristics of each of the six options are briefly summarised below.

Table 3 – Considered Option Characteristics

Name	Link Road Alignment	Relocate Junction 33 north slip roads	North bound off-slipway improved	Link to A588	Widened / new WCML Underpass
Eastern 1	East of M6	Yes	Yes	No	Yes
Eastern 2	East of M6	Yes	Yes	No	Yes
Central 1	Between Galgate and M6	Yes	Yes	No	Yes
Central 2	Between Galgate and M6	Yes	No	Yes	Yes
Western 1	West of the A6	No	No	No	Yes
Western 2	West of the A6	No	No	No	Yes

Access to Bailrigg Garden Village

3.2.5 All options will provide highway access to the proposed Bailrigg Garden Village, which is situated to the west of the West Coast Main Line Railway.

Changes to Junction 33

3.2.6 The changes to junctions in all relevant options would involve closing the southbound off slipway and the northbound on slipway and relocating the slipways to a location at the south east boundary of Lancaster University and to terminate at Hazelrigg Lane.

3.2.7 The alignment of the relocated slips roads is in part fixed by the rules in the Design Manual for Roads and Bridges[1] on slip road design. The location of these slip roads on Hazelrigg Lane presents several issues. The M6 motorway rises at it travels north – the maximum gradient motorway slip roads can reach a maximum gradient of 6%, which is likely to force the slip roads to be quite long to reach the motorway from Hazelrigg Lane.

3.2.8 The other issue to impact on the design of the proposed slip roads is the ground levels moving away from the motorway. The west side (Northbound) entry slip road is between the motorway and Lancaster University. The university is built on higher ground than the motorway and extensive excavation will be required. The height of the cutting slopes created will likely need engineering to keep them stable. The east side (Southbound) exit slip road to the east of the motorway again cuts into the ground quite significantly although not to the same depth.

West Coast Main Line Railway Underpass

3.2.9 The options are very limited for gaining access from the A6 corridor past the West Coast Main Line and through to the garden village area beyond.

3.2.10 The only option, which will be feasible, is at the western end of Hazelrigg Lane where the rail line is above the level of the surrounding land. There is an existing underbridge for landowner access but it is not large enough in either width or headroom for vehicle traffic to use. In the present form, it could be used as a cycleway or combined cycleway/footway.

3.2.11 To provide a headroom of 5.3m for the underbridge the proposed link road will be required to pass below the railway in a new cutting below the existing ground level. The depth of the cutting is expected to be approx. 1.5m below ground level dependent on the requirements of Network Rail. Owing to the reduced level being approx. 4.5m below the existing A6 and 2.4m below the level of the

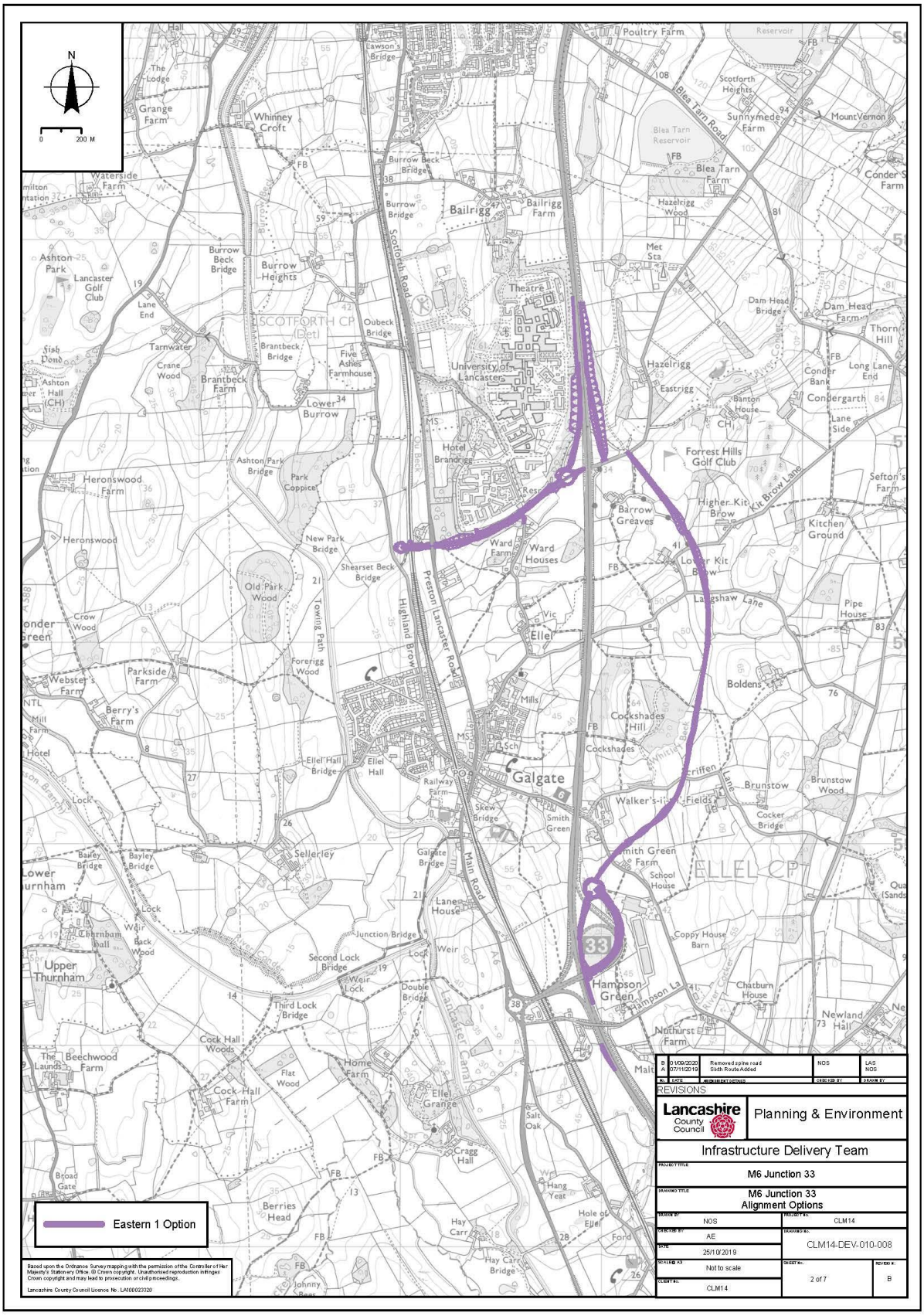
[1] Design Manual for Roads and Bridges: Volume 6 Road Geometry – CD122 found at:- http://origin.standardsforhighways.co.uk/ha/standards/dmrb/vol6/section2.htm

nearby Ou Beck it is expected that the drainage in this area would have to be assisted by a pump.

3.3 Detailed Route Option Description - Eastern

3.3.1 These options involve following a route within a corridor 0.6km to 0.9km to the east of the M6 motorway. Both options involve the closure of the southbound off and the northbound on slipways at Junction 33 and replacements at Hazelrigg Lane. The land to the east of the M6 on the opposite valley side to Galgate, Ellel, Lancaster University is rural in nature characterised by undulating low hills, and shallow valleys set in an elevated location in relation to the M6 motorway.

Figure 3.1 - Eastern 1 Route Option

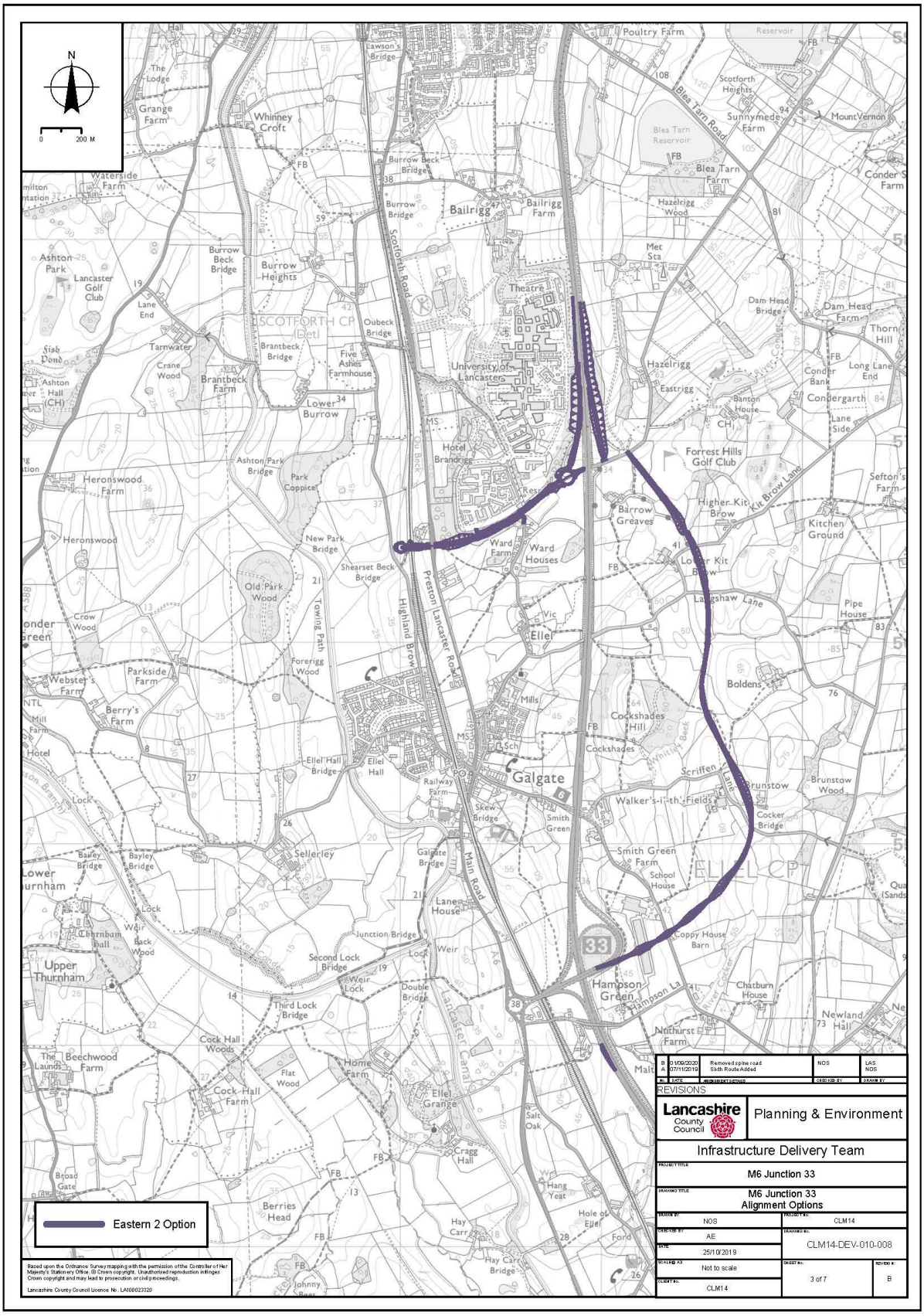


3.3.2 The Eastern 1 route option would create a road which has an arc through a predominantly countryside setting to the east of the M6 motorway. A roundabout would be constructed to the east of the existing southbound off slipway at Junction 33 in order to connect with the retained southbound-on slipway with the M6 and new link road. There would be alterations made to the retained southbound on slipway on the west side of the M6.

3.3.3 The route option would initially follow in a north east path severing Stoney Lane then the route is just north of Scriffin Lane it then passes between two hills, Little Cockshades Wood to the west and Brunstow Wood to the east. The route option would be parallel with Whitley Beck for a short section prior to making a crossing of the beck and in turn Langshaw Lane and then Kit Brow Lane. The route option would then turn slightly to the north west between Studley Hill and Barrow Greaves prior to joining Hazelrigg Lane approximately 190m east of the M6 motorway.

3.3.4 The route option will join the Bailrigg Garden Village via a new roundabout, reached by passing under the West Coast Main Line, at a location close to the junction of Leach House Lane and Highland Brow.

Figure 3.2 - Eastern 2 Route Option



3.3.5 This route option is provided as an alternative to Eastern 1. On leaving the existing motorway junction, the route option falls into a valley before then rising to the hill beyond. In the base of this valley is 'Hampson Farm', which the route option would pass straight through, thereby, removing the farm. This would keep the gradients on either side of this valley within acceptable DMRB limits, as an embankment of over 4m high is required.

3.3.6 The route option then climbs continuously at various grades up to 60m east of 'Walker in the Field' (Chainage 1320). There would be two areas on this climb of quite deep excavation and one of fill. The first area of excavation would be where the route option would cross Stoney Lane and would allow the route option to cross Stoney Lane by bridge.

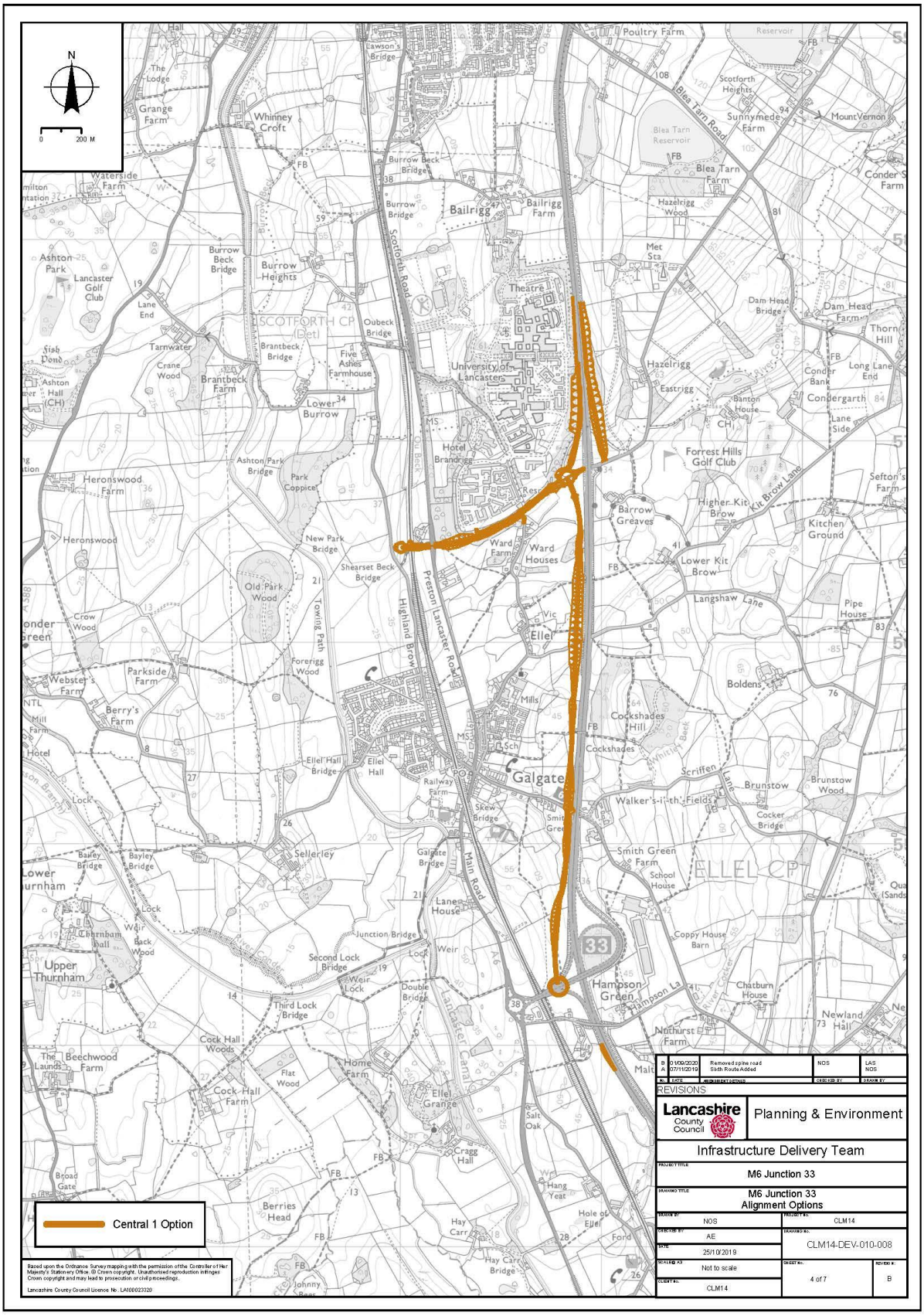
3.3.7 the northern section of Eastern 2 uses a the same route as Eastern 1

3.3.8 Whilst Eastern 2 route option is longer than Eastern 1, this option would produce a significant amount of fill that could be used on large embankments towards the northern part both routes where the route option would pass over the River Condor Valley. From the summit, where the route option falls to connect with norther section common to both routes, there is also potential to drain the road (after attenuation) into the adjacent Whitley Beck.

3.4 Detailed Route Option Description - Central

3.4.1 The Central route options would provide a link road which closely follows the western boundary of the M6 motorway between the motorway and the villages of Ellel and Galgate. The Central route option would join with Hazelrigg Lane as the eastern options but on the Galgate/Lancaster University side of the motorway. The route includes the improvement of Hazelrigg Lane to approach the Bailrigg Garden Village via the A6 junction/new bridge under the West Coast Main Line railway.

Figure 3.3 - Central 1 Route Option

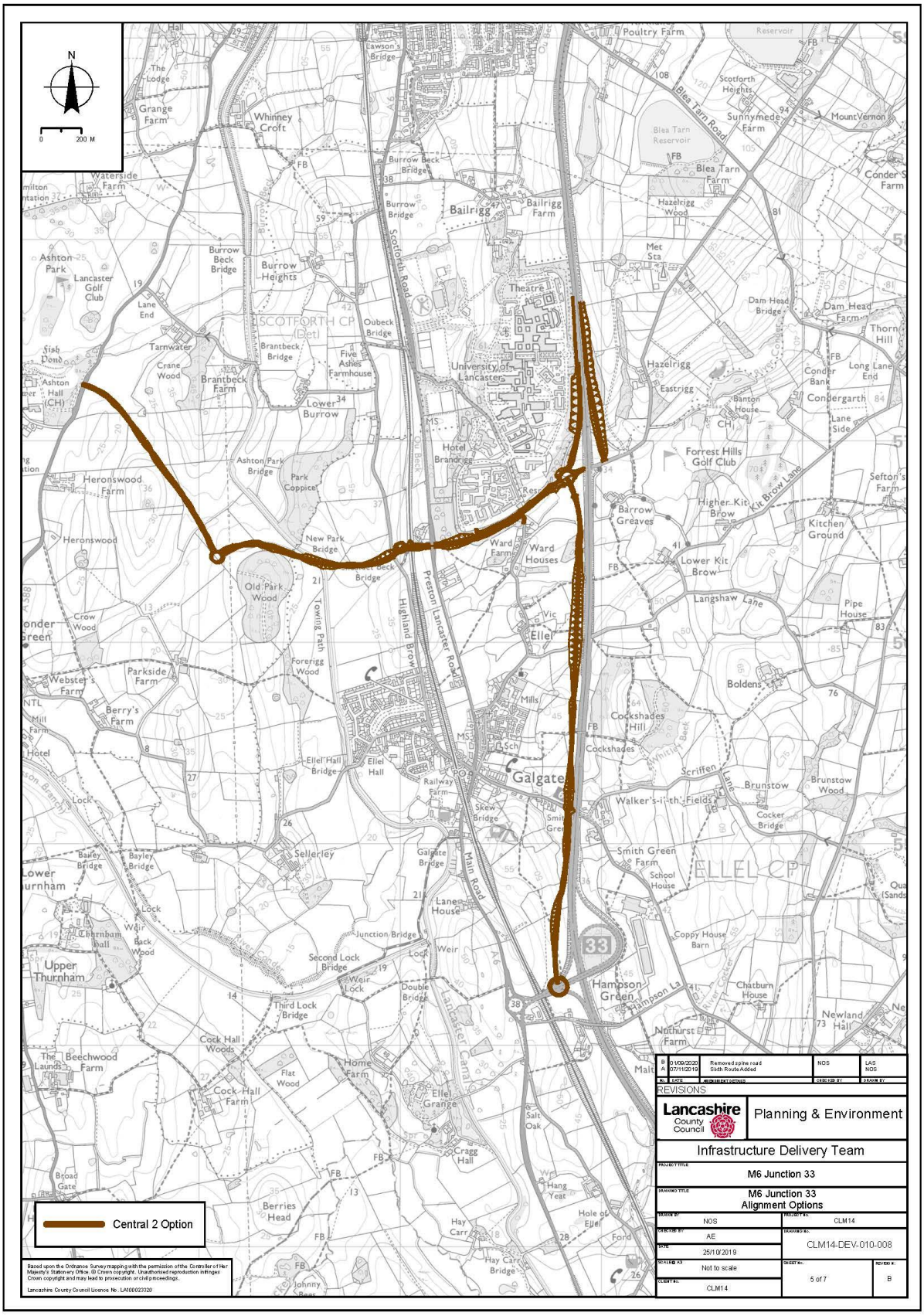


3.4.2 The Central 1 route option comprises the closure of the north slipways, the formation of a roundabout on the west side of Junction 33 and the construction of a new link road northwards to Hazelrigg Lane alongside the M6 northbound.

3.4.3 The land in this area is undulating in nature and north of the proposed roundabout the grade of route option would be initially maintained, by creating small cuttings and fill-embankments. The road would then fall over a kilometre or so in order to follow the vertical height of the M6 past the village of Galgate and then to bridge Stoney Lane. Beyond the Stoney Lane bridge the route option would continue to follow the M6 motorway and goes through undulating land between Ellel and the M6; first supported on an embankment, then into a half cutting and finally onto a longer embankment close to the village before falling in level to join a new roundabout.

3.4.4 The new roundabout would be located on Hazelrigg Lane close to the end of new motorway slipways. The capacity of Hazelrigg Lane will be improved to the A6 and then beyond the West Coast Main Line railway under a widened underbridge. The route option would provide access to the Bailrigg Garden Village.

Figure 3.4 - Central 2 (A588 Link) Route Option



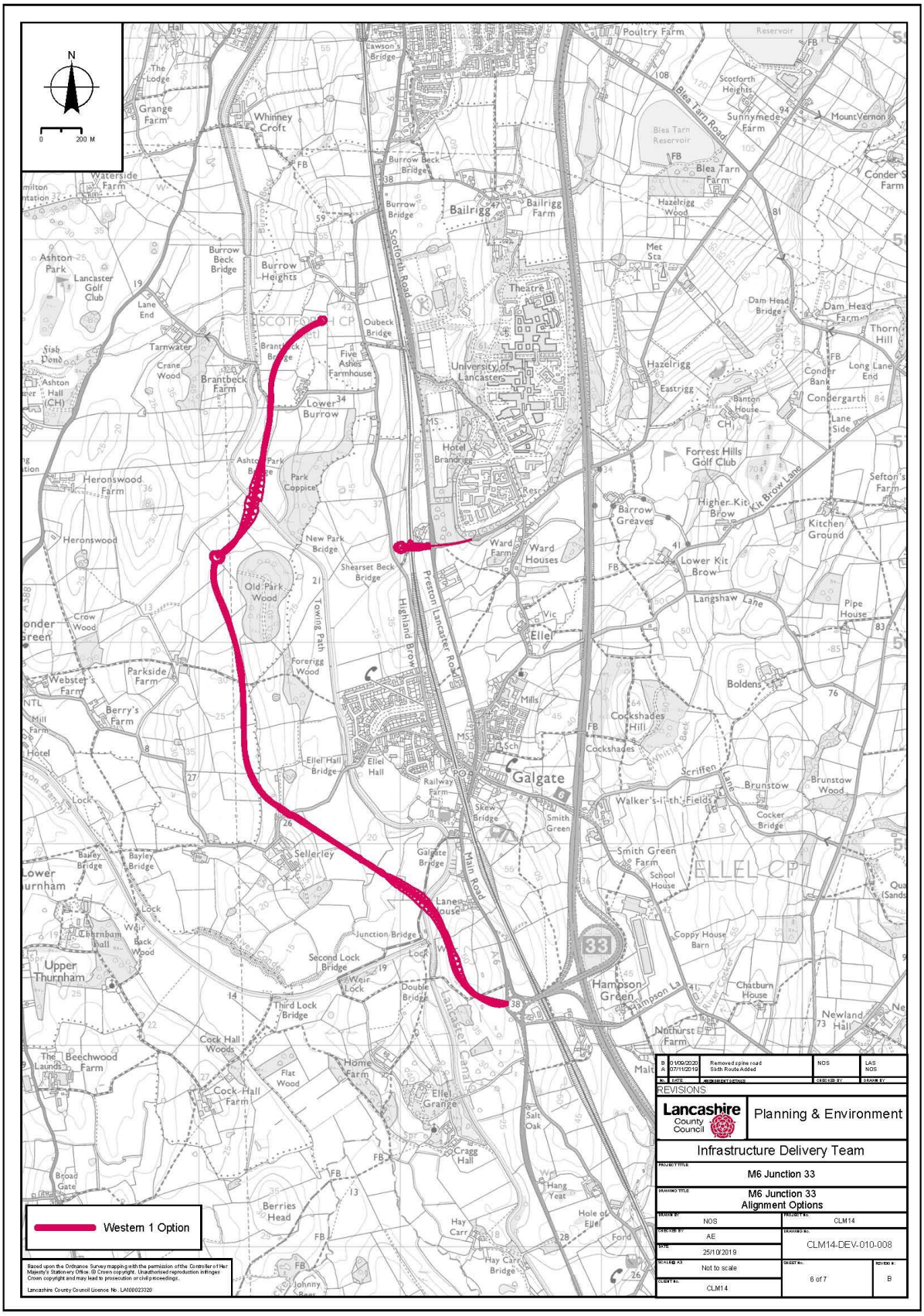
3.4.5 Central 2 option follows Central 1 route option but includes an extra 1,000m length of new highway link. Beginning at the southernmost end of the Bailrigg Garden Village it follows an east-west orientation until Old Park Wood where it turns to the north west in order to connect into the A588 at a location close to Ashton Hall. The option alignment chosen for the A588 link is one which passes in between two adjacent hills with the aim of avoiding high points in the landscape and wet spots which would create highway drainage/construction issues.

3.5 Detailed Route Option Description - Western

3.5.1 For the Western route options there are two known as, Western 1 and Western 2. Some elements of both options follow similar alignments. Neither Western route options propose changes to M6 Junction 33.

3.5.2 The two options follow the similar route up to north west of Old Park Wood where a roundabout would allow the route options to branch off in alternative directions

Figure 3.5 - Western 1 Route Option



3.5.3 Western 1 route option originates at the Preston Lancaster Road/A6/Junction 33 roundabout heading in a north western direction where the alignment would follow a western contour of low hill before being elevated on embankments leading up to a proposed bridge over the Lancaster Canal. This element of the alignment would avoid the nearby Quarry Wood. The route continues around the hill a 200m distance from the canal.

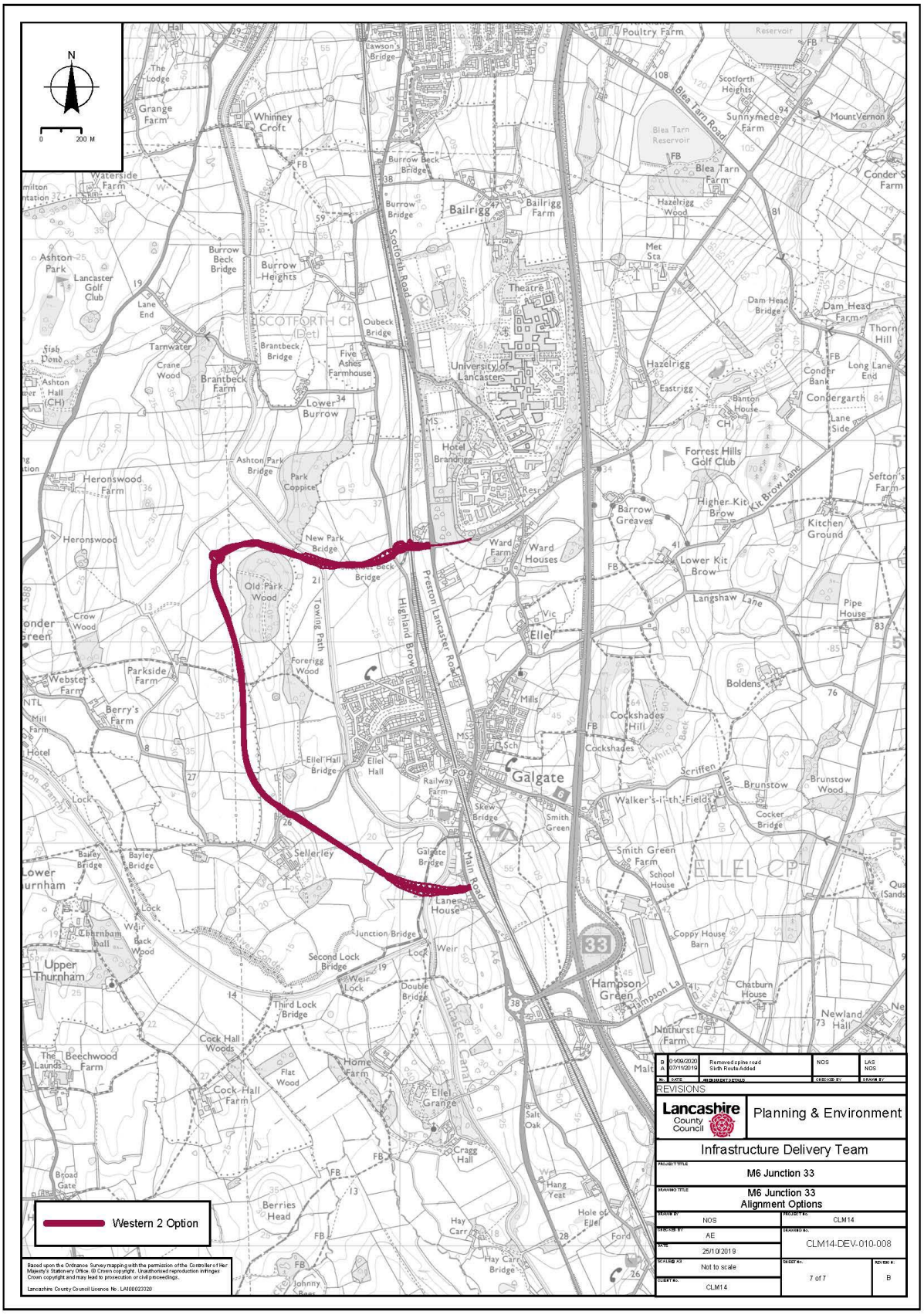
3.5.4 The alignment gradually falls from the previous section to a low point at the River Condor. From the River Condor the alignment proceeds along the valley floor and passes to the north of Sellerley Farm. The alignment curves to the north after this point to pass along a further valley, this is to reduce the impact of the alignment being on the top of the hill and is more cost effective than building on the valley side. Careful consideration will be required for any stream, which are in the same location.

3.5.5 The alignment would be parallel to a high voltage electricity pylon line. The route would pass beneath the cables at slightly below ground level to achieve clearance. The alignment follows the contours slowly rising to meet a roundabout to the north west of Old Park Wood where the route options split with Western 1 travelling in a northerly direction and Western 2 travelling in an easterly direction

3.5.6 From this roundabout the route heads in a more northerly direction where it would pass over Lancaster Canal and subsequently continue in a north eastern direction. A multi-span bridge or an embankment could be used to maintain the grade of the highway. At Lower Burrow farm buildings the alignment swings slightly west and then curves east to connect with the proposed Bailrigg Garden Village. The route option is kept close to grade for much of its length except where crossing the Lancaster Canal.

3.5.7 Tarnwater Lane would crosses the alignment and it may be beneficial to lower the alignment to allow this minor road to cross over without requiring a large bridge, this will also generate fill to be used on embankments.

Figure 3.6 Western 2 Route Option



3.5.8 The route option for Western 2 is an alternative to the first 900m of the west alignments that would commence 60m north of Lane House and meet the same route a Western 1 280m south of Galgate Cricket ground. This would require works to widen the A6 from the Junction 33 roundabout to the start of this option, it also goes across some of the moorings for Galgate Marina.

3.5.9 The alignment follows the contours slowly rising to meet a roundabout to the north west of Old Park Wood where the route options split with Western 1 travelling in a northerly direction and Western 2 travelling in an easterly direction

3.5.10 The Western 2 route option heads in a north east direction curving around an area of woodland classed as a biological heritage site. Approaching the Lancaster Canal there is an existing stone bridge to the north of the alignment, the route has been adjusted to avoid this bridge. The bridge is a listed building. A balance has to be struck with the alignment to either pass closer to the bridge or the woodland to the south which could be affected by the cutting slopes. These cutting slopes are quite extensive as the road is kept at a level to cross over the canal.

3.5.11 Once across the canal the alignment travels along the southern edge of a hill before a gradient down to the Bailrigg Garden Village. The alignment will require extensive earthworks around the hill however the material excavated will be used as fill elsewhere on the route option.

4 Biodiversity

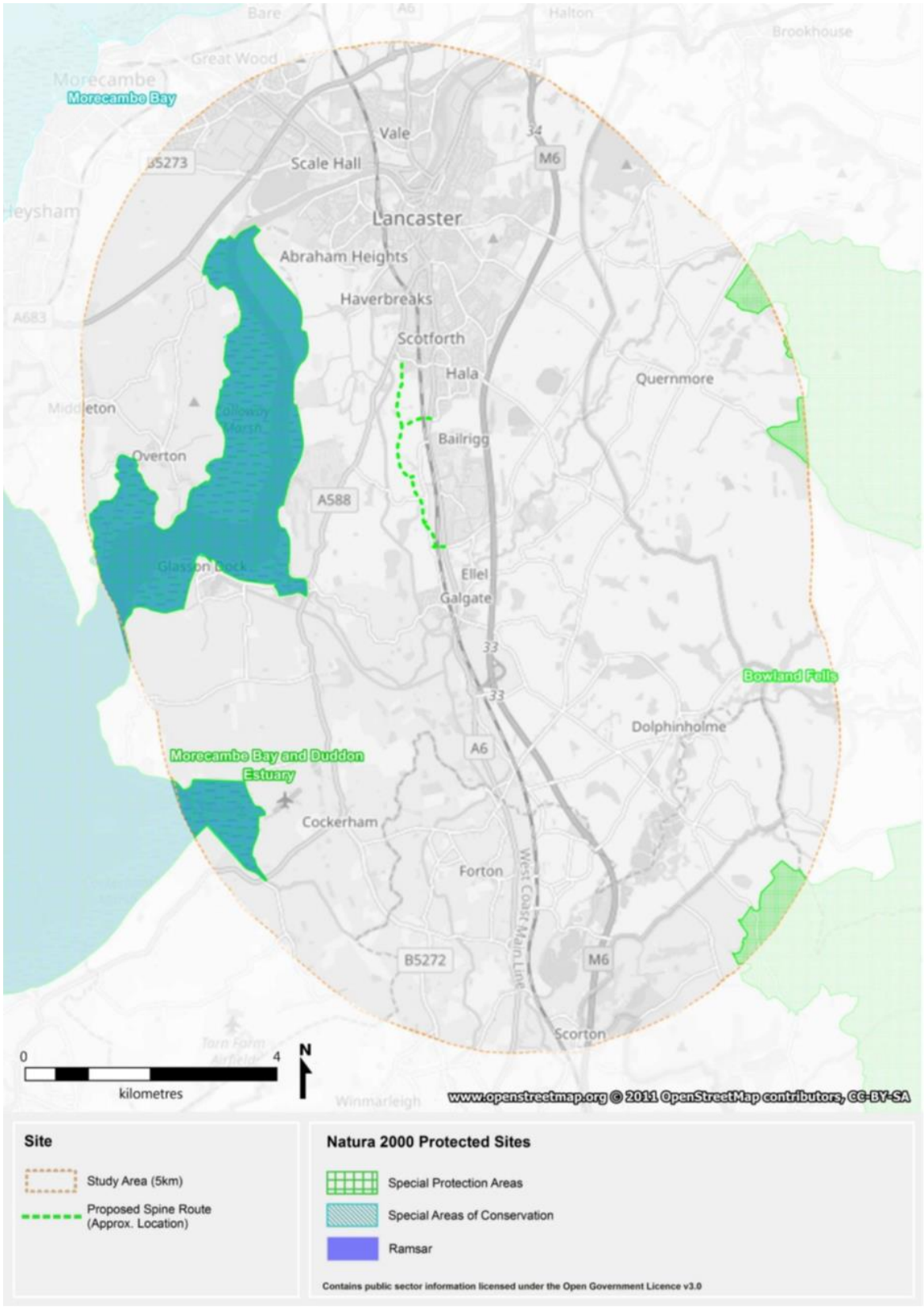
4.1.1 Within the Study Area there is a range of estuarine, freshwater and terrestrial habitats, many of which are designated for nature conservation purposes. Amongst these, there are a number of sites designated at the international or national level. These sites are Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR). In addition, there are a range of sites designated as Biological Heritage Sites, which are considered of importance within the county of Lancashire. It should be noted that there are no National Nature Reserves within the Study Area.

Table 4.1 Sites designated for nature conservation in the Study Area - International and National

Name of Site	Size of designation within Study Area (Ha)
Morecambe Bay SAC	1052
Morecambe Bay Ramsar	1052
Bowland Fells SPA	130
Morecambe Bay and Duddon Estuary SPA	1052
Boland Fells SSSI	128
Lune Estuary SSSI	1052
Morecambe Bay SSSI	1052
Cockerham Marsh SSSI	9
Wyre Lune MCZ	500

Source: Natural England web based search facility and open access GIS data. Overview descriptions by JNCC and Natural England

Figure 4.1 - Biodiversity International Sites



4.1.2 There are also a range of areas designated at the 'local' level (i.e. at the regional, local authority or community level) for nature conservation purposes. The most important of these are Biological Heritage Sites and adopted Policy E17 of the Lancaster Local Plan provides protection to these sites. This states that development likely to damage or destroy a county Biological Heritage Site (BHS) will not be permitted unless the need for development demonstrably outweighs the need to protect the site. Any adverse impacts caused by developments should be mitigated through appropriate habitat enhancement measures.

