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Richmondshire Local Development Framework

Catterick Garrison and Surrounding Area Strategic Transport Assessment

Main Report
Final

August 2011

North Yorkshire County Council
Business and Environmental Services

RICHMONDSHIRE DISTRICT COUNCIL
working for a better future

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1 Introduction

1.1 Richmondshire District Local Development Framework

Jacobs was commissioned by North Yorkshire County Council on behalf of Richmondshire District Council to assess the impact of implementing Richmondshire's Local Development Framework (LDF) on the existing highway network around Catterick Garrison, Catterick Village and the neighbouring stretch of A1.

The LDF consists of a Core Strategy, setting out the broad strategy and vision for the Richmondshire district, and allocation documents, which set out specific areas for future development. The LDF incorporates open market housing and employment sites and military related development.

1.2 Objectives of the Study

The purpose of the study is to evaluate the traffic impacts associated with potential strategic development in Richmondshire by 2026.

A SATURN traffic model, previously developed by Mouchel Parkman and Jacobs, was updated to include the new LDF development sites and proposed changes to the highway network for a future assessment year of 2026. The model was then used to evaluate the impact of the additional vehicles associated with the proposed LDF developments, including an assessment of the impacts and delays on selected junctions.

The objectives of the study are four-fold:

- Firstly, to assess the current levels of traffic and delay on the network in the base year 2011 with an agreed Baseline Scenario;
- Secondly, to assess the levels of traffic and delay on the network in the future assessment year 2026 with full implementation of the LDF;
- Thirdly, to propose remedial measures to ensure the local highway network can accommodate the development traffic to meet the capacity tolerances dictated by NYCC; and
- Fourthly, to propose an optimum reduced level of development if the remedial measures do not successfully ensure that future traffic congestion in 2026 does not exceed that assessed in the 2011 Baseline Scenario.

1.3 Report Structure

The remainder of this report is structured as follows:

- Chapter 2 explains the assessment and modelling process, including previous work undertaken;
- Chapter 3 sets out the development sites proposed under the LDF, their locations and likely traffic to be generated from them;
- Chapter 4 sets out the first scenario, the Baseline, and presents the results from the capacity assessment of existing junctions;
- Chapter 5 establishes the proposed level of development and highways improvement to be implemented in the Do Minimum future year scenario. The results of the impact on junction capacity are presented;
- Chapter 6 presents the proposed highways mitigation measures required to accommodate the full level of development traffic, along with the results from the Do Something capacity assessment;
- Chapter 7 looks at the likely impacts on the full LDF development if the A1 Leeming Bar to Barton upgrade had gone ahead as planned;
- Chapter 8 presents a summary of the four scenarios assessed;
- Chapter 9 details the engineering solutions proposed as part of the Do Something scenario to add capacity to the key junctions on the highway network; and
- Chapter 10 presents the findings and conclusions of this study.

A glossary of terms used in this report is provided in Appendix A.

2 Assessment and Modelling Methodology

2.1 Overview

This chapter describes the methodology used to examine the effects of a number of development scenarios on the local highway network. It also looks at the tools used to investigate and calculate future congestion levels and the software solutions used to mitigate this congestion. This chapter also details some of the key characteristics of the local highway network around the Catterick Garrison area.

The methodology used to undertake the Strategic Transport Assessment has been approved by North Yorkshire County Council as the Local Highways Authority.

2.2 SATURN Traffic Model

In 2009, Jacobs was commissioned by North Yorkshire County Council to update an existing traffic model of the Catterick Garrison and Catterick Village area. The existing model was originally developed by Mouchel Parkman with a base year of 2005, whereas Jacobs have updated and revalidated the model to a base year of 2009.

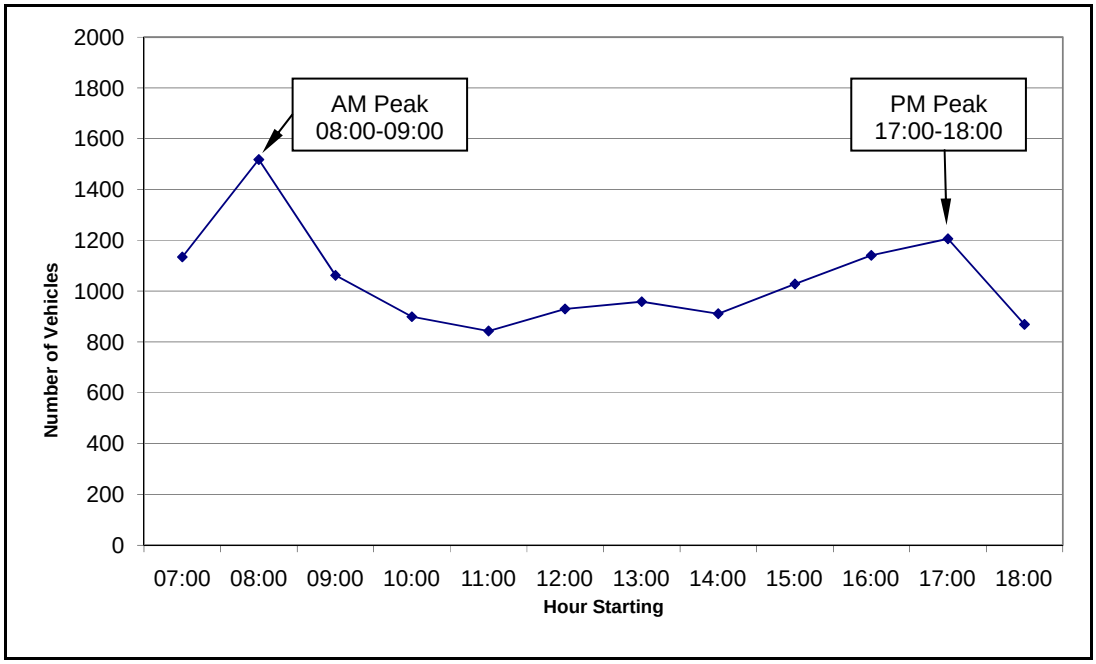
The validated model was developed using the SATURN software package. The model includes all the major highway links and junctions in and around the Catterick Garrison area, including the two junctions with the A1. The traffic model covers the whole of the built up area of Catterick Garrison and includes the surrounding villages of Hipswell, Colburn, Walkerville, Brough with St Giles, Scotton, Tunstall, Brompton-on-Swale, Catterick Village, and Scorton.

The 2009 model has been calibrated and validated in accordance with Government guidance to accurately reflect the local traffic and travel patterns and to ensure that it is sufficiently robust to reliably assess the transport impacts of new schemes and developments within Catterick Garrison and the surrounding villages.

Analysis of the 2009 Catterick traffic model confirms the AM peak is the busier of the two peaks in terms of traffic movements within the local area, see Figure 2.1. Therefore the AM peak period has been chosen for modelling Richmondshire's LDF plan period for providing housing, employment, retail and other development to 2026.

The AM peak is the busiest because the journey to work and journey to school traffic tends to operate at the same time in the morning where as in the evening the two types of traffic can be spread out more across the hour. It is worth noting that the Garrison area also has a high traffic flow in the hour prior to the AM peak (0700-0800) which is almost as busy as the PM peak. Figure 2.1 shows the level of traffic flow throughout the day in Catterick Garrison.

Figure 2.1 Changes in Average Hourly Traffic in Catterick Garrison



Consultation with local councillors revealed two potential issues, with reported high volumes of traffic during the Friday PM peak and on Sunday mornings with demand for the Catterick Sunday Market.

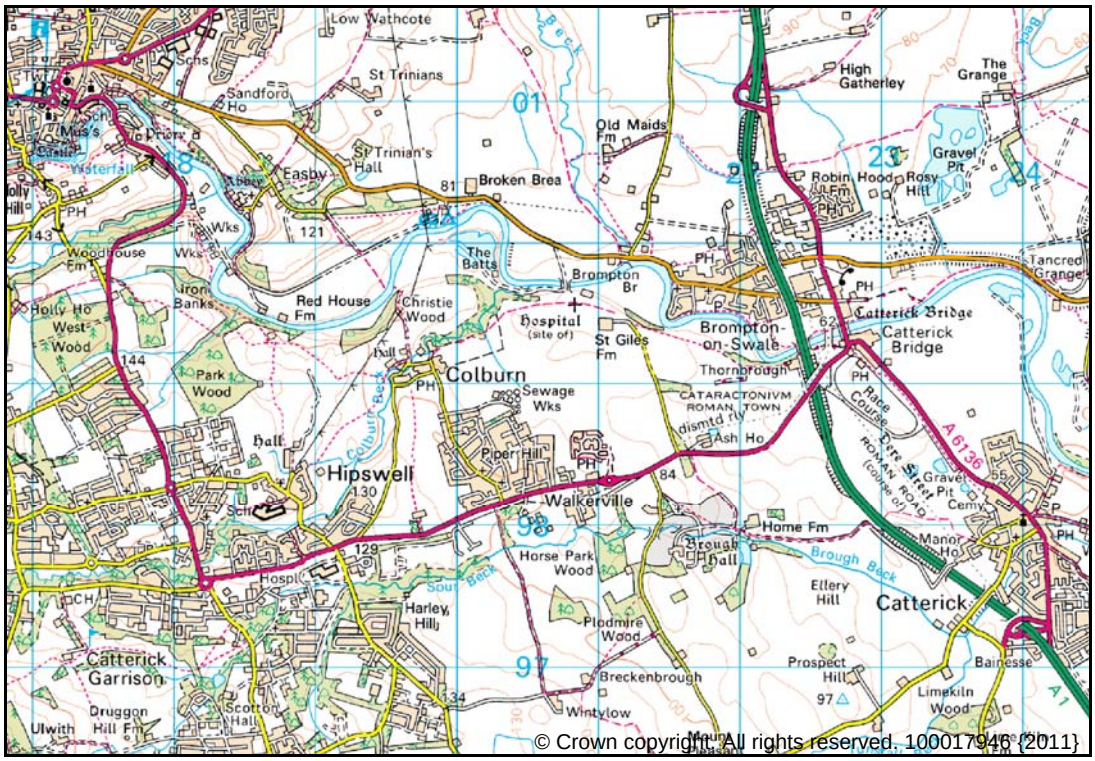
Count sites in the vicinity show a higher demand during the Sunday peaks on Gatherley Road, which occur between 11:00 and 12:00 in the AM and between 12:00 and 13:00 in the PM. This accounts for an average extra 325 vehicles on a Sunday when compared with the AM peak, an increase of 20%. The count site on Catterick Road indicates that there is a higher demand during the Friday PM peak, with an extra 218 vehicles over the average weekday AM peak, an increase of 25%. The two count sites show that at all other times, the AM peak traffic is the peak daily flow.

It is not feasible to individually assess and mitigate congestion which occurs during the Friday evening and Sunday peaks. The events and causation of this congestion occur once per week and it would be unjustifiable to provide for such occurrences over and above the twice-daily peak. This is because the burden and costs of mitigating against these occurrences would be placed upon future developers in their contributions towards the improvement of the highway network to accommodate LDF development. A possible solution is to ask the racecourse and market providers to better manage and contribute towards traffic management of their events.

2.3 Catterick Highway Network

Catterick Garrison and the surrounding villages are located around the A6136. Traffic generated by and attracted to the proposed new development sites will use this road which runs through the centre of Catterick Garrison and Catterick Village. The A6136 leads to the town of Richmond to the north-west and joins with the A1 to the north and south of Catterick, as shown in Figure 2.2.

Figure 2.2 Catterick Highway Network



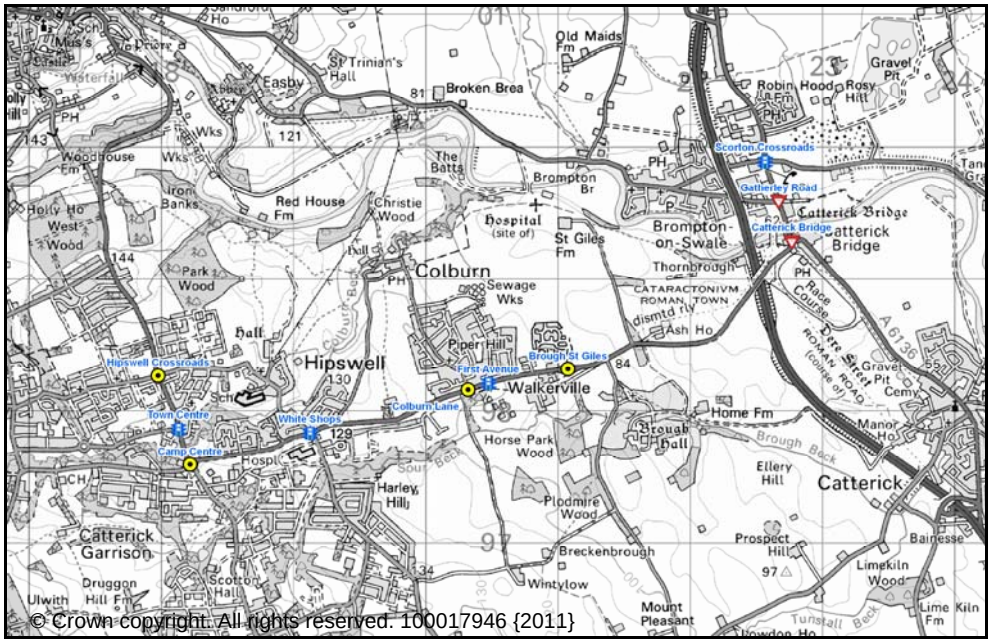
2.4 Junction Capacity Assessment

Due to the limited route choice for travel, there are ten key junctions along the A6136 that could come under strain from further traffic using the network as a result of proposed development. These junctions will be closely assessed for changes in congestion levels as a result of any development planned for the area and are listed below and shown in Figure 2.3:

- Scorton crossroads (signals)
- Gatherley Road (priority)
- Catterick Bridge (priority)
- Brough St Giles (roundabout)
- First Avenue (signals to be implemented in 2012)
- Colburn Lane (mini roundabout)
- White Shops crossroads (signals)

- Camp Centre (roundabout)
- Town Centre (signals)
- Hipswell crossroads (roundabout)

Figure 2.3 Locations of Junctions for Assessment



The SATURN model can assess overall traffic levels, but accurate junction capacity assessment can be better undertaken using specialist tools. Three types of junction are present in the model area: roundabouts, priorities, and signals. All three types have their own dedicated modelling software and so roundabouts have been modelled using ARCADY, priority intersections have been modelled using PICADY, and signalised junctions have been modelled using LINSIG.