Table 4.2 Sites designated for nature conservation within the Study Area – Local

Name of site	Size of designated area within the Study Area (Ha)	Name of site	Size of designated area within the Study Area (Ha)
Cockerham and Winmarleigh Moss Edge BHS	73.2	Long Bank Wood BHS	3.4
Meldham Wood BHS	3.8	Freeman's Wood BHS	0.9
Berry's Farm and Sellerley Farm Ponds, Conder Green BHS	0.4	Oxcliffe Road Lake BHS	0.7
Forerigg Wood BHS	2.2	Ghyll Wood BHS	1.5
Old Park Wood BHS	9.2	Mark Holme Wood (Hall Gill) BHS	5.5
Park Coppice BHS	8.6	Knots Wood BHS	1.0
Crane Wood BHS	3.3	Quernmore Churchyard BHS	0.3
Burrow Beck BHS	1.1	Nicky Nook BHS	3.8
Cockshades Wood BHS	3.5	Rowton Brook Wood BHS	7.9
Little Cockshades Wood BHS	5.1	Heysham Moss-land Adjoining SSSI BHS	1.5
Park Wood BHS	10.1	Wyresdale Road Verges BHS	0.8

Brunstow Wood BHS	2.0	Birk Bank Mire BHS	1.6
Cocker Clough Wood BHS	3.9	Newton Beck Valley BHS	7.2
Mainstones BHS	11.4	Conder Green Saltmarsh BHS	4.0
Wyre Wharf Wood BHS	2.0	Dolphinholme Churchyard BHS	0.4
Mill Wood BHS	4.3	Cocker Clough Rough BHS	0.8
Lordhouse Edge Mire BHS	1.5	Brigbank and Horse Holme Woods BHS	3.6
Weir Wood BHS	7.8	Long Wood BHS	1.1
Starbank Wood BHS	8.1	Cleveley Woods BHS	9.3
Throstle Nest Wood (Caw Brook) BHS	6.0	Fox's Wood BHS	3.5
Back Wood BHS	5.2	Brunstow North Wood BHS	2.2
Centre Wood BHS	4.5	River Lune BHS	86.7
Ellel Grange Woods BHS	7.3	Ortner Wood (Sparrow Gill) BHS	6.5
Scale House Farm Pond BHS	0.3	Mill Wood BHS	10.3
Oxcliffe Marsh BHS	1.9	Wyre Valley Gravel Pits BHS	110.5
Lancaster Moor Hospital Grassland BHS	2.3	Lancaster Canal BHS	68.6

4.1.3 In addition to designated sites, across the Study Area are a range of habitats which are important to biodiversity. These include:

- Ancient Woodlands and Traditional Orchards
- Wood Pasture and Parkland
- Woodland and isolated individual trees
- Ponds and areas of marshland
- River corridors and smaller watercourses
- Hedgerows

- Grassland / arable farmland and improved pasture
- Coastal fringe
- These areas provide important habitat for a range of species, many of which are legally protected.

4.1.4 There are 42 traditional orchards, which have been identified within the Study Area. Traditional orchards are noted as structurally and ecologically similar to wood-pasture and parkland[2], with open-grown trees set in herbaceous vegetation, but are generally distinguished from these priority habitat complexes by the following characteristics;

- The species composition of the trees;
- The (usually) denser arrangement of the trees;
- The small scale of individual habitat patches; and
- The wider dispersion and greater frequency of occurrence of habitat patches in the countryside.

[2] UK Biodiversity Action Plan Priority Habitat Descriptions Traditional Orchards

Figure 4.2 - Biodiversity National and Local Sites

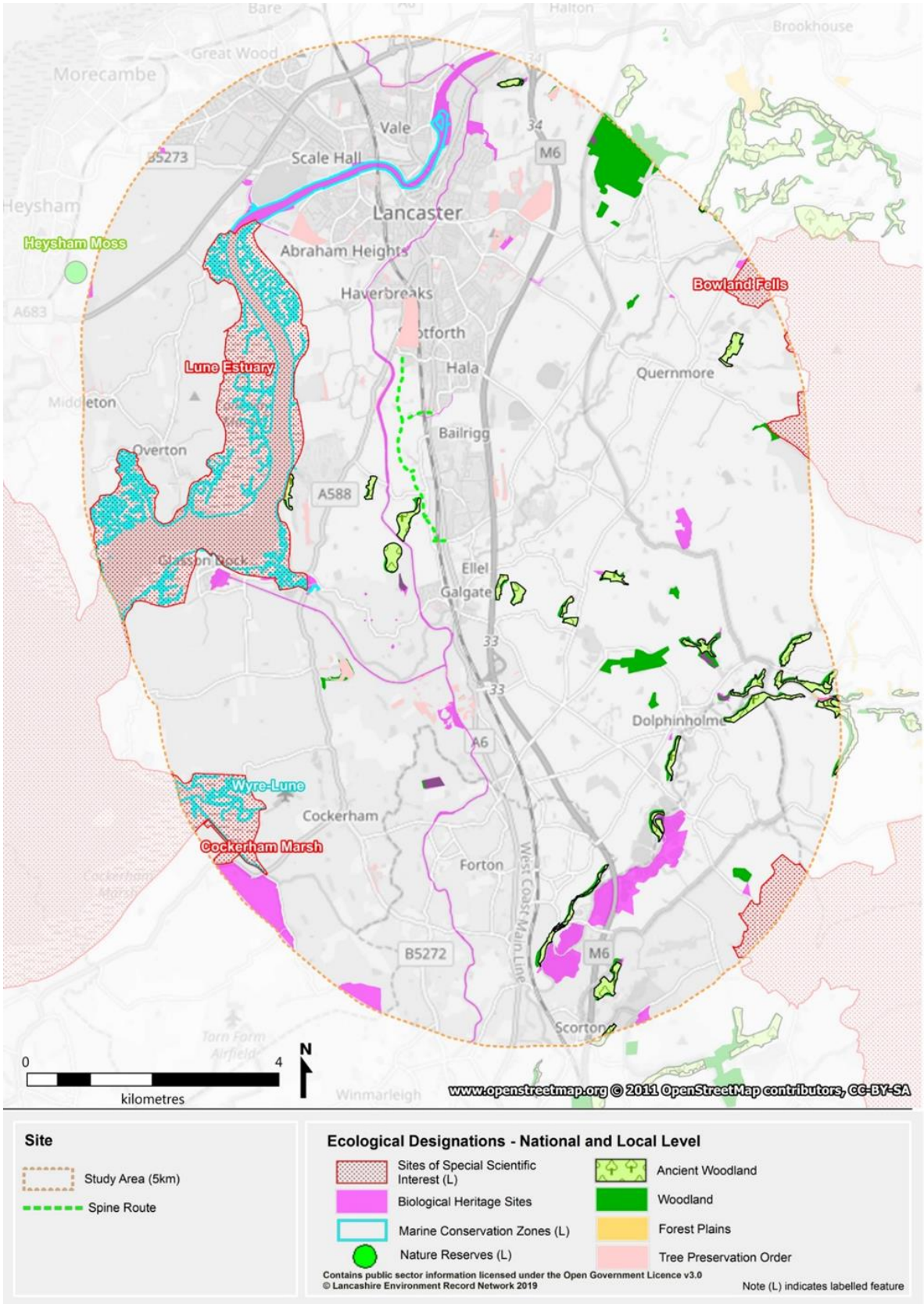
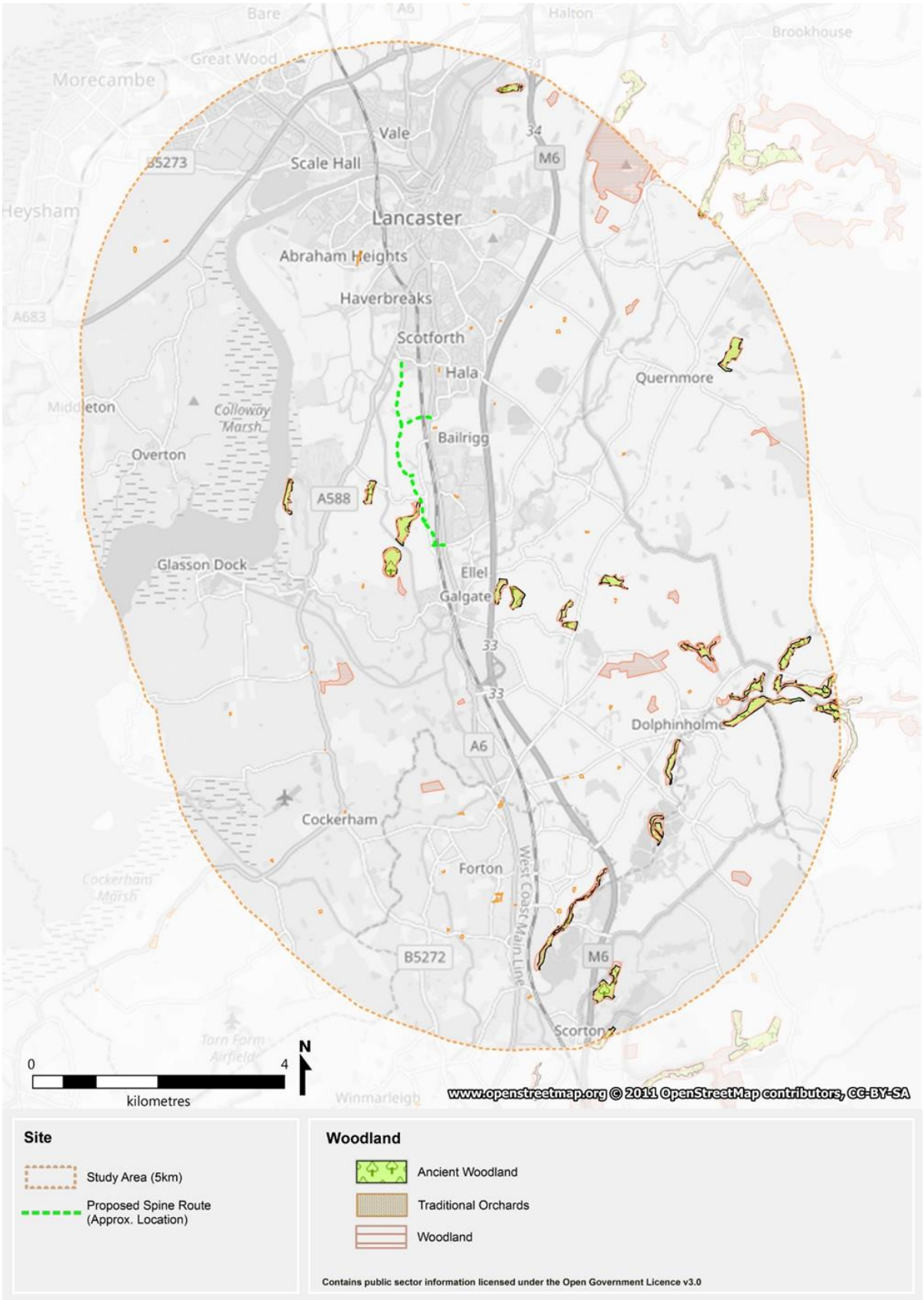


Figure 4.3 - Woodland Sites



4.1.5 The Multi-Agency Geographic Information for the Countryside (MAGIC) website was reviewed to obtain information relating to European and nationally designated sites (Site of Special Scientific Interest (SSSI)). Nationally (SSSI's) designated sites were assessed within 2km of the route corridors areas and non-statutory designated sites including Ancient Woodlands within 1km of the route corridors areas.

4.1.6 A comprehensive desk study was undertaken in June 2019 to obtain ecological data relevant to the Study Area. Species data records were provided by LERN for 5km and details of Biological Heritage Sites (BHS) within a 2km search area around the route corridors. Lancashire Badger Group provided records of setts within 4km. Ordnance survey maps and aerial imagery were also reviewed within 1km of the route corridors area for landscape features and notable habitats that could be present.

4.1.7 Across the Study Area there has also been a range of individual protected species recorded. An example of the types of species to be found were identified during Preliminary Ecological Appraisals carried out in 2017 for the development of the Lancaster Local Plan and which noted the following for South Lancaster (a large potential development site within the Study Area).

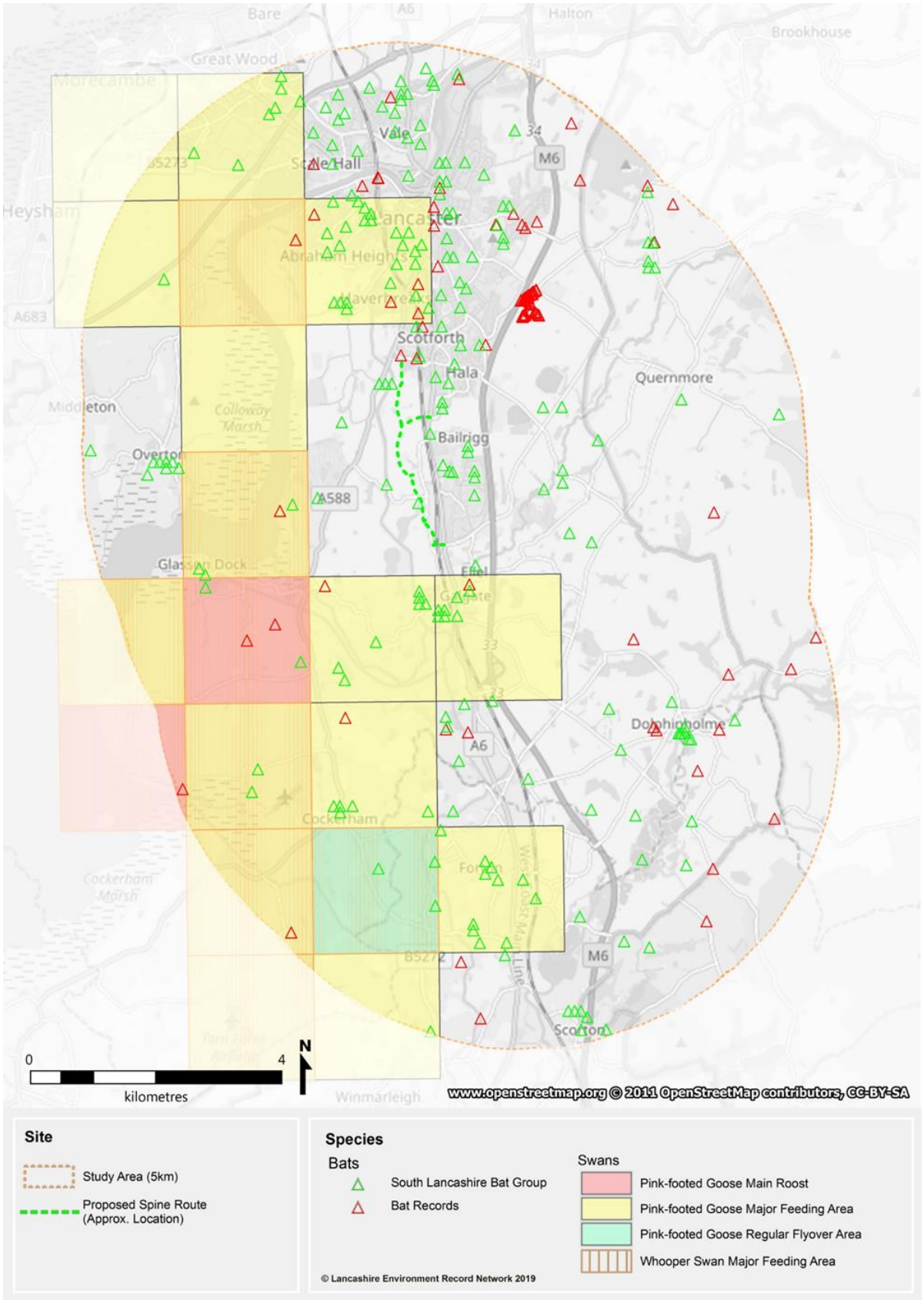
- Otters
- Great crested newt
- Water Vole
- Badger
- Bats
- Slow worm

4.1.8 These species were found together with a range of 'priority' invertebrate species and it was noted in the Preliminary Ecological Appraisal that this range and diversity of species is perhaps to be expected across what is a very large

site with a range of important habitat types present. During the field surveys signs of badgers were confirmed. The priority bird species dunnock, house sparrow, lapwing, reed bunting (probably breeding), skylark (probably breeding, starling, grey heron and willow warbler were all confirmed. The invasive plant Himalayan Balsam was recorded along the Canal corridor and along parts of the Burrow Beck.

4.1.9 The above note from the Preliminary Ecological Appraisal for the Local Plan relates to one discrete area within the Study Area and is used to illustrate the range of habitats and species to be found outside the designated areas. The potential for a greater range or greater value of habitats or species in other parts of the Study Area cannot be ruled out at this stage and it is indeed probable, given the noted value of some parts of the Study Area. LERN (Lancashire Environmental Records Network) compile and have identified a number of important bat, swan and goose sites

Figure 4.4 – Protected and Priority Species



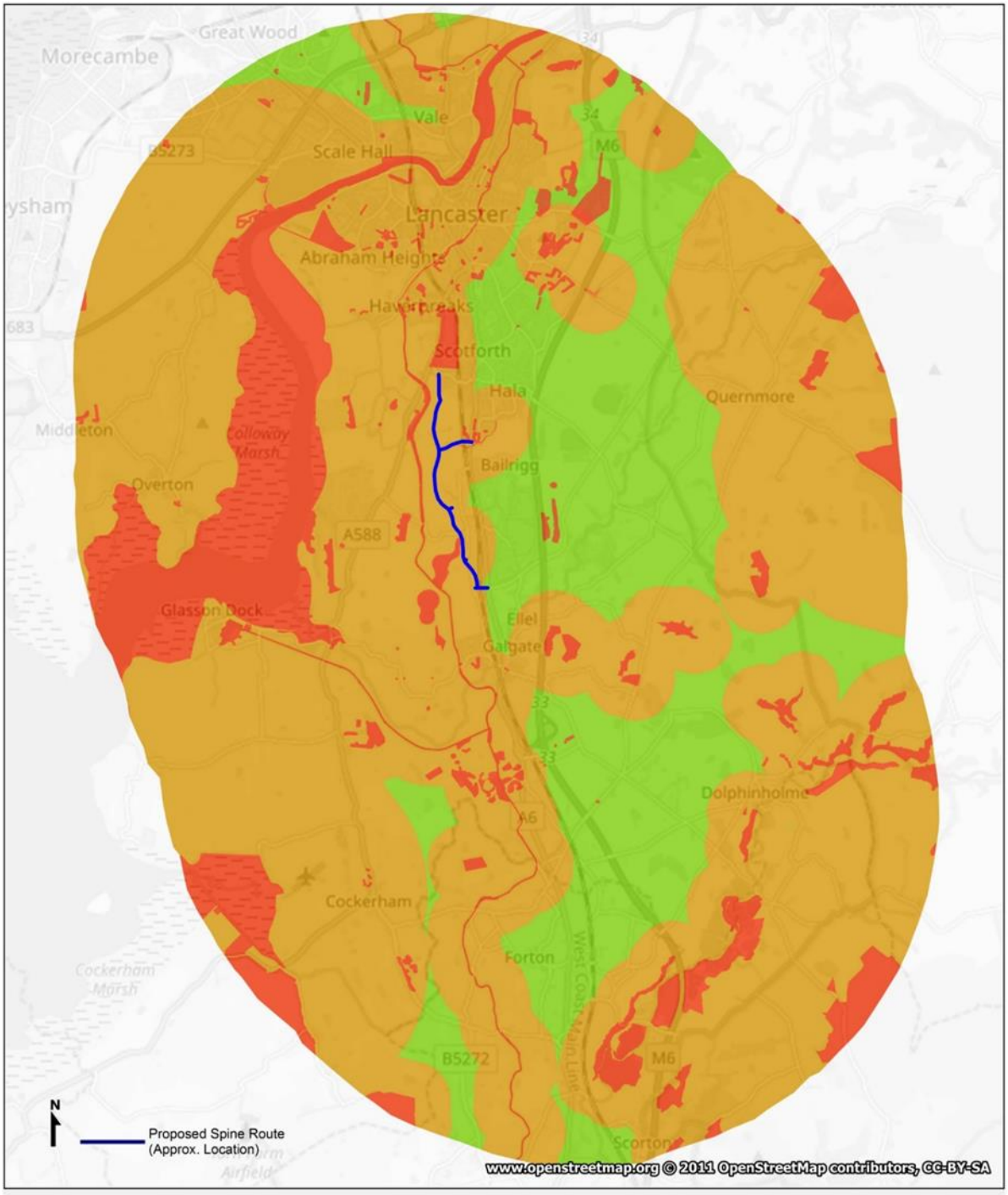
4.1.10 Ecological zones of influence (EZoI) have been established to identify and assess important ecological features with potential to be affected by the design, construction and/ or operational aspects of the Proposed Scheme. As part of the desktop study, an initial EZoI is established to identify the geographic context and complexity of ecological features that could be affected based on the nature of activities that will be carried out as part of the Proposed Scheme construction (e.g. location, scale, methods, duration, etc.).

4.1.11 All options would have potential to impact upon broadleaved woodland, individual/scattered trees, hedgerows together with waterbodies. The Western route options being closest to the estuarine area of the River Lune are potentially the most constrained. The Central route options would be on land, which is within Tier 2 zones for some of the route between Galgate and Hazelrigg Lane and would avoid close routing to Tier 1 constraints. The link into Bailrigg Garden Village has to cross the Lancaster Canal BHS and the Central 2 route option with a link would cross marsh land wildlife habitat. Other BHSs, which may be affected, are Park Coppice, Old Park Wood, Burrow Beck, Forerigg Wood. There are fewer buildings (which require further surveys to determine their constraint level) within this corridor.

4.1.12 The Eastern route options are in biodiversity terms considered to be less constrained mainly owing to the route crossing more open farmland and contains no ancient woodland. The wider route options would potentially have an impact upon Cockshades Wood BHS and mixed woodland generally.

4.1.13 Habitats such as individual and lines of scattered trees and hedgerows (including defunct hedgerows) aid connectivity within the landscape for protected species allowing them to commute between areas of woodlands, watercourses, ponds and grasslands and therefore should not be overlooked. All of these habitats are present throughout route corridors and therefore have the potential to provide suitable habitat for protected species.

Figure 4.5 – Biodiversity Constrained Areas



Biodiversity

Tier 1 Areas | Tier 2 Areas | Less Constrained Areas

Relevant source datasets:
- SAC;
- SPA;
- Ramsar;
- SSSI;
- Biological Heritage Sites;
- Marine Conservation Zones;
- Tree Preservation Orders; and
- Ancient Woodland

Table 4.3 - Biodiversity Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 1 criteria	Outcome
Protect and enhance biodiversity and green infrastructure Protect and enhance sites designated for nature conservation	Internationally designated sites are the most important sites for biodiversity and are legally protected. International sites comprise Special Protection Areas (SPA), Special Areas of Conservation (SAC), Ramsar Sites and candidate SPAs, and potential SACs. Sites designated at National or Local Level, including Marine Conservation Zones (MCZ), National Nature Reserves (NNR), Local Nature Reserves (LNR), Biological Heritage Sites (BHS), and other Nature Reserves (e.g. RSPB Reserves) and Wildlife Sites are all considered of importance for nature conservation. Ancient woodland present a physical and policy constraint to development, protected under planning policy for their wildlife, soils, recreational, cultural, historical and landscape value. Natural England suggest an exclusionary buffer to development of at least 15m in order to avoid root damage be applied[3]. Tree Preservation Orders (TPO) protect specific trees, groups of trees or woodlands.	Areas designated for Nature Conservation or identified as high biodiversity value are potentially excluded from further consideration Ancient woodland and areas up to 15m from ancient woodland are potentially excluded from further consideration. Areas within 15m of a TPO are potentially excluded from further consideration.
Topic & Objective	**Rationale for Tier 2 criteria**	**Outcome**
Protect and enhance biodiversity and green infrastructure Protect and enhance sites designated for nature conservation	The Impact Risk Zones (IRZs), developed by Natural England, provide an assessment of the potential risks posed by road Schemes to SSSI, SAC, SPA and Ramsar sites. The IRZs are used by local planning authorities to consider whether a proposed development is likely to affect these designated	The IRZ methodology is adopted - areas within 2km of an SSSI, SPA, SAC or Ramsar area designated for nature conservation to be considered

[3] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences#avoid-impacts-reduce-mitigate-impacts-and-compensate-as-a-last-resort

	areas. The IRZ applicable to proposed road Schemes defines a 2km buffer around a site designated for nature conservation[4]. Ancient woodland present a physical and policy constraint to development, protected under planning policy for their wildlife, soils, recreational, cultural, historical and landscape value. Natural England suggest the effect of air pollution from development that results in a significant increase in traffic is likely to require a larger buffer zone (than the 15m minimum requirement)[5]. MCZ, NNR, LNR, BHS, and other nature reserves (such as RSPB Reserves) and Wildlife Sites may be designated at national or local level and are considered of importance for nature conservation.	further if no other option available. Areas within 50m of ancient woodland to be included only if no other option available. Areas within 500m of a national or local level site of nature conservation to be included only if no other option available.

[4] https://nbn.org.uk/news/new-online-tool-helps-planners-assess-development/

[5] https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences#avoid-impacts-reduce-mitigate-impacts-and-compensate-as-a-last-resort

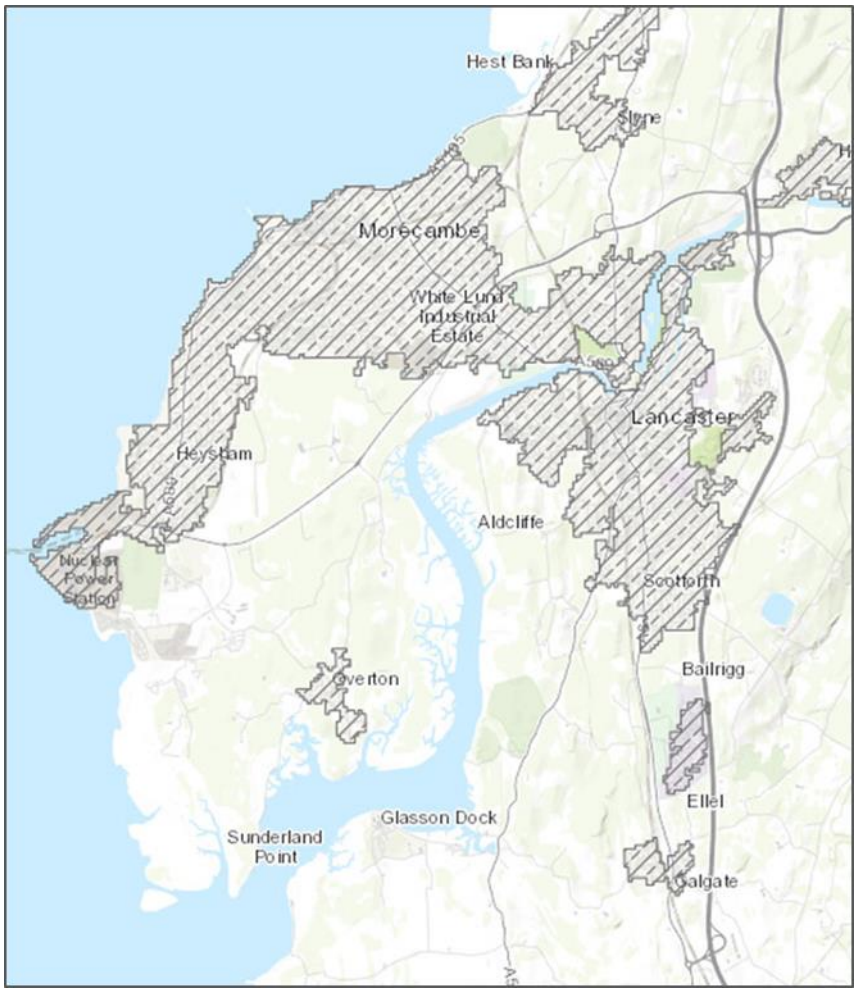
5 Population and Human Health

Population Characteristics

5.1.1 Lancaster extending to 576 km^2 is the second largest district within the county of Lancashire. The district area has changed since the 2011 Census with a boundary change reducing the number of wards to 27. The majority of the population live in the urban areas of Lancaster, Heysham and Morecambe.

5.1.2 Lancaster City Council area has a population of 142,487 (mid 2017 estimate), 50.8% are female and 49.2% are male. The population is anticipated to grow by 9.3% by 2039, which is a markedly higher rate than Lancashire (4.3%) as a whole.

Figure 5.1 Lancaster Urban Areas



5.1.3 The age structure for Lancaster is as follows

Table 5.1 - Age Structure Lancaster (2017)

Age band	Number	Percentage
0-4	7,515	5.27%
5-9	7,853	5.515
10-14	7,218	5.07%
15-19	9,833	6.90%
20-24	14,489	10.17%
25-29	9,400	6.60%
30-34	7,550	5.305
35-39	7,399	5.19%
40-44	7,246	5.09%
45-49	9,028	6.34%
50-54	9,639	6.76%
55-59	9,130	6.41%
60-64	7,860	5.52%
65-69	8,034	5.64%
70-74	7,369	5.17%
75-79	5,301	3.72%
80+	7,623	5.35%

Source: Office National Statistics, Census 2011

5.1.4 The 2011 Census questionnaire included the question ‘How is your health in general?’. Each member of the household was asked to rate their health, based on a self-assessed in general, with the possible answers; ‘Very Good’, ‘Good’, ‘Fair’, ‘Bad’ or ‘Very Bad’. Unlike simple indicators based on the presence or absence of disease, an important property of the general health status indicator is that it includes the entire spectrum of health states ranging from ‘Good’ to ‘Not Good’ health. Across Lancashire, how people consider the state of their health was reported as follows:

Table 5.2 - Consideration of Personal Health – Lancashire

State of Health	Number	Percentage
Very good health	538,205	45.9%
Good health	394,234	33.7%
Fair health	165,605	14.1%
Bad health	57,185	4.9%
Very bad health	16,110	1.4%

Source: Office National Statistics, Census 2011

5.1.5 Life expectancy at birth for males in Lancaster is 78.5 years, which is higher than that for the North West region (78.2 years) but lower England average of 79.6 years. Similarly life expectancy for females in Lancaster which is 82.4 years, more than the 81.8 years for the north west but less than the 83.1 years for England[6].

5.1.6 Lancashire Constabulary dealt with 17,042 road traffic collisions during 2017[7]. The rate of people killed and seriously injured (KSI) on the roads, all ages, is 70.8 per 100,000 people in Lancaster. This is significantly higher than both the regional rate (38.7) and the national rate (40.8)[8], though overall figures have declined in recent years.

Table 5.3 - Number of people killed or seriously injured in road traffic collisions

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Lancaster	112	105	98	96	83	72	88	114	114	94	93
Lancashire	1000	929	852	806	790	695	784	859	827	815	741
North West	3391	3324	3045	2867	2922	2764	2697	2968	2296	2831	2786
England	26720	24369	23206	21255	21717	21630	20387	21425	20929	22900	23825

Source: https://www.lancashire.gov.uk/media/906966/road-traffic-collisions-article.pdf

[6] Public Health England – Local Authority Health Profile for Lancaster
[7] https://www.lancashire.gov.uk/lancashire-insight/community-safety/road-collisions/
[8] Public Health England

5.1.7 The percentage of children killed or seriously injured on Lancashire's roads has reduced from 12.3% in 2016 to 11.9% in 2017. This is still higher than the national average of 8.1%.

Table 5.4 - Report child killed or seriously injured casualties in Lancashire

Area	2016			2017		
	Child	All	%	Child	All	%
Lancaster	6	94	6.4	12	93	12.9
Lancashire	100	815	12.3	88	741	11.9
England	1,833	22,900	8	1,919	23,825	8.1

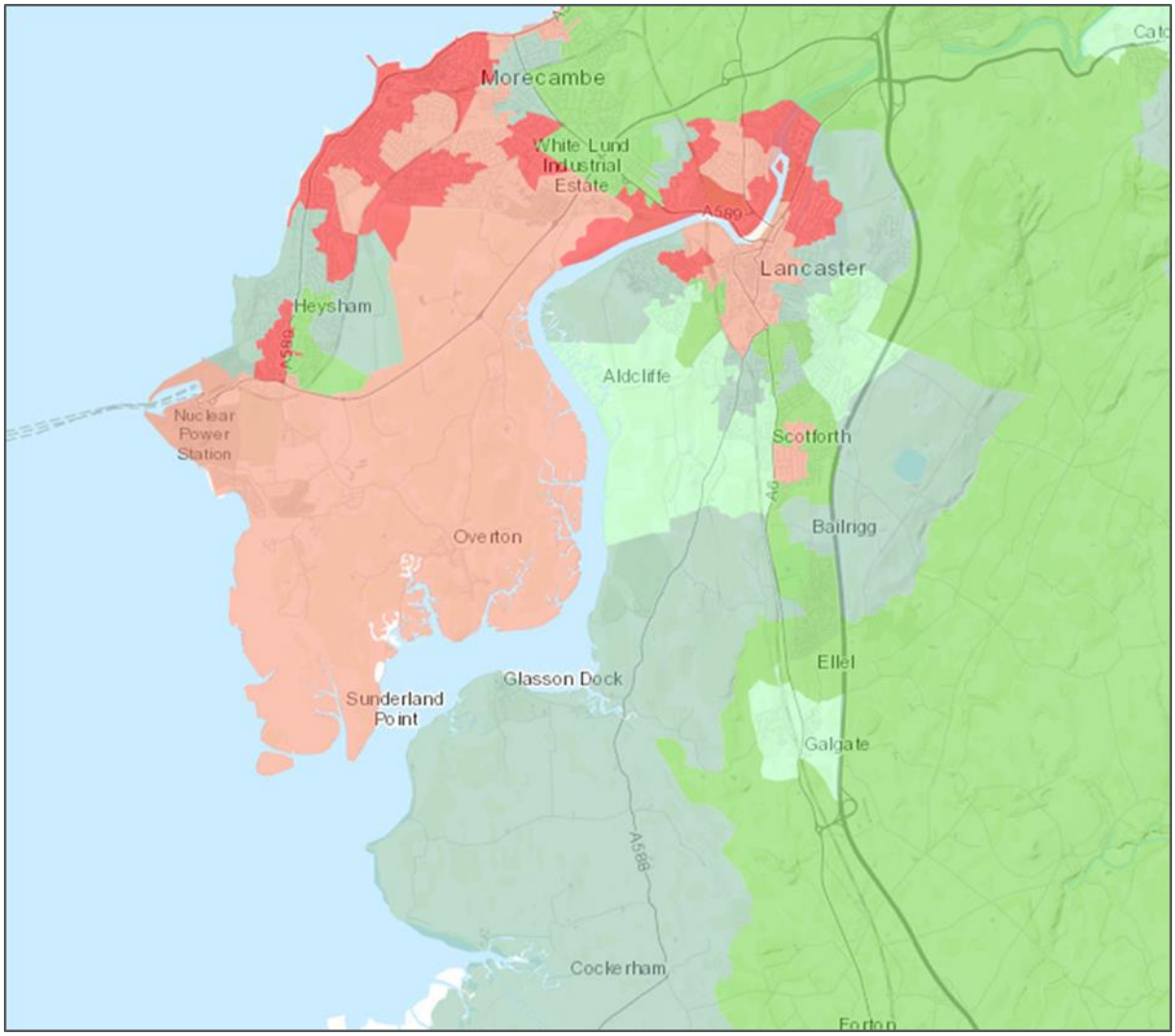
Source: https://www.lancashire.gov.uk/media/906966/road-traffic-collisions-article.pdf

5.1.8 The Indices of Deprivation (2015) are a relative measure of deprivation for Lower Super Output Areas (LSOAs) across England. All English LSOAs are ranked in order of most to least deprived by deprivation type. These ranks are the grouped into deciles 1 to 10, with 1 and 2 being the most deprived. Deprivation is usually measured in terms of the proportion of the population within the top 20% most deprived LSOAs.

5.1.9 Overall, a higher proportion of people in Northern England live within the top 20% most deprived LSOAs in England. Lancaster was ranked as being the 125th most deprived district area in England, out of a total of 326 district and unitary authorities.

5.1.10 As would be expected, levels of deprivation vary across Lancaster and the Study Area. Rankings of levels of deprivation are shown on Figure 5.2.

Figure 5.2 - Deprivation rankings across Lancaster - including the Study Area



5.1.11 Across Lancashire 18% of people utilise outdoor space for exercise/health reasons. The percentage of the population deemed physically active adults (aged 19+) is 65.3%. This is less than the national percentage (66%) but is more than the North West average (65.1%)[9]. The percentage of physically inactive adults (aged 19+) is 22.9%, which is higher than the national percentage (22.2%) but is lower than the North West average (23.4%). The percentage of adults (aged 18+) classified as overweight or obese is 63.9%, which is higher than both the regional (North West) level of 63.3%[10] and the national level of 61.3%. There is a mixed picture relating to children, where in

[9] Public Health England
[10] Public Health England

Lancashire 33% of children (aged 10-11) are overweight (including obese), which is less than both the national (34.3%) and regional (35.5%) levels. Younger children (aged 4-5) fare less well on a national level with 22.7% considered overweight as opposed to 22.4% nationally, though this is better than regionally where 23.9% are considered to be overweight.

5.1.12 A wide range of sporting and recreational activities is undertaken across Lancaster, with a mix of level and quality of provision. Some sports are able to meet demand, whereas in others there is an undersupply of suitable areas, or a requirement for upgrade of facilities. Overall it is considered that there is a need to protect all existing playing pitch provision until demand is met[11].

Amenity Greenspace and Playgrounds, Parks, Gardens and Natural / Semi-Natural Open Space

5.1.13 Across Lancaster there are 13 sites classified as parks and gardens[12]

Table 5.5 - Parks and Gardens - Lancaster

Area within Lancaster District			
	Number	Size (ha)	Current Provision (ha per 1,000 population)
Lancaster	5	7.66	0.91
Heysham and Morecambe	7	8.24	0.16
Carnforth / Rural	1	0.06	0.00
Lancaster District	**13**	**55.96**	**0.39**

Source: Lancaster City Council – Open Space Assessment

5.1.14 In total, 101 sites are identified as natural and semi-natural greenspace, totalling over 747 hectares of provision:

[11] Lancaster Playing pitch and outdoor sport strategy action plan 2018
[12] Lancaster City Council – Open Space Assessment 2018

Table 5.6 - Natural and Semi-Natural Open Space – Lancaster

Area within Lancaster District	Number	Size (ha)	Current Provision (ha per 1,000 population)
Lancaster	30	93.85	1.79
Heysham and Morecambe	22	73.11	1.46
Carnforth / Rural	49	580.67	14.52
Lancaster District	**101**	**747.62**	**5.25**

Source: Lancaster City Council – Open Space Assessment

5.1.15 The largest site and biggest contributor to provision is RSPB Leighton Moss and Morecambe Bay Nature Reserve at 131.9 hectares. This is followed by Gait Barrows National Nature Reserve (119.8 ha), Warton Crag (84.7 ha), Eaves Wood (52.1 ha) and Aughton Woods (41.1ha). All are located in the Carnforth/Rural Analysis Area.

5.1.16 There are 93 amenity greenspace sites in Lancaster District equivalent to over 88 hectares of provision. Sites are most often found within areas of housing and function as informal recreation space or open space providing a visual amenity. A number of recreation grounds and playing fields are also classified as amenity greenspace.

Table 5.7 - Amenity Greenspace – Lancaster

Area within Lancaster District	Number	Size (ha)	Current Provision (ha per 1,000 population)
Lancaster	34	46.35	0.88
Heysham and Morecambe	26	18.41	0.37
Carnforth / Rural	33	23.34	0.58
Lancaster District	**93**	**88.10**	**0.62**

Source: Lancaster City Council – Open Space Assessment

5.1.17 It is important to note that whilst a large proportion of provision may be considered as being smaller grassed areas or roadside verges, there is some variation of sites within this typology. For example, the smallest site is Caton Fell View AGS at 0.21 hectares whilst the largest site is Willow Lane Grounds AGS at over 5.89 hectares. Larger recreation grounds and playing fields serve a different purpose to smaller grassed areas and verges; often providing an extended range of opportunities for recreational and sporting activities due to their size.

5.1.18 It is also important to note that in addition to its multifunctional role, amenity greenspace makes a valuable contribution to visual aesthetics for communities.

5.1.19 A total of 109 sites are identified as provision for children and young people. This combines to create a total of over 11 hectares.

Table 5.8 - Playgrounds – Lancaster

Area within Lancaster District	Number	Size (ha)	Current Provision (ha per 1,000 population)
Lancaster	40	2.91	0.06
Heysham and Morecambe	36	4.78	0.12
Carnforth / Rural	33	3.41	0.09
Lancaster District	**109**	**11.10**	**0.08**

Source: Lancaster City Council – Open Space Assessment

5.1.20 There is a good spread of provision across the area. All areas with a greater population density are within walking distance of a form of play provision.

5.1.21 There are 23 sites classified as allotments in Lancaster and Morecambe Area, equating to over 22 hectares, though it is noted that supply does not meet demand. The provision of allotments includes a site in Galgate (Main Road).

Table 5.9 - Allotments – Lancaster

Area within Lancaster District	Number	Size (ha)	Current Provision (ha per 1,000 population)
Lancaster	14	15.25	0.29
Heysham and Morecambe	4	4.56	0.09
Carnforth / Rural	5	2.20	0.06
Lancaster District	**23**	**22.01**	**0.15**

Source: Lancaster City Council – Open Space Assessment

5.1.22 A total of 13 sites are classified as green corridors, equating to over 142 hectares (equivalent to 59 kilometres).

Table 5.10 – Areas of Green Corridors - Lancaster

Area within Lancaster District	Number	Size (ha)	Length (km)
Lancaster	5	35.19	15.39
Heysham and Morecambe	2	7.87	4.48
Carnforth / Rural	6	99.08	39.26
Lancaster District	**13**	**142.14**	**59.13**

5.1.23 Two forms of provision predominantly make up green corridors in the area. The largest is the Lancaster Canal at 96.65 hectares. It is also the longest green corridor at 38.41 kilometres. The other is the River Lune at 34.27 hectares (and 14.34 kilometres). Both these green corridors run through the Study Area.

Economy, Employment and Training

5.1.24 Lancaster District performs well across employment and skills measures, with salaries outperforming the North West average[13] .

5.1.25 Lancaster has suffered in recent years from a declining manufacturing sector, though this has been balanced to some extent by a growing service sector.

5.1.26 Lancaster has 57,000 total employee jobs (2017) and 63.3% of the population are of working age (90,200 people). There are a total of 74,400 economically active persons (2018), which at 77.4% is higher than the percentage for the North West (77%) but lower than that for Great Britain (78.5%)[14] . Of the 22.6% economically inactive, 37% are students and 25% are long term sick. Approximately 3.0% of the population claim unemployment benefit.

5.1.27 Lancaster has a total of 4,585 business enterprises, with the vast majority of business enterprises in Lancaster considered to be Micro (88.5%), which employ between 0 and 9 persons, with small businesses (employing 10 to 49 people) making up a further 9.4% of business numbers[15]. It is noted that 10,000 jobs are related to education within Lancaster and this, together with the 37% of economically inactive persons being students is a reflection of the size of the Universities and their importance to the area.

5.1.28 Lancaster does not form a significant locality of wealth generation through industrial and commercial activity, but the area exists within a much wider economic context. Many residents have average income levels generated from earnings, investments and welfare benefits (including pensions) that compare favourably with other localities in Lancashire. Commuting for work to other local authority areas is a key feature of the local economy, though most people (77%) who work in the area, live here also[16].

[13] https://planningdocs.lancaster.gov.uk/NorthgatePublicDocs/00942350.pdf
[14] NOMIS – Lancaster Overview
[15] NOMIS – Lancaster Overview
[16] https://www.lancashire.gov.uk/lancashire-insight/area-profiles/local-authority-profiles/lancaster-district/#Eco

Crime and Social Cohesion

5.1.29 There are strong variations in crime levels across Lancashire, with the highest crime rates (all above the national average) found in urban areas with high concentrations of deprivation. Such areas would generally experience worse community safety and reduced social cohesion. Rural areas have lower crime rates than urban areas and in many areas of Lancashire, are often significantly below the national average. Crime in Lancashire makes up 17.9% of crime in the North West and 2.6% of all recorded crimes in England and Wales. The Lancashire rate is 85.6 offences per 1,000 population (down from 94 per thousand in 2006/07). This is below Greater Manchester (122.3) and Merseyside (88.9), but higher than Cheshire (83.2) and Cumbria (57.2). Lancashire crime is just above the England and Wales rate of 83.5[17] per 1,000 population.

5.1.30 Crime has been increasing in Lancashire since 2015/16. This is shown as follows:

Table 5.11 - Recorded Crime in Lancashire

Year	Recorded crime (excluding fraud)	Percentage change on previous year
2011/12	97,679	
2012/13	92,357	-5.4%
2013/14	95,372	3.3%
2014/15	92,559	-2.9%
2015/16	97,112	4.9%
2016/17	107,610	10.8%
2017/18	127,028	18.0%

Source: ONS Crime in England and Wales (2017/18), reported by Lancashire County Council

A survey 'Living in Lancashire'[18] showed the following key elements relating to how local residents felt about their community and local area:

[17] https://www.lancashire.gov.uk/media/905924/crime-in-lancashire.pdf

[18] Reported by Lancashire County Council https://www.lancashire.gov.uk/lancashire-insight/community-safety/overview/

- 85% of respondents felt safe in their local area – with the age group of 60 yrs+ feeling most safe (88%).
- A lack of police presence (14%) was the most significant reason why respondents felt unsafe in their local area.
- More than three-quarters of respondents felt that issues with violence, sexual exploitation and organised crime were not a big problem.
- 8% of respondents felt that burglary, with half of respondents aged 25-44 years, was a problem.
- 53% felt drug dealing was a problem in their area, with respondents aged 25-59 years having most concern.
- Dangerous driving was seen as a big problem for 49% of respondents (increase from previous survey).
- Fewer than half of respondents felt that the police and other local public services are dealing with crime and ASB successfully – this has been reducing in recent surveys.
- Cleanliness of the streets (34%) and access to green areas (12%) were issues that had increased in dissatisfaction in local communities.

5.1.31 It was further reported in the Crime in Lancashire 2017/18 report[19] that 22% said that community spirit and good neighbours contributed to their local area feeling safe. 4% said that bad neighbours contributed to feelings of being unsafe.

5.1.32 It is also to be noted, that in line with most areas, social isolation is a significant issue across Lancashire, with tens of thousands of households estimated to be directly affected by social isolation and loneliness, causing poor health and wellbeing and reduced life expectancy[20]. Older people (especially aged 70+)

[19] https://www.lancashire.gov.uk/media/905924/crime-in-lancashire.pdf
[20] Lancashire County Council https://www.lancashire.gov.uk/lancashire-insight/health-and-care/mental-health-and-wellbeing/social-isolation-and-loneliness/

are in general more likely to experience social isolation and loneliness due to contributing factors such as loss of a partner, work, or health. Living in more deprived circumstances also tends to increase the chance of being socially isolated and lonely through, for example, higher likelihood of ill-health, and reduced access to financial and material resources[21] .

[21] Hidden from View – tackling social isolation and loneliness and Lancashire, Lancashire County Council, October 2016

Figure 5.3 - Population and Human Health Receptors

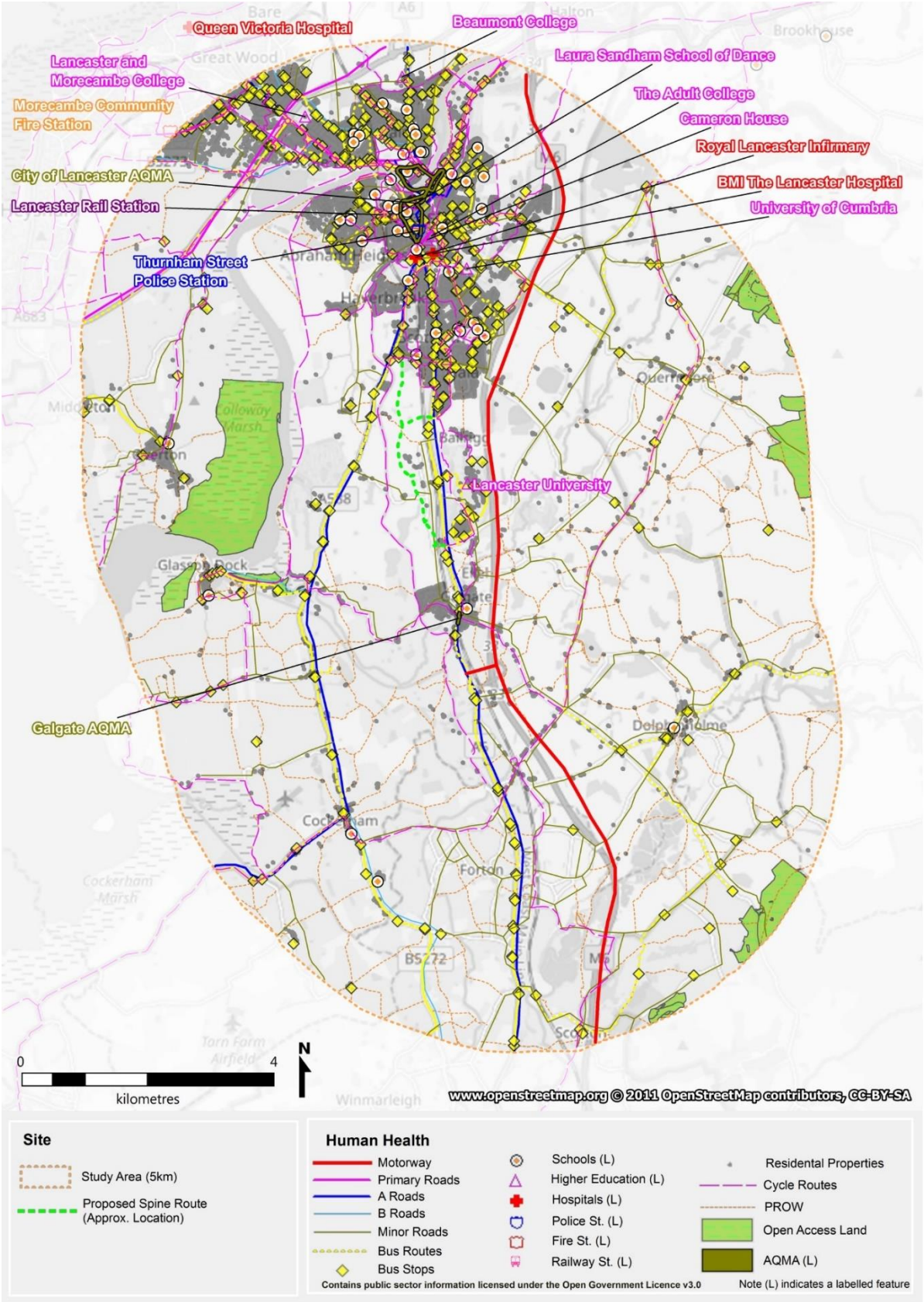
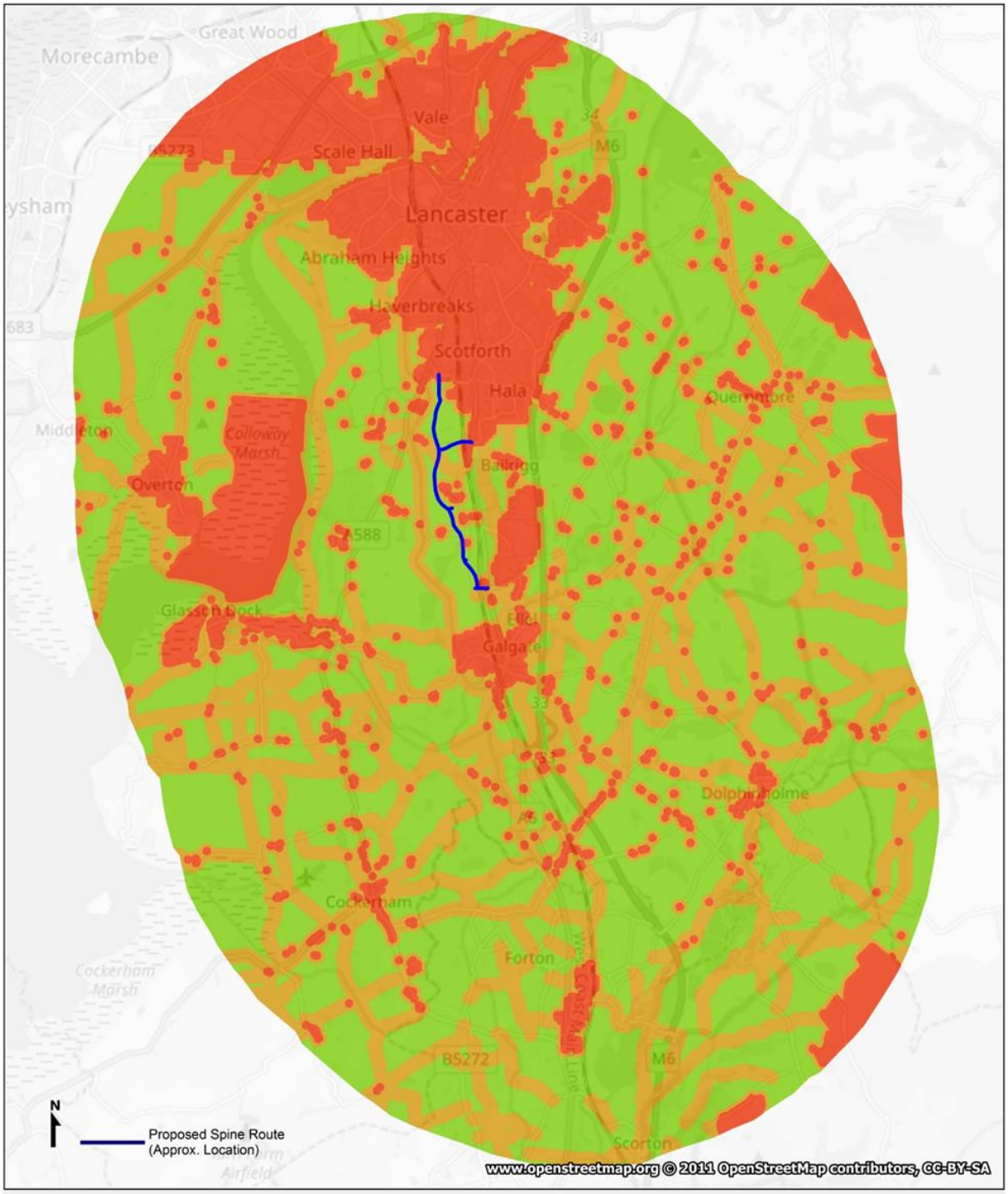


Figure 5.4 – Human Health Constrained Areas



Population and Human Health

Tier 1 Areas | Tier 2 Areas | Less Constrained Areas

Relevant source datasets:
- Schools;
- Higher Education;
- Librarys;
- Hospitals;
- Dwellings;
- Built up areas;
- Developments;
- Cycle Routes;
- Community Rights of Way Access; and
- Public Rights of Way.

Table 5.12 Human Health Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 2 criteria	Outcome
Population Health Determinants	Vulnerable road users can be defined in a number of ways, such as by the amount of protection in traffic (e.g. pedestrians and cyclists) or by the amount of task capability (e.g. the young and the elderly)22. DMRB defines a list of Non-Motorised Users (NMUs) including pedestrians, cyclists and equestrians. Areas of increased density of vulnerable road users may include nearby schools, GPs, hospitals, libraries and community halls for example. Receptors that are potentially sensitive to changes in air quality are defined in DMRB as residential properties, schools and hospitals. Indeed, increased levels of background noise and reduced air quality are considered to have a deleterious effect on human health. The availability and accessibility of assets such as recreational and sports facilities/grounds and CROW access land in an area can make significant contribution to local health and wellbeing as well as contribute to the amenity value of an area.	In order to reduce the likelihood of impacting upon vulnerable road users, areas within a buffer of 50m of existing urban areas and of facilities and services perceived to attract increased densities of vulnerable road users (such as schools and hospitals) are potentially excluded from further consideration. In view of air quality guidance, and in an effort to capture noise sensitive receptors areas within a buffer of 50m of residential properties, schools and hospitals are potentially excluded from further consideration. Areas within a buffer of 50m which are currently utilised for recreation or which benefit the community such as sports facilities, sports grounds and access routes are potentially excluded from further consideration.
Topic & Objective	Rationale for Tier 2 criteria	Outcome
Population Health Determinants	In order to reduce likelihood of impacting upon vulnerable road users, areas within a buffer of 50m of facilities and services perceived to attract increased densities of vulnerable road users (such as	Areas where a linear route would cause severance to be considered further only if no other option available.

22 https://www.swov.nl/sites/default/files/publicaties/gearchiveerde-factsheet/uk/fs_vulnerable_road_users_archived.pdf

	schools and hospitals) will be excluded from further consideration. Receptors that are potentially sensitive to changes in air quality are defined in DMRB as residential properties, schools and hospitals. Increased levels of background noise and reduced air quality will have a deleterious effect on human health. The availability and accessibility of assets such as recreational and sports facilities/grounds, cycle routes, open access land and Public Rights of Way in an area can make significant contribution to local health and wellbeing as well as contribute to the amenity value of an area.	In order to reduce the likelihood of impacting upon vulnerable road users, areas within a buffer of 100m of existing urban areas and of facilities and services perceived to attract increased densities of vulnerable road users (such as schools and hospitals) will be considered further only if no other option available. Areas which may increase congestion in townscape to be included only if no other option available In view of air quality guidance, areas within a buffer of 100m from a sensitive receptor such as residential building, a school or hospital will be considered further only if no other option available. Areas within a buffer of 100m from an area utilised for recreation or which benefit the community such as sports facilities, sports grounds, access routes, PRoW, cycle route etc. will be considered further only if no other option available.

6 Climate Change

6.1.1 Earth's climate is changing due to emissions of greenhouse gases (GHGs) resulting from human activities and the effects are felt at a global scale. As such, due to the scale of the issue, it is considered that the effects of a changing climate will be the same across the whole of the study area and indeed for the north west region of England as a whole. As with the rest of the United Kingdom, climate change within the study area has the potential to pose significant risks to population, the economy and ecosystems through changes in environmental conditions, including increased frequency of severe flooding and storm events, increased temperatures, loss of habitats and increased pressure on water resources.

Regional precipitation and temperatures

6.1.2 The study area falls into the North West England & Isle of Man region as defined by the Met Office[23]. As noted for this region, the mean annual temperature over the region varies from around 9 °C (Solway) to just over 10.5 °C (Cheshire). Temperature shows both seasonal and diurnal variations. January is the coldest month with mean daily minimum temperatures across the region varying from below 0 °C on highest ground to about 2 to 2.5 °C on the coast. July is the warmest month, with mean daily maximum temperatures of about 21 °C in Cheshire. Extreme maximum temperatures can occur in July or August. For example, on 3rd August 1990 a temperature of 34.5 °C was recorded at Knutsford, Cheshire, and in the heat wave in July 2006 34.3 °C was achieved at Crosby, Merseyside on the 19th July.

6.1.3 Across most of the region there are, on average, about 30 rain days (rainfall greater than 1 mm) in winter (December to February) and less than 25 days in

23 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/north-west-england--isle-of-man_-climate---met-office.pdf

summer (June to August) with the highest averages being at the higher altitude of the Wolds.

6.1.4 The exposure of NW England to westerly maritime air masses and the presence of extensive areas of high ground mean that the region has some of the wettest places in the UK. The higher parts of the Lake District are particularly wet, with an average of over 3200 mm of rain each year. In contrast, the reputedly wet city of Manchester averages only 830 mm and the more sheltered areas of Cheshire and the Eden valley in Cumbria are even drier with less than 800 mm per year. These areas benefit from the 'rain shadow' effect of the high ground of N Wales and the Lake District respectively.

6.1.5 Over much of the region, the number of days with rainfall totals of 1 mm or more (rain days') tends to follow a pattern similar to the monthly rainfall totals. In the higher parts in winter (December-February), 50-60 days are the norm but this decreases to 40-45 days in summer (June-August). In the drier areas of Cheshire and Merseyside, 35-40 days in winter and about 30 days in summer are typical. Periods of prolonged rainfall can lead to widespread flooding, especially in winter and early spring when soils are usually near saturation.

6.1.6 NW England and the Isle of Man are among the more exposed parts of the UK, being relatively close to the Atlantic and containing large upland areas. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest.

6.1.7 As Atlantic depressions pass the UK, the wind typically starts to blow from the south or south west but later comes from the west or north-west as the depression moves away. The range of directions between south and north-west accounts for the majority of occasions and the strongest winds nearly always blow from this range of directions. Spring time tends to have a maximum

frequency of winds from the north east. Summer can have a greater incidence of north-west or west winds associated with sea breezes.

6.1.8 A summary of changes in key climate variables in the North West of England for a medium emissions scenario for the 2050s is provided below. The climate projections indicate a robust pattern of warming of annual and seasonal temperatures, both during the day and night. Rainfall patterns are more uncertain indicated by their wider ranges, but the central estimate of change (50% probability level) indicates that summer precipitation will decrease, whilst winter precipitation will increase. The direction of change for annual mean precipitation is more uncertain, with the central estimate suggesting no change (50% probability level)[24]. All projected changes are relative to the baseline period 1961-1990.

Table 6.1 - Summary of changes for key climate variables under the medium emissions scenario for the 2050's

Climate variable	Probability level				
	10%	50%	90%	Wider range	
Annual mean temperature (°C)	1.4	2.3	3.3	0.8	4.4
Winter mean temperature (°C)	1.1	1.9	3.0	0.8	3.3
Summer mean temperature (°C)	1.2	2.6	4.1	1.1	4.7
Summer mean daily maximum temperature (°C)	1.0	3.3	5.8	1.0	6.5
Summer mean daily minimum temperature (°C)	1.0	2.5	4.4	0.9	4.9
Annual mean precipitation (%)	-6	0	6	-8	8
Winter mean precipitation (%)	3	13	26	-1	27
Summer mean precipitation (%)	-36	-18	1	-37	8

24 http://media.adaptingmanchester.co.uk.ccc.cdn.faelix.net/sites/default/files/ThefutureclimateofNorthWestEngland_000.pdf

Climate change, transport infrastructure and potential implications for health

6.1.9 As noted in the report Climate Resilient Infrastructure: Preparing for a Changing Climate (DEFRA, 2011)[25] it is the Government's vision for "An infrastructure network that is resilient to today's natural hazards and prepared for the future changing climate."

6.1.10 Key United Kingdom wide impacts of a changing climate are likely to include:

- Increases in the frequency of flooding affecting people's homes and wellbeing, especially for vulnerable groups (e.g. those affected by poverty, older people, people in poor health and those with disabilities), and the operation of businesses and critical infrastructure systems. Annual damage to properties in England and Wales, due to flooding from rivers and the sea, rises from £1.2 billion to between £2.1 billion and £12 billion by the 2080s. Without adaptive action, a range of important infrastructure such as roads and railways may be affected by a significantly increased risk of flooding based on future population growth.

- Summer overheating potentially contributing to heat-related health problems. Premature deaths due to hotter summers are projected to increase (e.g. by between 580 and 5,900 by the 2050s). This is likely to place different burdens on National Health Service (NHS), public health and social care services. Other health risks that may increase include problems caused by ground-level ozone and by marine and freshwater pathogens.

- Reductions in water availability, particularly during the summer, leading to more frequent water use restrictions and, in the longer term, water shortages. The gap between demand and availability will potentially widen, impacting homes, businesses, schools and hospitals. By the 2050s, between 27 million and 59 million people in the UK may be living

[25] Defra. (2011). Climate resilient infrastructure: Preparing for a changing climate. Available: https://www.gov.uk/government/publications/climate-resilient-infrastructure-preparing-for-a-changing-climate.

in areas affected by water supply-demand deficits (based on existing population levels). Adaptation action will be needed to increase water efficiency across all sectors and decrease levels of water abstraction in the summer months.

6.1.11 As noted by the UK Climate Change Risk Assessment (CCRA 2012)[26], the climate of the north of England is already impacted by extreme weather events which seriously damage property and threaten lives. This will only get worse as our climate changes.

6.1.12 Within the Climate Resilient Infrastructure: Preparing for a Changing Climate (DEFRA, 2011), the following risks have been identified in relation to transport:

Table 6.2 - Climate change risks to road infrastructure

Transport Sector	Climate Impact	Possible implication for infrastructure (based on no adaptation action)
Road	• Increased / more intense precipitation • Wetter winters / drier summers • Higher temperatures	• Flood risk to roads • Increased scour of bridges • Increased instability of embankments • Increased damage to road surfaces

Source: Climate Resilient Infrastructure: Preparing for a Changing Climate (DEFRA, 2011)

6.1.13 The highest order risks to infrastructure identified in the CCRA are associated with flooding[27], with strategic transport networks being seen as at significant risk of increased flooding and subsequent disruption having serious consequences for the effective functioning of organisations right across the country.

6.1.14 Specific threats to the study area from a changing climate have been identified through a series of regional risk assessments developed from the UK Climate Change Risk Assessment 2012. Taking the risk assessment for the North West

[26] The CCC. (2012). Climate Change Risk Assessment. Available: https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/climate-change-risk-assessment-2017/.

[27] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209866/pb13942-nap-20130701.pdf

of England[28] as an example of risks across the study area, it can be seen that the nature of the Northwest's transport infrastructure makes it particularly vulnerable to extreme weather events. The region relies heavily on the West Coast Mainline, M6 and M62, which have potential vulnerabilities around Warrington, across the Pennines and in Cumbria. It is considered likely that the Study area would also be vulnerable to such impacts, with a resulting potential detriment on people's health and wellbeing. Effects on health and wellbeing can be direct e.g. through direct risk to life, or indirect e.g. through increased stress.

6.1.15 As noted in the North West England Summary of Climate Change Risks (2012), regional data also suggests that the economic cost of road disruption in the region resulting from a 1 in 100 year flood could be as much as £11.7 million per annum. Likewise this can have an indirect effect on wellbeing, for example, by threatening livelihoods.

Carbon Emissions

6.1.16 Allied to air quality and of particular relevance to a changing climate are carbon emissions. Carbon emissions vary across the United Kingdom as shown in this graphic from the Local Authority Carbon Dioxide Emission Estimates 2014, DECC, 2016[29]. The North West region is particularly relevant to this study and makes up a total of 11% of the UK total.

6.1.17 Within the North West region, Lancashire accounted for 21% of total CO2 emissions out of a total of 12.7 million tonnes, with a 24% of that attributable to road transport[30].

[28] A Summary of Climate Change Risks North West England http://climateuk.net/sites/default/files/NorthWest-NewText-1-A4.pdf

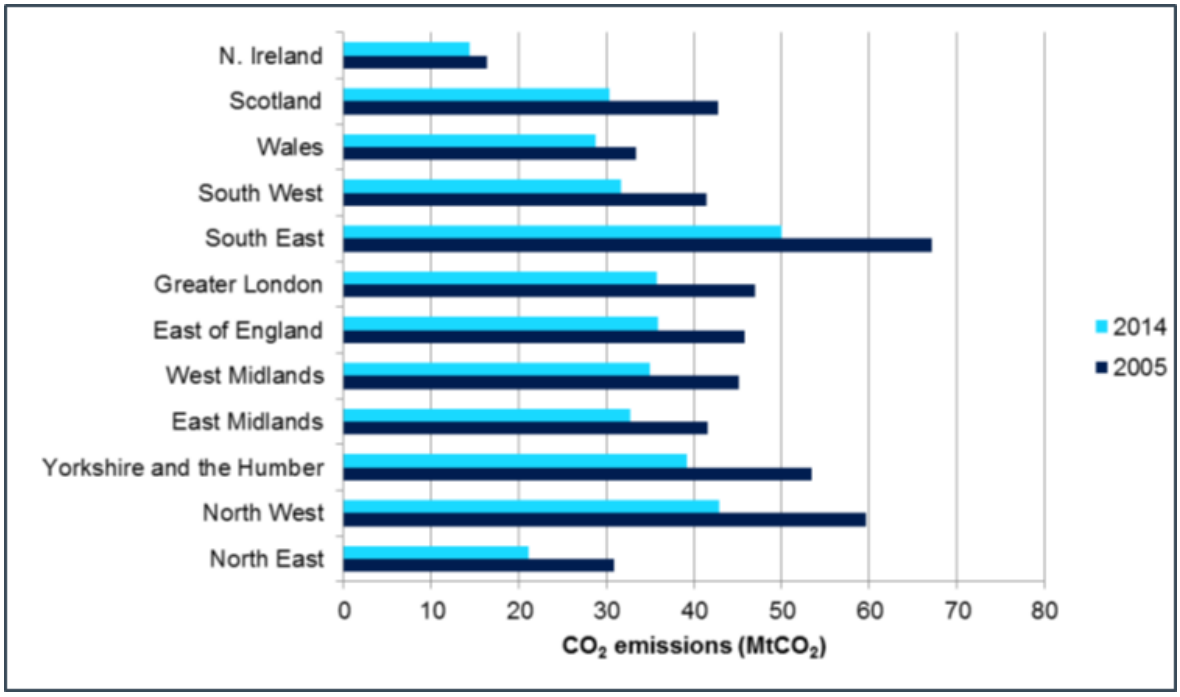
[29] DECC. (2016). Local Authority Carbon Dioxide Emissions Estimates 2014. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/533670/Local_Authority_CO2_Emissions_Statistical_Release_2014.pdf.

[30] Lancashire Climate Change Strategy 2009-2020

6.1.18 The Climate Change Act (2008) made the UK the first country to establish a long-term legally binding framework to cut carbon emissions. It contains a target requiring emissions reductions of 80% from 1990 levels by 2050.

6.1.19 Total CO_2 emissions decreased in all regions across the United Kingdom between 2005 and 2014. The decrease in annual per capita terms in the North West is shown in Figure 6.1[31].

Figure 6.1 - Regional Total CO2 emissions 2005 and 2014



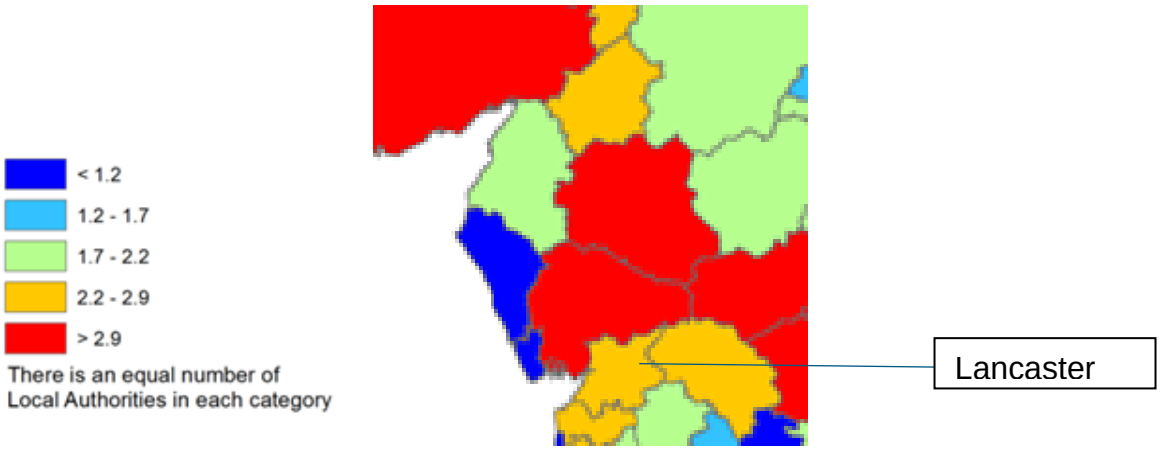
Source DECC, 2016

6.1.20 Within regions there are also variations in CO_2 emissions between areas. This is illustrated in the following map extract showing the north west of England and including the study area published by the DECC (2016) which shows differences in emissions due to the transport sector. Note that it is difficult to identify reasons behind the variations observed in the transport sector, since there are numerous factors (such as composition of the vehicle fleet and average annual daily statistics by vehicle type) which feed into these estimates. It is also the case that certain transport sectors have been removed from the

[31] DECC. (2016). Local Authority Carbon Dioxide Emissions Estimates 2014. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/533670/Local_Authority_CO2_Emissions_Statistical_Release_2014.pdf

figures e.g. motorways as local authorities do not have control over these areas. Lastly, these figures include all transport modes and not just road. Further explanation is provided in the relevant report. As such, the following is provided for information and to illustrate the different levels of emissions across the wider region.

Figure 6.2 - Map extract showing Annual Transport Emissions of CO2 per capita by Local Authority Area for 2014 (tonnes CO2 per capita)



Source: Local Authority CO2 Emission Estimates 2014, DECC 2016.

6.1.21 As noted by the Committee for Climate Change, domestic transport emissions of road transport account for around a quarter of UK greenhouse gas emissions, with the use of petrol cars being the single greatest user of fuel in the wider regional study area and indeed across the United Kingdom as shown in the following table which details the percentage of road transport fuel consumption by region and vehicle type in 2012

6.1.22 The Committee for Climate Change anticipate that projected emissions reductions from current policies fall short of the cost-effective trajectory and further measures will be needed to meet future carbon budgets. There is significant potential for emissions reductions through continued improvement in fuel efficiency for conventional vehicles, switching to alternatively fuelled vehicles and from changing behaviour. Nonetheless, a general downward trend is reflected in CO_2 estimations per local authority across the UK, where all but one has seen a decrease in emissions since 2005 (Local Authority Carbon

Dioxide Emission Estimates 2014, DECC, 2016). Overall, Lancashire is committed to reducing 1990 CO_2 levels by 30% by 2020.

6.1.23 In recognition of the need to reduce carbon emissions and the role of road transport in these emissions, local authorities across the wider regional area are exploring ways to further reduce emissions from road traffic. For example, the Lancashire Climate Change Strategy 2009-2020 notes the need to promote the use of more efficient vehicles and alternative transport fuels. This approach means that Lancashire County Council are investing in developing an electric vehicle charging network[32]. The above measures to support EV are in keeping with recommendations from The Committee for Climate Change to tackle barriers to EV uptake and will support the use of Electric Vehicles and as such, it is anticipated that the uptake of EV will continue to grow. This will reduce CO_2 emissions from road transport. Total GHG emissions from transport in 2035 are estimated to be 109 $MtCO_2e$, down from 119 $MtCO_2e$ in 2017. It is to be noted that Government forecasts for road traffic growth range from 19% to 55% growth between 2010 and 2040, with growth particularly strong on the Strategic Road Network (up to 60%).

6.1.24 Engine technology is increasing efficiency and there is a gradual roll out of EV charging points, with fresh government initiatives in this area for example through a refresh of the 'Plug In Vehicle Infrastructure strategy'. This will help make EV a more attractive vehicle option and may lead to reductions in GHG in the mid to long term. It is the UK Government aim for almost every car and van to be zero emission by 2050.

[32] https://www.lancashire.gov.uk/council/strategies-policies-plans/roads-parking-and-travel/installation-of-electric-vehicle-charge-points/

7 Noise

7.1.1 Several Noise Important Areas (NIAs) are, located in the Study Area and are shown on Figure 7.1. Examples of sensitive places within the Study Area include schools, places of worship, care homes and large numbers of residential dwellings.

7.1.2 It should be noted that both the M6 Motorway and West Coast Main Line railway pass through the Study Area and would be significant contributors to background noise levels.

7.1.3 A summary of noise sensitive receptors within NIA predicted to experience either adverse or beneficial effects, in either the short-term or long-term, day or night is presented in Table 7.1 below.

Figure 7.1 – Noise Important Areas

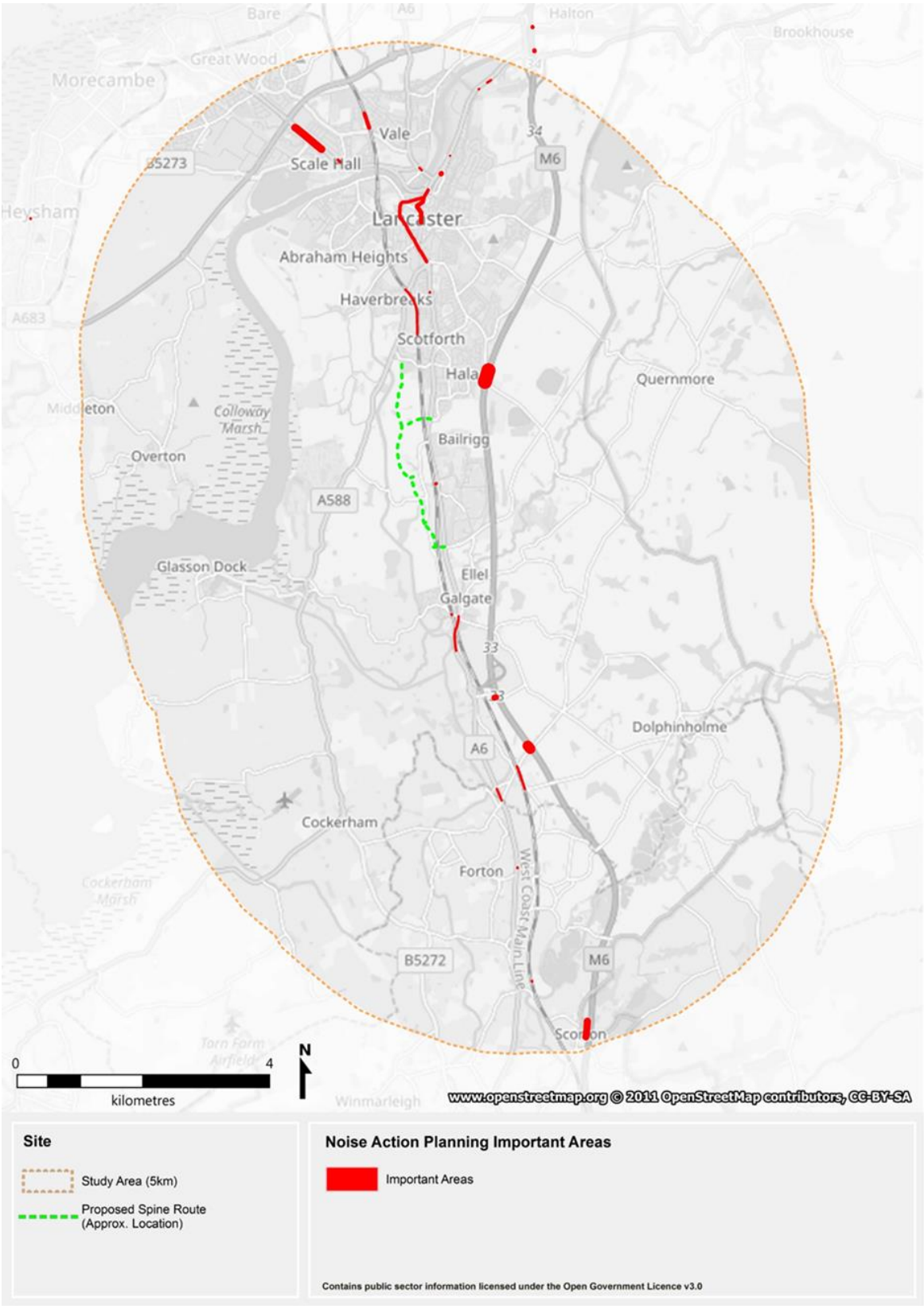


Table 7.1 - Noise sensitive properties predicted to experience a significant effect inside NIAs for each route option

NIA	Number of noise sensitive receptors meeting significance criteria in the short-term and long-term, day and night for each route option inside Noise Important Areas (NIAs)											
	Central 1		Central 2		Eastern 1		Eastern 2		Western 1		Western 2	
	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial	Adverse	Beneficial
10525	0	0	0	0	0	2	0	0	0	0	0	0
10526	0	43	0	10	0	43	0	44	0	0	2	0
1023	0	0	0	0	0	2	0	0	0	0	0	0
1024	2	0	0	3	0	0	0	0	0	0	0	2

7.1.4 All options, with the exception of Western 1, provide beneficial effects for noise sensitive receptors within NIAs inside the Study Area.