Throughout this report, to illustrate the levels of capacity of each junction, a traffic light system has been adopted (see Table 2.1) to represent the ratio of flow to capacity (RFC). The ratio of flow to capacity shows how much of the capacity of the junction is taken up with traffic flow. If the ratio is 100% or above (Red) the junction is over capacity, if it is between 85% and 100% (Amber) it is approaching capacity and below 85% (Green) the junction is under capacity.

This system of assessment has been agreed with NYCC, as the local highways authority, and has been used previously in other studies. NYCC prefer the RFC of each junction to be 85% or below (Green) and individual arms of junctions to operate with a RFC less than 100% (Green or Amber). In each case it is desirable that the junction is operating below capacity.

Table 2.1 Traffic Light System for Junction Capacity Assessment

Traffic Light	Description
	Under Capacity in AM Peak
	Approaching Capacity in AM Peak
	Over Capacity in AM Peak

NYCC would also prefer each junction to operate with a RFC in the future year (2026) which is no more than the RFC in the Baseline year (2011). This is because the objective of this study is to ensure that where appropriate the future junction operation shall be under capacity or the same or better than that assessed in the Baseline Scenario. To show how each junction in the future scenarios compares to the Baseline an up or down arrow has been used in the results tables of this report to show if the RFC is higher or lower than the Baseline. Each arrow is colour coded (red, amber or green) to show the magnitude of the future RFC. Table 2.2 shows an example of this.

Table 2.2 RFC Arrow Comparison

Traffic Light Arrow	Description
	RFC Less than Baseline and No AM Peak Capacity Issues
	RFC Greater than Baseline and Minimal AM Peak Capacity Issues
	RFC Greater than Baseline and Significant AM Peak Capacity Issues

2.5 Engineering Solutions to Accommodate Development Traffic

A package of junction improvement measures is essential to the accommodation of additional LDF Open Market and MoD development in the Catterick Garrison area. These mitigation measures will eliminate congestion or at least reduce the congestion to levels associated with a Baseline scenario in 2026. Without these mitigation measures the development traffic will present unacceptable impacts on the local road network. At this stage, improvement options have been considered at a strategic level as detailed designs are not yet required. The strategic work undertaken has focussed on junction improvements which may be required at the ten key junctions listed in Section 2.4.

For each of the junctions which require additional capacity a deliverable junction improvement has been developed which, where possible, can be constructed within the existing highway boundary. Where appropriate and necessary a further set of measures have been developed which provide maximum capacity at each junction but will require land take outside of the highway boundary. These are discussed later in the report.

These junction improvement options will provide improved access to the strategic developments and accommodate the additional traffic generated by the developments.

2.6 Major Scheme Consideration

As part of this study, Jacobs has been asked to undertake an assessment of the proposed A1 widening scheme and associated grade separated junction at Catterick.

To reduce current high levels of accidents, congestion and enhance journey time reliability the Highways Agency has proposals for upgrading the existing A1 to dual 3-lane motorway standard. The proposal is generally on the line of the existing road with a localised off-line section at Catterick South, to the west of Bainesse Farm. A grade separated junction is proposed to the north west of Catterick which will replace the existing Catterick North and South junctions. This Catterick Central junction will be accessed via the local access road on the eastern dumbbell and a link between the western dumbbell and Catterick Road. A Local Access Road will be provided where appropriate to meet the needs of local and non-motorway traffic. A schematic of the proposals is shown in Figure 7.1 in Section 7 of this report.

On 20th October 2010 the Chancellor made his announcement about the National Spending Review. Even though the results of the spending review has had an impact on the delivery of the A1 upgrade it is still anticipated that the upgrade could be in place by the year 2026 which is the assessment year being used for this project.

The SATURN model has been used to undertake a sensitivity test on effects of the A1 upgrade within the highway network, particularly to the east of the scheme. The results of this sensitivity test are shown in Section 7.

3 Developments and Trip Generation Methodology

3.1 Overview

This chapter describes the potential development sites put forward for modelling purposes and the procedures used to estimate the amount of traffic each development site will generate. They include a mixture of open market housing; office, storage and retail units; and hotel and leisure. Incorporated into the LDF are MoD developments consisting of housing for military personnel with families. In addition there is estimated to be four additional army units working and living in the Garrison by 2026. These additional units will occupy existing MoD employment sites in the Garrison.

To provide a set of comparable results the traffic modelling and the trip generation for each development site has been based on the 2026 AM peak period.

3.2 Development Trip Rates

The sizes of the developments have been provided by Richmondshire District Council. Trip rates have been sourced from the Trip Rate Information Computer System (TRICS) database and agreed by the Highways Agency and NYCC.

TRICS determines the number of trips generated by each new development, based on sites of similar sizes and function from a variety of locations across the country. The trip rates used for each development type are shown below in Table 3.1.

Using these trip rates, along with either the number of dwellings or the Gross Floor Area (GFA), the number of trips generated by each development can be predicted. Table 3.1 also shows the total number of vehicular trips generated by each type of development. A full table of modelled development sites and associated trip rates is shown in Appendix B.

Table 3.1 TRICS Trip Rates by Development Type

Development Type	In*	Out*	Vehicle Trips In	Vehicle Trips Out
Retail	4.889	3.986	301	245
Professional Services	4.889	3.986	85	70
Restaurants/Bars	4.889	3.986	95	77
Office	2.862	0.330	1247	144
Storage	0.348	0.249	204	146
Hotel	0.079	0.243	7	20
Apartments (Flats)	0.143	0.295	26	54
Residential	0.152	0.441	615	1664
Leisure	0.941	0.667	44	31
Total			**2624**	**2451**

* Trip Rates are in trips per 100m^2 of GFA or per dwelling for residential.

3.3 Development Trip Distribution

Using the development trip rates the traffic in and out of each development was determined. Each new development was given a specific new zone within the traffic model. To construct trip matrices including these new zones it was necessary to distribute the development traffic to and from existing and new zones.

The distribution was undertaken by calculating the distribution in the base year (2009) matrix for different land use types and journey purposes, e.g. residential (home) to employment (work) or employment (work) to Tesco (retail). These comparative distributions were then applied to the new development trips depending on land use type and journey purpose.

3.4 Department for Transport TEMPRO Traffic Growth

Government guidance requires the total growth in the number of trips in the model to be constrained to a maximum forecast dictated by the Department for Transport's (DfT) National Trip End Model (NTEM) which is accessed using software called TEMPRO.

TEMPRO provides growth rates so the existing 2009 traffic can be 'growthed' to represent 2026 traffic. These growth rates are based on planning assumptions made to estimate the amount of traffic flow there will be in the future in each TEMPRO output area. The planning assumptions consist of numbers of households, numbers of jobs and workers and other factors such as population.

The traffic model covers three TEMPRO output areas, Catterick Garrison, Richmond, and rural Richmondshire. The TEMPRO traffic flows provide the total predicted growth in trips generated by potential new developments, existing developments and non development traffic in the future year 2026.

Generally, TRICS data estimates the amount of trips generated by each specific development site, whereas TEMPRO provides a more accurate overall local picture of total overall growth in the Richmondshire area. As specific proposed future development sites have been modelled the TEMPRO growth factors applied to non-development trips have been adjusted downwards, to avoid double-counting of trips within the model and to ensure the total traffic growth is constrained to TEMPRO but still includes traffic flow predicted by TRICS for specific developments.

The currently available TEMPRO dataset, version 5.4, is based on outdated planning data for Richmondshire. Therefore it was necessary to adjust the planning assumptions (in line with LDF proposals) for the amount of housing and jobs in each of the TEMPRO output areas using a facility within the TEMPRO software. This was done based on the full LDF (Preferred Core Strategy) and MoD planning assumptions for 2026. Table 3.2 shows the differences between the default TEMPRO planning data and the adjusted data from the LDF proposals. The number

of jobs is based on the development type and uses a factor of jobs per square metre of gross floor area[1].

Table 3.2 Changes to TEMPRO Planning Assumptions

Dataset	Planning Data	Rural	Catterick Garrison	Richmond	Total
2009	Households	13,793	2,473	3,987	20,253
	Jobs	14,297	9,306	4,572	28,175
Default 2026	Households	16,827	2,946	4,878	24,651
	Jobs	16,448	10,411	5,342	32,201
Adjusted 2026	Households	14,448	6,049	3,987	24,484
	Jobs	15,027	14,895	4,572	34,494

It is clear that on a district level ('Total' column) the change between the default and adjusted TEMPRO assumptions is small. At a local level however there is more growth in Catterick Garrison and less growth in Richmond and rural areas.

3.5 Development Density Ratios

Given the strategic nature of this study, only the total plot size or area of each potential development site is known, unless stated otherwise in a Transport Assessment. To estimate trip rates using the TRICS database the area of useable floor space is required, and therefore a number of density ratios have been used to convert from total plot area to useable floor space. The development density ratios have been estimated based on the different land use types and previous planning submissions and developments in Richmondshire.

3.6 Mode Choice Trip Reduction

The physical characteristics of the Garrison area suggest the percentage of trips to work by sustainable modes will be greater than the national average. Using 2001 Census data sustainable travel was assessed as an alternative to a car trips. The number of people utilising sustainable travel was calculated as a percentage of the population who currently travel to a place of employment.

Table 3.3 shows that the percentage in the Garrison area is higher than the National Average.

The result of this is that 5% less journeys to work are made by car than the national average. As such the reduction in traffic generation from TRICS, which is based on the national average, has been set at a capped level of 5%. This results in the trip generation being representative of the area but remaining at a robust level for the future year assessment.

[1] Factor calculated using jobs and floor space data contained within the TRICS database.

Table 3.3 Journeys to Work Mode (2001 Census)

Mode	Area		Difference from National Average
	England	Garrison	
Bicycle	3%	5%	2%
On Foot	12%	28%	16%
Train	5%	0%	-5%
Bus	9%	3%	-6%
Car	**65%**	**60%**	**-5%**

3.7 Development Sites

A total of 51 potential development sites have been put forward by Richmondshire District Council to be included in the assessment as a base for modelling purposes. The sites were drawn from the Strategic Housing and Economic Land Availability Assessment (SHELAA) published by RDC in 2010. The use of these sites does not presume their eventual allocation or development. The sites have been split into the following categories:

- Residential (including apartments)
- Retail
- Professional Services
- Bars/Restaurants
- Office
- Storage
- Hotel
- Leisure

The sites are spread across Catterick Garrison, Brompton-on-Swale, Catterick Village, and Scorton. The full list of development sites supplied for this assessment is shown in Appendix B.

3.7.1 Catterick Garrison Ministry of Defence (MoD) Development

In Catterick Garrison there are proposals to build residential developments for soldiers wishing to live off site (or off barracks). This is part of the proposals to add military personnel to existing MoD employment sites in the Garrison. The changes to employment sites (barracks) with additional personnel living on site will not be directly included in the modelling assessment as the majority of soldiers will live on site, thus generating no additional light vehicular traffic in the AM peak.

Soldiers living off site but within the Garrison area will be mostly living in family accommodation and will therefore be accounted for when assessing the MoD residential sites. The model cannot account for additional MoD trips to or from areas outside the extents of the model, as it is not possible, given the current available information, to project this. This does mean however that in the future there may be a possible change in travel patterns for military staff.

A list of MoD residential developments proposed for Catterick Garrison is shown in Table 3.4.