7.1.5 An assessment of potential noise and vibration impacts for all six options has been carried out in line with guidance contained within the Design Manual for Roads and Bridges[33]. Operational Noise modelling studies are dependent on computer modelling of future traffic conditions. The noise model itself is dependent on input data taken from modelled traffic data and on a number of other assumptions. All computer modelled information is subject to an inherent degree of uncertainty and depends on a number of assumptions which were taken into account where applicable. Whilst all noise sensitive receptors have been assessed 18 sample receptors were selected within the Study Area which largely correspond with the sample roads presented in the traffic assessment.

7.1.6 Impacts from traffic noise have been assessed in the baseline year of 2025 and the year 2040, which may also be referred to as the design year. The impact of traffic noise was based upon the predicted traffic flow modelling of the road network in the Study Area without a Scheme in place.

7.1.7 Early noise assessment considered noise level changes at dwellings and other noise sensitive places, with the following comparisons made for both daytime and night time assessments:

- Do Minimum scenario in the baseline year (2025) against Do Something scenario in the baseline year (2025);
- Do Minimum scenario in the baseline year (2025) against Do Something scenario in the future assessment year (2040); and
- Do Minimum scenario in the baseline year (2025) against Do Minimum scenario in the future assessment year (2040).

[33] Design Manual for Roads and Bridges Volume 11, Section 3, Part 7 – Noise and Vibration LA 111 Rev-0 (DMRB LA 111)
found at https://www.standardsforhighways.co.uk/ha/standards/DMRB/vol11/section3.htm

7.1.8 Noise level predictions take account of the following variables:

- Typical weekday volumes of traffic during the eighteen-hour period from 6 am to midnight (18-hour annual average weekly traffic flows);
- Percentage of heavy goods vehicles (defined as any vehicle with an unladen weight greater than 3.5 tonnes);
- Traffic speeds derived in accordance with the requirements of the Design Manual for Roads and Bridges - DMRB LA 111;[34]
- Road gradient;
- Local topography;
- Nature of the ground cover between the road and the place/area;
- Shielding effects of any intervening structures, including allowances for limited angles of view from the road and any reflection effects from relevant surfaces; and,
- Road surfacing type (for this assessment, it has been assumed that the road surface on all of the existing highway network, including the M6, is conventional Hot Rolled Asphalt (HRA)).

7.1.9 Noise levels vary across the Study Area, with the M6 and West Coast Main Line being significant sources of noise disturbance.

7.1.10 Table 7.2 presents the predicted Do Something 2025 and Do Something 2040 and associated short-term and long-term daytime noise impacts at the sample receptor locations, for each of the route options.

[34] Design Manual for Roads and Bridges found at:- http://origin.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3.htm

Table 7.2 - Noise levels in the opening and future year Do Something scenarios for route options at sample sites

Receptor Name	Predicted day-time $L_{A10,18hr}$ (dB) noise level (Façade) and noise change for Do Something scenarios																							
	Central 1				Central 2				Eastern 1				Eastern 2				Western 1				Western 2			
	2025	2040	ST	LT	2025	2040	ST	LT	2025	2040	ST	LT	2025	2040	ST	LT	2025	2040	ST	LT	2025	2040	ST	LT
3 Oakwood Gardens	68.0	68.5	-0.9	-0.4	68.0	68.9	-0.9	0.0	67.5	68.7	-1.4	-0.2	67.7	68.9	-1.2	0.0	67.9	69.2	-1.0	0.30.4	68.3	69.0	-0.6	0.1
Canal Cottage, Main Road, Galgate*	72.3	71.8	-1.1	-1.6	72.5	72.5	-0.9	-0.9	72.2	71.9	-1.2	-1.5	72.1	72.2	-1.3	-1.2	73.1	73.7	-0.3	0.3	64.6	64.7	1.3	1.4
23a Salford Road, Galgate*	66.0	68.0	1.1	3.1	63.6	65.1	-1.3	0.2	65.9	68.0	1.0	3.1	52.5	53.3	-0.2	0.6	64.2	67.4	-0.7	2.5	63.8	67.4	-1.1	2.5
Corner House, Bay Horse Road	50.3	58.8	-6.3	2.2	50.2	56.9	-6.4	0.3	50.0	54.2	-6.6	-2.4	50.6	54.6	-6.0	-2.0	53.4	60.1	-3.2	3.5	57.0	61.3	0.4	4.7
Hampson Cottages, Hampson Lane*	73.3	73.7	0.0	0.4	73.3	73.7	0.0	0.4	73.3	73.7	0.0	0.4	69.6	70.1	-0.1	0.4	61.9	62.4	0.0	0.5	73.3	73.7	0.0	0.4
Beechcroft, Hazelrigg Lane	58.1	60.4	3.0	5.3	57.7	60.0	2.6	4.9	59.1	61.0	4.0	5.9	58.6	60.5	3.5	5.4	54.8	59.5	-0.3	4.4	55.4	59.0	-0.1	3.5
Langthwaite Terrace, Littlefell Lane	53.1	55.3	0.2	2.4	53.1	54.8	0.2	1.9	54.9	57.6	0.6	3.3	53.2	55.7	0.3	2.8	54.1	57.6	-0.2	3.3	54.2	57.6	-0.1	3.3
Sellerley Farm, Conder Green Road	65.8	69.8	3.4	7.4	61.6	65.5	-0.8	3.1	65.7	70.2	3.3	7.8	64.7	70.1	2.3	7.7	63.8	69.4	1.4	7.0	63.2	69.5	0.8	7.1
Woodside, Ashton Road	48.7	51.2	-0.2	2.3	45.4	46.8	0.5	1.9	48.7	50.9	-0.2	2.0	48.7	50.9	-0.2	2.0	48.6	50.9	-0.3	2	48.8	50.9	-0.1	2.0
Romar, Langshaw Lane	65.2	65.7	0.2	0.7	65.2	65.6	0.2	0.6	57.5	58.5	2.3	3.3	57.0	58.4	1.8	3.2	64.9	65.5	-0.1	0.5	62.9	63.4	0.0	0.5
Salt Oke, Bay Horse Lane	74.4	74.3	0.1	0.0	74.4	74.4	0.1	0.1	59.6	59.9	-0.1	0.2	74.5	74.7	0.2	0.4	74.4	74.3	0.1	0.0	70.1	71.0	-0.2	0.7
5 Leach House Lane	65.7	65.7	-0.2	-0.2	58.0	59.5	0.2	1.7	67.5	67.6	-0.5	-0.4	65.5	65.9	-0.4	0.0	68.0	68.8	0.0	0.8	58.1	59.6	0.3	1.8
Deep Cutting Farm, Ashton Road	69.1	71.3	0.1	2.3	55.9	59.2	-0.3	3.0	69.0	71.2	0.0	2.2	56.2	58.3	0.0	2.1	55.9	58.4	-0.3	2.2	69.2	71.3	0.2	2.3
33 Spruce Avenue*	46.7	47.3	-0.1	0.5	46.7	47.3	-0.1	0.5	46.6	47.2	-0.2	0.4	46.7	47.2	-0.1	0.4	47.1	47.5	0.3	0.7	47.0	47.5	0.2	0.7

Oubeck Cottage, Scotforth Road*	71.4	72.2	-0.5	0.3	71.4	72.4	-0.5	0.5	70.7	71.9	-1.2	0.0	71.0	72.3	-0.9	0.4	71.6	72.7	-0.3	0.8	71.8	72.5	-0.1	0.6
294 Bowerham Road*	75.0	75.6	0.2	0.8	75.1	75.7	0.3	0.9	75.3	75.8	0.5	1.0	75.2	75.7	0.4	0.9	74.3	75.1	-0.1	0.7	74.9	75.5	0.1	0.7
Lily Croft, Stoney Lane	59.3	59.1	-1.0	-1.2	61.2	61.4	-0.9	-0.7	64.5	64.9	0.6	1.0	63.5	63.8	-0.4	-0.1	60.0	60.0	-0.3	-0.3	61.5	63.0	1.2	2.7
Dam Head Farm, Procter Moss Road	49.4	54.0	-2.0	2.6	49.4	52.6	-2.0	1.2	49.5	52.2	-1.9	0.8	49.7	52.1	-1.7	0.7	49.4	54.2	-2.0	2.8	54.5	57.6	0.1	3.2
* *These receptors are inside a NIA as described in Section 5.3.4.1* ST = Short-Term noise change (Do Something 2025 – Do Minimum 2025) LT = Long Term noise change (Do Something 2040 – Do Minimum 2025)																								

Table 7.3: Daytime short-term noise impact Do Minimum 2025 vs Do Something 2025

Scenario / Comparison: Daytime Do Minimum 2025 against Do Something 2025														
Change in noise level			**Central 1**		**Central 2**		**Eastern 1**		**Eastern 2**		**Western 1**		**Western 2**	
			Dwelling	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**
Increase in noise level, $L_{A10, 18hr}$	0.1 – 0.9	Negligible	1,271	13	1,100	12	1,552	14	1,544	16	1,958	14	3,039	21
	1.0 – 2.9	Minor	1,030	5	879	4	1,185	5	1,121	4	273	0	143	0
	3.0 – 4.9	Moderate	257	0	231	0	88	0	79	0	25	0	7	0
	5+	Major	1	0	1	0	1	0	3	0	11	0	2	0
No change	0		102	0	102	0	101	1	167	0	1,116	6	735	1

Decrease in noise level, $L_{A10, 18hr}$	0.1 – 0.9	Negligible	2,293	13	2,643	16	1,953	10	1,998	10	1,830	13	1,273	11
	1.0 – 2.9	Minor	290	2	285	1	378	3	349	3	67	0	105	0
	3.0 – 4.9	Moderate	62	0	49	0	53	0	56	0	26	0	24	0
	5+	Major	25	0	41	0	20	0	14	0	25	0	3	0

Table 7.4: Night-time short-term noise impact - Do Minimum 2025 vs Do Something 2025

Scenario / Comparison: Night time Do Minimum 2025 against Do Something 2025													
Change in noise level			**Central 1**		**Central 2**		**Eastern 1**		**Eastern 2**		**Western 1**		**Western 2**	
			Dwelling	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**	**Dwelling**	**Other**
Increase in noise level, $L_{A10, 18hr}$	0.1 – 0.9	Negligible	1,299	13	1,055	12	1,572	14	1,535	15	1,971	13	2,707	17
	1.0 – 2.9	Minor	1,201	5	1,085	4	1,208	5	1,170	4	250	0	105	0
	3.0 – 4.9	Moderate	30	0	23	0	15	0	9	0	24	0	6	0
	5+	Major	1	0	1	0	1	0	3	0	5	0	1	0
No change	0		200	3	204	0	231	0	273	1	1,316	8	1,189	6
Decrease in	0.1 – 0.9	Negligible	2,307	11	2,654	16	1,919	11	2,000	11	1,658	12	1,209	10

noise level, $L_{A10, 18hr}$	1.0 – 2.9	Minor	225	1	228	1	321	3	279	2	65	0	92	0
	3.0 – 4.9	Moderate	56	0	49	0	55	0	55	0	29	0	19	0
	5+	Major	12	0	32	0	9	0	7	0	13	0	3	0

7.1.11 In summary the short-term daytime period, Western 1 would be considered the second most favourable route option from a noise perspective as it results in a lower number of adverse impacts compared to the other route options, whilst also providing a number of beneficial impacts. The short term results predict that all route options with the exception of Western 2, would be regarded as adverse in the short-term night time owing to the much larger numbers of adverse impacts of minor magnitude or more compared to the number of beneficial impacts of minor magnitude or more. Therefore, Western 2 is considered the most preferable route option from a noise point of view. As with the daytime short-term assessment, the remaining route options are considered to be comparable from a noise perspective as they provide similar numbers of impacts to one another.

7.1.12 Variations between the 2025 and 2040 traffic flow have resulted in differing impacts in the short-term and long-term scenarios for all route options. Whilst in the short-term, there is a clear distinction between the most adversely and least adversely impacted route options, in the long-term these differences are less pronounced.

7.1.13 Based on the magnitude of impact assessment, it is evident that the Western 1 and Western 2 route options are both the most preferable proposed Scheme options from a noise point of view. The joint second most preferable route options are considered to be the Central 1 and Central 2 options, whilst the least preferable are Eastern 1 and Eastern 2.

Table 7.5 – Noise Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 2 criteria	Outcome
Reduce noise pollution from transport	Increased levels of background noise and reduced air quality are considered to have a deleterious effect on human health. The availability and accessibility of assets such as recreational and sports facilities/grounds and CROW access land in an area can make significant contribution to local health	To capture noise sensitive receptors areas within a buffer of 50m of residential properties, schools and hospitals are potentially excluded

	and wellbeing as well as contribute to the amenity value of an area.	from further consideration. Areas within a buffer of 50m which are currently utilised for recreation or which benefit the community such as sports facilities, sports grounds and access routes are potentially excluded from further consideration.
Topic & Objective	Rationale for Tier 2 criteria	Outcome
Reduce noise pollution from transport	Increased levels of background noise will have a deleterious effect on human health. The availability and accessibility of assets such as recreational and sports facilities/grounds, cycle routes, open access land and Public Rights of Way in an area can make significant contribution to local health and wellbeing as well as contribute to the amenity value of an area.	Areas within a buffer of 100m from an area utilised for recreation or which benefit the community such as sports facilities, sports grounds, access routes, PRoW, cycle route etc. will be considered further only if no other option available.

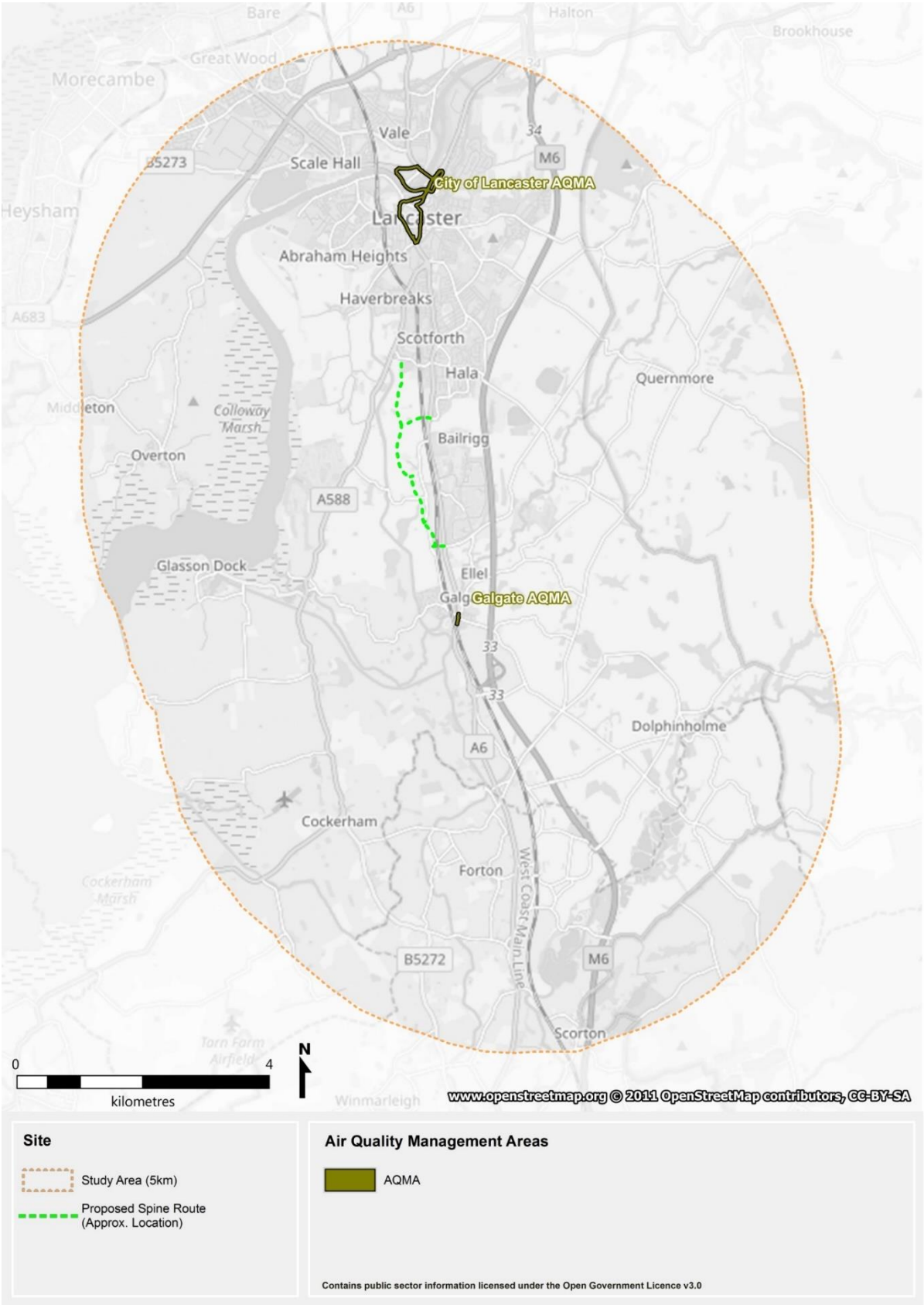
8 Air quality

8.1.1 Across the area are a number of sensitive receptors to air quality. These include educational facilities (for example schools, play groups etc.), social facilities (hospitals, GP Surgeries, old people's homes etc.) and general residential areas. There are also a number of European designated ecological sites (SACs, SPAs, Ramsar sites and a range of other areas designated for nature conservation purposes) that exist in the vicinity of the Study Area. Air pollution could potentially have an adverse impact on such areas.

8.1.2 Air quality data was taken from a number of national data sources, local Air Quality Management Areas (of which there are three and two of which are within the Study Area being – the City of Lancaster AQMA, Galgate AQMA Carnforth AQMA (approximately 6.4km north of the Study Area)) and a diffusion tube survey over the period 2007-2018.

8.1.3 Results in the Lancaster AQMA were mostly lower than previous years but still indicate exceedance of the annual mean/hourly mean nitrogen dioxide objectives. The main air quality issues in Lancaster remain linked to emissions from road traffic. These emission continue to cause exceedance of air quality objectives for the pollutant nitrogen dioxide (NO_2) and contribute towards elevated levels of particulate (PM_{10} and $PM_{2.5}$). In 2017 air quality monitoring in Galgate confirmed compliance with air quality objective levels for nitrogen dioxide for the first time since the location was designated as an Air Quality Management Area. General pollution levels giving rise to the AQMA are considered to be slow gradual decline over the last four years.

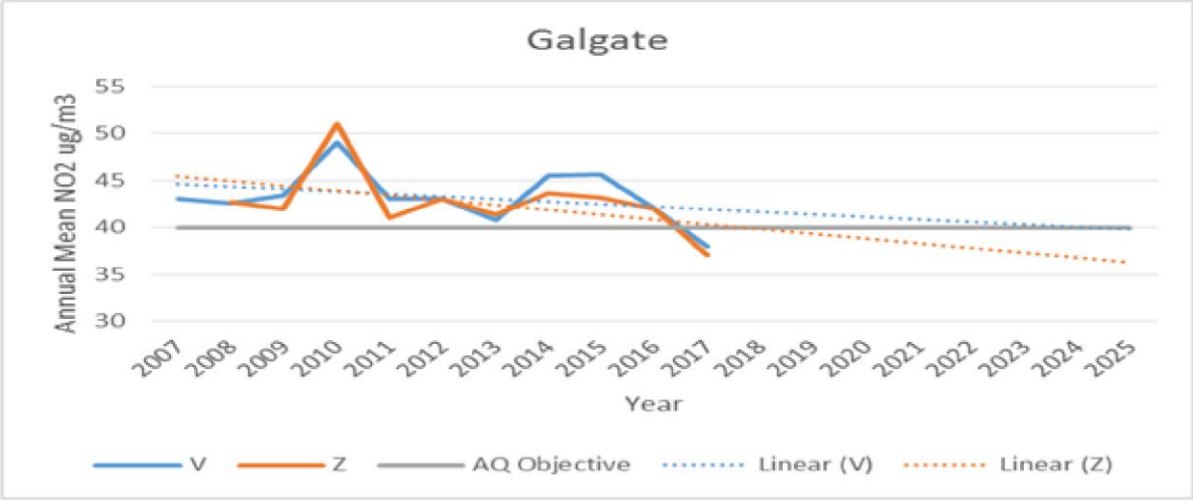
Figure 8.1 – Air Quality Management Areas



8.1.4 As noted in the Galgate Air Quality Action Plan Update[35] although air quality issues are changing e.g. there are arising concerns over the increased use of sold fuels, the issue giving rise to the designation of Galgate AQMA, are emissions from road traffic, specifically emissions of nitrogen oxides. In Galgate the AQMA is designated due to the likely exceedance of the annual mean objective for nitrogen dioxide. In 2014, discussions took place with Lancashire County Council to consider possible substantive action to relieve the traffic related air quality issues at the crossroads at Galgate. Although travel planning, cycling and walking measures etc. could contribute to reducing pollution levels in the locality, a more substantive action was considered to be required to significantly improve air quality in this location.

8.1.5 In 2017 air quality monitoring in Galgate indicated compliance with air quality objective levels for nitrogen dioxide for the first time since the location was designated as an Air Quality Management Area. General pollution levels giving rise to the AQMA are considered to be slow gradual decline, particularly evident over the last four years. This is illustrated in the following figure.

Figure 8.2 - Graph showing declining roadside NO_2 pollution levels in Galgate AQMA (annual mean NO2 ug/mg^3)



Source: Lancaster City Council – Galgate Air Quality Action Planning Update

[35] Lancaster City Council, 2018

8.1.6 Baseline results at each receptor/reference are set out in the table below and are then contrasted with the following summary of results in the year 2025 with the various options.

Table 8.1 - Air Quality Baseline Results

Receptor ID	Location	Modelled 2018 Annual Mean Concentration (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
R1	Bay Horse Lane	20.7	10.6	6.9
R2	Hampson Lane	19.8	11.7	7.4
R3	Stoney Lane	12.4	9.3	6.1
R4	Preston Lancaster Road	25.2	12.8	8.0
R5	Main Road	29.3	13.4	8.4
R6	Conder Green Road	8.5	9.0	5.8
R7	Main Road	37.7	14.1	9.0
R8	Main Road	39.7	14.1	9.0
R9	Stoney Lane	**45.7**	14.8	9.5
R10	Salford Road	14.2	11.4	7.2
R11	Langshaw Lane	12.7	9.1	6.0
R12	Bay Horse Road	7.9	8.5	5.6
R13	Leach House Lane	13.9	11.2	7.1
R14	Leach House Lane	15.1	11.4	7.2
R15	Alexandra Park Drive	7.3	11.4	7.2
R16	Ashton Road	7.0	8.5	5.6
R17	Scotforth Road	8.3	12.0	7.6
R18	Hazelrigg Lane	10.9	9.1	5.9
R19	Oakwood Gardens	15.4	11.8	7.4
R20	Blea Tarn Road	19.5	11.8	7.5
R21	Ashton Road	7.8	10.2	6.6
R22	Bowerham Road	8.7	13.3	8.7
R23	Alderman Road	12.0	9.7	6.3
R24	Newlands Road	**43.1**	14.5	9.5
R25	Lune Valley Interchange	**41.6**	14.5	9.4
Note: Exceedances of annual mean NO_2 AQO (40 µg/m³) shown in **bold** type.				

8.1.7 As of October 2018 however, additional action is still considered to be required in Galgate for three reasons (i) to reassure likely compliance with the objective in each future year (monitoring in 2017 indicated levels in some locations were just below the objective, not well under), (ii) to meet the Lancaster Air Quality Strategy objectives (which directs a reduction approach) and (iii) to respond to new demands arising from new development (which can add additional road traffic/emissions).

8.1.8 Some elements of the Masterplan/AQAP have however already been delivered e.g. delivery of the Bay Gateway link road in late 2016, adoption of new planning guidance, and it is anticipated that this will continue to take place. Actions being considered will comprise of a number of approaches, including a by-pass for Galgate, the development of a bus rapid transit route across the district, traffic route/management changes, measures to facilitate the use of Ultra Low Emission Vehicles, measures to reduce emissions from buses and measures to facilitate and promote cycling and walking.

8.1.9 During 2019 Jacobs prepared a report on behalf of Lancashire County Council (issued in early 2020)[36] which appraised all six route options in terms of traffic volumes and the consequent predicted improvement in air quality at the Galgate AQMA. The results of the study are summarised below and presented in the table which follows.

8.1.10 The Air Quality assessment predicts there would be an exceedance of the NO_2 Air Quality Objective at one location in the opening year Do-Minimum scenario. This location is within the Galgate AQMA however is modelled to experience a medium to large beneficial reduction in NO_2 concentrations in all DS route options, resulting in the Air Quality Objective being achieved at this receptor. NO_2 concentrations at all other human health receptors, and for PM_{10} and $PM_{2.5}$ at all receptors, were modelled be within the relevant Air Quality Objectives. In accordance with the Design Manual for Roads and Bridges[37], this indicates that

[36] Jacobs (2020) 14-RO-TAR-F M6 J33 Traffic, Noise and Air Report
[37] DMRB LA 105 (Highways England, 2019)
Found at https://www.standardsforhighways.co.uk/ha/standards/DMRB/vol11/section3.htm

the air quality impacts of the route options can be considered beneficial. Furthermore, the results of the compliance risk assessment indicate that the route options are unlikely to have a significant effect on national compliance with the annual mean NO_2 EU Limit Value.

Table 8.2 – Summary Comparison of Results at Galgate AQMA (2025)

	AQMA Air Quality Objective Met	Reduction in NO_2 at 2025	Resulting NO_2 level at 2025	$PM_{2.5}$ and PM_{10} below AQO
Central 1	Yes	9.5 µg/m³	31.6 µg/m³	Yes
Central 2:	Yes	11.2 µg/m³	29.9 µg/m³	Yes
Western 1	Yes	4.1 µg/m³	37.0 µg/m³	Yes
Western 2	Yes	3.9 µg/m³	37.2 µg/m³	Yes
Eastern 1	Yes	8.6 µg/m³)	32.6 µg/m³	Yes
Eastern 2	Yes	7.6 µg/m³)	33.5 µg/m³	Yes

8.1.11 Jacobs also undertook a compliance risk assessment for the roads identified in the Pollution Climate Mapping model which are also within the Affected Road Network of the Study Area. The compliance risk assessment is presented within a document entitled 'M6 J33 Options Report Addendum: Public Transport Only Route - Air Quality Sensitivity Test'.

8.1.12 The model results were used to assess whether there are any significant effects as a result of the Scheme. Highways England's approach to evaluating significant air quality effects is set out in DMRB LA 105 (Highways England, 2019).

8.1.13 The results of the compliance risk assessment confirms the Scheme is unlikely to have a significant effect on national compliance with the annual mean NO_2 EU Limit Value.

8.1.14 The model predicts the Scheme will result in a large reduction in annual mean NO_2 concentrations where the Air Quality Objective is currently exceeded. This is considered to represent a significant beneficial impact. A medium increase is modelled to occur at fewer than 10 receptors where the Air Quality Objective is

exceeded but this is considered to represent a significant beneficial impact. Whilst a medium increase is modelled to occur at less than 10 receptors where the AQO is exceeded, these changes can be considered not significant, particularly as annual mean NO_2 concentrations are thought likely to be overestimated at these receptors. Therefore, the overall impact of the Scheme on local air quality is considered to be a significant beneficial impact.

8.1.15 A further assessment entitled 'M6 J33 Options Report Addendum: Comparative Ecological Assessment of Air Quality Impacts' also involved a study of the impact of the Scheme on ecological receptors. There were no veteran trees identified on the Woodland Trust Ancient Tree Inventory that would be significantly affected by any of the route options.

8.1.16 The nitrogen deposition assessment results in Table 8.3 confirm two route options have potential to impact on two ecological sites as project-related nitrogen deposition changes are above 0.4 kg N/ha/y: These sites are Berry's Farm and Sellerley Farm Ponds impacted by Western 1 and Little Cockshades Wood impacted by Eastern 1. The consequences of these increases in nitrogen deposition are detailed below, based on the habitats and species listed in the relevant designated site citations.

Table 8.3 – Predicted Impact of the Scheme on Designated Sites

Designated Site	APIS Data Average Total N Deposition Kg N/ha/yr	Increase in Nitrogen Deposition DS – DM kg N/ha/yr					
		Central 1	Central 2	Eastern 1	Eastern 2	Western 1	Western 2
Berry's Farm and Sellerley Farm Ponds, Conder Green	19.97	0.01	-0.01	0.00	0.00	**0.43**	0.15
Long Bank Wood	29.4	0.06	0.06	0.02	0.06	0.00	0.00
Wyresdale Road Verges	18.62	0.26	0.27	0.27	0.28	-0.01	-0.01
Park Coppice	30.8	0.26	0.14	0.25	0.25	0.10	0.24
Old Park Wood	30.8	0.00	0.15	0.00	0.00	0.20	0.17
Little Cockshades Wood	30.8	-0.01	-0.01	**0.46**	0.14	0.00	0.00
Brunstow (North) Wood)	34.72	-0.02	-0.02	0.00	0.01	-0.01	0.01
Brunstow Wood	34.72	-0.02	-0.02	0.00	0.02	-0.01	0.08

8.1.17 It is recommended that if the Eastern 1 route option is taken forwards, a botanical field survey should be carried out to assess nitrogen-sensitivity of the habitats present and to note indicators of existing elevated nitrogen. This survey should be designed such that they consider the direction and distance to the route, depth of surrounding woodland and canopy cover. This should be followed by a reassessment of the significance of the increases in atmospheric nitrogen deposition on this woodland.

8.1.18 It is also noted the status of ponds at Berry's Farm and Sellerby Farm designated site was determined using aerial photography from 2018. It is therefore recommended that if the Western 1 route option is taken forwards, a field verification survey is undertaken to confirm the current trophic status of these ponds. This survey should be followed by a reassessment of the significance of the increases in atmospheric nitrogen deposition on this site.

8.1.19 As a consequence of implementing the Scheme it is unlikely any of the route options will have such a significant effect on designated habitats that will result in the loss of a species. In order to confirm this further surveys.

Figure 8.3 – Areas Constrained by or Sensitive to Air Pollution

Air Quality

Tier 1 Areas | Tier 2 Areas | Less Constrained Areas

Relevant source datasets:
- Air Quality Management Areas;
- Built up areas;
- Hospitals;
- Schools;
- Dwellings;
- SPA;
- SAC;
- Ramsar; and
- SSSI.

Table 8.4 - Air Quality Tier 1 and Tier 2 Criteria

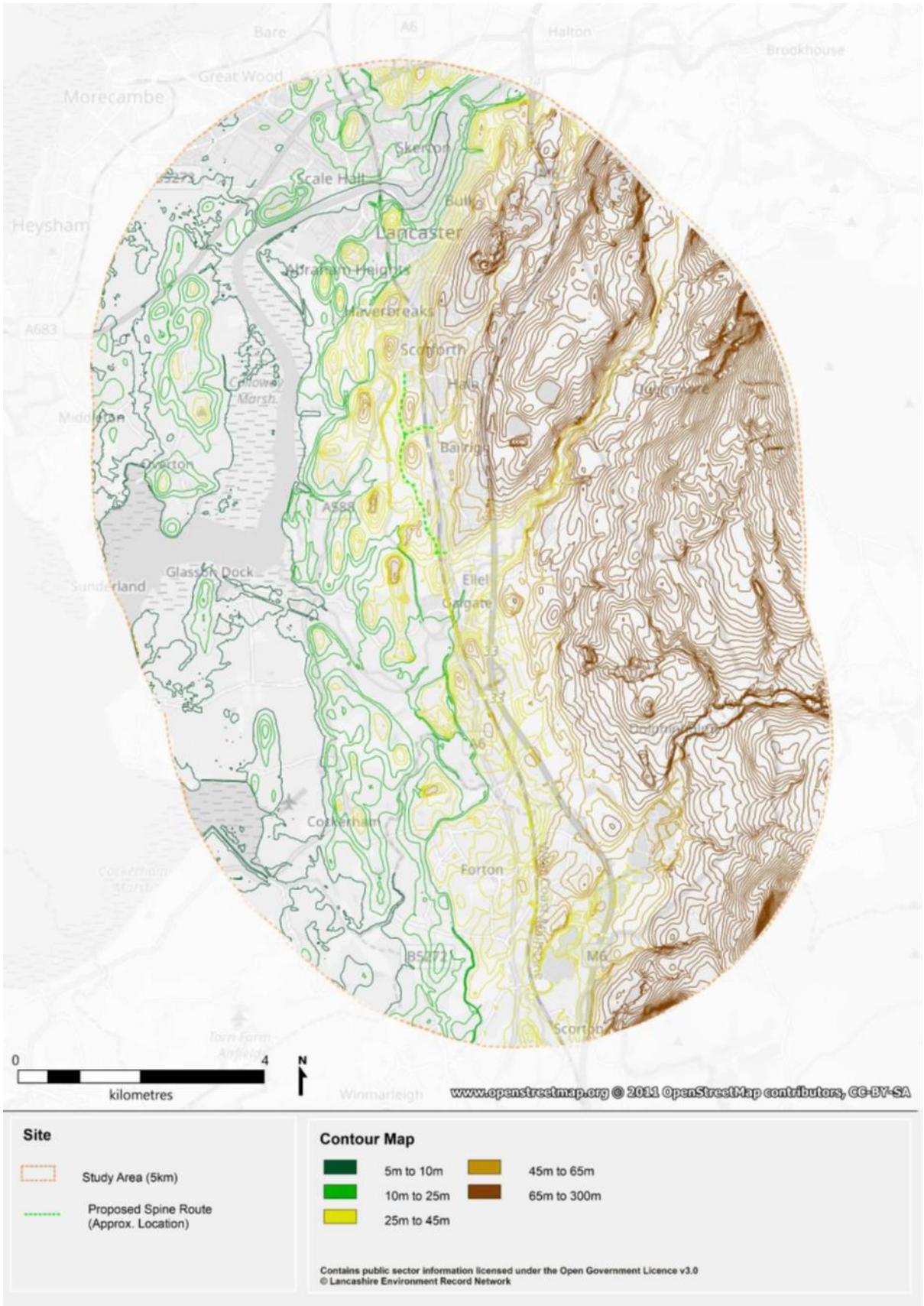
Topic & Objective	Rationale for Tier 1 criteria	Outcome
Reduce air pollution impacts	The Environment Act 1995 introduced a system of Local Air Quality Management which obliges local authorities to periodically review and assess local air quality in their areas, declare air quality management areas where the prescribed objectives are not likely to be achieved, and work towards meeting them. A deterioration in air quality will adversely affect nature conservation sites (SAC, SPA, SSSI, Ramsar) and sensitive populations (e.g. young and elderly in concentrations such as schools and hospitals). As noted by DEFRA https://laqm.defra.gov.uk/documents/FallOffWithDistanceReptJuly08.pdf it is usually acknowledged that beyond 50m from the road, concentrations approach background levels. Thus, at 100m or more from the road, the difference between the total concentration and the background concentration should be as close to zero as will make virtually no difference.	Areas designated as Air Quality Management Area are potentially excluded from further consideration. Areas within a buffer of 50m of a Nature Conservation site (SAC, SPA, SSSI or Ramsar) are potentially excluded from further consideration. Areas within a buffer of 50m containing sensitive receptors, such as schools and hospitals are potentially excluded from further consideration.
Topic & Objective	**Rationale for Tier 2 criteria**	**Outcome**
Reduce air pollution impacts	The Environment Act 1995 introduced a system of Local Air Quality Management which obliges local authorities to periodically review and assess local air quality in their areas, declare air quality management areas where the prescribed objectives are not likely to be achieved, and work towards meeting them. A deterioration in air quality will adversely affect nature conservation sites (SAC, SPA, SSSI, Ramsar) and sensitive populations (e.g. young and elderly in concentrations such as schools and hospitals). As noted by DEFRA https://laqm.defra.gov.uk/documents/FallOf	Areas within 100m of an AQMA to be considered further if no other option available. Areas within a buffer of 100m containing sensitive receptors including those of nature conservation importance (SAC, SPA, SSSI, Ramsar), residential properties, schools and hospitals will be considered further only if no other option available Areas within a buffer of 100m which are currently utilised for recreation or

	fWithDistanceReptJuly08.pdf it is usually acknowledged that beyond 50m from the road, concentrations approach background levels. Thus, at 100m or more from the road, the difference between the total concentration and the background concentration should be as close to zero as will make virtually no difference.	which benefit the community such as sports facilities, sports grounds, etc. will be considered only if no other option available Route length to be minimised in such areas.

9 Ground Conditions

9.1.1 The topography varies across the Study Area (see Figure 9.1) but falls generally towards the west, approaching sea level upon reaching the Lune estuary. The high ground of the Forest of Bowland to the east of the M6 is clearly distinguished from the centre and western lowland areas. The valley of the River Conder is also situated in the Study Area running northeast to southwest.

Figure 9.1 – Contour Map

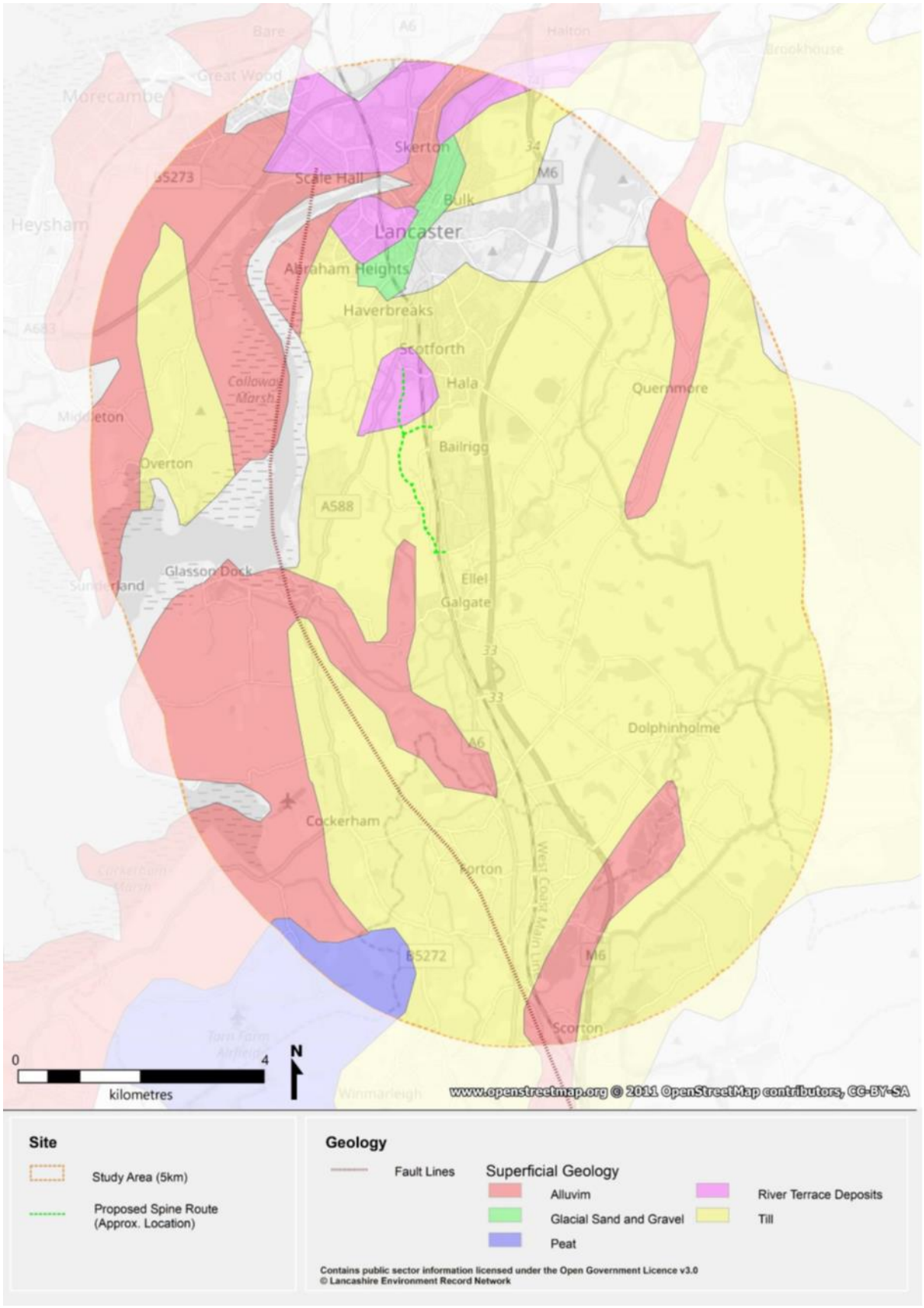


9.1.2 The baseline information has been obtained from the British Geological Survey (BGS) and the BGS 1:50,000 Lancaster Drift and Solid Geology maps, a detailed overview of the superficial geology within the Study Area. Practice and guidance is found within UK legislation, national and local planning policy and guidance and good practice documents. The presence of man-made features within the Study Area has been ascertained from the study of historical maps, mine and mineral depots records, unexploded ordnance/UXO risk map and aerial photographs.

9.1.3 The superficial geology of the eastern and central route is entirely underlain by Till-Diamicton and the western route is underlain by areas of Clay, Silt and Sand, Sand and Gravel associated with river terrace deposits as well as Till-Diamicton.

9.1.4 Bedrock geology across the route corridors is indicated to be of the Millstone Grit Group comprising mudstone, siltstone and sandstone.

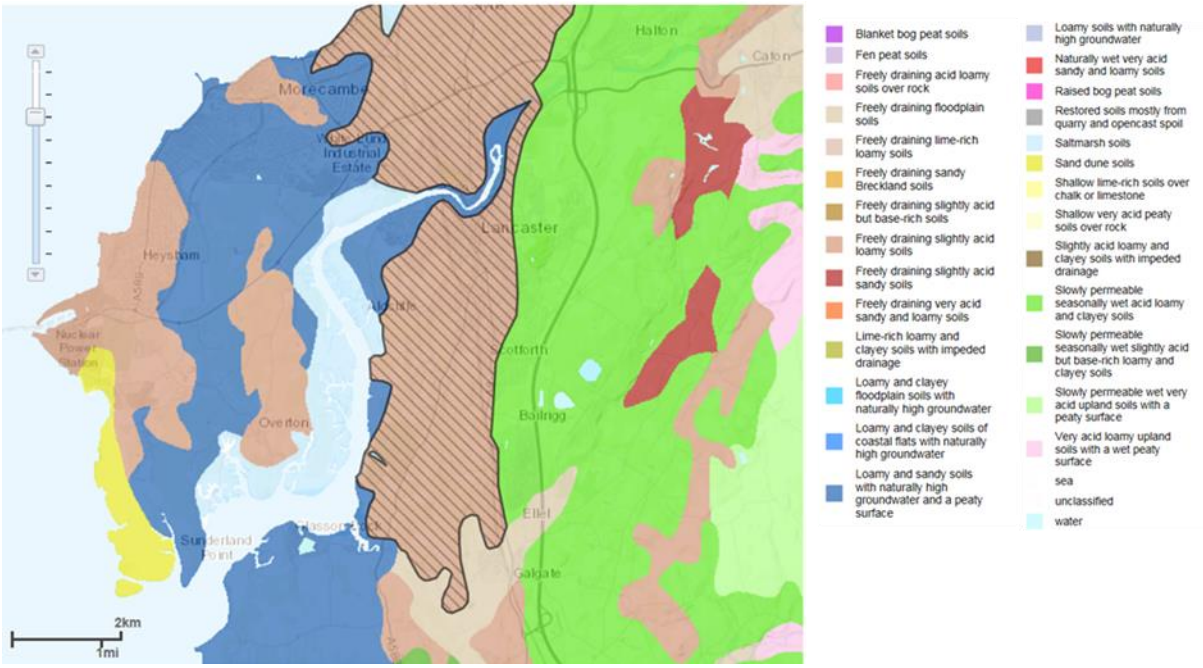
Figure 9.2 – Superficial Geology Map



9.1.5 The soilscapes website describes the soil conditions throughout the Study Area. Soils to the east are predominately described as slowly permeable seasonally wet acid loamy and clayey soils with impeded drainage (soilscape 17). Smaller areas of freely draining slightly acid loamy soils (soilscape 6) and freely draining slightly acid sandy soils (soilscape 10) also persist across the Study Area.

9.1.6 Soils to the west are predominately defined as freely draining slightly acid loamy soils (soilscape 6) but soils closer to the river basin are also a mix of naturally wet loamy and sandy soils with naturally high groundwater and a peaty surface (soilscape 23) and naturally wet saltmarsh soils (soilscape 1).

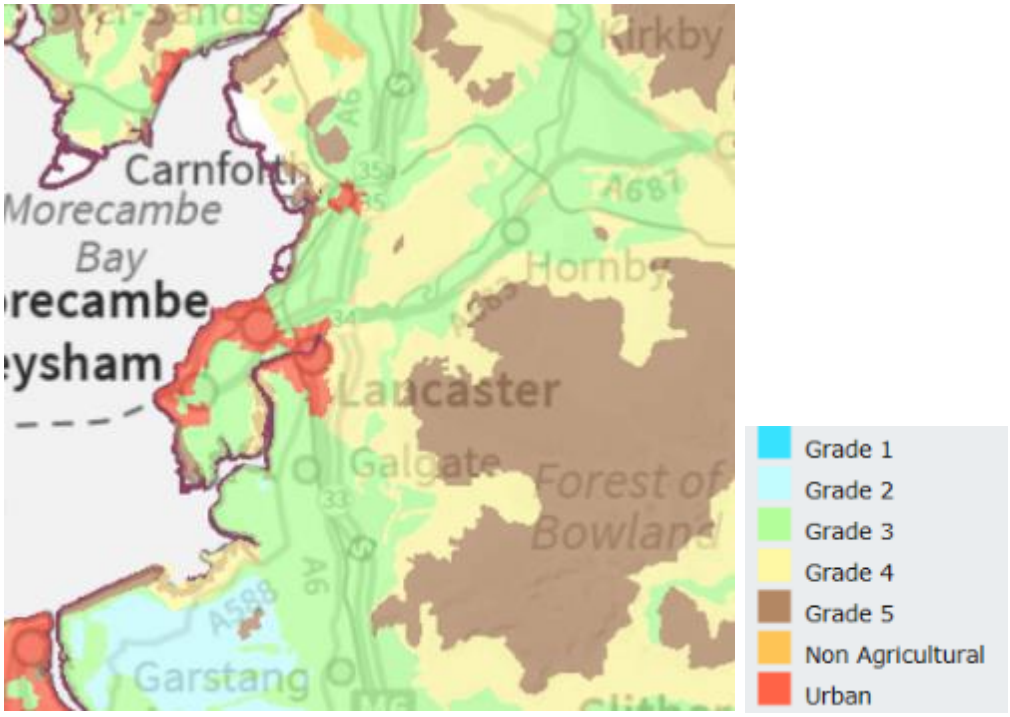
Figure 9.3 – Soil Types within the Study Area



9.1.7 A review of MAGIC confirms that the Agricultural Land Classification within the eastern routes is predominantly Grade 3. This is with the exception of two small areas of Grade 4 land which intersects the corridor towards the east and again towards the north. The western and central routes are entirely classified as Grade 3.

9.1.8 From examination of raster maps and aerial imagery along with a general walkover site visit, it is clear that the Study Area is predominately agricultural in nature with the main exception being Lancaster to the north, the village of Galgate, the Lancaster University campus and transport links such as the M6 motorway and West Coast Main Line railway.

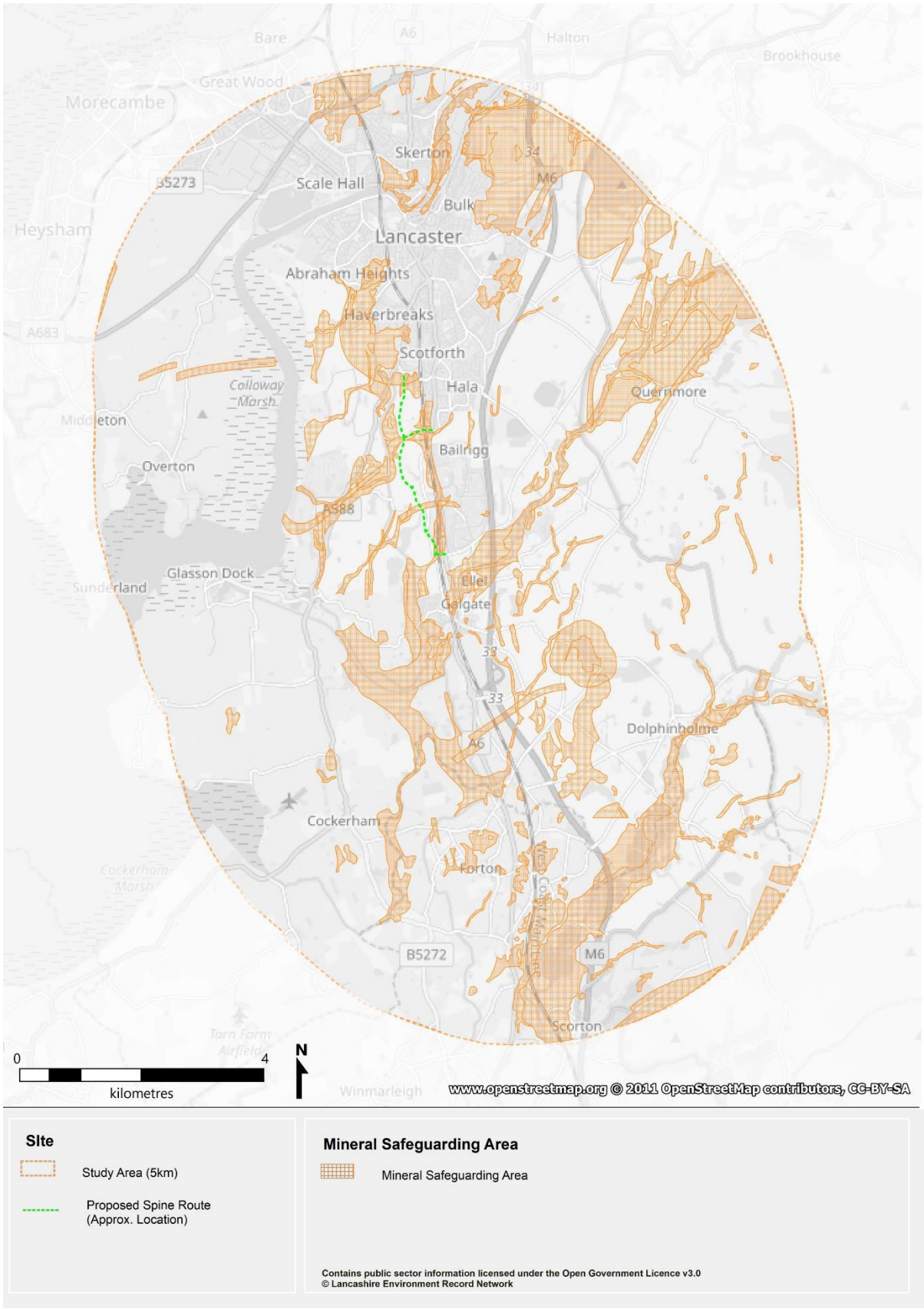
Figure 9.4 – Agricultural Land Grades within the Study Area



Source: https://magic.defra.gov.uk/magicmap.aspx

9.1.9 Mineral Safeguarding Areas have been identified within all the route corridors. The Lancashire Minerals and Waste Local Plan and for development to be acceptable certain criteria must first have been met in terms of the value of the resource. Historic mapping does indicate presence of a number of small 'Old Quarries' and 'Clay and Gravel Pits' across all route corridors.

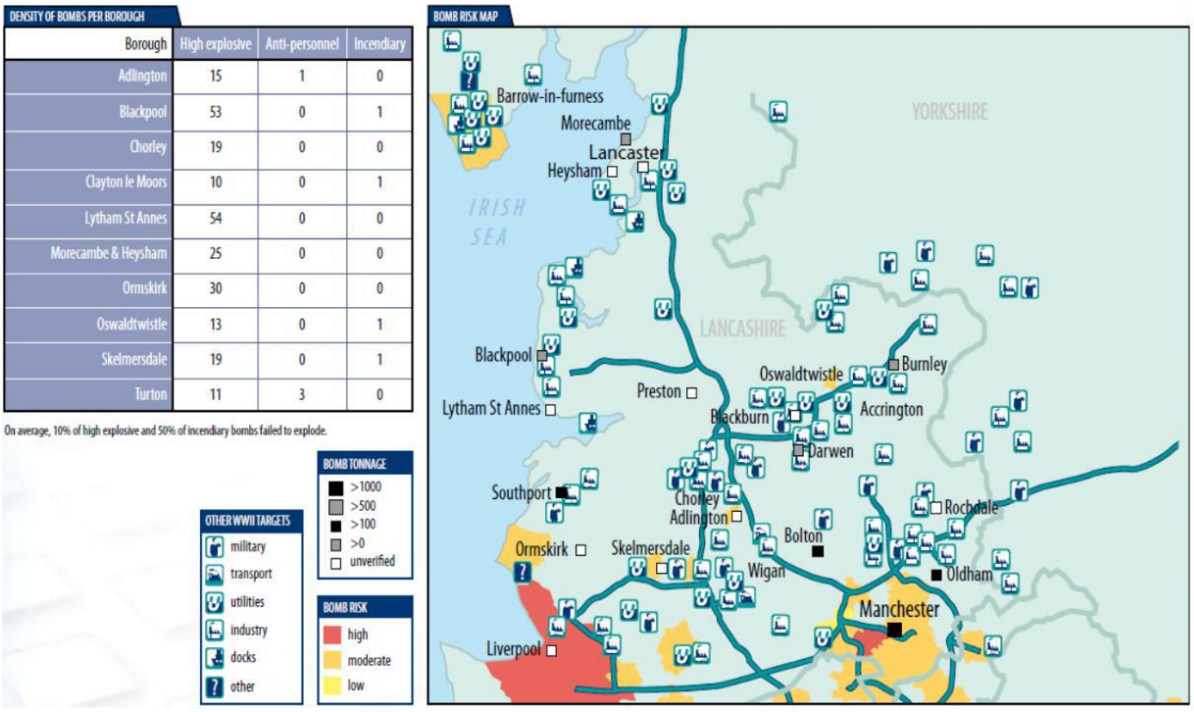
Figure 9.5 – Mining Safeguarding Areas within the Study Area



9.1.10 The Radon Map for this area, Map 17 Lancashire, South Cumbria and Western North Yorkshire, BR211 (2007), and the interactive map (www.uk radon.org), both indicate that the Scheme is in an area where the underlying geology has the potential to generate Radon gas, as reported in the M6 Junction 33 PSSR (2018). Review of the UK radon maps indicated that the area has a maximum radon potential of between 5% and 10%.

9.1.11 A high level consideration of the potential for unexploded ordnance was explored using the Zetica Regional Unexploded Bomb Risk Map for Lancashire, as reported in the M6 Junction 33 PSSR (2018). Whilst the bomb tonnage for the area between Galgate and Scotforth remains unverified the bomb risk is considered low. Low-risk regions are those with a bombing density of up to 10 bombs per 1000 acres. These areas are considered to have a significant but low UXB risk. As such the potential for UXB risk cannot be discounted at this stage and it is to be noted that this issue would require detailed further investigation.

Figure 9.6 – Zetica Regional Unexploded Bomb Risk Map for Lancashire



Source: https://zeticauxo.com/downloads-and-resources/risk-maps/

9.1.12 A wide range of potentially contaminating activities have been undertaken within the Study Area. Likely sources include but are not limited to:

- Old clay pits and ponds infilled with unknown material;
- Historical industry/ industrial practices such as vehicle repairs, textile/dye works etc.;
- Contaminants associated with road use at existing crossings;
- Previous site uses, e.g. farm buildings, dwellings;
- Existing properties in the Study Area;
- Agricultural activities such as slurry spreading and use of pesticides; and
- Transport links such as existing roads (e.g. risk of tarbound material and fuel spills) and railway activities (e.g. diesel spillage, asbestos from brakes etc.).

9.1.13 Recorded by the Environment Agency, it is noted that there are a number of historic landfill sites within the Study Area, which may therefore represent areas of contaminated land/made ground, as follows:

- Clifton Hill Pitt;
- Rear of Forton Service Area;
- Bracken Lea;
- Mainstones;
- Parkside Farm;
- Blea Tarn Reservoir (embankment);
- Willow Lane;
- Scotch Quarry;

- Marsh Point;
- Oxcliffe Hall Farm.

9.1.14 Within the Study Area there are a number of significant infrastructure gas pipelines and overhead High Voltage electricity transmission lines, shown in Figure 9.7, and are in a north-south orientation some distance to the east and west of the main existing transport networks (West Coast Mainline, the M6 motorway and the A6).

9.1.15 The Eastern route options are the only routes which may have to consider the location of underground gas pipelines.

9.1.16 Nether the Eastern or Central 1 route options have to consider to location of overhead electricity lines.

9.1.17 The Central 2 route option will have to take into account of required electricity line clearance in construction and for operation. The common parts of the Western route options runs parallel to the HV electricity pylons, passing beneath the cables at one part of the route. The vertical alignment will have to be slightly below ground level to provide clearance from the cables.

Figure 9.7 – Historic Landfill Sites within the Study Area

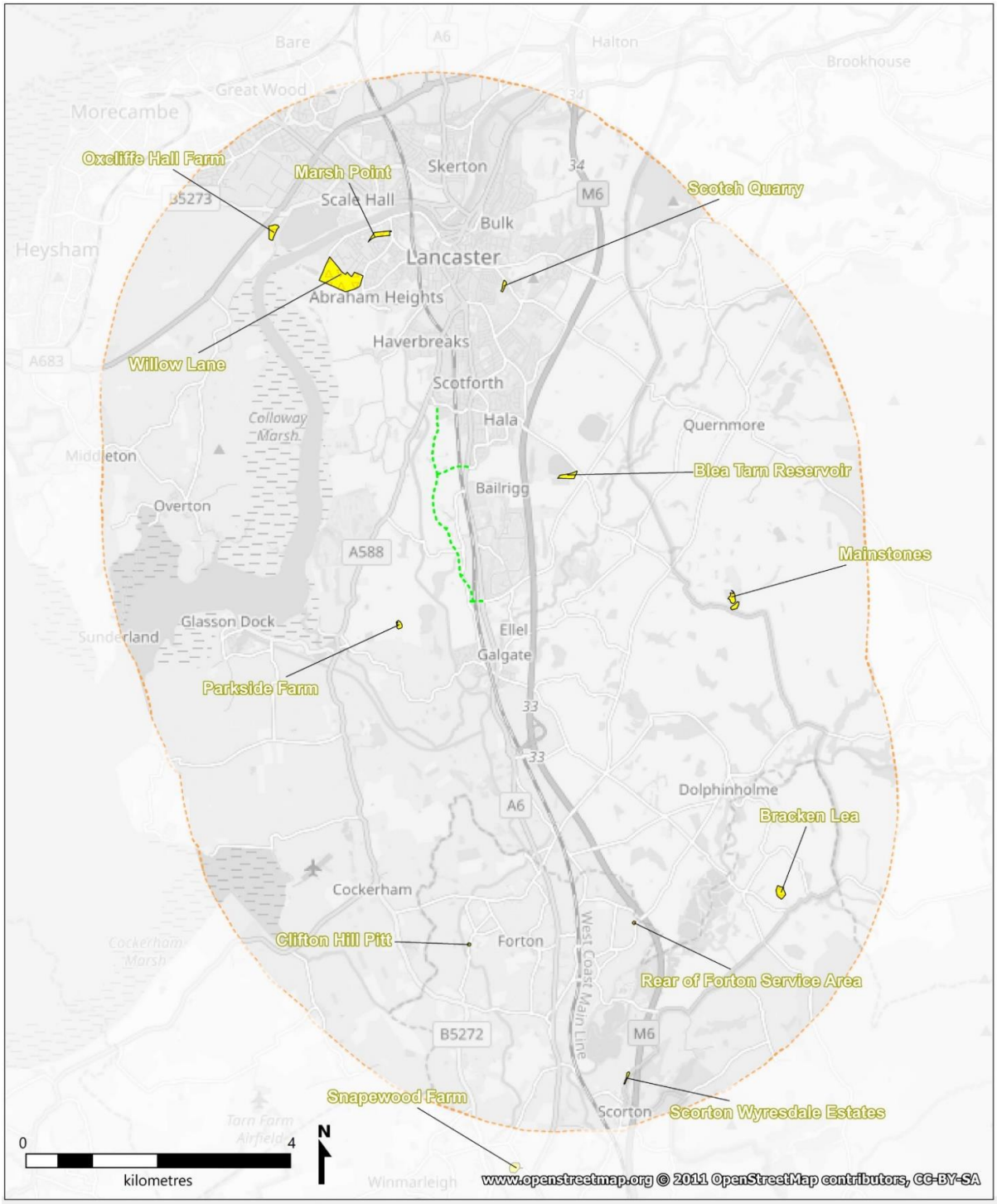
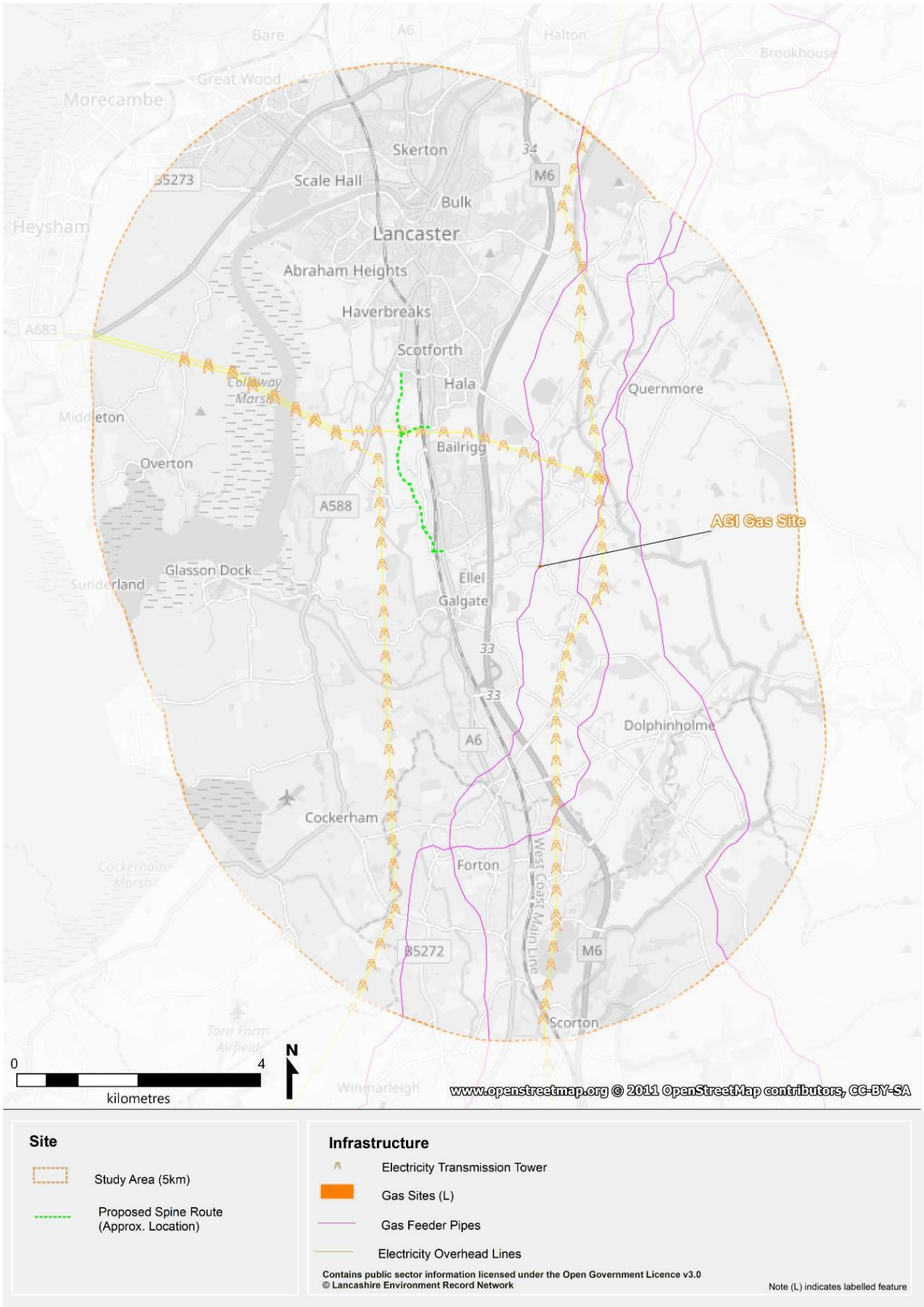


Figure 9.8 – Significant Infrastructure/Utilities within the Study Area



9.1.18 Having considered the detailed baseline data reported it is evident that whilst there would be a number of challenges to development, including in respect to issues of topography, soils (presence of BMV), uptake within mineral safeguarding areas and prevalence of buried and overhead services, no constraints have been identified which are thought to preclude development of a road in any route corridor.

Figure 9.9 – Ground and Soils Conditions Constrained Areas

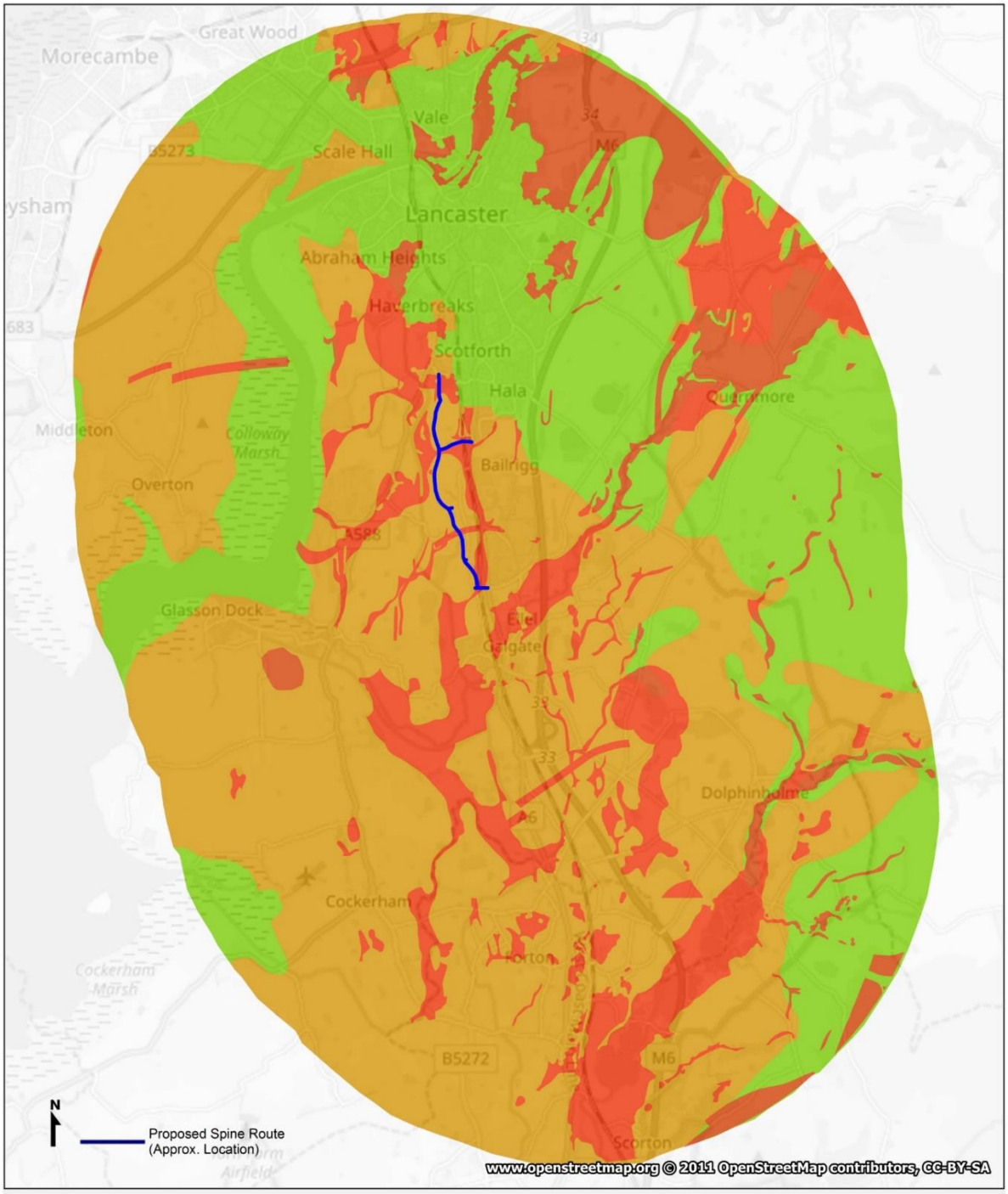


Table 9 –Ground and Soils Conditions Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 1 Criteria	Outcome
Soil and Mineral Resources Conserve soil and agricultural resources and seek to remediate / avoid land contamination	Geological Sites of Special Scientific Interest (SSSI) are legally protected Local Geological Sites/Local Geodiversity Sites (LGS) are non-statutory sites that have been identified by local geo-conservation groups as being of importance There is a need to protect the best areas of soil and agricultural resources. There is a need to remediate / avoid land contamination Areas of Mineral Safeguarding are important to protect for potential future economic exploitation	Areas could be potentially excluded if they would cause a significant adverse effect on a geological SSSI or LGS through overlapping physical location Areas of Agricultural Land Use Class 1 or 2 potentially excluded from further consideration Areas of Mineral Safeguarding potentially excluded from further consideration
Topic & Objective	**Rationale for Tier 2 Criteria**	**Outcome**
Soils and Mineral Resources Conserve soil and agricultural resources and seek to remediate/avoid land contamination	Geological Sites of Special Scientific Interest (SSSI) are legally protected Local Geological Sites/Local Geodiversity Sites (LGS) are non-statutory sites that have been identified by local geo-conservation groups as being of importance There is a need to protect the best areas of soil and agricultural resources	Areas of Agricultural Land Use Class 3a to be considered further only if no other option available Route length in such areas to be minimised Areas within 50m of a Geological SSSI or LGS will be considered only if no other option available

10 Water Resources

10.1.1 This section discusses the environment within the Study Area in terms of the water environment. The WFD divides the UK into regional River Basin Districts (RBDs). These RBDs are further divided into Management Catchments (12 no. in the Study Area); the Management Catchments further divided into Operational Catchments; and, finally the Operational Catchments divided into water bodies (631 no.). The Study Area is situated within the North West River Basin District and the following surface catchments Lune; Wyre; and North West Transitional and Coastal (TraC).

Figure 10.1 – Management Catchments within the Study Area (Lune, left; Wyre, central; North West TraC, right)

10.1.2 The Lune Management Catchment encompasses the whole of the River Lune and all of its many tributaries. This includes the Rivers Keer, Rawthey, Clough, Dee, Greta, Roeburn, Conder, Cocker, Hindburn and Wenning, as well as the many smaller streams and becks that flow into the Lune. It covers a varied landscape and supports a wide range of habitats, wildlife and industries. The Catchment spans a huge geographical area from above Tebay in the North to

the sea in Morecambe and out to the East including Ingleton Falls and Clapham. the operational catchments that intersect with the 5 km Study Area are:

- Pilling Ridgy Cocker and Conder; and,
- Lune – Rawthey to Greta.

10.1.3 The 5 km Study Area intersects the following water bodies within the Pilling, Ridgy, Conder and Calder operational catchment:

- Conder;
- Cocker (Lune);
- Overton Dyke;
- Langthwaite Reservoir; and,
- Cockerham.

10.1.4 There is also a non-reportable water body within the Pilling, Ridgy, Cocker and Conder Operational Catchment which borders along the River Lune. Although not a formal water body, watercourses within this area are still protected and the same aims and objectives are applied (i.e. no deterioration) as for water bodies.

Table 10.1 – WFD status for water bodies in Pilling Cocker and Conder Operational Catchment

Water body	HM/AWB?	Water body ID	Overall Current Status	Overall Objective Status
Conder (river)	HMWB	GB112072065900	Moderate (2016)	Good (2027) Disproportionate burdens
Cocker (Lune) (river)	HMWB	GB112072065880	Moderate (2016)	Good (2027) Disproportionate burdens
Overton Dyke (river)	HMWB	GB112072065950	Moderate (2016)	Good (2027) Disproportionate burdens
Langthwaite Reservoir (lake)	AWB	GB31229988	Good (2016)	Already Good
Cockerham (lake)	No	GB31247021	Good (2016)	Already Good

10.1.5 The 5km Study Area intersects the following water body within the Wyre and Calder operational catchment:

- Lune – conf Wenning to Tidal

Table 10.2 – WFD status for water bodies in Lune-Rawthey to Greta Operational Catchment

Water body	HM/AWB?	Water body ID	Overall Current Status	Overall Objective Status
Lune – conf Wenning to tidal	No	GB112072065980	Moderate (2016)	Good (2027)

10.1.6 The Wyre Catchment features a wide variety of habitats. The catchment drains a small area in North West Lancashire. It is bordered by the Lune catchment to the North and the Ribble Catchment to the South and East. The upper reaches of the catchment are centred on the Bowland Fells. The catchment then takes in the Amounderness plain at the base of the fells, which features towns such as Garstang and villages that are situated to the north of Preston. The lower catchment takes in the northern Fylde Coast and the villages of the Over Wyre area such as Hambleton and Stalmine.

10.1.7 The catchment supports a wide variety of flora and fauna for instance the estuarine area of the catchment is a key feeding location for many internationally important species of wading bird such as the Eurasian Oyster Catcher and the Redshank, whilst the mid river is home to Salmon and Sea Trout. The Bowland Fells at the top of the catchment supports many species of birds such as the Marsh Harrier and the Lapwing along with invertebrate species like the Manchester Treble Bar Moth. The vast majority of the Bowland Fells are within the Forest Of Bowland Area of Outstanding Natural Beauty they also host many Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs), which are areas of habitat that are nationally designated, these designations are in place to protect the flora and fauna that is contained within them. Only the Wyre and Calder catchment intersects with the 5 km Study Area.

10.1.8 The 5 km Study Area intersects the following water bodies within the Wyre and Calder operational catchment

- Wyre – Upper

Table 10.3 – WFD status for water bodies in Lune-Rawthey to Greta Operational Catchment

Water body	HM/AWB?	Water body ID	Overall Current Status	Overall Objective Status
Wyre - Upper	No	GB112072065821	Good (2016)	Already Good

10.1.9 The North West TraC Management Catchment Transitional (Estuarine) and Coastal water bodies. Only the Morecambe Bay operational catchment intersects with the 5 km Study Area.

10.1.10 The 5 km Study Area intersects the following two water bodies within the Morecambe Bay operational catchment:

- Lune; and
- Morecambe Bay

Table 10.4 – WFD status for water bodies in Morecambe Bay Operational Catchment

Water body	HM/AWB?	Water body ID	Overall Current Status	Overall Objective Status
Lune	No	GB531207212100	Bad (2016)	Good(2027) Disproportionate burdens
Morecambe Bay	HMWB	GB641211171000	Poor (2016)	Good (2015)

10.1.11 The 5km Study Area is within one artificial water body management catchment – the North West Artificial Water Body Management Catchment. Within this management catchment there are 11 operational catchments.

10.1.12 The Cumbria and Lancashire Canals and SWT (surface water transfers) operational catchment intersects the 5km Study Area. The 5km Study Area intersects one of the water bodies within the Cumbria and Lancashire Canals and SWT operational catchment:

- Lancaster canal, cruising section

Table 10.5 – WFD status for water body in Cumbria and Lancashire Canals and SWT Operational Catchment

Water body	HM/AWB?	Water body ID	Overall Current Status	Overall Objective Status
Lancaster canal cruising section	AWB	GB71210228	Moderate (2016)	Good (2021)

10.1.13 There are a large number of small watercourses within the Study Area, however, four primary watercourses have been identified. These are as follows:

- River Lune – The River Lune is the largest of all watercourses within the Study Area and flows from the northern extent of the Study Area to the south-east extent.
- River Condor – This river is one of the Lune's largest tributaries flowing from the western extent of the Study Area south, before turning east and flowing into the River Lune.
- River Wyre – The river flows from the western edge of the Study Area to the southern edge. This includes through an area dominated by lakes towards the south/south-eastern boundary of the Study Area.
- Lancaster Canal – The Lancaster canal flows from the northern edge of the Study Area moving south before turning east, following a similar path as the River Condor, where it meets the River Lune.

10.1.14 A number of reservoirs are also situated on the western edge of the Study Area – Langthwaite Reservoir and Blea Tarn Reservoir.

10.1.15 The groundwater operational catchment/water bodies cover the same area as those for surface water. The two operational catchments which intersect the 5 km Study Area are:

- Lune and Wyre Carboniferous Aquifer; and
- Fylde Permo-Triassic Sandstone Aquifers

10.1.16 The Lune and Wyre Carboniferous Aquifer operational catchment covers the majority of the 5km Study Area. This groundwater operational catchment only contains one groundwater water body.