Table 3.4 Ministry of Defence Residential Developments in Catterick Garrison Area

Development Site		Development Size (Ha) or GFA (m^2)	Number of Dwellings	Trips In	Trips Out
Haig Road (MoD H/01)		1.60 Ha	43	7	18
Plumer Road (MoD H/02)		7.80 Ha	209	32	86
Richmond Road (MoD H/05)		8.90 Ha	239	36	98
Pinhill Messes (MoD H/13) and DSDA TMP (MoD H/14)		4.30 Ha	115	17	47
DKB (MoD H/12)		4.80 Ha	129	20	53
Harden Barracks (MoD H/11)		4.00 Ha	107	16	44
West of Harden Barracks	MoD H/10	1.00 Ha	27	4	11
	MoD H/09	2.30 Ha	62	9	25
Horne Road	MoD H/18	0.70 Ha	19	3	8
	MoD H/17	3.50 Ha	94	14	39
	MoD H/19	2.10 Ha	56	9	23
	MoD H/20	3.90 Ha	105	16	43
Land off Loos Road	MoD H/22	3.50 Ha	94	14	39
	MoD H/23	0.70 Ha	19	3	8
	MoD H/21	3.10 Ha	83	13	34

3.7.2 Other Open Market Development in Catterick Garrison Area

Open Market development, consisting of a mixture of residential and employment, will be included in Catterick Garrison, Hipswell, Colburn and Walkerville.

Employment opportunities will be provided in the Colburn area, with a new business park and office and storage units. The Colburndale development has already been assessed with a Transport Assessment by BWB Consulting. Construction of this site and associated highways improvements was due to start in 2010 and so this would have been included in the 2011 Baseline Scenario. Construction has now been delayed until 2012 and therefore all development will occur after the production of the Baseline Scenario and hence is only included in the 2026 Do Minimum and Do Something Scenarios.

Additionally, the town centre area will be redeveloped with new opportunities for retail, professional services, restaurants and bars, offices, a hotel, leisure centre, and additional housing.

The Open Market developments in Catterick Garrison are listed in Table 3.5

Table 3.5 Open Market Developments in Catterick Garrison Area

Development Site		Development Type	Development Size (Ha) or GFA (m^2)	Number of Dwellings or Jobs	Trips In	Trips Out
Catterick Road		Residential	1.47 Ha	47	7	19
Old sports field, Catterick Road		Residential	3.40 Ha	102	16	42
		Residential	0.66 Ha	20	3	8
Somerset Close (MoD H/04)		Residential	1.10 Ha	44	7	18
Gough Road (MoD H/03)		Residential	1.30 Ha	40	6	16
Coronation Park (MoD H/07)		Residential	0.60 Ha	20	3	8
Catterick Road	MoD H/08	Residential	0.20 Ha	10	2	4
	MoD H/16	Residential	3.80 Ha	130	20	53
Sour Beck (MoD H/15)		Residential	2.00 Ha	20	3	8
Belton Park		Residential	0.24 Ha	7	1	3
Richmond Park		Residential	1.87 Ha	48	7	20
Town Centre Redevelopment		Flats	14800 m^2	183	26	54
		Retail	6148 m^2	339	301	245
		Professional Services	1748 m^2	97	85	70
		Restaurant	1942 m^2	107	95	77
		Office	1945 m^2	107	56	6
		Hotel	3270 m^2	181	7	20
		Leisure	4690 m^2	259	44	31
Colburn Grange		Residential	16.28 Ha	488	74	201
		Residential	6.35 Ha	190	29	78
Colburn Business Park 2		Office	6800 m^2	615	195	22
Site to the south of Colburn Business Park		Residential	117.90 Ha	498	76	205
		Office	17020 m^2	1540	487	56
		Storage	29000 m^2	730	101	72
Colburndale (Pipeworks)		Residential	n/a	285	43	117
		Office	12900 m^2	712	369	43
		Storage	16150 m^2	892	56	40
Hipswell Croft		Residential	3.04 Ha	91	14	37
Unadopted Growth Strategy		Residential	15.19 Ha	228	35	94

3.7.3 Development Sites in Primary Service Villages

Two developments are proposed for Brompton-on-Swale, both on Gatherley Road. These consist of residential housing, and office and storage facilities. Catterick village has two sites for proposed development located between the A1 and Leeming Lane and two sites have been proposed in Scorton for residential development to the south side of Clara Meyer, and south of St Mary's Roman Catholic School. Details are shown in Table 3.6 below.

Table 3.6 Developments in Primary Service Villages

Development Site	Development Type	Development Size (Ha) or GFA (m^2)	Number of Dwellings or Jobs	Trips In	Trips Out
Gatherley Road Phase 2	Residential	19.41 Ha	200	30	82
Land to the east of Gatherley Road	Office	4900 m^2	271	140	16
	Storage	13400 m^2	740	47	33
Land South West of Bishops Way	Residential	0.97	31	5	13
Land to the North of Tunstall Road Bridge	Residential	10.69	59	9	24
Clara Meyer, South Side	Residential	0.03	1	1	1
Land south of St Mary's RC School	Residential	2.92	88	13	36

3.8 Heavy Goods Vehicles (HGV) and Military Vehicles

HGV movements associated with the development proposals have been calculated using the TRICS database, following the same methodology and criteria as detailed earlier. Trip rates have been calculated for Public Service Vehicles (PSV) and Ordinary Goods Vehicles (OGV). Some surveys were unable to supply information for OGV or PSV. Where this data was not readily available, trip rates for a similar land use have been adopted. The 2009 national Road Traffic Forecasts (RTF09) supplied by the DfT have been used to calculate a general growth rate for HGVs between 2009 and 2026.

Additional HGVs (including heavy military vehicles) have been modelled in 2026 to account for the influx of four additional military units to the Catterick Garrison MoD employment areas. A HGV trip rate per unit has been calculated based on existing observed traffic counts and the known number of resident military units currently in Catterick Garrison. This trip rate has then been applied to the additional four units to calculate the associated number of additional HGVs. These additional HGVs have been distributed on a 3:1 basis between two existing MoD employment sites, land west of Munster Barracks Camp and vicinity of Loos Road.

The junction improvements proposed later in this report do allow for large MoD vehicles either through standard junction movements/manoeuvres or through the use of traffic management. MoD's preferred main route along the A6136 to and from the A1 northern junction, avoiding Catterick Village, can be achieved by these vehicles without any specific traffic management measures.

3.9 Assessment Scenarios

Five scenarios have been modelled, these are

- Scenario 1 – Baseline Scenario, 2011, Existing Network.
- Scenario 2a (Do Minimum) – Full LDF and MoD Development Scenario, 2026, Committed Future Network.
- Scenario 2b (Do Something) – Full LDF and MoD Development Scenario, 2026, Proposed Future Network with Improved Capacity.
- Scenario 3a (Leeming Bar to Barton A1 Upgrade) – Full LDF and MoD Development Scenario, 2026, Committed Do Minimum Future Network and A1 Upgrade.
- Scenario 3b (Leeming Bar to Barton A1 Upgrade) – Full LDF and MoD Development Scenario, 2026, Do Something Future Network and A1 Upgrade.

For each scenario the SATURN model has been used to assign traffic flows to the highway network for analysis and to extract traffic flows to be used for detailed junction capacity assessments using PICADY, ARCADY and LINSIG. The model has also been used to assess the change in flows on the network to identify potential route choice changes and rat-running which may occur in the future.

The following chapters describe the assessment scenarios and the results of the modelling work in more detail. It was found that the remedial measures to increase network capacity proposed in Scenario 2b were suitable for accommodating the proposed full level of LDF development. Consequently, there was no requirement to model a scenario with an optimum level of reduced LDF development.

4 Scenario 1 – Baseline Scenario

4.1 Overview

This chapter looks at the first scenario to be tested, Scenario 1, which shall be referred to as the 'Baseline'. The Baseline Scenario models existing development traffic on the existing network and determines the existing levels of stress on the ten key junctions. The results from this scenario provide a Baseline against which any future development can be assessed. Future year assessments must ensure junctions operate with a ratio of flow to capacity no worse than what has currently been assessed. To achieve this, the existing 2009 traffic model has been updated to represent 2011 traffic conditions. Firstly, the network was updated to include any junction modifications or new developments that have occurred since 2009. Then secondly, TEMPRO growth factors have been applied to the matrices to grow the traffic from 2009 to 2011. The Baseline Scenario does not contain any specific development sites built after 2009.

4.2 Baseline Network

The Baseline network remains as per the 2009 traffic model, as no major network changes have taken place. Since building the 2009 traffic model, Jacobs have received more up-to-date signal timing data for the White Shops junction. As such, this junction has been updated with the latest data. Table 4.1 shows the updated signals data for White Shops; the inter-green timings are shown in brackets.

Table 4.1 Signal Timing Data at the White Shops Junction (Intergreen Times)

Data	Signal Timings (seconds)				
	Stage 1	Stage 2	Stage 3	Stage 4	Cycle Time
2009	30 (9)	7 (7)	13 (5)	13 (6)	90
2011	43 (11)	7 (9)	14 (6)	10 (6)	106

4.3 Matrices (No Development)

The light vehicles matrix has been growthed from the 2009 matrix used in the traffic model to 2011 using appropriate TEMPRO factors adjusted for fuel and income. The combined fuel and income factor was derived from WebTAG 3.5.6 and was calculated to be 1.0441. The heavy vehicles matrix has been growthed using a single National Traffic Model (NTM) growth factor. Table 4.2 shows this growth.

Table 4.2 Traffic Growth 2009 to 2011 (% Growth)

	Light Vehicles	Heavy Vehicles	Matrix Total
2009	8,298	1,269	9,567
2011	8,911	1,278	10,189
Growth 2009 - 2011	613 (7.4%)	9 (0.7%)	622 (6.5%)

4.4 Baseline Junction Capacity Analysis

The ten junctions were assessed with the results shown below in Table 4.3. The last column of the table shows how the junction performs as a whole. The performance of each arm is presented in the third column, with arms over 85% capacity highlighted.

Table 4.3 Baseline 2011 Junction Capacity Analysis

Junction	Arm Name	RFC per Arm	Overall Junction RFC
Scorton Crossroads	A - B6271 Scorton Road	101.1	84.6
	B - A6136 Gatherley Road NB	75.2	
	C - B6271 Station Road	93.8	
	D - A6136 Gatherley Road SB	81.3	
Gatherley Road	A - A6136 Gatherley Road NB	0.0	13.7
	B - Bridge Road	47.5	
	C - A6136 Gatherley Road SB	0.7	
Catterick Bridge	A - A6136 Leeming Lane	0.0	96.9
	B - A6136 Catterick Road	117.7	
	C - A6136 Gatherley Road	80.1	
Brough St Giles	A - A6136 Catterick Road WB	34.3	24.8
	B - A6136 Catterick Road EB	26.5	
	C - Cookson Way	8.8	
First Avenue	A - A6136 Catterick Road WB	N/A	N/A
	B - Colburndale Development	N/A	
	C - A6136 Catterick Road EB	N/A	
	D - First Avenue	N/A	
Colburn Lane	A - A6136 Catterick Road WB	48.4	49.3
	B - Colburndale Development	N/A	
	C - A6136 Catterick Road EB	80.3	
	D - Colburn Lane	32.7	
White Shops	A - A6136 Catterick Road WB	68.8	64.8
	B - Horne Road	83.7	
	C - A6136 Catterick Road EB	49.7	
	D - Byng Road	82.7	
Camp Centre	A - A6136 Catterick Road	49.0	45.0
	B - Scotton Road	49.3	
	C - Leyburn Road	37.0	
	D - A6136 Richmond Road	44.4	
Town Centre	A - A6136 Richmond Road SB	51.6	48.0
	B - A6136 Richmond Road NB	42.0	
	C - Gough Road	51.3	
Hipswell Crossroads	A - Hipswell Road WB	16.9	26.1
	B - A6136 Richmond Road NB	29.6	
	C - Hipswell Road EB	16.8	
	D - A6136 Richmond Road SB	41.9	

Looking at the overall RFC, it shows that all junctions are operating below capacity in the Baseline, although Catterick Bridge is approaching capacity. Closer inspection reveals that there is a capacity problem on one arm at Scorton Crossroads, with another arm approaching capacity, and Catterick Bridge has one arm over capacity.

White Shops is shown to be performing under capacity, but two arms are approaching the 85% threshold. The perceived level of congestion at the White Shops junction is worse than that assessed here. On-site observations at this junction show that the queues at the signals include stationary vehicles and also rolling vehicles in a 'rolling queue'. The modelling software used to undertake the assessment of the junction cannot measure rolling queues but the static queues that it calculates have been confirmed by on-site observations. These static queues were observed to clear when given a green light at the signals and that is why this junction has been assessed to be performing under capacity

The First Avenue junction has not been assessed for the Baseline Scenario, but would operate with a RFC below 85% due to low amount of flow from the minor arms.

4.5 Baseline Queue Length Analysis

A queue length analysis was undertaken for the two junctions with arms operating over the 85% threshold and the White Shops junction. These results are shown in Table 4.4. The arms of the junctions operating over or near to capacity are shown in bold type. As explained previously, the models can only predict static queues, but on-site observations show rolling queues can occur beyond those listed below.

Table 4.4 Baseline 2011 Queue Length Analysis

Junction and Arm		Queue (Vehicles)	Delay (s/vehicle)
Scorton Crossroads	A - B6271 Scorton Road	**18**	**173**
	B - A6136 Gatherley Road northbound	13	100
	C - B6271 Station Road	**15**	**112**
	D - A6136 Gatherley Road southbound	12	65
Catterick Bridge	A - A6136 Leeming Lane	0	0
	B - A6136 Catterick Road	**28**	**145**
	C - A6136 Gatherley Road	4	21
White Shops	A - A6136 Catterick Road westbound	15	33
	B - Horne Road	9	80
	C - A6136 Catterick Road eastbound	10	29
	D - Byng Road	8	85

4.6 Baseline Scenario Summary

The objective of this study is to ensure that where appropriate the future junction operation shall be under capacity or the same or better than that assessed in the Baseline Scenario. The results from the Baseline Scenario show that future junction RFCs should be less than 85% on the nine junctions assessed to have a 'green light', whereas, for the Catterick Bridge junction, which was assessed to have a 'amber light', the future RFC should be less than 100%.

It should be noted that the Baseline assessment does not account for congestion which occurs on a Friday evening peak or as part of the racecourse or market day events at the weekend. This has not been assessed as developers cannot be expected to contribute towards improvements to the existing road capacity to mitigate against these events which are not associated with their developments.

The results of the Baseline assessment correlate with on-site observations.

5 Scenario 2a – Full Development Do Minimum Scenario

5.1 Overview

This chapter looks at the second scenario to be tested, Scenario 2a, which shall be referred to as the 'Do Minimum'. The Do Minimum scenario includes a range of potential developments to meet proposed LDF targets as set out in section 3 along with all currently committed highways improvements. This scenario models the total amount of development for open market residential and employment sites and military related sites and acts as a worse case scenario for traffic congestion on the network. The total level of development is summarised in Table 5.1.

Table 2 Total Modelled Open Market and Military Related Development in the Future Year Scenario

Table 5.1 Total Proposed Development to 2026 (MoD and LDF)

Development Type	Total Area
Residential	4231 dwellings
Retail	GFA = 7,896 m^2
Office and Storage	GFA = 102,115 m^2
Hotel and Leisure	GFA = 9,902 m^2

5.2 Do Minimum Network

The Do Minimum network consists of the Baseline network, modified with proposed improvements. Those improvements are summarised below in Table 5.2.

Table 5.2 Scheduled Highways Improvements in Catterick to 2026

Location	Improvement	Comment
White Shops Junction	Improved Signal Timings and addition of right turn lanes on Catterick Road.	Funded as part of the Colburndale and Town Centre developments.
First Avenue Junction	New signalised junction.	Part of Colburndale development.
Colburn Lane Junction	Fourth arm added to junction and mini roundabout upgraded to a compact.	Part of Colburndale development.
Town Centre Junction	Improved signal timings and addition of left turn filter lane on Richmond Road.	To be updated upon completion of Tesco, Leisure Centre and Town Centre LDF Development.

The proposed improvements for White Shops, Colburn Lane and First Avenue have been included in the model. Changes have been recommended to the proposals for the Town Centre junction. As such, the proposed design has been modified before inclusion in the model. The proposed signal timings and phase order for the Town Centre junction have been improved to add capacity. It is recommended that the signals run on a four stage cycle of 90 seconds, rather than a three stage cycle of 60 seconds.

5.3 Matrices (Full Development)

The matrices have been updated to include trips being generated by the new development zones. Trip rates have been acquired from TRICS, whilst the distribution is based on similar existing zones and existing trip purposes.

Trips from MoD residential sites stay within the model area and are split by a 3:1 ratio between two existing MoD employment sites, land west of Munster Barracks and vicinity Loos Road. Open Market and service village development trips are both internal and external to the model area.

Matrices for light vehicles have been growthed using the adjusted TEMPRO factors, which have been further adjusted to account for future rises in fuel prices and income.

Matrices for heavy vehicles have been growthed using government standard National Traffic Model (NTM) factors. Table 5.3 shows the total number of vehicles in 2009 and in 2026 and the growth in traffic between 2009 and 2026 as a result of the development sites.

Table 5.3 2009 and 2026 Vehicles Numbers and Traffic Growth 2009 to 2026 (% Growth)

Year	Light Vehicles	Heavy Vehicles	Matrix Total
2009	8,298	1,269	9,567
2026	12,715	1,703	14,418
Growth 2009 - 2026	4,417 (53.2%)	434 (34.2%)	4,851 (50.7%)

5.4 Do Minimum Junction Capacity Analysis

The ten junctions were assessed for the Do Minimum scenario and the results are shown in Table 5.4. All junctions show an increase in RFC when compared to the Baseline. The most severely affected junctions are Catterick Bridge (144%) and White Shops (119%), which see an overall increase in RFC of 47.5% and 54.1% respectively. Scorton Crossroads and First Avenue are also affected and are forecast to operate over capacity in 2026 with the full level of LDF development. Camp Centre also sees an increase in RFC and is forecast to perform at 87% which is 'approaching capacity'.

Table 5.4 Scenario 2a Do Minimum 2026 Junction Capacity Analysis

Junction	Arm Name	Do Minimum 2026 Full Development RFC per Arm	Do Minimum 2026 Full Development Overall Junction RFC	Change in Overall Junction RFC relative to Baseline
Scorton Crossroads	A - B6271 Scorton Road	131.2	106.8	↑
	B - A6136 Gatherley Road NB	97.0		
	C - B6271 Station Road	106.9		
	D - A6136 Gatherley Road SB	105.9		
Gatherley Road	A - A6136 Gatherley Road NB	0.0	17.6	↑
	B - Bridge Road	63.0		
	C - A6136 Gatherley Road SB	2.1		
Catterick Bridge	A - A6136 Leeming Lane	0.0	144.3	↑
	B - A6136 Catterick Road	211.3		
	C - A6136 Gatherley Road	81.9		
Brough St Giles	A - A6136 Catterick Road WB	62.9	45.5	↑
	B - A6136 Catterick Road EB	42.0		
	C - Cookson Way	24.0		
First Avenue	A - A6136 Catterick Road WB	113.8	105.8	↑
	B - Colburndale Development	60.7		
	C - A6136 Catterick Road EB	113.7		
	D - First Avenue	70.5		
Colburn Lane	A - A6136 Catterick Road WB	70.2	62.3	↑
	B - Colburndale Development	19.1		
	C - A6136 Catterick Road EB	78.6		
	D - Colburn Lane	58.3		
White Shops	A - A6136 Catterick Road WB	132.7	118.9	↑
	B - Horne Road	131.8		
	C - A6136 Catterick Road EB	98.3		
	D - Byng Road	127.2		
Camp Centre	A - A6136 Catterick Road	88.3	86.8	↑
	B - Scotton Road	100.9		
	C - Leyburn Road	67.6		
	D - A6136 Richmond Road	90.5		
Town Centre	A - A6136 Richmond Road SB	69.1	70.7	↑
	B - A6136 Richmond Road NB	71.2		
	C - Gough Road	72.5		
Hipswell Crossroads	A - Hipswell Road WB	33.0	38.0	↑
	B - A6136 Richmond Road NB	41.0		
	C - Hipswell Road EB	21.1		
	D - A6136 Richmond Road SB	58.1		

5.5 Do Minimum Queue Length Analysis

Queue length analysis of the five junctions forecast to operate over the 85% threshold in 2026 has been undertaken, the results of which are shown in Table 5.5. The arms of the junctions operating over capacity are shown in bold type. The queue lengths highlight the extent to which certain junctions are affected by the increase in traffic. The queue lengths and delay from the Baseline Scenario are included for comparison.

Table 5.5 Scenario 2a Do Minimum 2026 Queue Length Analysis

Junction and Arm		Baseline 2011		Do Minimum 2026	
		Queue (vehicles)	Delay (s/vehicle)	Queue (vehicles)	Delay (s/vehicles)
Scorton Crossroads	A - B6271 Scorton Road	**18**	**173**	**59**	**557**
	B - A6136 Gatherley Road northbound	13	100	36	323
	C - B6271 Station Road	15	112	**27**	**233**
	D - A6136 Gatherley Road southbound	12	65	**34**	**208**
Catterick Bridge	A - A6136 Leeming Lane	0	0	0	0
	B - A6136 Catterick Road	**28**	**145**	**296**	**1238**
	C - A6136 Gatherley Road	4	21	4	27
First Avenue	A - A6136 Catterick Road westbound	-	-	**100**	**291**
	B - Colburndale Development	-	-	3	76
	C - A6136 Catterick Road eastbound	-	-	**94**	**280**
	D - First Avenue	-	-	4	101
White Shops	A - A6136 Catterick Road westbound	15	33	**176**	**537**
	B - Horne Road	9	80	**77**	**546**
	C - A6136 Catterick Road eastbound	10	29	37	91
	D - Byng Road	8	85	**46**	**519**
Camp Centre	A - A6136 Catterick Road	1	4	7	16
	B - Scotton Road	1	6	**19**	**41**
	C - Leyburn Road	1	5	2	10
	D - A6136 Richmond Road	1	5	8	19

5.6 Do Minimum Traffic Flow Analysis

Due to the increase in traffic which will cause junctions on the A6136 to operate over capacity, some traffic will find an alternative route to avoid the congestion. As a result, 'rat running' will occur on Tunstall Road through Tunstall Village. This increase in traffic will be quite significant without the design of appropriate mitigation measures to improve capacity at the key junctions on the A6136.

5.7 Do Minimum Scenario Summary

The capacity analysis shows five junctions; Scorton Crossroads, Catterick Bridge, First Avenue, White Shops, and Camp Centre; are forecast to operate over 85% capacity in 2026. Therefore, it is recommended that mitigation measures are developed for these junctions to improve capacity and enable them to accommodate the additional development traffic resulting from the implementation of the LDF strategy.

The results also show that the proposed signalised junctions that will be implemented as part of the Colburndale development are forecast to operate over capacity if the full level of LDF development is in place and mitigation measures are not implemented. The proposed roundabout at Colburn Lane and improved signals at the Town Centre have the spare capacity necessary to accommodate the additional traffic as a result of the LDF development.

The mitigation measures to improve the capacity issues in the Do Minimum scenario are discussed in detail in the following sections of this report.

6 Scenario 2b – Full Development Do Something Scenario

6.1 Overview

The aim of the Do Something scenario is to devise low cost mitigation measures to improve the over capacity junctions highlighted from the Do Minimum scenario assessment. To keep the cost of these measures low, the designs are constrained to the existing highways boundary where possible, although in certain cases junctions that extend outside of the highways boundary are also proposed. This scenario assessment will determine whether the junction improvements are able to accommodate the full amount of development traffic.

This assessment makes use of the same amount of development traffic as that used in the Do Minimum scenario (Table 5.3).

6.2 Proposed Junction Mitigation Measures

6.2.1 Scorton Crossroads

The Scorton Crossroads junction is operating at just over capacity on one arm in the Baseline 2011 scenario. By 2026 with the full amount of development traffic, the junction is operating over capacity on three arms.

The existing junction operates as a four arm, signalised crossroads, with each phase running in a separate dedicated stage to allow unopposed movement during the green time. Two mitigation options were considered at this junction, a revised signals layout and a roundabout. Table 6.1 displays the results of the mitigation options in terms of a percentage RFC per arm, and shows a roundabout would significantly improve the performance of this junction.

Table 6.1 Scorton Crossroads Mitigation Options Comparison

Arm	Unmitigated Signals RFC	Mitigated Signals RFC	Roundabout RFC
A - B6721 Station Road	131.2	94.4	43.9
B - A6136 Gatherley Road southbound	97.0	77.6	32.6
C - B6721 Scorton Road	106.9	94.8	53.5
D - A6136 Gatherley Road northbound	105.9	94.2	31.2

It is therefore recommended that a roundabout is installed at this junction to improve capacity.

6.2.2 Catterick Bridge

The Catterick Bridge junction is shown to be operating at well over its capacity by 2026. The junction currently operates as a priority intersection, with Catterick Road as the minor arm and Leeming Lane and Gatherley Road accommodating the major flow. The delay lies with traffic waiting to turn from the minor arm onto either of the major arms. Four proposals have been considered for this junction within the existing highways boundary:

- A change of priority;
- Full signalisation of all approaches;
- A mini roundabout; and
- A normal roundabout.

Changing the priority at this junction offered little to no improvement over the existing junction layout. The other three mitigation measures are compared against the existing junction layout in Table 6.2. Analysis of the RFCs shows the normal roundabout is the best option for accommodating the full amount of development traffic at Catterick Bridge. The proposed design may require a small amount of land take, however, a Land Registry search would be required to determine the exact boundaries. It will also impact on the exit of the racecourse car park and access to the property to the west of the junction.

Table 6.2 Catterick Bridge Mitigation Options Comparison

Arm	Existing RFC	Signals RFC	Mini Roundabout RFC	Normal Roundabout RFC
A - A6136 Leeming Lane	0.0	133.1	91.6	71.2
B - A6136 Catterick Road	211.3	133.6	154.8	83.8
C - A6136 Gatherley Road	81.9	134.5	125.9	94.7

All values show % RFC

6.2.3 First Avenue

The signalised junction proposed for First Avenue as part of the Colburndale development has been shown to be unsuitable for accommodating traffic levels in 2026. Without mitigation, queues on Catterick Road (eastbound) from the signals would backup onto the roundabout at Colburn Lane.

Optimisation of the signals at First Avenue was not found to be effective. Instead it is proposed that the signals be replaced with a compact roundabout, similar in design to the proposed roundabout at Colburn Lane. This is in line with the Design Manual for Roads and Bridges (DMRB) guidance, TD 16/07 paragraph 4.8 states that "*where several roundabouts are to be installed on the same route, they should be of similar design in the interests of route consistency and hence safety, to the extent*

that this is possible with the traffic volumes concerned". Traffic flows are similar at both junctions and they are located in close proximity.