Table 10.6 – WFD status for water body in Lune and Wyre Carboniferous Aquifer Operational Catchment

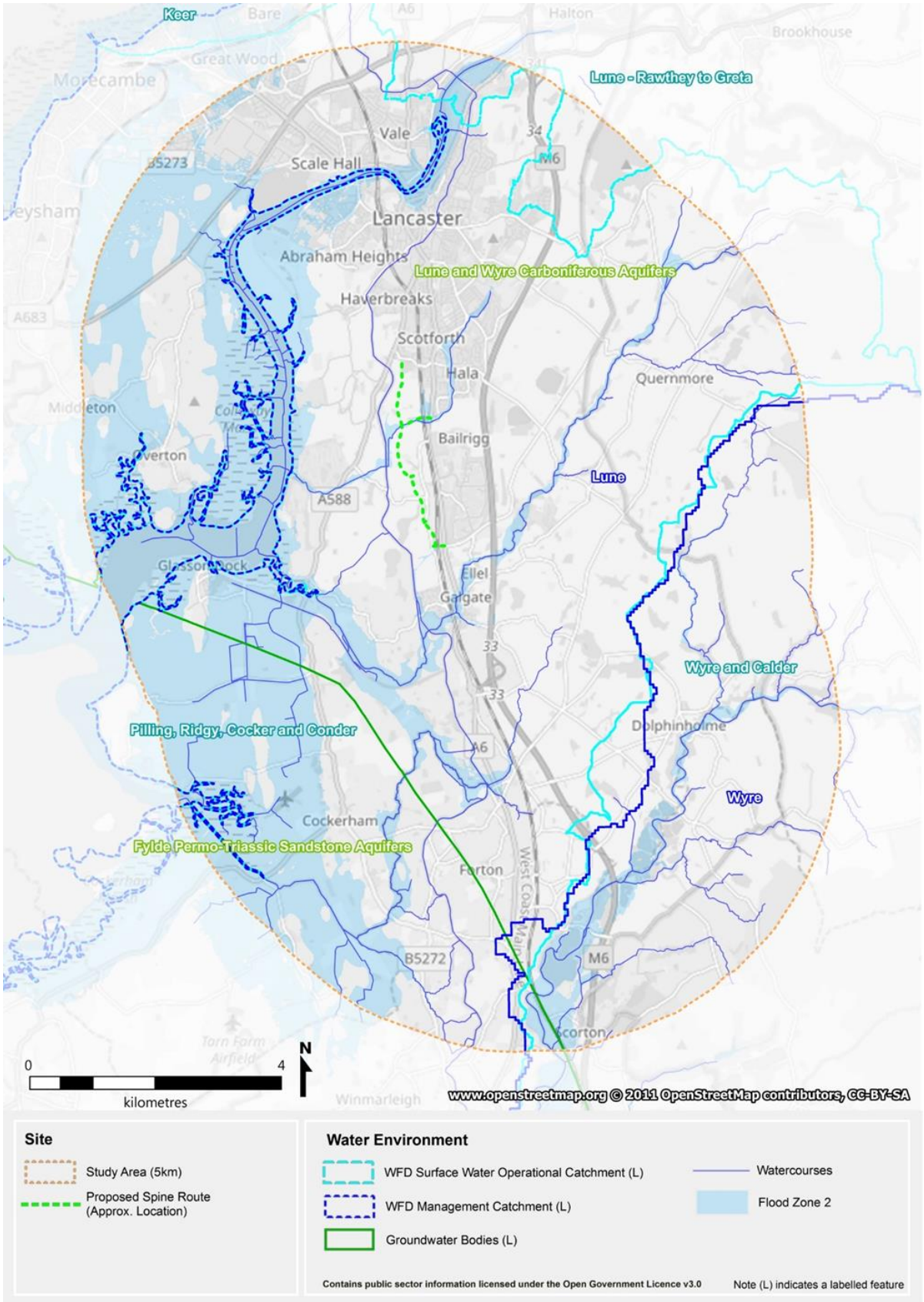
Water body	Water body ID	Overall Current Status	Overall Objective Status
Lune and Wyre Carboniferous Aquifer	GB112072065900	Good (2016)	Already Good

10.1.17 The Fylde Permo-Triassic Sandstone Aquifers operational catchment covers the southwest of the 5km Study Area. This groundwater operational catchment only contains one groundwater water body.

Table 10.7 – WFD status for water body in Fylde Permo-Triassic Sandstone Aquifers Operational Catchment

Water body	Water body ID	Overall Current Status	Overall Objective Status
Fylde Permo-Triassic Sandstone Aquifers	GB41201G100500	Good (2016)	Already Good

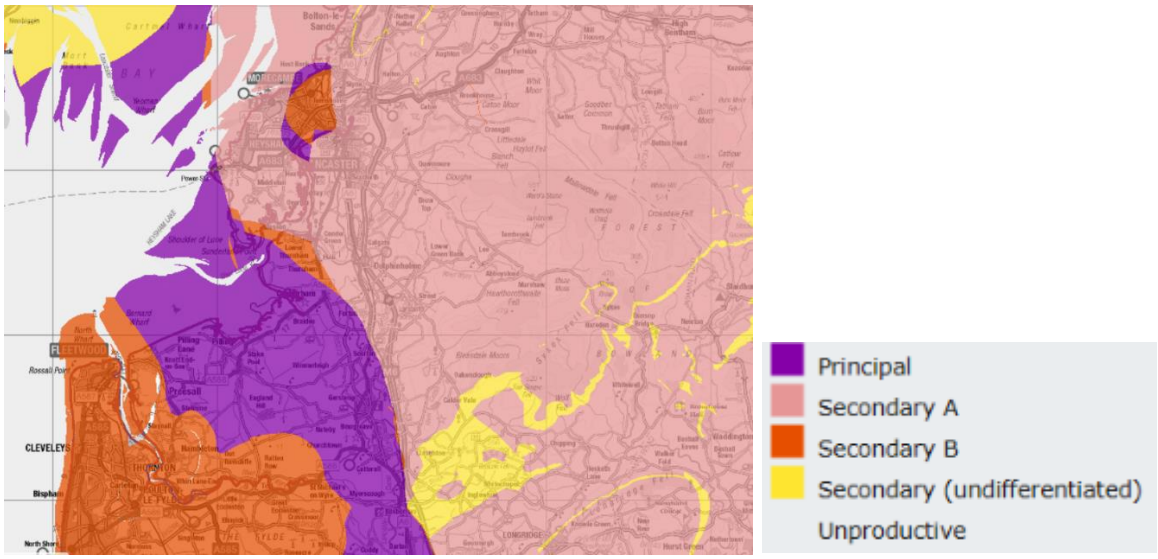
Figure 10.2 – Water Environment Diagram



10.1.18 The 5km Study Area intersects the following bedrock aquifers (Figure 10 3):

- Principal: The northern and southern area of the 5km Study Area. Principal aquifers are layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- Secondary A: The central area of the 5km Study Area. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- Secondary B: The northern and southern area of the 5km Study Area. These are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Figure 10.3 - Bedrock Aquifer Map ((c) Crown Copyright and database rights 2019. Ordnance Survey 100022861)



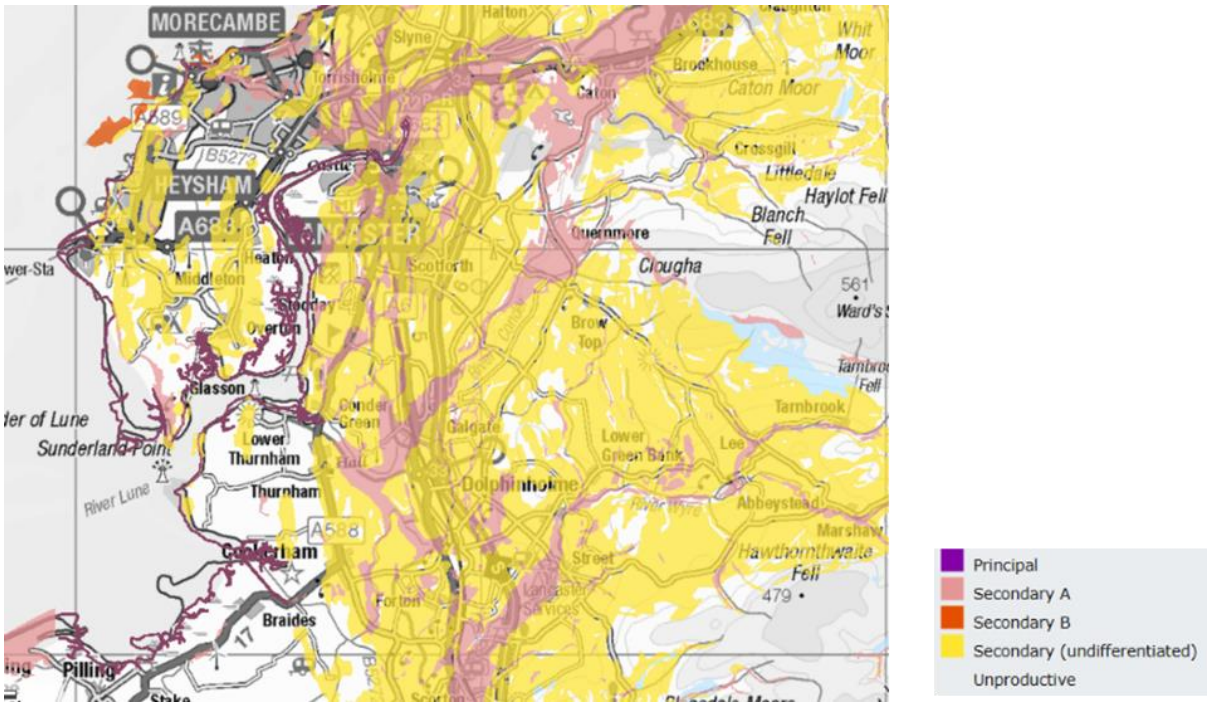
Bedrock Aquifers Source: https://magic.defra.gov.uk/magicmap.aspx

10.1.19 The 5km Study Area intersects the following superficial aquifers (Figure 10.4):

- Secondary A: These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

- Secondary undifferentiated: Areas where it is not possible to attribute either Secondary A or B to a rock type. In most cases this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characters of the rock type.[38]

Figure 10.4 – Superficial aquifer map ((c) Crown Copyright and database rights 2019. Ordnance Survey 100022861)

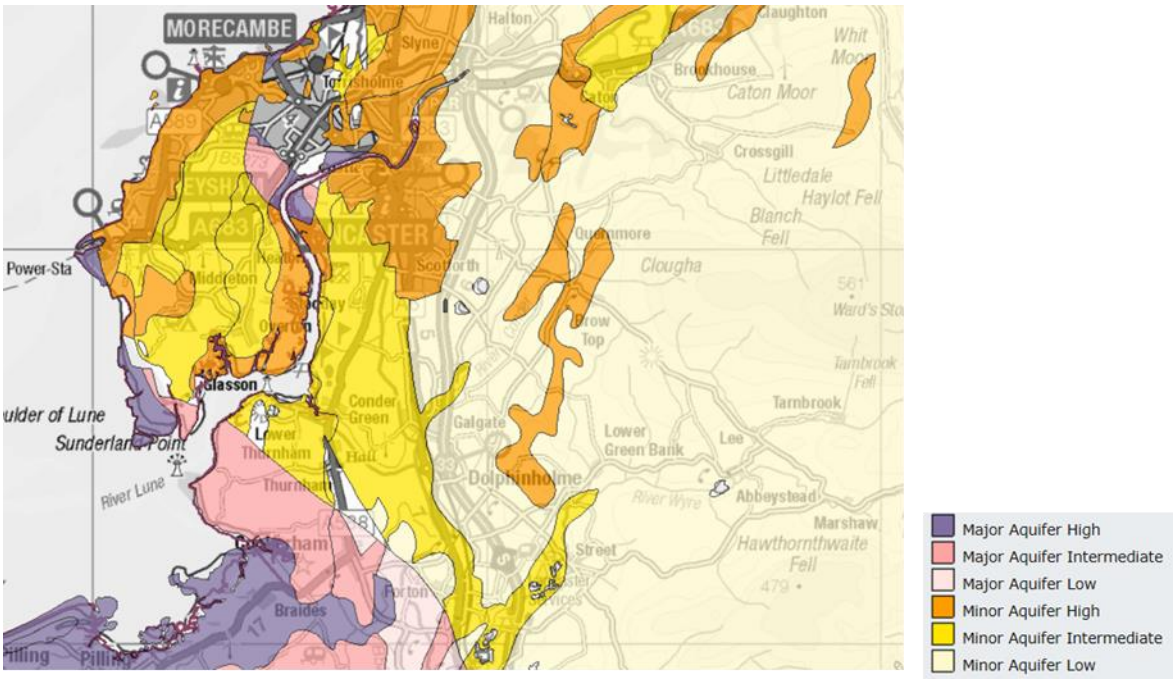


Superficial Aquifers Source: https://magic.defra.gov.uk/magicmap.aspx

10.1.20 The groundwater vulnerability map (Figure 10 5) shows that the majority of the area to the east has a designation of Minor Aquifer Low. The southern and central areas have a designation of Minor Aquifer Intermediate whilst areas to the north and along the river are classed as Minor Aquifer High.

[38] http://apps.environment-agency.gov.uk/wiyby/117020.asp

Figure 10.5 – Groundwater vulnerability ((c) Crown Copyright and database rights 2019. Ordnance Survey 100022861)



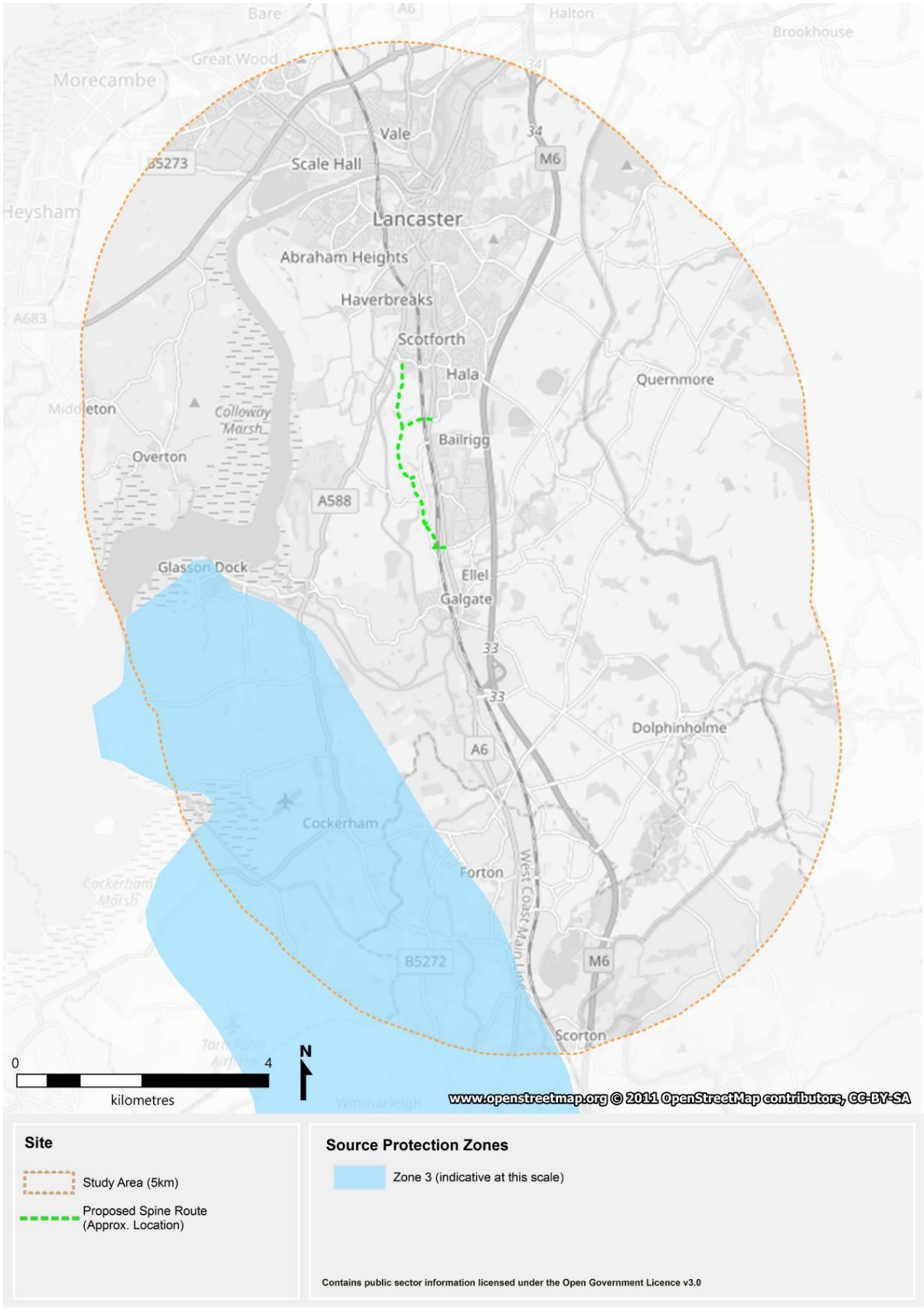
Groundwater Vulnerability Map Source: https://magic.defra.gov.uk/magicmap.aspx

10.1.21 Groundwater provides a third of drinking water in England. Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

10.1.22 The Environment Agency use the zones in conjunction with the Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

10.1.23 The 5km Study Area intersects one such ground water protection zone (Figure 10.6). This is noted as SPZ3 – Total Catchment Zone 3. This is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

Figure 10.6 - Source Protection Zones within Study Area



10.1.24 There are also a number of groundwater designations to consider as the Study Area intersects a number of bedrock aquifers (principal, Secondary A and Secondary B). Groundwater provides a third of drinking water in England. Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. New activities and Schemes that affect the water environment may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality components, leading to a deterioration in the ecological status of a water body under the Water Framework Directive. The closer the activity, the greater the risk. The Study Area intersects one ground water protection zone.

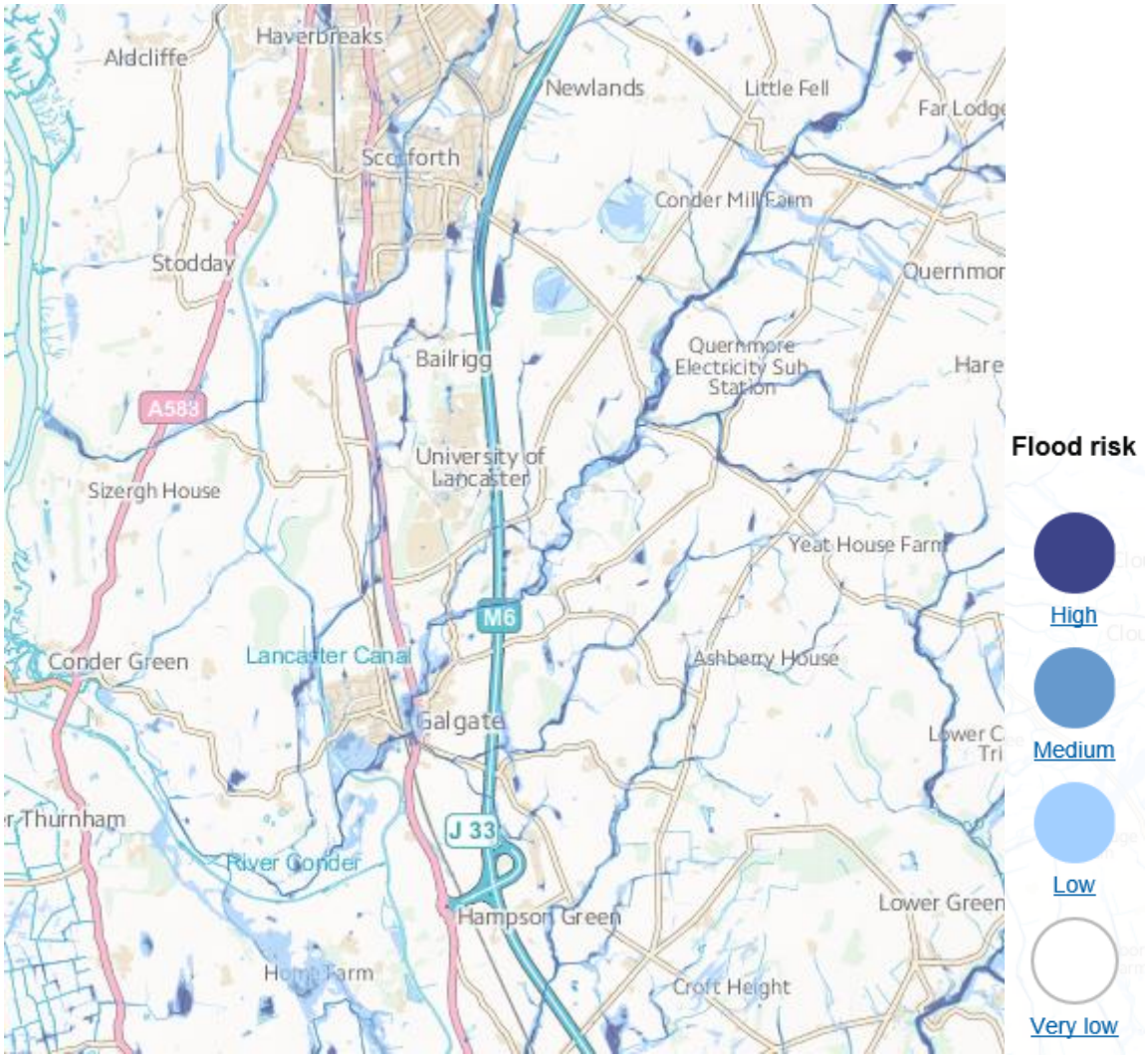
10.1.25 The primary objective of the Lancaster District Strategic Flood Risk Assessment (SFRA) is to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Development Framework (LDF). The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the District. The SFRA covers areas sat within the 5km buffer zone.

10.1.26 The River Lune poses a risk of flooding along with its tributaries, including the River Wenning, River Conder, River Hindburn, Burrow Beck and Overton Dyke. The River Keer also poses a potential risk of flooding to the area of Carnforth. These rivers and drains are far more susceptible to 'flashier' flooding as a result of localised intense rainfall. With changing climate patterns it is expected that intense storms will become increasingly common. The Lancaster Canal runs along the western edge of the River Lune catchment, with the River Conder feeding the canal through a side weir. There is a potential risk posed by a breach in the canal substructure. No reports of flooding to or from the canal have been identified.

10.1.27 The overloading of the sewer system due to inflows exceeding the underground system capacity (i.e. resulting in surcharging) is a known problem in some areas.

10.1.28 The SFRA has identified areas of zone 3b functional floodplain, zone 3a high probability and zone 2 medium probability affect areas within relatively close proximity of the river channel. These can be found along the River Lune, River Condor, Burrow Beck.

Figure 10.7 - Flood Risk from Surface Water within Study Area



10.1.29 There are no marked differences in the following:-

- surface water impacts to WFD water bodies between any of the route corridor as all of the currently reportable water bodies have the same overall, ecological and chemical WFD status.

- groundwater between any of the route corridors with similar underlying aquifers.
- WFD groundwater bodies between any of the route corridors as they are underlain by the same groundwater body.

10.1.30 The Eastern and Western route corridors have similar percentage of land within each flood zone. Central route corridor has least amount land within flood zone.

10.1.31 There is a domestic discharge in the western broad route corridor, which potentially discharges into Ou Beck.

Figure 10.8 – Areas Constrained and Less Constrained in Flooding Terms

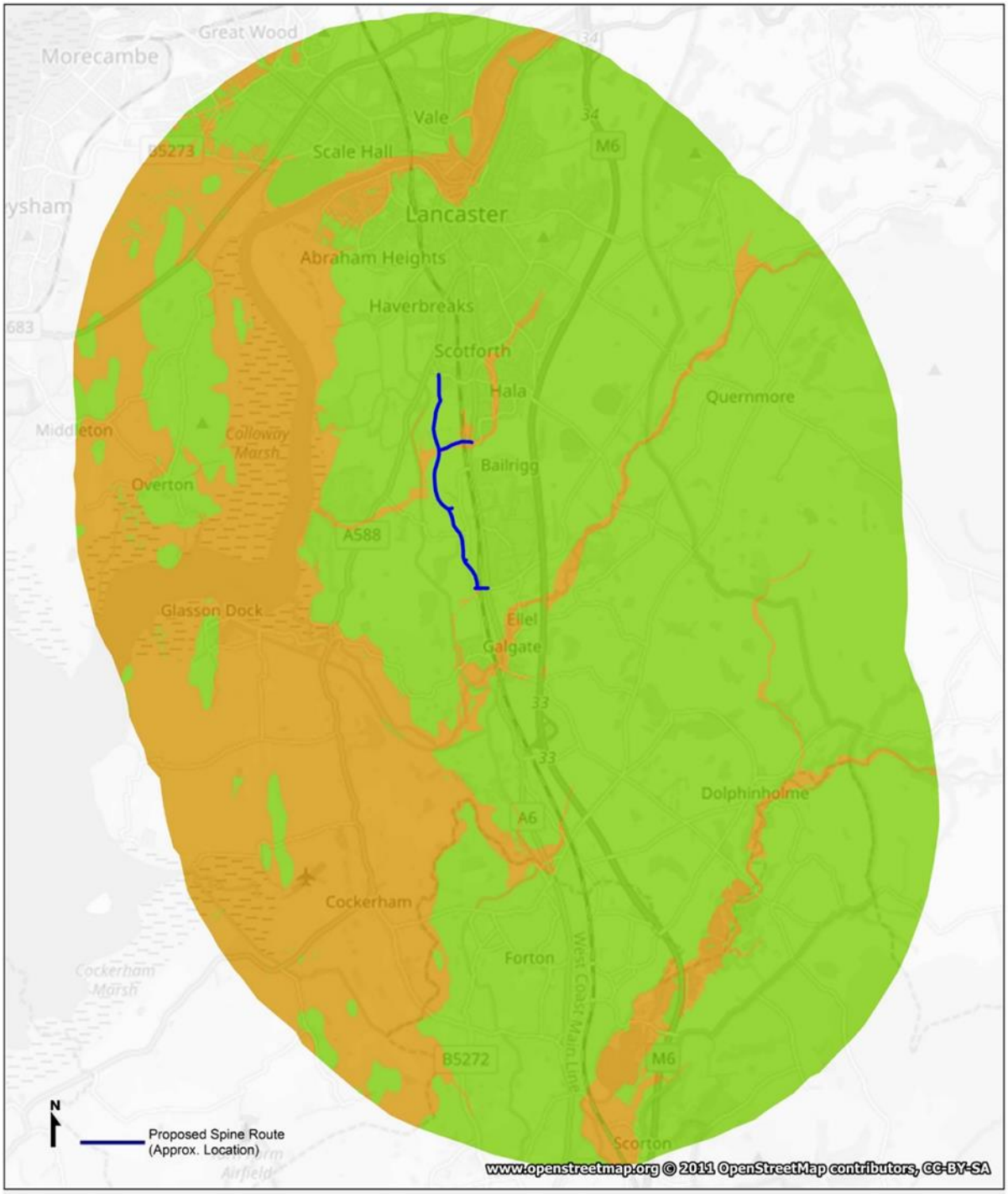


Figure 10.9 – Areas Constrained and Less Constrained in Water Environment Terms

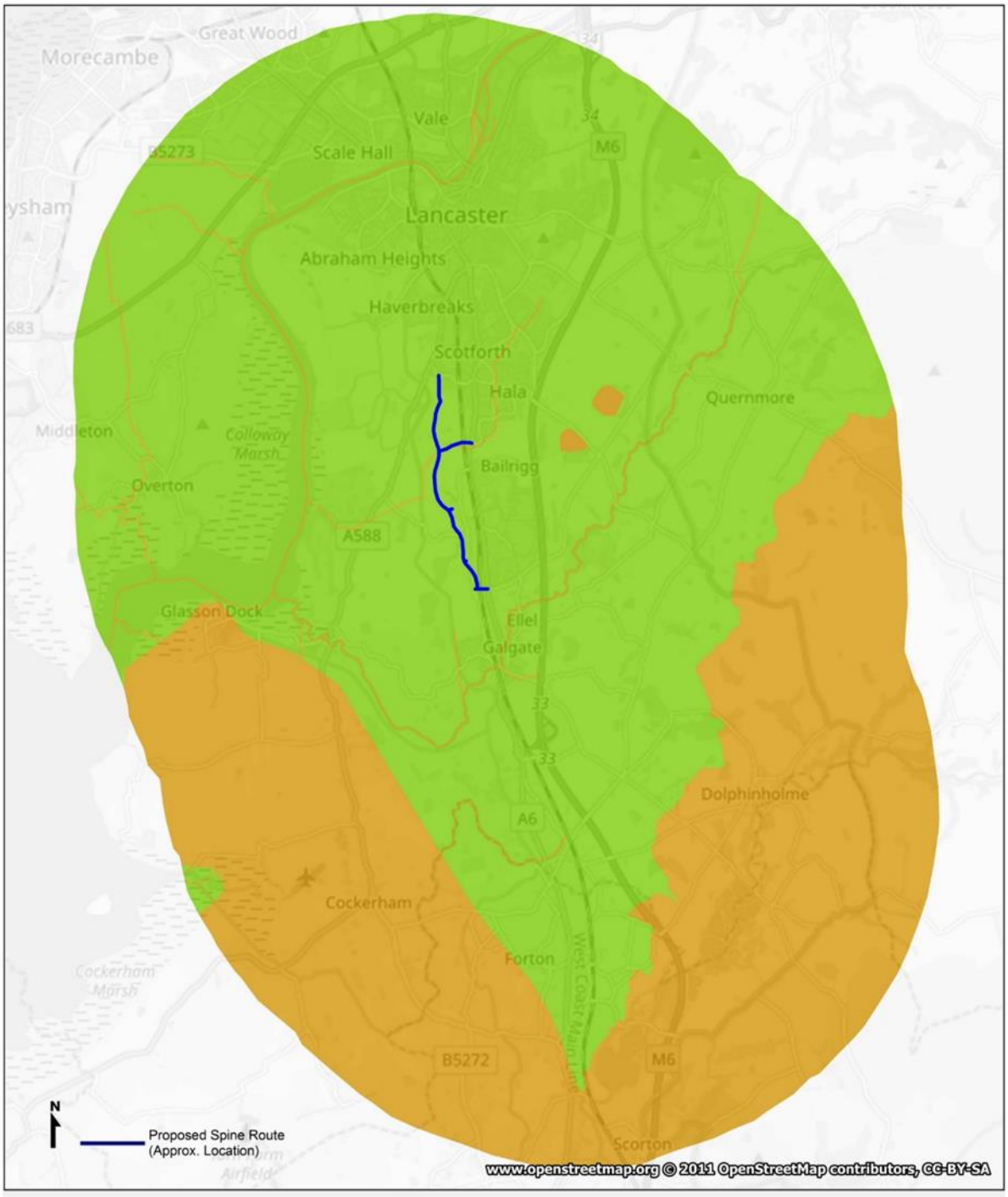


Table 10.8 - Water Resources Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 1 criteria	Outcome
Water Protect and enhance where possible, the water environment	Source Protection Zones form an important part of groundwater protection policy as they provide a significant element in the protection of public drinking water supplies. Lakes, ponds and reservoirs provide important functions within the local environment and may be valued as recreational features. They can provide ecological habitat and act as primary sources of potable water. It is therefore important to protect them and their sources/catchments.	Areas designated SPZ1 and 2 potentially excluded from further consideration
Flooding Identify areas of floodplain and avoid these where possible. If avoidance is not possible, minimise length of route through these areas.	Flooding and coastal erosion can have devastating impacts. In addition to major economic and financial cost, it can also cause major disruption to energy, water, communications and transport infrastructure. It can interfere with public services such as schools and hospitals and have significant indirect effects through disruption to travel. Flooding can also have significant impacts on the environment and on cultural heritage, including causing pollution or damage to historic buildings and changes to habitats. There are a range of measures that can be taken to reduce flood risk, or to reduce it occurring elsewhere. Examples include controlling inappropriate development to avoid increasing risk or by transferring risk to other areas where the consequences are low, for example by allowing land to flood and contain floodwater to prevent flooding elsewhere. A key element of these measures is to ensure flood plains are able to maintain their function and that flood storage in mitigation, is achieved. Areas at flood risk considers Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems. Development may be	

	necessary within floodplain, and where this is the case making it safe without increasing flood risk elsewhere is a priority. Road development will require first the application of the Sequential Test (prove that no alternative in Flood Zones 1 and 2) before developing in Flood Zone 3 and then if in Flood Zones 3a and 3b the Exception test is required. In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood. In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to: Remain operational and safe for users in times of flood; Result in no net loss of floodplain storage; Not impede water flows and not increase flood risk elsewhere. Flood Zones will not be excluded due to the requirement of further flood risk assessment and opportunities for mitigation	
Topic & Objective	**Rationale for Tier 2 criteria**	**Outcome**
Water Protect and enhance where possible, the water environment	Statutory Main Rivers are designated by the Environment Agency and generally define the larger streams and rivers but also some small watercourses of significance. Source Protection Zones form an important part of groundwater protection policy as they provide a significant element in the protection of public drinking water supplies. Drinking Water Safeguard Zones (DWSZ) are designated areas in which the use of certain substances must be carefully managed to prevent the pollution of raw water sources that are used to provide drinking water.	Areas within 10m of a statutory river to be considered only if no other option available. Areas designated SPZ 3 to considered only if no other option available. Drinking Water Safeguard Zones will be considered only if no other option available.

Flooding Identify areas of floodplain and avoid these where possible. If avoidance is not possible, minimise length of route through these areas.	Flooding and coastal erosion can have devastating impacts. In addition to major economic and financial cost, it can also cause major disruption to energy, water, communications and transport infrastructure. It can interfere with public services such as schools and hospitals and have significant indirect effects through disruption to travel. Flooding can also have significant impacts on the environment and on cultural heritage, including causing pollution or damage to historic buildings and changes to habitats. There are a range of measures that can be taken to reduce flood risk, or to reduce it occurring elsewhere. Examples include controlling inappropriate development to avoid increasing risk or by transferring risk to other areas where the consequences are low, for example by allowing land to flood and contain floodwater to prevent flooding elsewhere. A key element of these measures is to ensure flood plains are able to maintain their function. Areas at flood risk considers Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems. Development may be necessary within floodplain, and where this is the case making it safe without increasing flood risk elsewhere is a priority. However, it is recognised that where uptake of land within a Flood Zone is proposed, commensurate flood storage capacity must be integrated in mitigation. As a result, it is considered favourable to minimise the area of land uptake within a flood zone	Areas within floodplain to be considered further only if no other option available. Route length to be minimised in such areas.

11 Landscape

National Character Areas

11.1.1 In landscape terms England is separated into natural subdivisions based on a combination of landscape, biodiversity, geodiversity and economic activity. These National Character Areas are areas that share similar landscape characteristics, and which follow natural lines in the landscape rather than administrative boundaries and it is considered that this makes them a good decision-making framework for the natural environment. The Study Area falls into two NCA's as follows:

- No. 31 Morecambe Coast and Lune Estuary (the Study Area to the west of the M6 motorway); and
- No. 33 Bowland Fringes and Pendle Hill (the Study Area to the east of the M6 motorway).

No. 31 Morecambe Coast and Lune Estuary

11.1.2 The Morecambe Coast and Lune Estuary is described as a relatively small and low-lying NCA bordering Morecambe Bay. It includes areas of high population in the towns of Heysham and Morecambe and the City of Lancaster, but also encompasses areas of high tranquillity, particularly around the Lune Estuary and westwards along the Pilling Coast. Its distinctive identity is strongly linked to the coastal environment along its margin with Morecambe Bay, and inland through the estuaries of the Lune and the Keer. It is to be noted that this NCA includes part of one AONB; the Arnside and Silverdale AONB, though this AONB is outside the Study Area.

11.1.3 The landscape of the NCA has notable coastal and urban areas. These urban and suburban landscapes are associated with the development of Lancaster as the (former) administrative capital of Lancashire; the seaside resort of

Morecambe; and the port and the power station at Heysham, the latter with a connecting infrastructure of power lines.

11.1.4 As part of this NCAs urban and suburban development transport links are a key landscape feature within the Study Area, with Lancaster Canal being the earliest major link, the first parts of which were built in the 1790s. The canal was superseded by the railway in the 1840s but the route established for the canal is now followed by both the rail and road networks, most notably the West Coast Mainline and the M6 motorway which opened in 1968.

11.1.5 Away from the coast and urban areas, the landscape is mainly one of pastoral agriculture, including dairy, which varies in character from reclaimed grasslands bounded by wet ditches in the lowest-lying areas to a hedged landscape including frequent boundary trees as the land begins to rise. Towards the boundary with the adjacent upland NCAs, and where drumlins are present providing abundant field stone, stone walls start to predominate. To the north and east the NCA is framed by areas of higher ground, including the Lake District Fells and Bowland Fells.

11.1.6 Among the key characteristics of this NCA which are relevant to the Study Area are:

- Broad and relatively flat lowlands enclosed by escarpments which open out dramatically into the undulating landscape of the coastal strip with substantial drumlin features;
- The sheltered expanse of the Lune Estuary with its salt marshes and tidal channels overlooked by low ridges on the Heysham peninsula and around Lancaster;
- Range of coastal landscape features including extensive salt marshes backing extensive sand and mud flats, particularly around the Lune Estuary; reclaimed mosses and marshland;

- Intensively managed pastoral landscape bounded by ditches in the lowest-lying reclaimed areas, hedges with mature trees in low-lying areas and grading into stone walls on drumlin fields and upland foot slopes with limited extent of semi-natural habitats away from the coastal strip;

- Low woodland cover throughout with woodland largely restricted to the sides of the Lune Valley on the boundary of the NCA and small copses on farmland;

- The cathedral city of Lancaster, which was mainly built from Millstone Grit sandstone, the city overlooks a former fording point at the head of the Lune Estuary with a castle, cathedral, neo-Georgian town hall, canal and Victorian parks;

- Rural architecture, including farmsteads, that mostly results from rebuilding in brick and stone in the late 18th and 19th centuries, with fragments of earlier timber frame, sandstone, Millstone Grit and earth constructions, with fields subject to high levels of boundary change since the mid-19th century; and

- Traversed north–south by the west coast transport network including the M6, the West Coast Main Line railway and the Lancaster Canal, which pass between the Bowland Fells and Morecambe Bay. These are significant features within the Study Area.

11.1.7 The key opportunities reflect the importance of the coastal zone, including its sense of place and recreation. There are opportunities presented by the juxtaposition of areas of urban development with a coastal zone of exceptional quality. The key environmental opportunities include:

- Maintain and enhance the historic and landscape character of the coastal environment, including the mudflats, salt marsh, sand dunes, vegetated shingle and the Lune Estuary, to support its key features, and reflect the dynamic nature of the coastal systems;

- Enhance the mainly pastoral, rural landscape; and
- Enhance the historic character of the rural landscape.

11.1.8 Its sense of place is of local value and is provided by distinctive, broad, flat lowlands enclosed by higher land and steeply sloping, often wooded escarpments to the north and east opening out to a coastal, undulating landscape dominated by the presence of drumlins, the dynamic coastal environment with constantly changing views governed by the tide.

No.33 Bowland Fringe and Pendle Hill

11.1.9 The Bowland Fringe and Pendle Hill NCA is described as a transitional landscape that wraps around the dramatic upland core of the Bowland Fells, underpinned by Carboniferous geology. Over half of this NCA, along with the Bowland Fells, makes up the Forest of Bowland Area of Outstanding Natural Beauty, which extends into the Study Area. This is a diverse landscape of herb rich hay meadows, lush pastures, broadleaved woodland, parkland and waterbodies. The numerous river valleys and associated woodlands are a major component of the area.

11.1.10 The influence of human habitation and activity, and the area's long farming history, contribute significantly to its character. In contrast to the predominantly rural feel of the area, this NCA includes several relatively urban areas including Clitheroe, Bentham and Longridge, though none of these areas are within the Study Area. The road network is typified by a complex system of narrow lanes, with few direct routes between settlements. The railway, canal and M6 form the major north–south links in Lancashire, and are confined to a narrow corridor within the eastern boundary of the Morecambe Coast and Lune Estuary NCA, which in turn defines the western boundary of this NCA. It is also noted that while lying just beyond the boundary of the NCA, the major conurbation of Lancaster to the west, exerts an influence over the area, through visits for recreational activities, tourism and commerce.