ARCADY analysis of the design shows that a compact roundabout installed at First Avenue would operate below capacity for all arms and for the full amount of development traffic modelled. Table 6.3 shows the results.

Table 6.3 First Avenue Mitigation Option

Arm	Signals RFC	Compact Roundabout RFC
A - A6136 Catterick Road westbound	113.8	91.1
B - Colburndale development	60.7	16.2
C - A6136 Catterick Road eastbound	113.7	95.4
D - First Avenue	70.5	16.1

6.2.4 White Shops

The White Shops junction is shown to be operating over capacity in 2026. This junction currently operates on a four stage cycle with the main road (A6136 Catterick Road) traffic phases running together in one stage with right turning vehicles encroaching into the junction and turning in gaps or during the intergreen period. The two unopposed side road phases run in separate dedicated stages.

An improvement is proposed for this junction as part of the Do Minimum scenario, however this proposal cannot accommodate the full level of LDF development. As a consequence of the re-designed signals layout, there is no room for further engineering work to be carried out within the existing highways boundary. A proposal requiring land taken from the neighbouring MoD sites would be used to replace the signals with a normal roundabout. A comparison of the forecast RFCs in Table 6.4 shows that this improvement would solve any potential capacity issues at this junction.

Table 6.4 White Shops Mitigation Option

Arm	Proposed Signals RFC	Roundabout RFC
A - A6136 Catterick Road westbound	134.9	89.7
B - Horne Road	131.8	73.3
C - A6136 Catterick Road eastbound	99.2	84.6
D - Byng Road	127.2	58.6

6.3 Do Something Junction Capacity Analysis Summary

The measures proposed in this chapter have been shown to increase capacity at the affected junctions. Each proposed measure is described in more detail in chapter 9. Table 6.5 shows the mitigation measure proposed and the results of the Do Something scenario against the Baseline Scenario assessment.

Table 6.5 Scenario 2b Do Something 2026 Junction Capacity Analysis

Junction	Arm Name	RFC per Arm	Overall Junction RFC	Mitigation Measure Proposed	Change in Overall Junction RFC relative to Baseline
Scorton Crossroads	A - B6271 Scorton Road	43.9	32.2	Roundabout	↓
	B - A6136 Gatherley Road NB	32.6			
	C - B6271 Station Road	53.5			
	D - A6136 Gatherley Road SB	31.2			
Gatherley Road	A - A6136 Gatherley Road NB	0.0	0.7	None	↓
	B - Bridge Road	1.2			
	C - A6136 Gatherley Road SB	1.2			
Catterick Bridge	A - A6136 Leeming Lane	71.2	84.3	Roundabout	↓
	B - A6136 Catterick Road	83.8			
	C - A6136 Gatherley Road	94.7			
Brough St Giles	A - A6136 Catterick Road WB	60.1	51.8	None	↑
	B - A6136 Catterick Road EB	55.7			
	C - Cookson Way	28.2			
First Avenue	A - A6136 Catterick Road WB	91.1	74.2	Roundabout	↑
	B - Colburndale Development	16.2			
	C - A6136 Catterick Road EB	95.4			
	D - First Avenue	16.1			
Colburn Lane	A - A6136 Catterick Road WB	69.4	66.3	None	↑
	B - Colburndale Development	15.2			
	C - A6136 Catterick Road EB	96.0			
	D - Colburn Lane	53.5			
White Shops	A - A6136 Catterick Road WB	89.7	71.5	Roundabout	↑
	B - Horne Road	73.3			
	C - A6136 Catterick Road EB	84.6			
	D - Byng Road	58.6			
Camp Centre	A - A6136 Catterick Road	89.1	77.6	None	↑
	B - Scotton Road	75.8			
	C - Leyburn Road	60.7			
	D - A6136 Richmond Road	79.9			
Town Centre	A - A6136 Richmond Road SB	68.9	67.8	None	↑
	B - A6136 Richmond Road NB	63.3			
	C - Gough Road	72.2			
Hipswell Crossroads	A - Hipswell Road WB	38.3	38.7	None	↑
	B - A6136 Richmond Road NB	39.4			
	C - Hipswell Road EB	21.8			
	D - A6136 Richmond Road SB	57.0			

All junctions are forecast to operate below capacity with the recommended improvements in place. Some arms on individual junctions are forecast to operate at a RFC greater than 85%, but still operate below 100%. As a whole, there is no detrimental impact forecast to the junctions assessed with the full LDF implementation. The Camp Centre junction has no mitigation proposed, but mitigation at surrounding junctions has improved the RFC in the Do Something scenario over the Do Minimum scenario.

6.4 Do Something Queue Length Analysis

Queue length analysis has also been undertaken for the Do Something assessment. Table 6.6 shows the results. The over capacity arms are shown in bold type, and queues worse than those assessed in the Baseline Scenario are shown with a grey background. This analysis shows that the mitigation measures at Scorton Crossroads and White Shops have improved queuing and delay much further than Baseline levels. It also shows that overall queuing and delay at Camp Centre is worse than the Baseline, even though the junction operates below capacity. However, the average vehicle at Camp Centre is delayed by only 11 seconds in 2026.

Table 6.6 Scenario 2b Do Something 2026 Queue Length Analysis

	Arm	Baseline 2011		Do Something 2026	
		Queue (vehicles)	Delay (s/vehicle)	Queue (vehicles)	Delay (s/vehicle)
Scorton Crossroads	A - B6271 Scorton Road	**18**	**173**	1	6
	B - A6136 Gatherley Road northbound	13	100	1	2
	C - B6271 Station Road	15	112	1	6
	D - A6136 Gatherley Road southbound	12	65	1	3
Catterick Bridge	A - A6136 Leeming Lane	0	0	2	8
	B - A6136 Catterick Road	**28**	**145**	5	11
	C - A6136 Gatherley Road	4	21	12	20
First Avenue	A - A6136 Catterick Road westbound	-	-	9	16
	B - Colburndale Development	-	-	0	5
	C - A6136 Catterick Road eastbound	-	-	14	20
	D - First Avenue	-	-	0	6
White Shops	A - A6136 Catterick Road westbound	15	33	8	14
	B - Horne Road	9	80	3	8
	C - A6136 Catterick Road eastbound	10	29	5	11
	D - Byng Road	8	85	1	10
Camp Centre	A - A6136 Catterick Road	1	4	7	14
	B - Scotton Road	1	6	3	13
	C - Leyburn Road	1	5	2	8
	D - A6136 Richmond Road	1	5	4	10

6.5 Do Something Traffic Flow Analysis

By increasing capacity in the Do Something scenario at the junctions along the A6136, the 'rat running' through Tunstall Village will reduce (in comparison to the Do Minimum), as the A6136 becomes a more attractive route.

The 2026 Do Something flows through Tunstall Village would be equivalent to existing 2011 traffic flows on the A6136 Catterick Road around the Colburn area. This equates to one vehicle every 9 seconds eastbound (6 vehicles per minute) and one vehicle every 7 seconds westbound (8 vehicles per minute).

6.6 Do Something Scenario Summary

The recommended mitigation measures are shown to improve capacity at the affected junctions to enable them to accommodate the full amount of LDF traffic. However, the mitigation options at White Shops extend beyond the existing highway boundary. Their implementation may require land from adjacent properties, subject to checks on land ownership in these areas. If the land take is not possible, trip reduction will be required through the removal of LDF development sites to ensure the junction operates below capacity, based on the assumptions adopted. Using the measures proposed in this chapter, a reduction in the scale of the LDF proposals is not required.

7 Scenario 3 – Leeming Bar to Barton A1 Upgrade

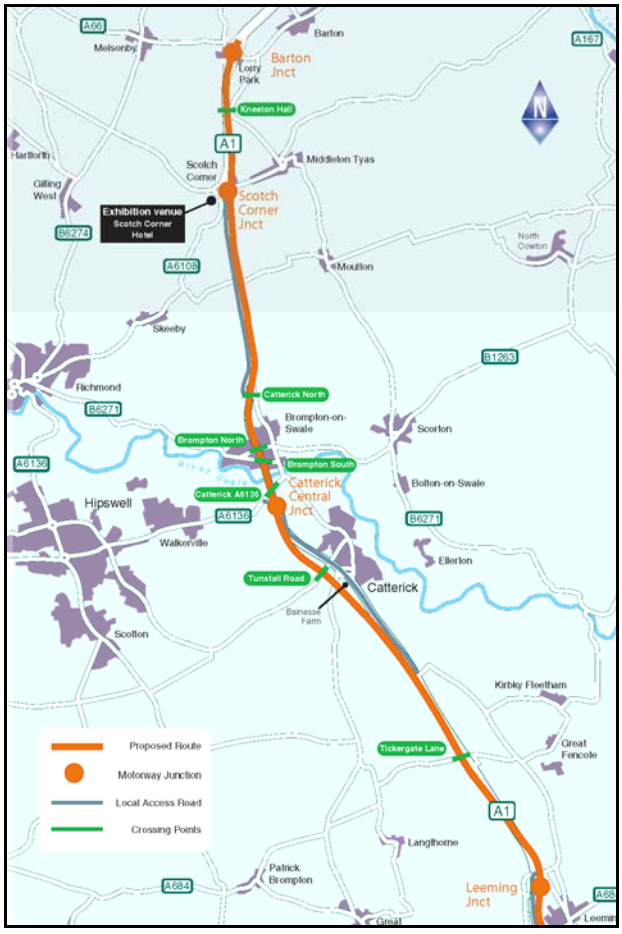
7.1 Overview

The A1 Leeming Bar to Barton upgrade scheme was cancelled on 26th October 2010 as part of the Coalition Government's Comprehensive Spending Review. Jacobs has been asked to model the alignment of the proposed A1 upgrade as a sensitivity test to assess its effect with the full level of LDF development.

7.2 Modelling Undertaken

In SATURN, the Do Minimum network has been modified to accommodate the proposed A1 upgrade. The existing A1 has been modelled with the characteristics of a rural three-lane motorway to represent the upgrade. Access to the A1 via the two existing junctions to the north and south of Catterick has been removed, with all traffic accessing the A1 via the proposed grade separated junction at a new Catterick Central junction. The proposed local access road has also been included, which links in with the old southern A1 junction and the new Catterick Central junction, and links Scotch Corner with the old northern A1 junction. The alignments have been based on the Highways Agency schematic shown in Figure 7.1.

Figure 7.1 A1 Leeming Bar to Barton Proposed Upgrade Scheme



7.3 Impact

It was thought that the A1 upgrade would assist in the deployment of the full LDF strategy by taking traffic away from the Catterick Bridge junction. With the A1 upgrade in place, traffic travelling from the Garrison to the A1 and visa-versa would no longer have to route through Catterick Bridge. The modelling shows this to be the case. However, whilst this traffic no longer uses Catterick Bridge, the removal of the two existing A1 junctions requires traffic travelling from areas to the east of Catterick to now route through Catterick Bridge to access the A1. The result is that there is a small reduction in traffic volumes at Catterick Bridge, but not the significant decrease that was expected.

A capacity assessment of the Do Minimum and Do Something junctions was undertaken with the new flows from this scenario. The results are shown in Table 7.1 with Scenario 2 Do Minimum and Do Something results as a comparison.

Table 7.1 Junction Capacity Assessment with A1 Upgrade

Junction	Baseline 2011 RFC	Do Minimum 2026 RFC	A1 Upgrade Do Minimum 2026 RFC	Do Something 2026 RFC	A1 Upgrade Do Something 2026 RFC
Scorton Crossroads	84.6	106.8	57.3	32.2	15.8
Gatherley Road	13.7	17.6	24.7	0.7	24.7
Catterick Bridge	96.9	144.3	125.0	84.3	68.2
Brough St Giles	24.8	45.5	57.3	51.8	57.3
First Avenue	N/A	105.8	115.9	74.2	65.7
Colburn Lane	49.3	62.3	75.4	66.3	75.4
White Shops	64.8	118.9	121.9	71.5	68.4
Camp Centre	45.0	86.8	85.8	77.6	85.8
Town Centre	48.0	70.7	72.9	67.8	72.9
Hipswell Crossroads	26.1	38.0	35.5	38.7	35.5

The results indicate that the A1 upgrade on its own would not enable the successful implementation of the full LDF development strategy. This is indicated by comparing the Scenario 2 and Scenario 3 Do Minimum results. Comparison of the Do Something results for Scenario 2 and Scenario 3 show that with the A1 upgrade in place, five junctions would see an improvement in performance, notably Catterick Bridge. The Camp Centre junction sees a decrease in performance, but this is due to an increased flow on Catterick Road.

This increased flow is a result of the A1 upgrade mitigating against rat running through Tunstall Village. There is still an increase in flow through Tunstall over the Baseline, but that increase is more in line with that expected from the level of development proposed. Between the Do Minimum scenario and the A1 Upgrade scenario, traffic accessing the A1 via Catterick Road increases from 254 vehicles to 472 vehicles, whilst traffic accessing the A1 via Tunstall Road reduces from 394 vehicles to 53 vehicles through Tunstall in the A1 upgrade scenario.

7.4 Scenario 3 Summary

The A1 upgrade is unlikely to go ahead in the LDF period but as it remains an aspiration for Richmondshire it has been modelled in this report as a sensitivity test. This sensitivity test shows that the deliverability of the A1 upgrade does not affect the amount of LDF development that can take place in Catterick Garrison. Instead this hinges upon the two junctions at White Shops and Catterick Bridge.

8 Summary of Scenario Assessments

Sections 4 to 7 show the estimated levels of capacity for each of the scenarios tested as part of the Strategic Transport Assessment.

The AM peak junction capacity levels have been measured using percentage RFC values to assess the total junction capacity and have been illustrated using a traffic light system for each of the ten key junctions on the A6136. The traffic light system works by giving a 'green light' if the RFC is less than or equal to 85%, an 'amber light' if the RFC is between 85% and 100% and a 'red light' if the RFC is more than 100%, as previously shown in Table 2.1.

Table 8.1 summaries the level of capacity at each junction for each of the three main scenarios modelled.

Table 8.1 Junction Assessment Summary per Junction

Junction	Baseline RFC	2026 Full LDF Development Do Minimum RFC	Proposed Do Something Mitigation	2026 Full LDF Development Do Something RFC	Change in RFC relative to Baseline
Scorton Crossroads	84.6	106.8	Roundabout	**32.2**	↓
Gatherley Road	13.7	17.6	None	**0.7**	↓
Catterick Bridge	96.9	144.3	Roundabout	**84.3**	↓
Brough St Giles	24.8	45.5	None	**51.8**	↑
First Avenue	N/A	105.8	Roundabout	**74.2**	↑
Colburn Lane	49.3	62.3	Roundabout	**66.3**	↑
White Shops	64.8	118.9	Roundabout	**71.5**	↑
Camp Centre	45.0	86.8	None	**77.6**	↑
Town Centre	48.0	70.7	None	**67.8**	↑
Hipswell Crossroads	26.1	38.0	None	**38.7**	↑

The results show that with the full level of development and the mitigation measures in place none of the key junctions will operate above 85% of their overall capacity. Each junction operates below 85% (green light) and therefore meets the requirements of the local highway authority (NYCC) and the aspirations of RDC for implementing the proposed LDF development sites within the Catterick Garrison area.

Whilst assessing the junctions as a whole, each arm of the junctions was also assessed for capacity issues specific to a single arm. The values in Table 8.2 represent the actual RFC values for each scenario and each junction, displayed per arm. As a relative measure, the cells or boxes with a green background show where the congestion is less than of Scenario 1, or less than 85%, and the cells or boxes with a pink background show where the congestion is greater than Scenario 1. Individual arms with capacities between 85% and 100% are highlighted amber and for capacities greater than 100% are highlighted red.

Table 8.2 Junction Assessment Summary per Arm

Junction	Arm Name	Baseline 2011 RFC	Do Minimum 2026 RFC	Do Something 2026 RFC*
Scorton Crossroads	A - B6271 Scorton Road	101.1	131.2	43.9
	B - A6136 Gatherley Road NB	75.2	97.0	32.6
	C - B6271 Station Road	93.8	106.9	53.5
	D - A6136 Gatherley Road SB	81.3	105.9	31.2
Gatherley Road	A - A6136 Gatherley Road NB	0.0	0.0	0.0
	B - Bridge Road	47.5	63.0	1.2
	C - A6136 Gatherley Road SB	0.7	2.1	1.2
Catterick Bridge	A - A6136 Leeming Lane	0.0	0.0	71.2
	B - A6136 Catterick Road	117.7	211.3	83.8
	C - A6136 Gatherley Road	80.1	81.9	94.7
Brough St Giles	A - A6136 Catterick Road WB	34.3	62.9	60.1
	B - A6136 Catterick Road EB	26.5	42.0	55.7
	C - Cookson Way	8.8	24.0	28.2
First Avenue	A - A6136 Catterick Road WB	N/A	113.8	91.1
	B - Colburndale Development	N/A	60.7	16.2
	C - A6136 Catterick Road EB	N/A	113.7	95.4
	D - First Avenue	N/A	70.5	16.1
Colburn Lane	A - A6136 Catterick Road WB	48.4	70.2	69.4
	B - Colburndale Development	N/A	19.1	15.2
	C - A6136 Catterick Road EB	80.3	78.6	96.0
	D - Colburn Lane	32.7	58.3	53.5
White Shops	A - A6136 Catterick Road WB	68.8	132.7	89.7
	B - Horne Road	83.7	131.8	73.3
	C - A6136 Catterick Road EB	49.7	99.2	84.6
	D - Byng Road	82.7	127.2	58.6
Camp Centre	A - A6136 Catterick Road	49.0	88.3	89.1
	B - Scotton Road	49.3	100.9	75.8
	C - Leyburn Road	37.0	67.6	60.7
	D - A6136 Richmond Road	44.4	90.5	79.9
Town Centre	A - A6136 Richmond Road SB	51.6	69.1	68.9
	B - A6136 Richmond Road NB	42.0	71.2	63.3
	C - Gough Road	51.3	72.5	72.2
Hipswell Crossroads	A - Hipswell Road WB	16.9	33.0	38.3
	B - A6136 Richmond Road NB	29.6	41.0	39.4
	C - Hipswell Road EB	16.8	21.1	21.8
	D - A6136 Richmond Road SB	41.9	58.1	57.0

* Green Shading = RFC is less than Baseline

Pink Shading = RFC is greater than Baseline

All Values Show % RFC

The results show that on an individual arm basis there are some junctions which will operate with a greater amount of congestion than in the Baseline. However, in each of these cases the arm in question will operate below capacity and therefore will experience only minimal congestion within the tolerances of the local highway authority (NYCC). On a whole junction basis each junction operates at a level below 85% capacity.

9 Engineering Solutions to Facilitate Development

9.1 Introduction

Sections 4 to 8 discuss the traffic impact on the highway network within the Catterick Garrison area by giving a commentary on the congestion at the ten key junctions in their existing format, committed Do Minimum format and with Do Something mitigation measures in place.

This section of the report describes the proposed mitigation measures for each junction in more detail. These improvement options, proposed where necessary to increase the capacity of the key junctions, fall into two categories:

- Immediately deliverable; and
- Not immediately deliverable (due to land take restraints).

The deliverable options will allow the layout or format of the junction to be changed without any land take outside of the highway boundary, and are therefore immediately 'deliverable' subject to funding availability.

It should be noted that the deliverable options are not necessarily the optimum in terms of delivering maximum capacity to each junction. This section of the report will also describe the range of improvement options which have been developed to provide the maximum realistic capacity at each junction but which take up land outside of the highway boundary.

These improvements are preliminary and indicative design options only and will require further investigation before consideration for final design. No account has been taken of potential utility diversions in either the design or the cost of the improvement and all costs are indicative and would require affirmation as part of a detailed design process.

A design contingency of 20% has been applied to each cost estimate to allow for the fact that at detailed design or construction there could be more elements to the construction that can't be anticipated this early in the design process. Availability of land or the cost of moving statutory undertakers' apparatus and utility diversions are not accounted for in this contingency.

9.2 Junctions Not Requiring Mitigation

The following six junctions were assessed and show no significant capacity problems with the full implementation of the LDF. As a result, no mitigation measures were required.

- Gatherley Road
- Brough St Giles
- Colburn Lane
- Camp Centre
- Town Centre
- Hipswell Crossroads

9.3 Junction Mitigation Options

The junction options described below have all been assessed in detail using relevant industry standard software packages (SATURN, ARCADY, PICADY and LINSIG). The options have been assessed for the worst case development traffic generated by the full MoD and LDF development scenario.

The costs given for each recommended junction option are indicative and do not include any costs which may arise as result of land purchase or a search which could identify statutory undertakers that may be affected by the proposals.

9.3.1 Scorton Crossroads

The existing junction operates as a four arm, signalised crossroads junction with four full traffic phases, one right turn indicative green arrow phase and six pedestrian phases. Each phase runs in a separate dedicated stage to allow unopposed movement during the green time. Two mitigation options were considered at this junction.

Improved Signals
The first consideration looked at a previous assessment of this junction, undertaken in July 2010 by North Yorkshire County Council. The assessment considered a revised set of timings and stage sequences and concludes the method of control can be improved at this junction. The revised method of control uses a five stage scenario which allows the two unopposed side road phases to run in separate dedicated stages. The main road southbound and northbound full green traffic phases run together in one stage with right turning vehicles encroaching into the junction and turning in gaps or during the intergreen period. A right turn overlap stage is provided for traffic turning right from Gatherley Road into Station Road. Four of the six pedestrian phases are facilitated within the first four stages in a “walk with traffic” strategy while the remaining two pedestrian facilities are catered for in an “all red to traffic, all pedestrian stage”. The proposed scenario has been modelled using a double cycle with the all-pedestrian stage activated every other cycle. This

double cycle has a 240 second cycle time. It has been discovered that the revised method of control previously operated at this junction between August 2007 and June 2009.

The new layout of this junction was modelled using a LINSIG model provided by NYCC and using flows taken from the SATURN model. The revised layout is shown to be an improvement on the existing layout, as shown by Table 6.1, which shows a comparison of the junction's performance with the different scenarios.

Roundabout (Recommended Option)
Whilst changing the signals setup reduces the junction RFC to below 100%, it does not provide adequate spare capacity. A further option was considered to replace the current traffic signals layout with a roundabout. The junction has a large footprint with sufficient space for a normal roundabout with inscribed circle diameter of 36 metres.

The design allows for a single lane approach on each arm, splitting into two lanes nearer the junction. HGV tracking has been undertaken to ensure longer vehicles can negotiate the roundabout.

A width of at least 2 metres has been maintained around the perimeter of the roundabout to allow for a footpath. Controlled pedestrian crossings have not been considered at this initial stage, but uncontrolled crossings can be incorporated into the design without impacting on the junction's capacity.

The roundabout would be the preferred option at this junction to allow it to sufficiently handle the forecast level of traffic. The indicative cost for the scheme is £520,000 which includes a 20% contingency but does not include for land purchase required or any potential utility diversions or moving statutory undertakers' apparatus. This cost includes uncontrolled pedestrian crossings costing approximately £20,000 per arm.

9.3.2 Catterick Bridge

The junction currently operates as a priority intersection, with Catterick Road as the minor arm and Leeming Lane and Gatherley Road accommodating the major flow. The delay lies with traffic waiting to turn from the minor arm onto either of the major arms. Four proposals have been considered for this junction, all within the existing highways boundary:

- A change of priority;
- Full signalisation of all approaches;
- A mini roundabout; and
- A normal roundabout.

Change of Priority

The first proposal involved changing the priority. Initially, Leeming Lane was modelled as the minor arm. However, this reduced capacity further and made the junction perform worse. Then, Gatherley Road was modelled as the minor arm, which made a small but insignificant improvement to performance. In summary, changing the priority of the junction has no effect on improving the capacity and therefore is not a recommended option.

Full Signalisation

The second proposal involved signalising the junction and a LINSIG model was built for this purpose. The preferred arrangement consists of a four stage cycle including a pedestrian stage. Each phase runs in a separate dedicated stage to allow unopposed movement during the green time. The junction was modelled to operate on a double cycle due to the anticipated low demand from pedestrians, with a 240 second cycle time. Signal control provides flexibility as a different cycle could operate on race days if necessary, to cater for higher pedestrian flows around the racecourse. Table 6.2 shows that installing signals at this junction would not make it operate below capacity and therefore, installing signals would not offer a cost effective measure for increasing capacity and reducing delay at this junction.

Mini Roundabout

The third proposal would be to introduce a mini roundabout at Catterick Bridge. A preliminary design has been produced and modelled with ARCADY using the same turning flows as the priority set up. The results are again shown in Table 6.2. The mini roundabout does not solve the capacity problems at Catterick Bridge, but offers a lower cost alternative to improve capacity at this junction. The proposal for a mini roundabout would require the re-designation of Gatherley Road and Leeming Lane as a 30mph zone. The constrained nature of the site means that sight lines are minimal and the preliminary design just conforms to DMRB standards. Additional traffic calming may also be required to reduce 85th percentile vehicle speed to 25mph to ensure the DMRB criteria are met.

Normal Roundabout (Recommended Option)

The fourth proposal is to install a normal roundabout at Catterick Bridge. This would have an inscribed circle diameter of 28 metres and a single lane approach and entry. HGV (including large MOD vehicles) tracking has been undertaken to ensure longer vehicles can negotiate the roundabout. This design can be accommodated within the existing highways boundary.

The location of the proposed roundabout will also impact upon the exit of the racecourse car park. The exit cannot be accommodated into the design and so it is suggested that the racecourse upgrades the existing car park entrance approximately 180 metres further along Catterick Road to accommodate an exit lane. It may also be necessary for the bus stop on the north bound side of Catterick Road to be moved south west and an alternative access point to the property in the north west quadrant of the roundabout (Old Bridge House) to be incorporated opposite the racecourse paddock car park entrance so that vehicles to and from the property do not access into the circulatory carriageway.

The paddock car park entrance is suitable far back from the exit of the roundabout onto Catterick Road so as not to create any safety issues. The entrance provides access to the car park which has a capacity of 20 vehicles and will therefore be very lightly trafficked.

Existing footpath provision will remain and controlled or uncontrolled pedestrian crossings could be installed on Leeming Lane and Catterick Road at a standard distance away from the roundabout. The speed limit on the approaches to the roundabout could also be reviewed to maximise pedestrian and driver safety.