11.1.11 This is an intimate, tamed landscape in contrast to the wild, exposed moorland of the Bowland Fells. The combination of well-maintained hedgerows and hedgerow trees, areas of parkland and well-grazed pasture, gives this area a managed character.

11.1.12 Among the key characteristics of this NCA which are relevant to the Study Area are:

- This is an undulating, rolling landscape, with local variation created by numerous river valleys and by the moorland outliers of Beacon Fell, Longridge Fell and Pendle Hill;
- On the northern edge of the area, drumlins are characteristic;
- Semi-natural woodland, much of which is ancient, occurs in the main valley bottoms, side valleys and ridges, and is dominated by oak, ash and alder;
- Small to medium-sized fields are defined by hedgerows with mature hedgerow trees. Drystone walls are also common in some areas. Metal railings around estate boundaries and highway corners and junctions are characteristic of the southern and western edges of the NCA;
- Land use is mainly permanent, improved pasture for livestock and dairy farming;
- There are numerous rivers as well as many brooks and small reservoirs;
- A network of winding, hedge-lined lanes connect small, often linear, villages, hamlets and scattered farmsteads, mostly in local stone. Traditional stone barns are commonplace on higher ground and are of stone with slate or stone flag roofs; and
- Isolated country houses set in formal parkland are typical of the area and may be enclosed by belts of woodland and estate fencing.

11.1.13 This NCA faces the challenge of managing substantial pressures to accommodate urban expansion around the major centres of population (including Lancaster which is in the Study Area) and recreational destinations, while maintaining and protecting its valuable assets.

11.1.14 A priority for the area is the protection of its rich and distinct landscapes, including the substantial extent of seminatural woodland, tree-fringed rivers, species-rich hay meadows, and irregular field patterns defined by well-maintained hedgerows and hedgerow trees. To protect the rural quality of the open countryside, it is essential to control and manage the development of the urban fringe. The key environmental opportunities include:

- Protect and enhance the distinctive landscape character of the Bowland Fringe and Pendle Hill NCA for its sense of place, historical and cultural heritage, tranquillity, accessibility and recreational opportunities; and
- Manage and enhance the landscape character of the farmed environment, with its mosaic of pastures and meadows, and strong field patterns defined by drystone walls and hedgerows, to strengthen landscape character.

11.1.15 Its sense of place is of National value and is provided by the undulating, rolling landscape which skirts the edge of the Bowland Fells forming a dramatic backdrop. There are sharp variations in the local landscape resulting from the river valleys and numerous small hills/moorland. This area has a strong and distinctive landscape character and over half (38,175 ha) of the NCA falls within the Forest of Bowland AONB.

Lancashire Landscape Character Assessment

11.1.16 The Lancashire Landscape Character Assessment also presents a county-wide classification of landscape character.

11.1.17 There are 13 LCTs which predominately make up the 5km study area, but 3 of these are urban LCTs (Suburban; Historic; and Industrial Age) and are therefore as previously mentioned not included in the Landscape Strategy.

11.1.18 Within the LLCA the Study Area is within Landscape Character type 12: 'Low Coastal Drumlins', Type 5i 'West Bowland Fringes'. Sub Areas to these LLCA include:

- Sub Area: Carnforth – Galgate – Cockerham; and,
- Sub Area – Undulating Low Land Farmland.

11.1.19 The LCTs of relevance to the study area which are contained within the Landscape Strategy are summarised below.

Table 11.1 - Lancashire Landscape Character Areas

Landscape Character Area	Key characteristics appropriate to the Study Area
2b Central Bowland Fells	This LCA just borders the Study Area to the east. This distinctive landscape character is defined by land above the limit of enclosed farmland occurring on the central massif of the Bowland Fells. It encompasses the smooth heather clad profiles of the escarpment slopes on the western limit of the fells. There are few intrusive elements in this landscape.
4d Bowland Gritstone Fringes	A small section of this LCA can be found within the Study Area to the east. The western edges of the Central Bowland Fells are marginal farmed landscapes in the narrow, steep transitional zone between upland unenclosed moorland and the lower wooded fringes of the Lancashire Plain to the west. It is highly rural, unaffected by exploitation of resources, and sparsely populated; isolated farm dwellings at the end of dead-end tracks are built of distinctive, dark local gritstone. Rough pasture, low growing gorse, bramble and small windswept hawthorns add to the texture and exposed character of the gritstone fringes.
5i West Bowland Fringes	A transitional landscape between the gritstone scarps of the Bowland Fells and the coastal plain of Amounderness. A fault line provides a corridor along which the motorway, road and railway run and provides a transition to the agricultural plain. However, this transition is softened by glacial deposits, for example at Galgate where the lowland farmland merges imperceptibly with the low drumlin fields.

	However, at Quernmore, there is a dramatic wooded ridge (7c) which forms a definite boundary between the grit lowland fell edges and the adjacent glacial landscape to the west. The Wyre valley is relatively dramatic, descending from the fells in a deeply incised wooded valley.
7c Langthwaite Ridge	This gritstone outcrop forms a prominent rounded ridge which forms a southern extension to the Docker-Kellet-Lancaster Drumlin Field. It separates the city of Lancaster and developed coastal drumlin landscape from the rural landscapes of the Bowland Fells. It is distinguished from the adjacent drumlin field by its smooth rounded form. It is typical of a farmed ridge with a rich mosaic of pasture, woodland and parkland. It provides suitable location for reservoirs and communication masts which stand out against the skyline. Mixed woodlands are a feature of this area, associated with the Quernmore estate and the reservoirs. The largest block is Knots Wood, managed by Forest Enterprise.
10a Wyre Valley	The Wyre Valley, which descends the western flanks of the Bowland Fells starting at the Trough of Bowland, is particularly characteristic of this landscape type. Downstream the result of man's influence begins to affect the character of the landscape. The historic textile village of Dolphinholme clusters in the valley bottom and there is a series of weirs along the course of the river, the first controlling water flows at the Abbeystead reservoir. Further downstream a series of open lakes (resulting from gravel extraction) has produced a unique mosaic of open water and woodland which, although picturesque, is alien to the natural environment. There are many public footpaths and lanes in the area providing access to the valley and potential threats to its seclusion and rural character. Further downstream the M6, mainline railway and parking, picnic and camping sites have eroded the secluded character of the valley.
12a Carnforth-Galgate-Cockerham	The Low Coastal Drumlins, on or near which Lancaster is built, extend along the coast behind Morecambe Bay from Cockerham in the south to Carnforth in the north. This landscape supports an extremely high proportion of built development including the large Settlement of Lancaster and recent built development along the A6. The Low Coastal Drumlins provide a convenient transport corridor; the Lancaster Canal, M6, A6 and mainline railway run side-by-side in a north-south orientation. The canal, which weaves through the drumlins, is an important reminder of the area's industrial heritage; a branch emerges into the Lune at Glasson Dock. To the west of Cockerham settlement is sparse and dominated by scattered large scale farmsteads in contrast to the towns and large villages further north. Fields are largely of post medieval pattern, however there are areas of older enclosure and settlement, notably at Cockersand Abbey.
12c Heysham-Overton	It is a pastoral landscape with flat areas of reclaimed land where grazing is rougher and rushes mark the course of drainage channels. Hedgerows form field boundaries but there are few trees; those which exist are found sheltering the large stone built farmsteads on the low drumlin forms which protrude from the plain. Other built development, including villages and industrial development, is also restricted to the

	higher land and pressure for holiday accommodation has resulted in a number of static caravan parks which have become a feature of the landscape.
13c Docker-Kellet-Lancaster	This drumlin field has a distinctive north-east, south-west grain and runs from the edge of Lancaster northwards into Cumbria. The area is underlain by limestone and is distinguished by large scale undulating hills of pasture. The smooth rolling scenery is emphasised by the network of stone walls. Woodlands are often associated with designed landscapes. The drumlins create a setting for the city of Lancaster and its university.
15e Forton-Garstang-Catterall	This area of lowland farmland forms a transition between the fringes of the Bowland Fells. A geological fault runs along the eastern boundary of the area and, although the motorway and railway broadly follow this line, the transition between the Millstone Grits to the east and the sandstones to the west is masked by glacial deposits and river alluvial fans which produce a gently undulating landscape. The area is a rural farmed landscape dominated by improved pasture and scattered with historic halls, farms and woodland. A network of lanes link the villages of Cockerham and Forton, although the A6 provides a fast route along the length of the character area. This area is affected by urban fringe activities such as golf courses, hotels and schools which have eroded the rural character of the landscape.
16a North Fylde Mosses	This landscape character area, located within the Fylde, including Cockerham Moss. The reclaimed moss is devoid of development, but the low islands surrounding the moss support a network of minor lanes and modern houses. Dead end raised tracks run from the farmsteads into the moss, where the dominant land use is improved pasture for dairy herds. The principal building material is red brick and modern styles and materials are common. The fields are large and some shelter belts of Scot's pine and beech together with occasional birch copses on dried out peat, give a sense of a well wooded horizon. Raised roads are hedged and bordered by ditches.
16f Heysham Moss	Located between the built up areas of Lancaster to the east and Heysham to the west only a small part of Heysham Moss is now uncultivated. It is largely a pastoral landscape where fields are drained by straight ditches and divided by post and wire fencing, resulting an open and expansive landscape. The A683 between Lancaster and Heysham also crosses the moss, bringing traffic movement into the open landscape. The proximity of the city of Lancaster influences the character of the mossland in the north of the character area where trading estates, residential estates and caravan parks spill out onto the mosslands, obscuring the landscape pattern and eroding the rural nature of the landscape.
18d Lune Marshes	The sheltered mouth of the Lune Estuary supports an extensive saltmarsh which stretches almost into the centre of Lancaster and provides a dramatic contrast to the built environment of the city and its industrial edges. There are a number of footpaths, nature trails, cycle routes and viewpoints alongside the marsh which ensures that the area is well visited and highly visible. This, along with the area's proximity to the centre of Lancaster means the Lune Marshes are

	under pressure from visitors and from development. This is evident from the reclamation of the marshes immediately downstream of Lancaster.
18e Pilling and Cockerham Marshes	The intertidal salt marsh and sands of Cockerham form the southern bank of the Lune Estuary. The more sheltered eastern end of the character area is more typical of a salt marsh landscape.

Forest of Bowland AONB

11.1.20 A major landscape designation which partly falls within the 5 km Study Area is the Forest of Bowland Area of Outstanding Natural Beauty. The part of the Study Area within the AONB is shown on Figure 11.1. This area is considered to be one of England's finest landscapes and is internationally important area for its heather moorland, blanket bog and rare upland birds.

11.1.21 The Forest of Bowland AONB long term vision states 'The Forest of Bowland landscape retains its sense of local distinctiveness, notably the wide open moorland character of the Bowland Fells, undulating lowland farmland, clough woodlands, traditional buildings and the settlement patterns of its villages, hamlets and farmsteads… The Forest of Bowland is a truly outstanding landscape, where it can clearly be demonstrated that the management of the AONB has conserved and enhanced the quality, understanding and enjoyment of the landscape for all.' The objectives and actions applicable to the AONB in the Study Area are as follows.

Table 11.2 - Forest of Bowland AONB Management Plan objectives and actions

Objective	Action
1.1 Landscape Apply the guiding principles of the European Landscape Convention, using landscape characterisation as the basis for policy- and decision-making for land and development management, to conserve and enhance natural beauty of the landscape	1.1A Provide landscape planning advice and guidance for local planning authorities, highway authorities, government agencies, local communities and developers based on the Forest of Bowland AONB Landscape Character Assessment 2009
	1.1B Influence planning and development policy-making at a local, county and

	national level by responding to consultations for relevant plans and strategies, e.g. neighbourhood plans, local plans and national planning policy guidance
	1.1C Carry out a 'refresh' of the AONB Landscape Character Assessment, focusing on new and emerging forces for change affecting the AONB.
	1.1D Develop and review bespoke policy statements and guidance on current landscape planning issues affecting the AONB landscape
	1.1E Develop an AONB Woodland Strategy to conserve and enhance existing woodlands

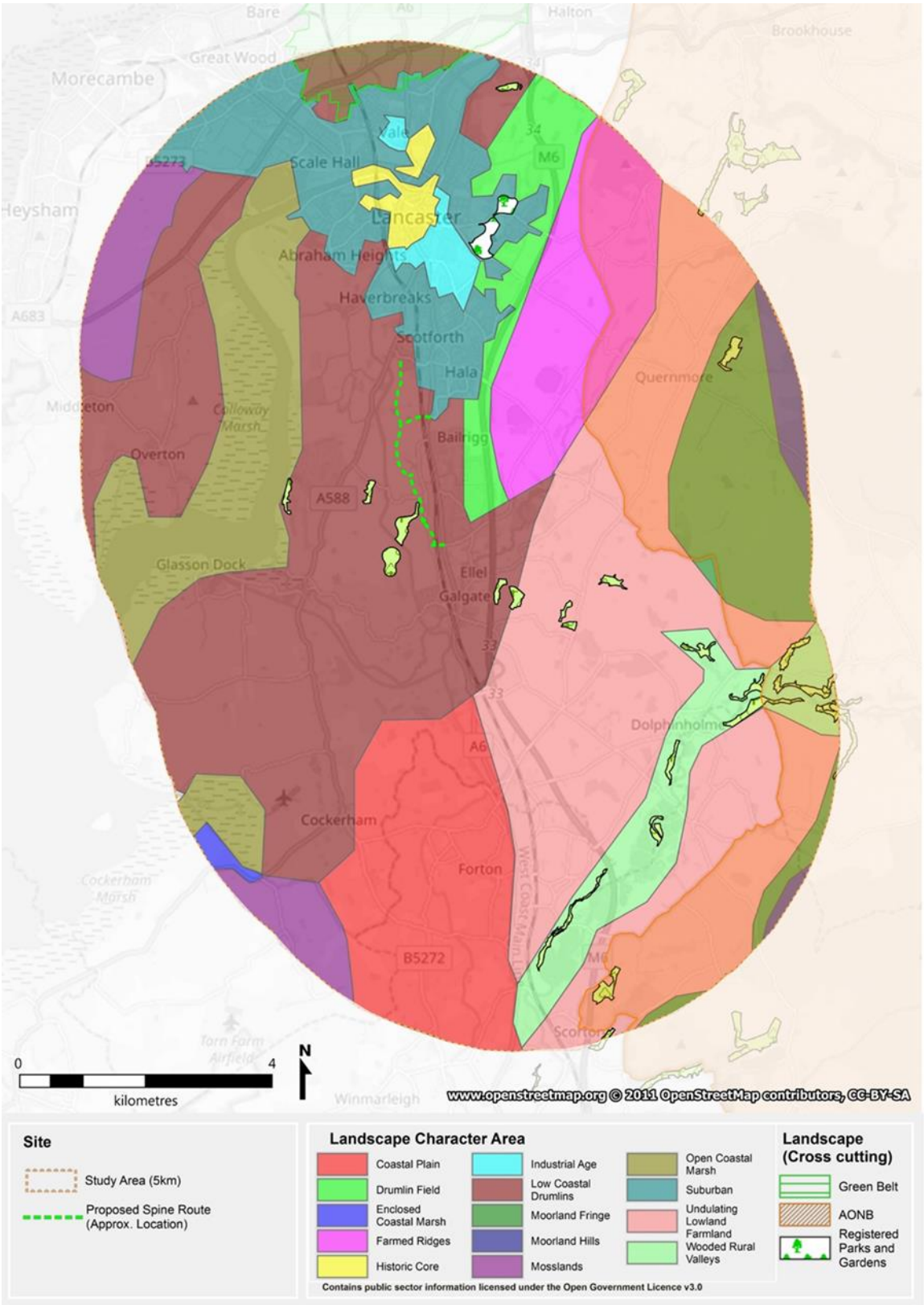
11.1.22 In 2009, the Forest of Bowland AONB commissioned a detailed landscape character assessment of the AONB. The overall study consists of two principal sections dealing with landscape classification and managing landscape change respectively. The landscape character assessment also provides analysis on the landscape sensitivity and its capacity to accommodate change, alongside guidelines for planners, developers, land managers and others on managing landscape change, within each of the landscape character types of the AONB.

Table 11.3 – Forest of Bowland AONB Landscape Character Types and Areas

Landscape Character Type and Area	Key characteristics appropriate to the Study Area
LCT - E: Undulating Lowland Farmland	• Many mixed farm woodlands, copses and hedgerow trees; • Intricate tapestry of grazed fields; and • A patchwork of wood and pasture when viewed from the fells.
LCA - E2: Quernmore	• Distinctive pattern of low drystone walls (several of which contain smooth boulders) cross the patchwork of pastoral fields; • A patchwork of pastoral fields, interspersed with patches of coniferous and mixed woodland and occasional single deciduous field trees;

	• Landscape is crossed by a network of minor roads which are often lined with stone walls, and occasional hedgerows (which include a mix of beech, hawthorn and holly); • Beech hedgerows are also a striking feature in places; and • The M6 introduces a source of noise and movement.
LCT – N: Farmed Ridges	• Mosaic of mixed farmland and woodland forms a textural backdrop to the surrounding lowlands; • Low stone walls often delineate field boundaries; • Settlement pattern of isolated stone farmsteads; and • Rounded ridge profiles of the gritstone outcrops.
LCA – N1: Quernmore	• Dense, mixed woodland on the top of the ridge provides a strong sense of enclosure and limits views across the area; • Quernmore Park Hall estate, with its estate gates and parkland trees is a key landscape feature which contributes to recognisable sense of place; • Distinctive landscape pattern of mixed woodland and pastoral farmland, predominantly delineated by stone walls; and • Minor road corridors are often lined with trimmed hedgerows.

Figure 11.1 – Landscape Character Areas



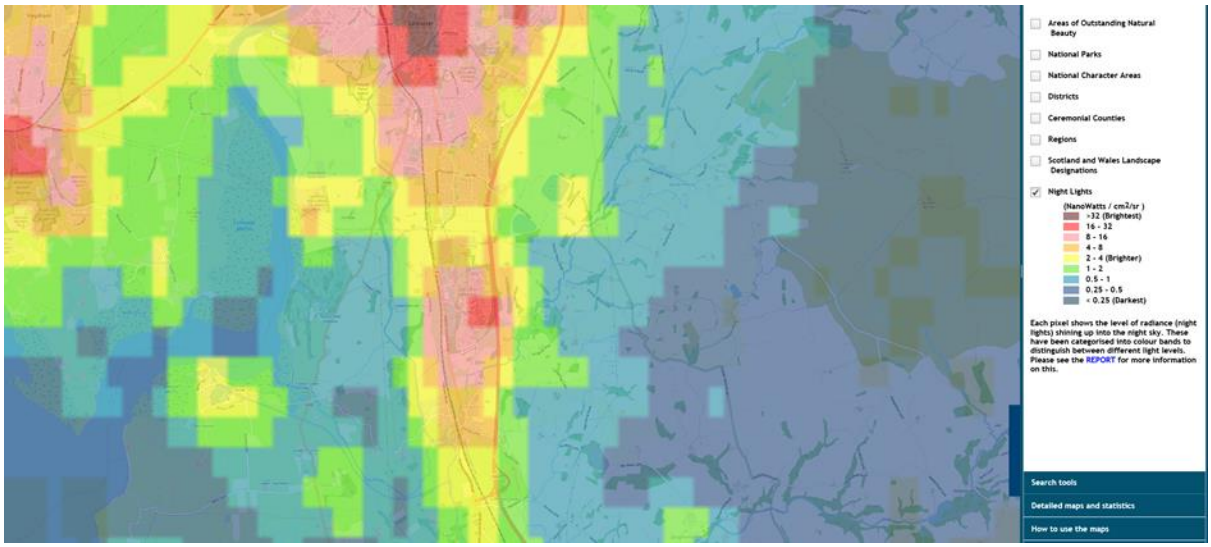
Loss of Tranquillity

11.1.23 Loss of tranquillity can be a major issue in certain, usually rural, areas and can also have a negative impact on the setting of cultural heritage assets. This was documented in a 1991 map (revised 2007) produced by the Campaign to Protect Rural England (CPRE) - it is considered this map is still appropriate. The mapping confirms tranquillity is reduced around the towns and roads with areas of red having the lowest tranquillity scores and green the highest.

11.1.24 It is evident from the map through 'hotspots' around Bailrigg, Lancaster, Morecambe and to a lesser extent Middleton and Galgate that these locations represent areas of reduced tranquillity in addition to a general trend of reduced tranquillity along the M6 motorway.

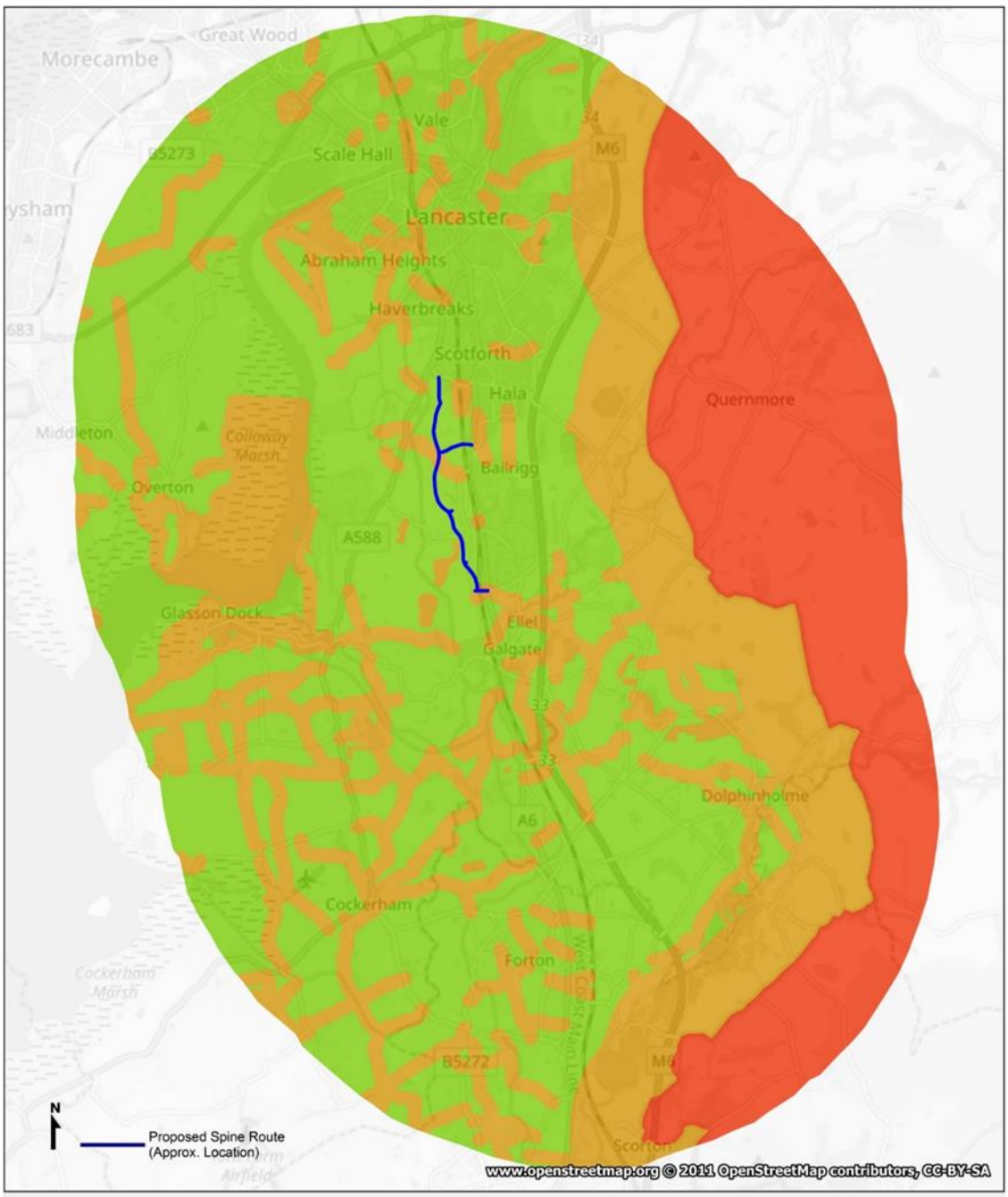
11.1.25 Areas of marshland such as 'Colloway marsh' in the west and the Forest of Bowland AONB to the east stand out as areas of increased tranquillity within the Study Area. This overview can be seen utilising an Interactive Map Viewer produced by CPRE, which shows light pollution and dark skies and a screenshot of which is provided below to illustrate.

Figure 11.2 - Light Pollution and Dark Skies



Source: Screenshot of Study Area from CPRE Interactive Map Viewer

Figure 11.3 - Areas Sensitive to Development in Landscape Terms



Landscape

Tier 1 Areas

Tier 2 Areas

Less Constrained Areas

Relevant source datasets:
- AONB;
- Community Rights of Way;
- Public Rights of Way;
- Registered Parks and Gardens; and
- Woodland and Forest.

11.1.26 The Eastern route options is not within the Forest of Bowland AONB. However, the setting for the AONB (as defined by its character areas) extends to cover the majority of the Eastern route options. The Central route options northern part from Langshaw Lane until Hazelrigg Lane is within the setting of Forest of Bowland AONB.

11.1.27 By virtue of the landscape character of the AONB and its setting the landscape character is more sensitive across the Eastern route options than it is across the other route options. The Western route options are more heavily influenced by the appreciable built development within the surrounding area which combines with the transport corridor (M6, major A roads, mainline railway and canal) to reduce its sensitivity.

11.1.28 All routes options are within open countryside. All route options accommodate a number of watercourses and areas of woodland. The Western route options and Central 2 route option contains two notable Ancient Woods (Park Coppice and Old Park Wood), which are most likely associated with parkland. Another notable feature, which crosses the Western route options and Central 2 route option, is the Lancaster Canal.

11.1.29 There is a designated viewpoint at Jubilee Tower within the Forest of Bowland AONB which has long distance views into and across the all route options.

11.1.30 All route options contain a network of public rights of ways (PRoW) and long distance paths, but the Eastern route options does contain more and a greater length. It is also important to stress that the Eastern route options is largely within the setting to the Forest of Bowland AONB and at its closest, it is within approximately 780m of the boundary. As such, it is likely that a new road in the Eastern route options would likely have significant adverse landscape and visual effects on the area that forms part of the setting to the Forest of Bowland AONB and potentially to the designated area itself. Future consideration of a road in this area would also need to recognise the potential for infill development / further development along the line of the road.

Table 11.4 – Landscape Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 1 criteria	Outcome
Landscape	An area of outstanding natural beauty (AONB) is land protected by the Countryside and Rights of Way Act 2000 (CROW Act). It protects the land to conserve and enhance its natural beauty. Under the CROW Act, the relevant local authority, must make sure that all decisions have regard for the purpose of conserving and enhancing the natural beauty of areas designated as AONB. Decisions and activities must consider the potential effect it will have within the AONB and land outside its boundary.	Areas within an AONB are potentially excluded from further consideration.
Topic & Objective	**Rationale for Tier 2 criteria**	**Outcome**
Landscape	It is recognised that the surrounding areas to an AONB form an important part in the AONBs wider setting. Care should be taken to ensure that no development is permitted outside AONB which would damage their natural beauty[39].	Areas that will impact on features important to landscape such as woodland, parks, green spaces, CRoW (100m) and PRoW (50m) will be considered further only if no other option available Areas within 1km of AONB will be considered further only if no other option is available.

[39] http://www.ccwwdaonb.org.uk/uploads/docs/Planning/Pos3_Relevance.pdf

12 Cultural Heritage

12.1.1 The Study Area is situated in the Lancashire-12 area and built heritage features in this wider area which encompasses wards from 'Lancaster' in the north and 'West Lancashire' in the south, and from 'Pendle' to the east to 'Fylde' to the west.

12.1.2 Lancashire county and Lancaster City have a long and important heritage, which is reflected in the range of cultural heritage assets identified. Many of these are of national or international importance and are recognised with appropriate designation.

12.1.3 Within the Study Area are:

- 511 listed buildings (7 Grade I, 473 grade II and 31 Grade II*)
- 6 Scheduled Monuments
- 2 Registered Parks & Gardens
- 11 Conservation Areas

12.1.4 Other features of note within the Study Area include Galgate viaduct and Lancaster Canal.

12.1.5 It is noteworthy that the nature of cultural heritage features means that not all are known at present, such features may include buried archaeological remains.

12.1.6 A total of six scheduled monuments have been identified within the Study Area and a brief summary of their significance is noted in Table 12-1.

Table 12.1 - Scheduled monuments within the 5km Study Area

NHLE number	Asset Name
1010794	Castle Hill motte, Dolphinholme
41031	Glasson Dock
1020456	Glass melting and annealing workshop (part of Shrigley and Hunt's glass manufacturing workshops)
42864	Roman kilns (25yrds (20m) NE of Fairyhill Cottage)
1020668	Part of a Roman fort (and its associated vicus and remains of a pre-Conquest monastery and a Benedictine priory on Castle Hill)
41364	Skelton Bridge

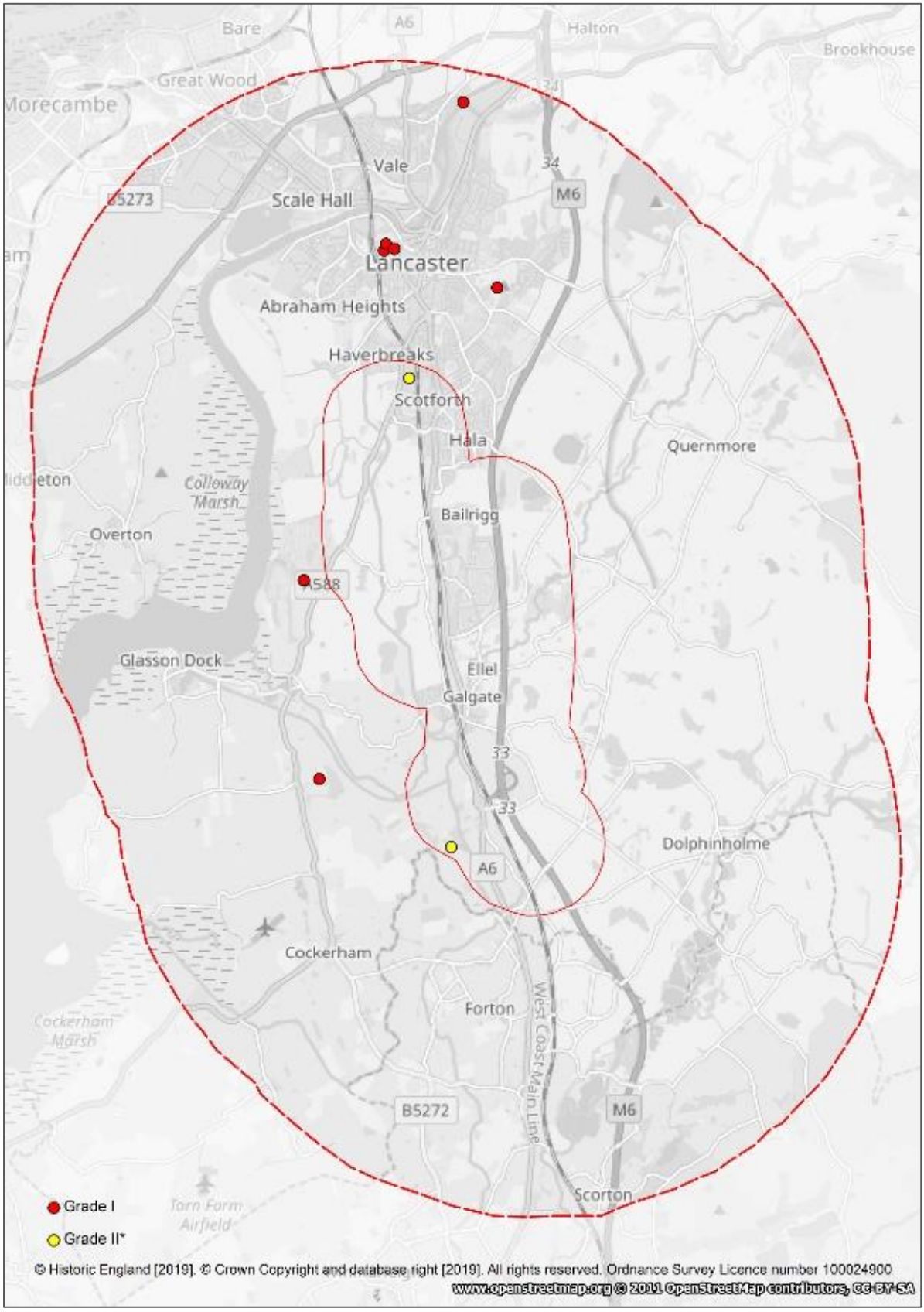
12.1.7 A total of 511 listed buildings are present within 5km Study Area. Areas of greatest density are evident in the historic core of Lancaster and to a lesser extent villages and hamlets of Galgate, Forton, Scorton and Dolphinholme. Of note, many of the bridges and structures associated with the Lancaster Canal, which runs along the centre of the Study Area from south to north, are also listed.

Table 12.2 – Grade I listed buildings within the 5km Study Area

NHLE number	Asset Name
1288429	Ashton Memorial
1362451	Lancaster Canal Lune Aqueduct
1194905	Lancaster Castle
1195068	Priory and Parish Church of St Mary
1298414	The Judges' Lodgings and associated structures
1071756	Ashton Hall
1317674	Thurnham Hall

12.1.8 Grade I and grade II* listed buildings have been mapped in Figure 12.1. Five of the grade I listed buildings are located within the Lancaster City area, in the northern part of the Study Area. Only Ashton and Thurnham Halls lie outside the city area. These are situated 2.6km north west and 2km south west of the village of Galgate respectively, west of the M6 and A6 roads.

Figure 12.1 - Grade I and grade II* listed buildings within the 5km Study Area

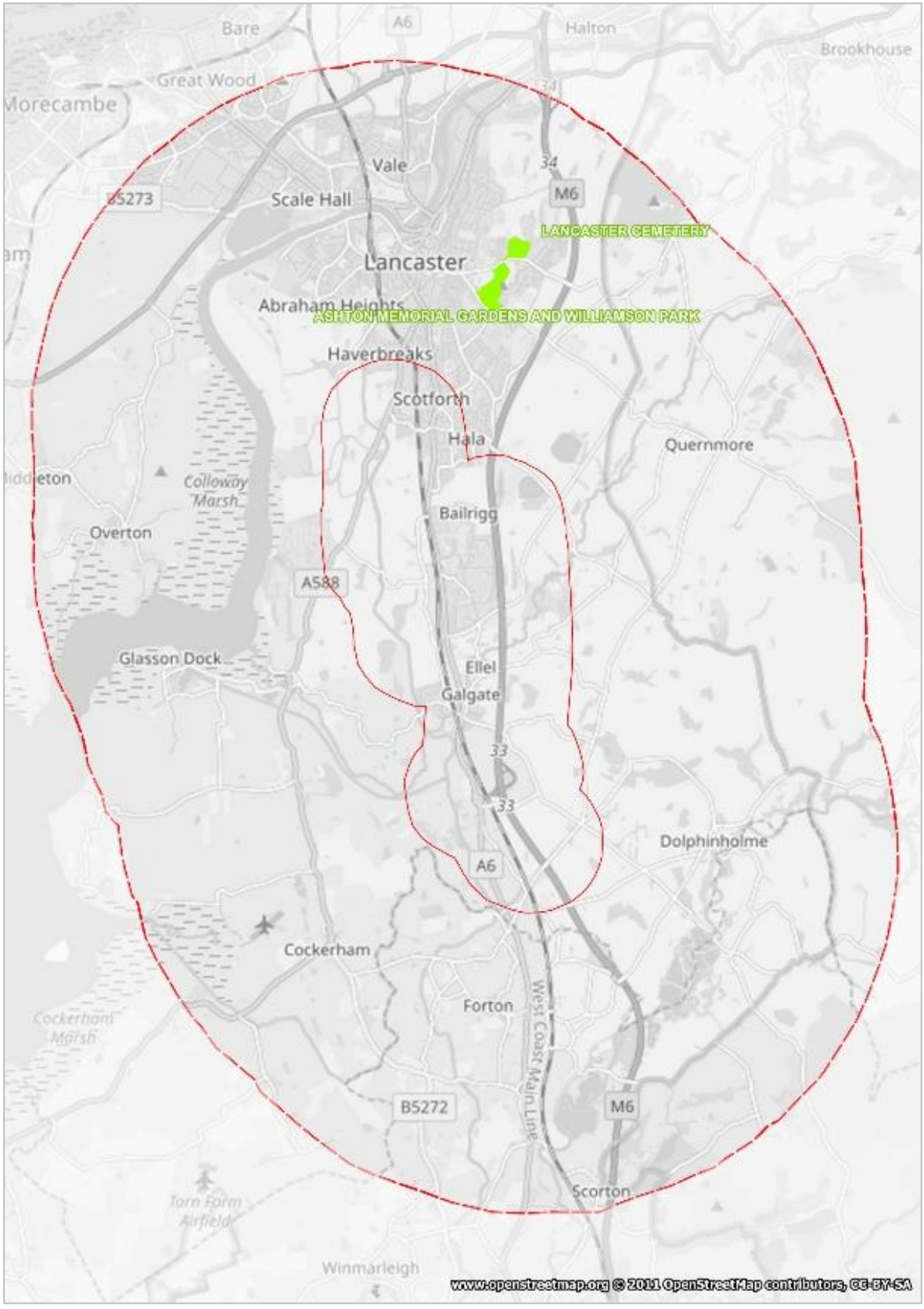


12.1.9 Within the 5km Study Area, there are two assets which are included on the register.

12.1.10 The grade II registered park and garden of Ashton Memorial Gardens and Williamson Park (NHLE 1000942) is a public park situated on steeply sloping land overlooking the city of Lancaster and the Lune valley beyond to the west. Covering an area of c.32ha, the park was established in the 1870s by James Williamson Senior to the designs of Mr J McLean of Castle Donington. A major phase of work was undertaken in the 1900s with the construction of the grade I listed Ashton Memorial, and various other structures, funded by Lord Ashton. The park surrounds the landmark building of the Ashton Memorial, surrounded by an open area of grassland, with landscaped former quarries to the north and south. A defining feature of the park is the long views northwest, west and southwest from the Ashton Memorial.

12.1.11 The grade II registered park and garden of Lancaster Cemetery (NHLE 1001567) is located adjacent to the Memorial Gardens, 1km east of the centre of Lancaster. Established in 1855, the cemetery is of national importance as a good example of an early High Victorian public cemetery for a provincial town and includes a notable ensemble of buildings designed by the eminent Lancaster architect Edward Paley. The layout of the cemetery may be by the notable cemetery designer William Gay and survives intact, with a variety of 19th century monuments.