Table 6.2 shows that the proposed normal roundabout would be the best option for accommodating the full amount of development traffic at Catterick Bridge. The indicative cost for this junction, without the land purchase, is £290,000 which includes a 20% contingency but does not include for any potential utility diversions or moving statutory undertakers' apparatus. The cost also does not include for works to move the bus stop, the vehicular access for the property or moving the racecourse car park exit.

9.3.3 First Avenue

First Avenue currently operates as a four-arm priority crossroads. As part of the Colburndale development, this is due to be upgraded to a signalised crossroads.

Compact Roundabout (Recommended Option)
Analysis of DMRB TD 16/07 shows that the construction of a compact roundabout with the minimum allowed inscribed circle diameter of 28 metres can be accommodated at this site, although some re-alignment of the pavement and land take from the Colburndale development would be required. This design proposes a single lane approach on all arms, with short flares and tighter radii to control vehicle speed. The design also incorporates a central over-run area to accommodate HGVs and military vehicles which regularly use this route. The design would be very similar to that proposed at Colburn Lane as part of the Colburndale development. DMRB TD 16/07 paragraph 4.8 states that "*where several roundabouts are to be installed on the same route, they should be of similar design in the interests of route consistency and hence safety, to the extent that this is possible with the traffic volumes concerned*". Traffic flows are similar at both junctions and they are located in close proximity.

The pedestrian facilities currently provided at First Avenue will remain, with footpaths on the northern side of each roundabout and on the northern arms. Uncontrolled pedestrian crossing points would be provided using the splitter islands as pedestrian refuges. To the south of each roundabout the existing cycle track and footpath will need to be realigned as part of the development master plan and crossing facilities be provided across the development access roads.`

ARCADY analysis of the design shows the roundabout would operate below capacity for all arms and for the full amount of development traffic modelled, as shown in Table 6.3.

The signalised junction proposed at First Avenue as part of the Colburndale development have been shown to be unsuitable for accommodating traffic levels in 2026. Replacing this with a compact roundabout of similar design to Colburn Lane is recommended to enable the junctions to accommodate the level of traffic forecast. The indicative cost for this junction is £250,000 which includes a 20% contingency but does not include for land purchase required or any potential utility diversions or moving statutory undertakers' apparatus.

9.3.4 White Shops

This junction currently operates as a four arm signalised crossroads with four full traffic phases and four pedestrian phases. The main flow is accommodated by a single stage, with right turning vehicles encroaching into the junction and turning in gaps or during the intergreen period. The two side road phases run in separate stages to allow unopposed movement. Pedestrians are accommodated in a separate dedicated stage.

As part of the Colburndale development, this junction is due to be re-designed and widened to accommodate dedicated right turn lanes on both Catterick Road approaches.

In terms of mitigation proposals at this junction, no further engineering work to widen the junction can be carried out within the existing highways boundary and optimisation of the signal timings has already been achieved for the proposed upgrade. However, discussions with the MoD indicate that there may be the possibility for further land take from the two MoD sites located to south of the junction, either side of Horne Road.

Roundabout (Recommended Option)
The possibility for land take would enable the replacement of the signals with a normal roundabout with an inscribed circle diameter of 28 metres. This allows for a single lane approach on all arms, with two lanes at the stop line on all arms. This improvement would increase capacity at this junction and reduce queue lengths on Catterick Road.

One issue with the roundabout proposal is it does not cater for pedestrians. Uncontrolled crossings can be accommodated within the roundabout splitter islands, but the addition of controlled pedestrian crossings would impact upon the roundabout's capacity and could cause queues to back up onto the roundabout. Further investigation into pedestrian flows at this junction will need to be undertaken. Zebra crossings or uncontrolled pedestrian refuge crossings in the vicinity of the junction could be a possibility as they do not impact upon traffic flow as much as a pelican or puffin crossing.

Table 6.4 shows the effects on capacity of installing a roundabout at this location. The capacity increases so that the junction will operate below 85% capacity with the full LDF development in place.

Land take would be required from the site to the south-west of the junction only, approximately 180 square metres. The indicative cost for this junction without the land purchase is £350,000 which includes a 20% contingency but does not include for any potential utility diversions or moving statutory undertakers' apparatus. This cost includes uncontrolled pedestrian crossings costing approximately £20,000 per arm.

9.4 Summary

Given the strategic nature of this study, these mitigation measures are theoretical solutions to the impact on the highway network and it is important to note that:

- Additional modelling work will be required to test the impact of site specific allocations to demonstrate that the proposed solutions are still necessary, suitable and appropriate.
- Alternative mitigation measures may be considered and developed as part of the additional modelling work.
- Mitigation measures identified within the report could work in traffic modelling terms but any delivery will be subject to normal NYCC scheme approval and consultation procedures.
- Should the proposed mitigation measures in this study not take place, alternative measures which achieve at least the same level of mitigation will be necessary. This will need to be agreed with NYCC.

Table 9.1 shows the deliverable junction option for each of the key junctions which will require mitigation. Preliminary design drawings of the proposed options are contained within Appendix C.

Table 9.1 Deliverable Junction Improvement Option Summary

Junction	Deliverable Option	Indicative Cost*	Comments
Scorton Crossroads	Normal Roundabout	£520,000	Cost includes an uncontrolled pedestrian crossing at each arm @ £20,000 per arm.
Catterick Bridge	Normal Roundabout	£290,000	Land-take required within highway boundary. Design requires relocation of bus stop, property access and car park exit.
First Avenue	Compact Roundabout	£250,000	Pedestrian crossings will be provided using splitter islands as pedestrian refuges.
White Shops	Normal Roundabout	£350,000	Land-take required (c. 180m^2). Cost includes an uncontrolled pedestrian crossing at each arm @ £20,000 per arm.
Total Indicative Cost		**£1,410,000**	

* Costs do not include any land purchase, potential utility diversions or moving statutory undertakers' apparatus etc.

It should be noted that the costs listed above in Table 9.1 are based on current Highways North Yorkshire contract rates. The costs are indicative for the preliminary design stage only and do not include any land purchase required nor do they take account of any potential utility diversions or moving statutory undertakers' apparatus.

10 Summary & Conclusion

10.1 Summary

The aim of this study is to assess the traffic impacts associated with potential strategic development in Richmondshire by 2026.

Scenario 1 provides a Baseline against which future congestion levels could be assessed. The junction capacity assessed in future scenarios should be the same or better than that assessed in this Baseline scenario or if not better the junction should operate below capacity. Two junctions were assessed to be operating over capacity, Scorton Crossroads and Catterick Bridge.

Scenario 2a, the Do Minimum, looks at the impact of implementing the full level of proposed LDF development on the existing highway network. The junction capacity assessment shows that six junctions are forecast to operate over capacity in 2026.

Scenario 2b, the Do Something, looks at devising mitigation measures for those over capacity junctions, then assessing them against the traffic resulting from the proposed level of development as agreed in the Local Development Framework. Assessment of the mitigation measures forecasts that all the junctions will operate below capacity in 2026.

A scenario for an 'optimum' level development is not required as the recommended mitigation measures successfully allow implementation of the proposed Local Development Framework strategy without resulting in delays at the junctions assessed.

Scenario 3 shows that the deliverability of the A1 upgrade does not affect the amount of development that can take place as part of the Local Development Framework in Catterick Garrison. Instead this hinges upon the capacity of the two junctions at White Shops and Catterick Bridge.

10.2 Conclusion

In conclusion, the modelling work undertaken shows that the proposed level of development included in Richmondshire District Council's Local Development Framework can be accommodated within Catterick Garrison on traffic grounds if the recommended junction mitigation measures are implemented. These mitigation measures are summarised in Table 10.1.

Table 10.1 Summary of Recommended Junction Mitigation Measures

Junction	Proposed Mitigation	Indicative Cost*
Scorton Crossroads	Normal roundabout inside junction footprint	£520,000
Catterick Bridge	Normal roundabout with possible land take	£290,000
First Avenue	Compact roundabout	£250,000
White Shops	Normal roundabout with land take	£350,000
Total Indicative Cost		**£1,410,000**

* Costs do not include any land purchase, potential utility diversions or moving statutory undertakers' apparatus etc.

The study shows that the key junctions on the Catterick Garrison highway network are Catterick Bridge and White Shops. The level of development that can be accommodated hinges upon the capacity of these two junctions.

The proposed junction mitigation measures are dependent upon the land take around the existing junction footprint. The consequences of not being able to obtain the land required at Catterick Bridge and White Shops would be that the proposed level of development would have to be scaled back to ensure that traffic congestion resulting from the developments does not exceed that as assessed in 2011.

Overall, from a highways perspective, the Richmondshire Local Development Framework can be successfully delivered.

Appendix A Glossary of Terms

ARCADY	Assessment of Roundabout Capacity and DelaY, used to assess capacity of roundabout junctions.
Capacity of a Junction	The maximum volume of vehicles per hour that can pass through a certain point or arm of a junction in a given time without causing unreasonable delays, hazard or restriction to the drivers.
Congestion	Traffic congestion is a condition on road networks and junctions that occurs as use increases, and is characterised by slower speeds, longer trip times, and increased vehicular queuing.
Delay	Amount of time individual journey times are increased by as a result of congestion.
Fuel & Income Traffic Growth Factor	A factor provided by DfT to account for traffic growth as a result in fuel cost changes and income level changes.
GFA	Gross Floor Area – useable floor space in a development.
Junction Types	Priority – a junction where one or more arm must give way. Also called a T-junction. Signals – a junction controlled by traffic lights. Roundabout – a few types are mentioned in this report, mini roundabouts, compact roundabouts and normal roundabouts. Mini roundabouts have a painted central dome, whereas all other types have a kerbed central island.
LINSIG	Used to assess capacity of signalised junctions.
Matrix	An array of traffic flows from one location to another or from an origin to a destination.
Model Validation and Calibration	The process of ensuring the traffic flows and journey times in the base traffic model match those observed in reality.
Model Zone	Points in the traffic model representing origin/destination locations.
PICADY	Priority Intersection Capacity and DelaY used to assess capacity of priority junctions.

Queue Length	The queue lengths are calculated using the standard unit lengths above. Queues at priority and roundabout junctions will begin to occur once the junction starts nearing capacity and increase exponentially as the volume of traffic increases thereon in. Queues will always occur at signals, but these only become problematic when the whole queue cannot dissipate upon the lights turning green.
Ratio of Flow to Capacity (RFC)	This is a measure used to assess the performance of a junction. It is simply the sum of the traffic flow on all inbound arms divided by the sum of the capacities of the inbound arms. When flow is less than capacity, this will give a figure less than 1, indicating the junction is performing under capacity. For the purposes of this report that figure has been multiplied by 100 to give it as a percentage. The junctions have also been assessed by the RFC of each arm. This is calculated in the same way, using the flow of the arm divided by the capacity of that arm.
Rolling Queue	A queue of vehicles at a junction that are moving at a steady pace. May be perceived by the driver as being in a queue but is not categorised as being in a queue or being delayed.
SATURN	A strategic traffic modelling software, used to model traffic flows and distribution around Catterick Garrison and the surrounding area.
Signal Optimisation	Adjusting signal timings to maximise roadway mobility, capacity, and efficiency with minimal, if any, capital improvements, such as roadway widening.
Splitter Island	The small island in the centre of each carriageway on each arm of a roundabout.
Static Queue	A queue of vehicles at a junction that are stationary or are moving at a slow speed <5mph.
TEMPRO	Trip End Model Presentation pROgramme, used to calculate growth in traffic to 2026.
Traffic Light Phase	A junction is described to the controller in terms of separate traffic or pedestrian movements known as 'phases'. A phase would be a single approach or a filter arrow or a single pedestrian movement (crossing) at the junction.
Traffic Light Stage	A combination of phases all running together is known as a stage. One stage will incorporate a number of phases that do not conflict with each other, i.e. north bound phase and south bound phase on a main road and maybe a pedestrian phase across a side road.

Traffic Model	A computer simulation that uses mathematical models to conduct experiments with traffic flows on a transportation network over extended periods of time.
TRICS	Trip Rate Information Computer System, used to calculate the trip rates for each development type.
Trip Distribution	Matching origins and destinations to develop a trip matrix that displays the number of trips going from each origin to each destination.
Trip Generation	Prediction of the number of trips originating in or destined for a particular development or zone.
Trip Rate	The trip rate can be defined as the number of trips from a particular development type during a specific time period. For residential this is given as the number of trips per household in the AM peak. For employment sites it is given as the number trips per $100m^2$ of floor area in the AM peak. Trips can be inbound and outbound, so a separate trips rate is used for each. For example, a residential development will have a high number of outbound trips during the AM peak with commuters going to work, but this will be reversed in the PM peak with a high number of inbound trips from commuters returning from work.
Vehicle	A vehicle is defined as one vehicle on the network, regardless of its size. The models categorise vehicles by type: cars, light vehicles and heavy vehicles. Cars and light vehicles represent 1 standard unit of length 6 metres. A heavy vehicle represents 2 standard units of length 12 metres.
WebTAG	Web based DfT guidance for developing and using traffic models.