Figure 12.2 - Registered Parks and Gardens



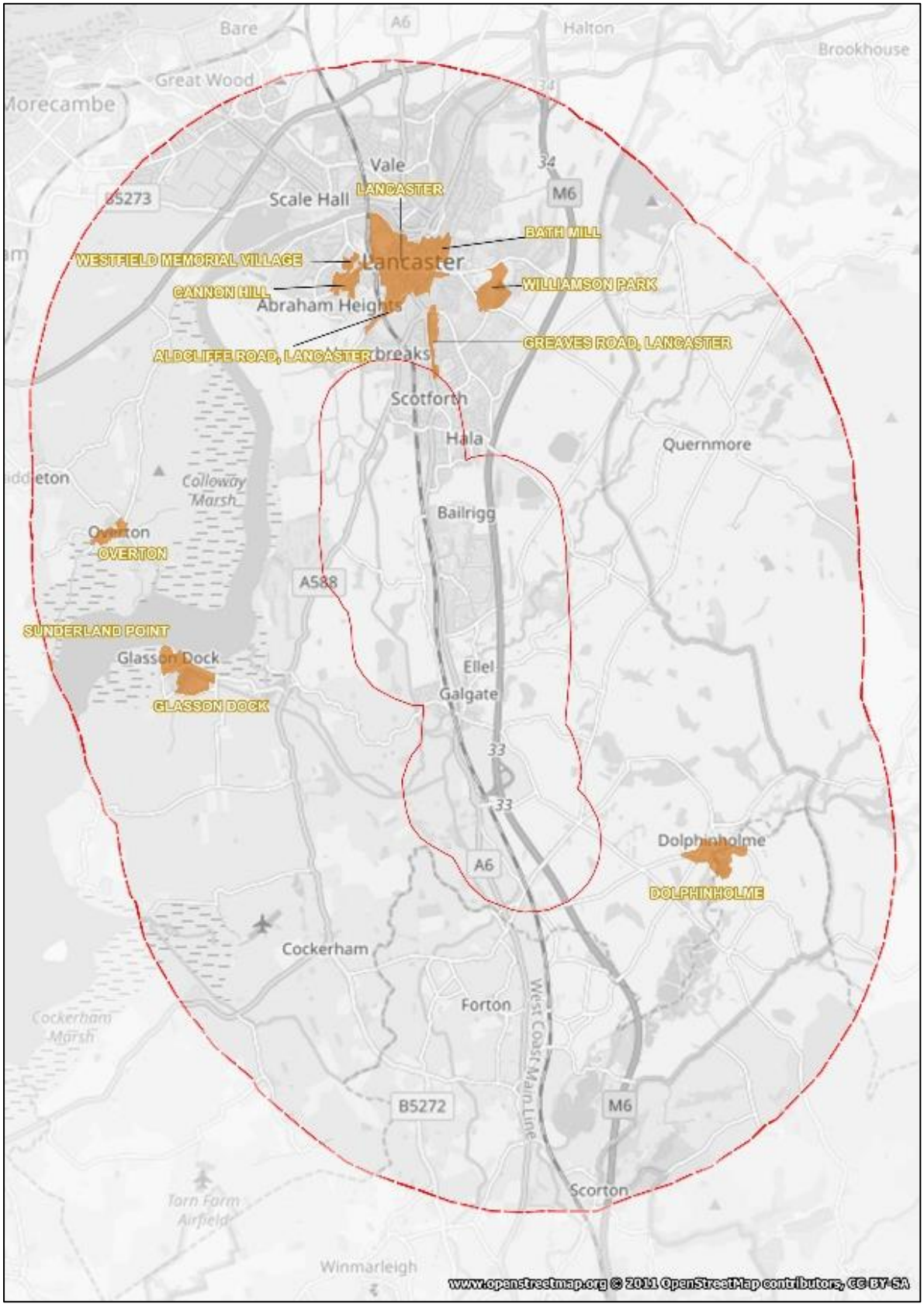
12.1.12 There are no World Heritage Sites within the Study Area.

12.1.13 There are a number of conservation areas falling within the Study Area.

Table 12.3 - Conservation Areas

Conservation Area	District
Glasson Dock	Lancaster
Cannon Hill	Lancaster
Greaves Road	Lancaster
Williamson Park	Lancaster
Sunderland Point	Lancaster
Aldcliffe Road	Lancaster
Bath Mill	Lancaster
Overton	Lancaster
Dolphinholme	Lancaster and Wyre
Lancaster	Lancaster
Westfield Memorial Village	Lancaster

Figure 12.3 - Conservation Areas



12.1.14 Based on the findings of the desk-based assessment it can be seen that there is potential for impacts on heritage assets to result from development of a new road in any of the route options, with marginally lower potential for adverse impacts identified in the Eastern route options.

12.1.15 No major heritage constraints have been identified within any route option. The closest high value asset is Ashton Hall (NHLE 1071756, grade I listed building), which is located immediately to the west of the Western route options. Whilst there may be potential for impacts on its setting, the Western route option does not extend into the associated non-designated historic parkland (PRN2520) and available information suggests that the route option is unlikely to be prominent in key views from the listed building.

12.1.16 The Western route options cross the Lancaster Canal (medium value) and includes two grade II listed canal structures (medium value) within its boundaries. Due to its nature as a linear historic feature, which follows a sinuous path through the landscape, the canal is crossed at multiple points along its length by road network. Any route option located west of the M6 would have to cross the canal, however it is likely that, if appropriately sited and designed, this impact may be accommodated without substantial harm to the assets' value.

12.1.17 Impacts on the setting of listed buildings surrounding the route corridors may result from road development, however available information suggests that there is potential for avoidance or reduction of any such impacts through careful consideration of the historic environment during detailed design of the preferred route.

Figure 12.4 – Cultural Heritage

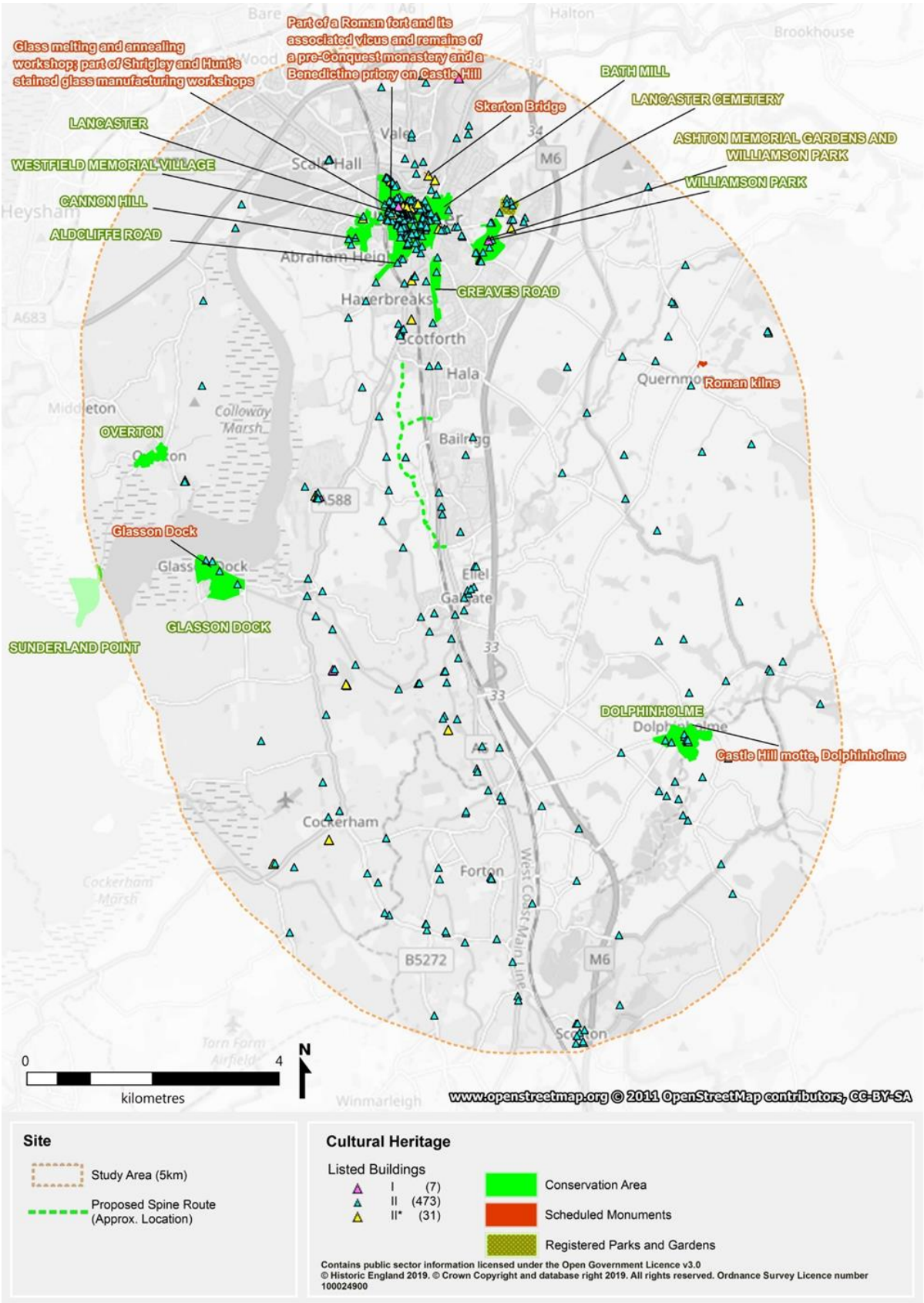


Figure 12.5 – Heritage at Risk

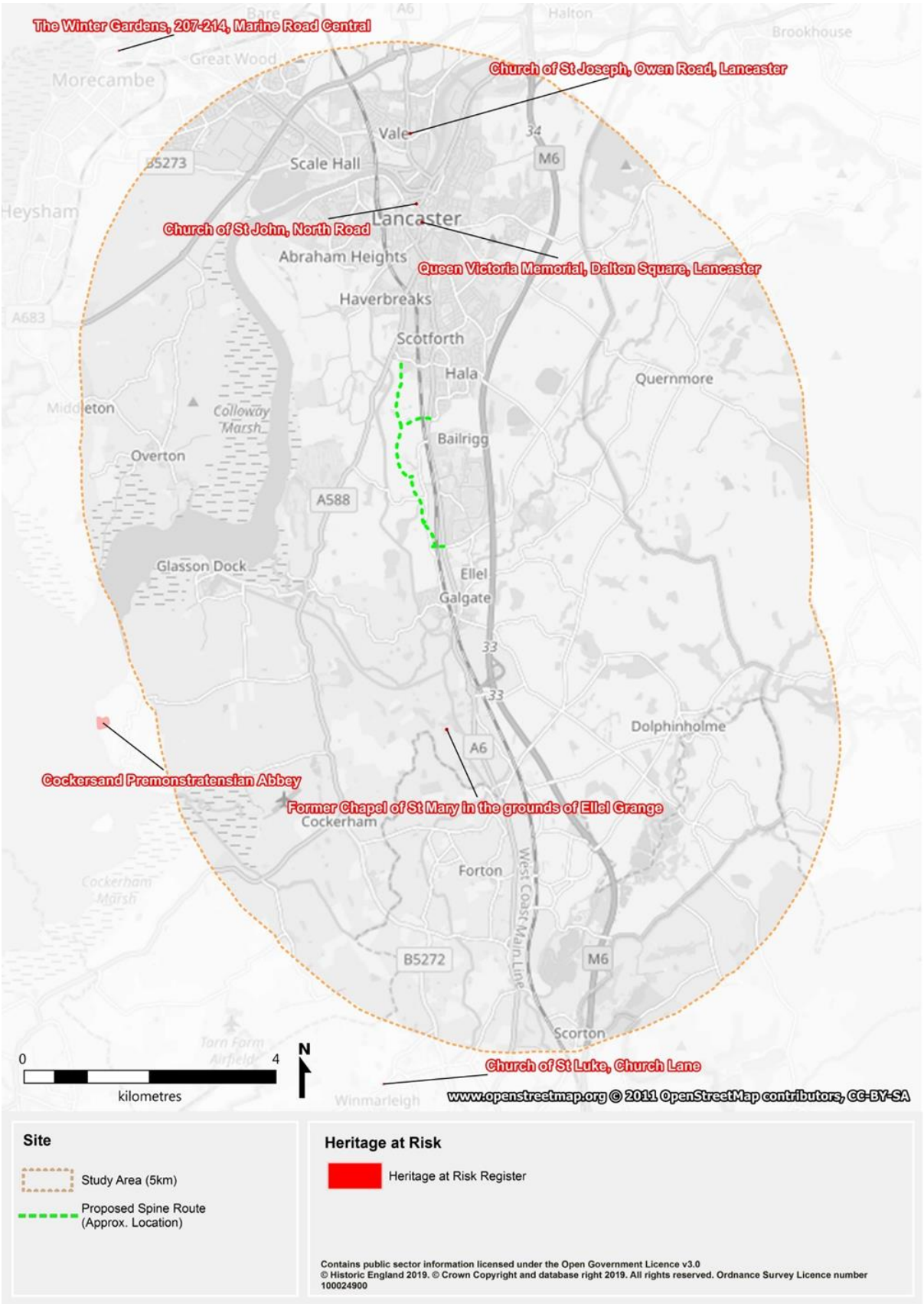
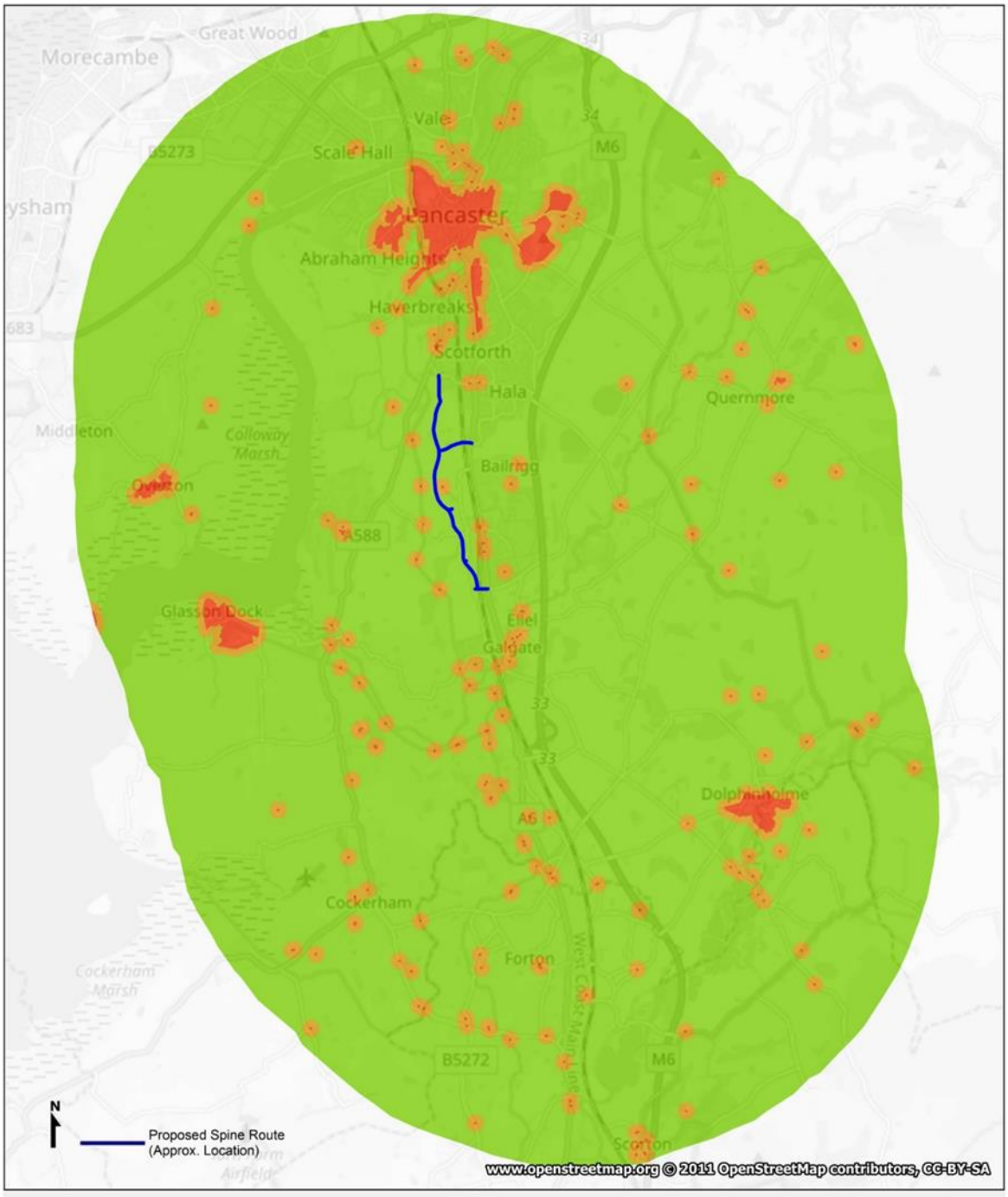


Figure 12.6 – Heritage Constraints Areas



Cultural Heritage

Tier 1 Areas | Tier 2 Areas | Less Constrained Areas

Relevant source datasets:
- Listed Buildings;
- Scheduled Monuments;
- Registered Parks and Gardens; and
- Conservation Areas

Table 12.4 - Cultural Heritage Tier 1 and Tier 2 Criteria

Topic & Objective	Rationale for Tier 1 criteria	Outcome
Protect and enhance the quality and distinctiveness of the Study Areas historic and cultural heritage.	The NPPF recognises the historic environment as an irreplaceable resource which should be conserved in a manner appropriate to its significance. Heritage assets that are deemed to be of national significance are World Heritage Sites, Scheduled Monuments and other sites of national heritage significance, Grade I and II* Listed Buildings, Registered Parks and Gardens and Registered Battlefields Substantial harm or total loss of significance of national heritage asset or development within its setting is not acceptable.	Areas within a buffer of 100m containing sensitive cultural heritage receptors, such as scheduled monuments or listed buildings will be considered further only if no other option available.
Topic & Objective	**Rationale for Tier 2 criteria**	**Outcome**
Protect and enhance the quality and distinctiveness of the Study Areas historic and cultural heritage.	The NPPF recognises the historic environment as an irreplaceable resource which should be conserved in a manner appropriate to its significance. Heritage assets that are deemed to be of national significance are World Heritage Sites, Scheduled Monuments and other sites of national heritage significance, Grade I and II* Listed Buildings, Registered Parks and Gardens and Registered Battlefields Substantial harm or total loss of significance of national heritage asset or development within its setting is not acceptable.	Scheduled Monuments or other designated cultural heritage features are potentially excluded from further consideration*. *Note some GIS datasets (including Listed Buildings) are obtained in point format, and that a nominal boundary of 10m radius around each point is assumed to represent the feature in such cases.

13 Overall Constraints

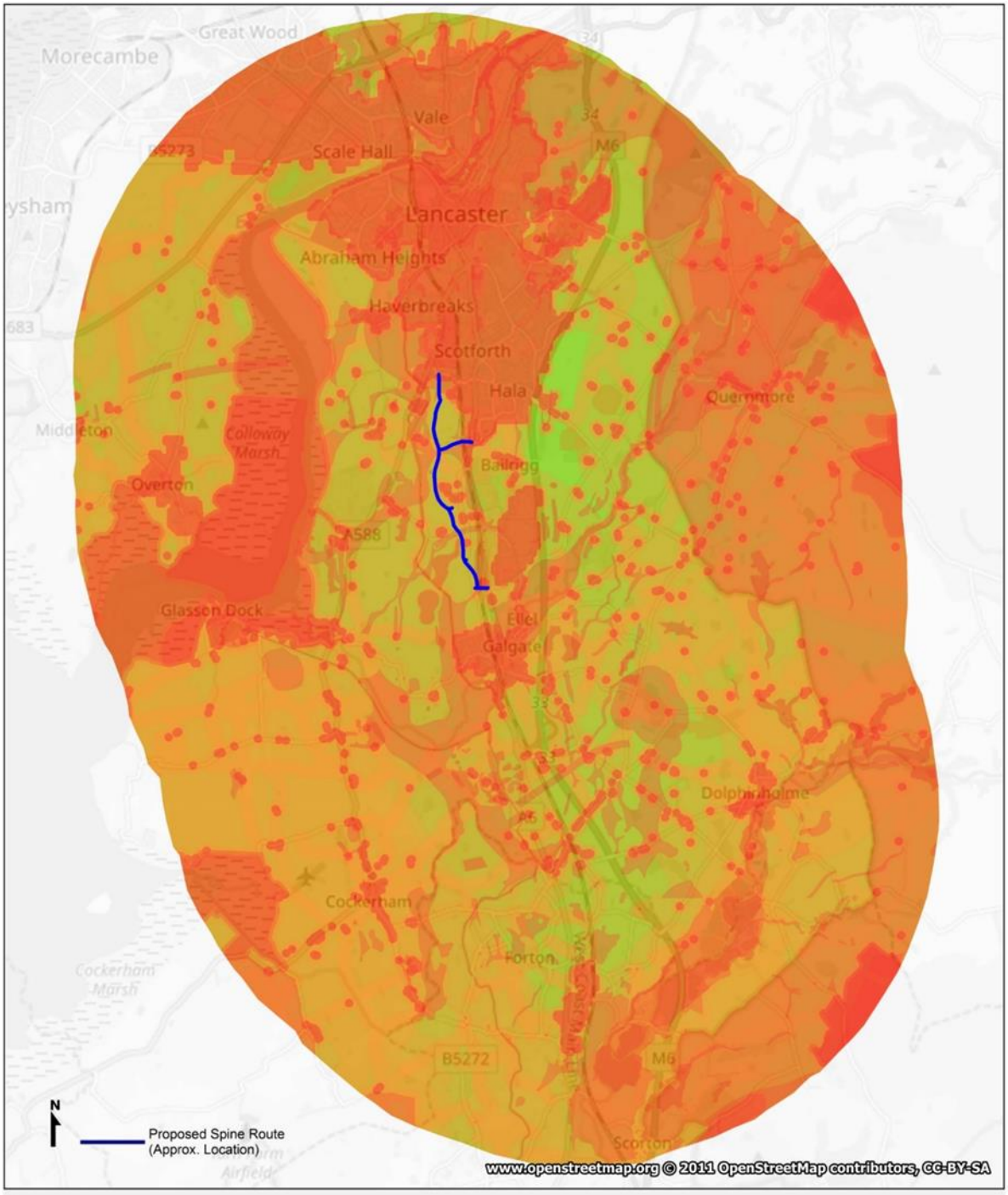
13.1.1 Following the application of Tier 1 and Tier 2 criteria for each environmental topic, as displayed on the above figures, it is possible to amalgamate these together into one 'Overall Constraints Map' of the Study Area. Within this figure, an indication of how constrained or not a particular location is in terms of all environmental issues examined. This can be expressed through the colour - deeper red areas being most constrained whereas deeper green areas are less constrained.

13.1.2 Having identified the more constrained / less constrained areas, it was then possible to re-focus on the broad objectives of the any potential intervention, as determined by Lancashire County Council, namely to:

- Improve the M6 Junction 33 junction;
- Examine the Bailrigg Garden Village connection; and,
- Relieve congestion in Galgate (centred on the main crossroads in the village) to remove the Air Quality Management Area.

13.1.3 It is to be noted that while the route options can optimise the less constrained areas to meet the broad objectives set there will be a need for some proposed routes to 'cross' areas that are considered more constrained in terms of the Tier 1 and Tier 2 criteria.

Figure 13 – Overall Constraints



All Constraints

Tier 1 Areas | Tier 2 Areas | Less Constrained Areas

0 — 5

kilometres

Note: The following layers are overlayed:
- Biodiversity;
- Flooding;
- Water Resources;
- Cultural Heritage;
- Ground Conditions;
- Air Quality;
- Landscape; and
- Population and Human Health.

Transparency is then adjusted in order to provide an indication of 'cross-topic receptor density' within the study area.

14 Traffic

Information and method

14.1.1 The basis for the traffic estimation and modelling predictions was carried out using the Lancaster Traffic Model. This model was used to test six proposed route options. It is a model originally developed in preparation of a Business Case in support of the M6 Junction 33 Improvement Scheme and, in turn, it will be the primary data source in traffic prediction terms for the development of Bailrigg Garden Village to the south of Lancaster.

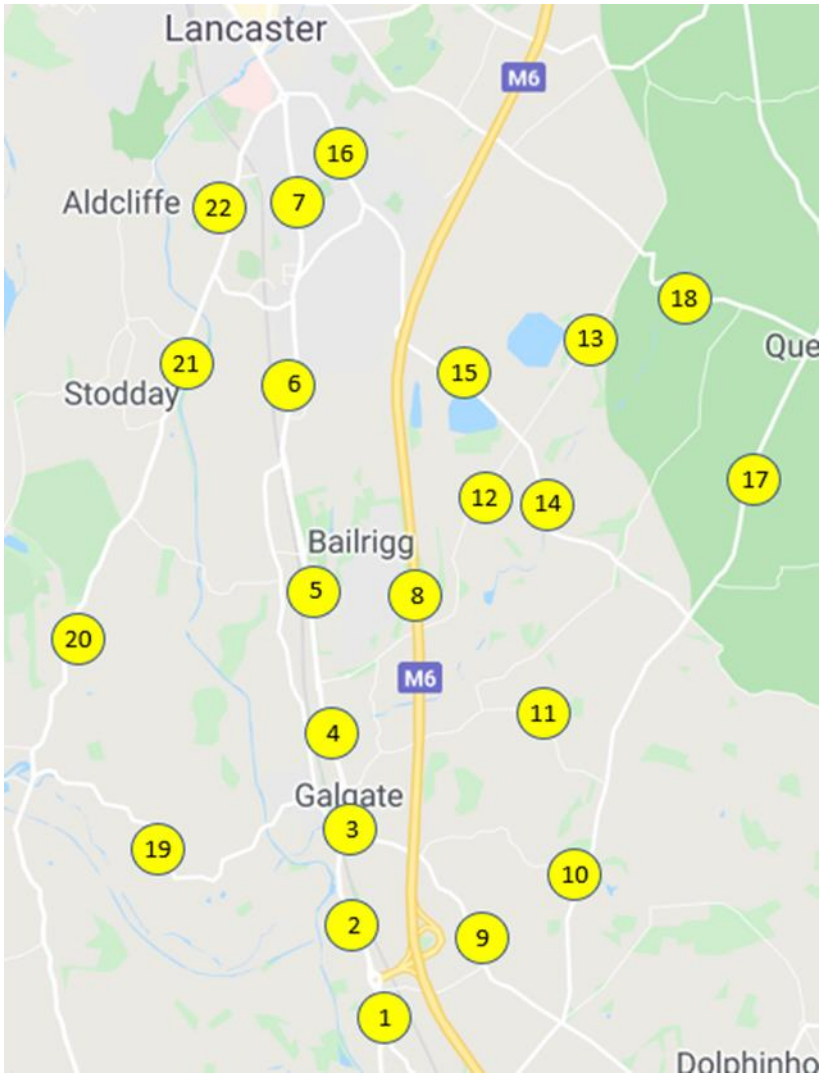
14.1.2 The scenarios assessed as part of the preliminary study are:

- A baseline: without development demand and without Scheme;
- Do Minimum: with development demand and without Scheme;
- Do Something: with development demand and with the 6 Scheme options.

14.1.3 The model peak hours will be AM – 08:00 – 09: 00, PM – 17:00 – 18:00 and Intermediate Peak of average hour of 10:00 to 16:00, and two forecast years: 2025 and 2040. The analysis of the model included runs for all peak periods and years available with and without all proposed route options

14.1.4 There are a number of specific places or key links where traffic information data was collected collection and outputs are measured the Study Area. The detailed outputs from the model for each route made in relation to this are presented in the following illustration.

Figure 14.1 - Key links



Traffic Predictions

14.1.5 This section summarises the detailed model outputs generated from the traffic model.

14.1.6 Table 14.1 shows the flows travelling along each route option. The Central 1 route option is the one option which is predicted to attract the most vehicles in all the peak periods and years modelled except in the 2040 AM, where Eastern 1 route option achieves a higher throughput.

Table 14.1 - Flow travelling along each route option

	AM			IP			PM		
Scheme	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)
Central 1	998	804	1801	416.5	528.3	944.7	684	833	1517
Central 2	992	775	1767	404.3	524.3	928.6	671	801	1472
West 1	365	293	658	163.6	156.1	319.7	279	228	507
West 2	34	106	140	0.4	6.8	7.2	104	280	385
East 1	510	902	1412	129.1	607.8	736.9	229	921	1150
East 2	408	444	852	83.1	301.0	384.1	170	540	710

Scheme	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)	2025 NB flow (pcu)	2025 SB flow (pcu)	2025 flow (pcu)
Central 1	949	669	1618	505.6	814.1	1319.7	845	790	1634
Central 2	958	651	1609	480.6	773.8	1254.4	693	717	1410
West 1	544	398	942	336.1	319.7	655.8	580	252	833
West 2	164	298	461	197.6	239.1	436.7	403	230	633
East 1	722	1041	1763	226.2	899.4	1125.6	508	1083	1591
East 2	678	682	1360	175.2	579.6	754.8	438	748	1186

14.1.7 Table 14.2 shows how effective each route option is in achieving a reduction of flows in the A6 through Galgate. Central 1 is the only route option achieving a reduction of flow in the A6 through Galgate in both directions, in all peak periods and years modelled.

Table 14.2 - Flow changes at the A6 though Galgate under each route option

Scheme	Dir	2025 change (%)			2040 change (%)		
		AM	IP	PM	AM	IP	PM
Central 1	NB	-21%	-20%	-31%	-1%	-7%	-38%
	SB	-39%	-30%	-36%	-65%	-37%	-1%
Central 2	NB	-25%	-24%	-33%	-1%	-14%	12%
	SB	-40%	-35%	-45%	-48%	-36%	2%
West 1	NB	3%	-19%	-13%	-2%	2%	56%
	SB	-20%	-14%	-5%	-9%	21%	27%
West 2	NB	-19%	1%	-25%	-30%	-19%	3%
	SB	-1%	5%	-13%	-5%	5%	34%
East 1	NB	-8%	-8%	-6%	-1%	3%	5%
	SB	-45%	-41%	-43%	-59%	-41%	-16%
East 2	NB	0%	-2%	1%	2%	9%	7%
	SB	-42%	-36%	-44%	-57%	-35%	-22%

14.1.8 Table 14.3 summarises the information related to congestion. The Central 1 route option, able to subtract more flows from the A6, achieves a greater congestion relief on the A6 Lancaster Preston Road and Stoney Road junction. For all the other route options, congestion is still present at this junction, even in the 2025 opening year.

14.1.9 The new infrastructure also experiences some congestion, which is particularly noticeable in the Central 1 route option, around the new road junction with Hazelrigg Lane.

Table 14.3 - Congestion changes under each route option

Criteria	Central 1	Central 2	Western 1	Western 2	Eastern 1	Eastern 2
Reduces congestion at A6/Stoney Lane in 2025	Yes	Yes	Partially	Partially	Partially	Partially
New infrastructure operates congestion free in 2025	No	No	Yes	Yes	Yes	Yes
Reduces congestion at A6/Stoney Lane in 2040	Partially	Partially	Partially	Partially	Partially	Partially
New infrastructure operates congestion free in 2040	No	No	No	No	No	No

14.1.10 The Central 1 route option provides the most competitive alternative to the A6 in terms of travel distance. The Central 2 route option adds a link to the A588; however, in the future year this link is attracting additional flows from the A588 to the A6, causing a detrimental effect on traffic conditions along Galgate. Although none of the route options operate congestion free in 2040, the main disadvantage of the Central 1 route option is that the new junctions experience high levels of congestion. A feasible design that provides enough capacity needs to be studied in subsequent stages of work if this route option is taken forward.

14.1.11 The Western route options provide routes that do not offer additional connection to the motorway. These route options have a relatively lower rate of success, as they only achieve moderate flow reductions in the A6 in some of the peak periods and directions modelled.

14.1.12 The Eastern route options provide a similar arrangement to the Central route options however due to slightly longer route alignments they are not successful in subtracting flow from the A6 in all periods and directions modelled.

15 Engineering Considerations

15.1.1 There may be other more overriding environmental reasons for choosing an alternative route option for the link road however, from a purely engineering perspective the key advantages of the Central 1 route option are set out as follows.

Maintenance of consistent speed limit

15.1.2 Changes in speed can cause confusion for drivers. The Central 1 route option uses only two design speeds and the changes in this are at junctions. The Western routes options have three design speeds whilst the Eastern route options have two design speeds.

Shortest distance

15.1.3 The Western 2 route option is the shortest route but do not offer additional connection to the motorway. The next shortest route is Central 1 route option A shorter route provides considerable cost saving to construct, operate and in terms of the desirability of user route choice.

15.1.4 The geometry of the Central 1 route option, being almost straight, is the most attractive for use particularly by HGVs, there is a potential drawback to this in that higher speeds may be encouraged (however, this could be assessed during the detailed design stage).

Lowest gradients

15.1.5 The Central 1 route option has the lowest highway gradients at 3% and this gradient is only reached for a short section. The Eastern route options owing to the topography on the east side of the M6 motorway have gradients, which reach the max permissible under Design Manual for Roads and Bridges at 6%. There is potential for HGVs to be dissuaded from using the Eastern route options owing to this and continue to travel through Galgate.

Construction

15.1.6 Common with other route options the Central 1 route option would require a partnership with Network Rail. All options other than the Western route options can only be constructed from both sides of the West Coast Main Line after the new rail underbridge is constructed.

15.1.7 There are fewer large structures with the Central 1 route option in comparison to the Western route options. There would be no canal crossings for Central 1 whereas some canal crossings on Western route options in particular the one on the west is very close to the Glasson Dock spur and would likely require a much higher quality of appearance and consequent expense.

15.1.8 Whilst the Eastern route options potentially have fewer structures there may be more requirement for farm accesses to be crossed and require more small structures along the alignments. Further to this, the depth of cuttings on the Eastern route options may require retaining walls.

15.1.9 The Central 1 route option is constructed on an embankment and because there is expected to be extensive excavation of material to construct the north facing slip roads for M6 Junction 33 there could be surplus material available for these embankments. If this is possible a considerable cost saving can be made over the Eastern and Western route options.

Drainage

15.1.10 The drainage on the Central route options are preferable because there are watercourses situated along the route, which could be, used to outfall from the required highway attenuation ponds. All other routes have at least one section where the drainage solution will be problematic at best owing to the general topography. The drainage issues at the West Coast Main Line crossing are common to all options and so have not been included as a scoring issue with any alignment.

Table 15 – Comparison of Route Options

	Western 1	Western 2	Central 1	Central 2	Eastern 1	Eastern 2
Design Speed	30, 40, 60mph	30, 40, 60mph	40, 60mph	40, 60mph	40, 60 mph	40, 60mph
Length	Between 4230 and 6521m (to the slip roads)	Between 3487 and 4572m (to the slip roads)	Between 2529m and 3450m (to the slip roads)	Between 2529m and 4410m (to the slip roads)	Between 3193m and 4220m (to the slip roads)	Between 3335m and 4256m (to the slip roads)
Max gradient	4.5%	4.5%	3%	4%	6%	6%
Lancaster Canal Crossing	Yes	Yes	No	Yes	No	No
WCML Crossing	Yes	Yes	Yes	Yes	Yes	Yes
Crossing a river	Yes	Yes	Yes	yes	Yes	Yes
Geometry	Several tight radii bends including 2 on structures, several large cut and fill areas.	Several tight radii bends including 2 on structures, several large cut and fill areas.	Almost straight, short lengths of cut and long lengths of fill	Straight over half the length, several tight radii and an area of cutting over the other half	Several tight radii bends, several large cut and fill areas including two at very large	Several tight radii bends, several large cut and fill areas including two at very large

	Western 1	Western 2	Central 1	Central 2	Eastern 1	Eastern 2
Design Speed	30, 40, 60mph	30, 40, 60mph	40, 60mph	40, 60mph	40, 60 mph	40, 60mph
Number of large structures	5, includes 2 over canal, one over a river and one overbridge for farm access	4, includes 2 over canal and one over a river	4 including one over river, there may be one pedestrian overbridge depending on PROW requirements	5 including one over river, there may be one pedestrian overbridge depending on PROW requirements	2 includes one over river, there are at least 4 farm accesses that may require overbridges	3 includes one over river, there are at least 4 farm accesses that may require overbridges
Drainage Difficulty 1-10	8 There is one area that does not seem to have natural drainage and may require a deep (>10m) pipe to drain.	8 There is one area that does not seem to have natural drainage and may require a deep (>10m) pipe to drain.	4 Several streams and a river all at convenient locations, but most of route on flood plain	6 Several streams and a river all at convenient locations on 50%, more difficult over the other 50%	6 One area near the start of route that may present difficulties	8 Near the start of route will need investigation to determine if Stoney Lane has a system that could be used.

16 Next Stages

16.1 Development Consent Order (DCO) Process

16.1.1 Owing to the size of the proposed development it is proposed to submit the proposal for consideration by the Planning Inspectorate under the Nationally Significant Infrastructure Projects (NSIPs) process. There are six stages of making an application for a development under the Development Consent Order process, which are briefly summarised below.

1. Pre-application

16.1.2 This is the current stage of the process and before submitting an application potential applicants have a statutory duty to carry out consultation. The aim of the process is to have a two-way dialogue between the applicant and the organisations and individuals, which are affected by the development so that the development can be improved.

2. Acceptance

16.1.3 The Acceptance stage begins when an applicant submits an application for development consent to the Planning Inspectorate. Following the submission of the application the Planning Inspectorate are allowed a period of up to 28 days to decide whether or not the application meets the standards required to be accepted.

3. Pre-examination

16.1.4 During this stage the public will be able to register with the Planning Inspectorate to become an Interested Party by making a Relevant Representation. A Relevant Representation is a written summary of a person's views on an application. An Examining Authority is also appointed at the Pre-examination stage and all Interested Parties will be invited to attend a

Preliminary Meeting, run and chaired by the Examining Authority. The pre-examination stage usually takes approximately three months to complete.

4. Examination

16.1.5 The Planning Inspectorate has up to six months to complete an examination. During this stage Interested Parties who have registered by making a Relevant Representation are invited to provide more details of their views in writing following which consideration is given by the Examining Authority to all the important and relevant matters including the representations of all Interested Parties together with supporting evidence submitted.

5. Recommendation and Decision

16.1.6 The Planning Inspectorate must prepare a report on the application to the relevant Secretary of State, including a recommendation, within three months of the close of the six month Examination. The relevant Secretary of State then has a further three months to make the decision on whether to grant or refuse development consent.

6. Post decision

16.1.7 Once a decision has been issued by the relevant Secretary of State, there is a six week period in which the decision may be challenged in the High Court. This process of legal challenge is known as Judicial Review.

16.2 Consultation

16.2.1 The way in which Lancashire County Council and Lancaster City Council will consult on the scheme but also the way in which responses are made is set out in a document entitled Statement of Community Consultation. The Statement of Community Consultation also presents the stages of the scheme where stakeholders will be consulted on and a broad timeline for doing so.

Preferred Route

16.2.2 Lancashire County Council will first make a formal consultation on the route options in order to ensure that residents, individuals, local groups, councillors, commercial and statutory organisations (stakeholders) have a chance to have a say so that a preferred route can be decided.

Review of environmental Information

16.2.3 There will be a chance to comment on the reports of environmental surveys prior to the application been submitted to the Planning Inspectorate.

The DCO Application

16.2.4 During the pre-examination and examination there will be an opportunity to register in order to make comments on the application. The way that this can be done is to register to comment directly to the Planning Inspectorate once the DCO application has reached the acceptance stage.

Next Steps/Get involved

16.2.5 There are a number of ways to get involved and these are to make contact via Lancashire County Council's Have Your Say website during open consultations or email us at TLT@lancashire.gov.uk or write to us at Transforming Lancaster Travel, Infrastructure Delivery Team, Lancashire County Council, County Hall, Pitt Street, Preston, PR1 0LD.