Appendix B Richmondshire District Proposed LDF Sites

This lists of all the development sites proposed as part of the Richmondshire District LDF. The table includes for each development; the sizes, the amount of development taking place by either number of dwellings for residential sites or gross floor area (GFA) for retail, employment and other sites, the number of likely jobs for each employment site, the AM peak trip rate per dwelling or 100m^2 of GFA for origin trips (outbound trips produced by the development) and destination trips (inbound trips attracted by the development), and the actual number of origin and destination trips during the AM peak.

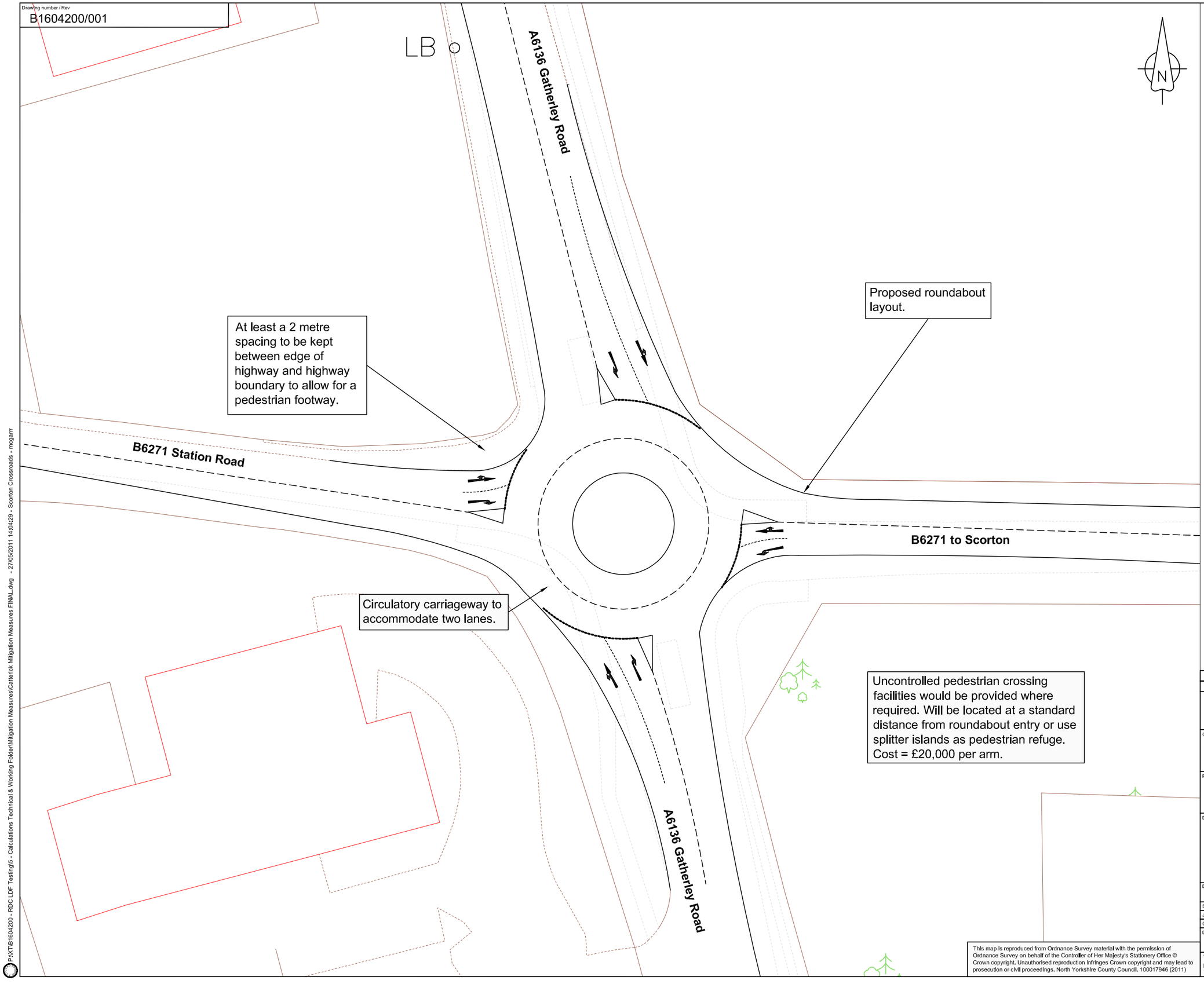
No	Site ID	Site Name	Location	LDF or MoD	Development Type	Total Size (Ha)	GFA (100m2)	Number of Jobs	Number of Dwellings	Trip Rate		Number of Trips	
										Orig	Dest	Orig	Dest
1	29	Catterick Road	Catterick Garrison	LDF	Residential	1.47			47	0.411	0.152	19	7
2	56	Old sports field, Catterick Road				3.40			102	0.411	0.152	42	16
3	58	Old sports field, Catterick Road				0.66			20	0.411	0.152	8	3
4	119	Town Centre Redevelopment (MoD H/06)			Apartments		147.64		183	0.295	0.143	54	26
5	120	Somerset Close (MoD H/04)			Residential	1.10			44	0.411	0.152	18	7
6	121	Gough Road (MoD H/03)				1.30			40	0.411	0.152	16	6
7	122	Coronation Park (MoD H/07)				0.60			20	0.411	0.152	8	3
8	123	Catterick Road (MoD H/08)				0.20			10	0.411	0.152	4	2
9	124	Catterick Road (MoD H/16)				3.80			130	0.411	0.152	53	20
10	125	Sour Beck (MoD H/15)				2.00			20	0.411	0.152	8	3
11	155	Belton Park				0.24			7	0.411	0.152	3	1
12	186	Richmond Park				1.87			48	0.411	0.152	20	7
13	105	Colburn Grange	Colburn			16.28			488	0.411	0.152	201	74
14	106	Colburn Grange				6.35			190	0.411	0.152	78	29
15	156	Colburndale (Pipeworks)							285	0.411	0.152	117	43
16	204	Site to the south of Colburn Business Park				117.90			498	0.411	0.152	205	76
17	12	Hipswell Croft	Hipswell			3.04			91	0.411	0.152	37	14
18	128	Unadopted Growth Strategy	Walkerville			15.19			228	0.411	0.152	94	35
19	145	Gatherley Road Phase 2	Brompton on Swale			19.41			200	0.411	0.152	82	30
20	8	Land South West of Bishops Way	Catterick Village			0.97			31	0.411	0.152	13	5
21	142	Land to the North of Tunstall Road Bridge				10.69			59	0.411	0.152	24	9
22	52	Clara Meyer, South Side	Scorton			0.03			1	0.411	0.152	0	0
23	80	Land south of St Mary's RC School				2.92			88	0.411	0.152	36	13
24	119	Town Centre Redevelopment	Catterick Garrison		Retail		61.48	339		3.986	4.889	245	301
25	119				Professional Services		17.48	96		3.986	4.889	70	85
26	119				Restaurants / Bars		19.42	107		3.986	4.889	77	85
27	119				Office		19.45	107		0.330	2.862	6	56
28	119				Hotel		32.70	181	84	0.243	0.079	20	7
29	119				Leisure		46.90	259		0.667	0.941	31	44
30	141	Land to the East of Gatherley Road	Brompton on Swale		Office	7.97	49.00	271		0.330	2.862	16	140
31	141				Storage	7.97	134.00	740		0.249	0.348	33	47
32	156	Colburndale (Pipeworks)	Colburn		Office		129.00	712		0.330	2.862	43	369
33	156				Storage		161.50	892		0.249	0.348	40	56
34	204	Site to the south of Colburn Business Park			Office		170.20	1540		0.330	2.862	56	487
35	204				Storage		290.00	730		0.249	0.348	72	101
36	1000	Colburn Business Park 2			Office	3.00	68.00	615		0.330	2.862	22	195
37	187	Haig Road (MoD H/01)	Catterick Garrison	MoD	Residential	1.60			43	0.411	0.152	18	7
38	188	Plumer Road (MoD H/02)				7.80			209	0.411	0.152	86	32
39	189	Richmond Road (MoD H/05)				8.90			239	0.411	0.152	98	36
40	190	Pinhill Messes (MoD H/13) and DSDA TMP (MoD H/14)				4.30			115	0.411	0.152	47	17
41	191	DKB (MoD H/12)				4.80			129	0.411	0.152	53	20
42	192	Harden Barracks (MoD H/11)				4.00			107	0.411	0.152	44	16
43	193	West of Harden Barracks (MoD H/10)				1.00			27	0.411	0.152	11	4
44	194	West of Harden Barracks (MoD H/09)				2.30			62	0.411	0.152	25	9
45	195	Horne Road (MoD H/18)				0.70			19	0.411	0.152	8	3
46	196	Horne Road (MoD H/17)				3.50			94	0.411	0.152	39	14
47	197	Horne Road (MoD H/19)				2.10			56	0.411	0.152	23	9
48	198	Horne Road (MoD H/20)				3.90			105	0.411	0.152	43	16
49	199	Land off Loos Road (MoD H/22)				3.50			94	0.411	0.152	39	14
50	200	Land off Loos Road (MoD H/23)				0.70			19	0.411	0.152	8	3
51	201	Land off Loos Road (MoD H/21)				3.10			83	0.411	0.152	34	13

Appendix C Junction Mitigation Measures

This contains the proposed mitigation measure for each of the four junctions listed below with their drawing number:

- Scorton Crossroads – 001;
- Catterick Bridge – 002;
- First Avenue – 003; and
- White Shops Crossroads – 004.

Drawing number / Rev
B1604200/001



Overall Cost = £520,000
(Including ped crossings
Estimated cost for ped crossings = £20,000 per arm).

Costs do not include any land purchase, potential utility diversions or moving statutory undertaker's equipment.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	10/05/2011		CW	MG	RM	RJ

JACOBS
Mount View, Standard Way, Northallerton, North Yorkshire, DL6 2NY
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www.jacobs.

Client
RICHMONDSHIRE DISTRICT COUNCIL

Project
RICHMONDSHIRE DISTRICT COUNCIL
LOCAL DEVELOPMENT FRAMEWORK
STA

Drawing title
JUNCTION MITIGATION MEASURES
SCORTON CROSSROADS ROUNDABOUT

Drawing status
PRELIMINARY DESIGN

Scale	@ A3	DO NOT SCALE
Jacobs No.	B1604200	
Client no.		
Drawing number	001	Rev 0

P:\XTB\1604200 - RDC LDF Testing\5 - Calculations Technical & Working Folder\Mitigation Measures\Catterick Mitigation Measures FINAL.dwg - 27/05/2011 14:54:29 - Scorton Crossroads - mogarrr

Drawing number / Rev
B1604200/002

A6136 Gatherley Road

1.6 metre spacing to be maintained between edge of highway and highway boundary to allow for a pedestrian footway.

Footpath to be kept in place up to bridge.

Land within Highway Boundary.

Existing vehicular access point to property to be accommodated on Catterick Road before splitter island and away from roundabout.

Existing car park exit to be closed and relocated. No access onto roundabout.

Bus stop to be moved south on A6136 away from junction.

Traffic island (pedestrian refuge) to be installed in carriageway near the car park exit.

A6136 Catterick Road

A6136 Leeming Lane

Single lane entry on all arms.

Proposed roundabout layout.

Racecourse
Paddock Car Park
(20 cars)

LB

Paddo

N

Overall Cost = £290,000
(Cost does not include for relocating bus stop, vehicular access to property or racecourse entry/exit and pedestrian crossing)

Costs do not include any land purchase, potential utility diversions or moving statutory undertaker's equipment.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	10/05/2011		CW	MG	RM	RJ

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Client
RICHMONDSHIRE DISTRICT COUNCIL

Project
RICHMONDSHIRE DISTRICT COUNCIL
LOCAL DEVELOPMENT FRAMEWORK
STA

Drawing title
JUNCTION MITIGATION MEASURES
CATTERICK BRIDGE ROUNDABOUT

Drawing status
PRELIMINARY DESIGN

Scale	@ A3 DO NOT SCALE
Jacobs No.	B1604200
Client no.	
Drawing number	002
Rev	0

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Drawing number / Rev
B1604200/003

OLB

TCBs

Car Park

First Avenue

Central over-run area to be coloured with red tarmac.

Single lane entry on all arms.

A6136 Catterick Road

Footpath to be re-aligned.

A6136 Catterick Road

Existing pedestrian crossing may need to be relocated further away from junction. (Pedestrian crossing will be removed with the implementation of the proposed signals.)

Proposed roundabout layout.

Splitter islands need to be able to accomodate pedestrian refuge for an uncontrolled crossing.

Footpath, cycle path and bridleway to be re-aligned as part of Colburndale Development. (Details yet to be agreed)

Access to Colburndale

N

Overall Cost = £250,000

Costs do not include any land purchase, potential utility diversions or moving statutory undertaker's equipment.

Roundabout will replace proposed signals as part of Colburndale Development.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	10/05/2011		CW	MG	RM	RJ

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Client
RICHMONDSHIRE DISTRICT COUNCIL

Project
RICHMONDSHIRE DISTRICT COUNCIL
LOCAL DEVELOPMENT FRAMEWORK
STA

Drawing title
JUNCTION MITIGATION MEASURES
FIRST AVENUE
COMPACT ROUNDABOUT

Drawing status
PRELIMINARY DESIGN

Scale	@ A3	DO NOT SCALE
Jacobs No.	B1604200	
Client no.		
Drawing number	003	Rev 0

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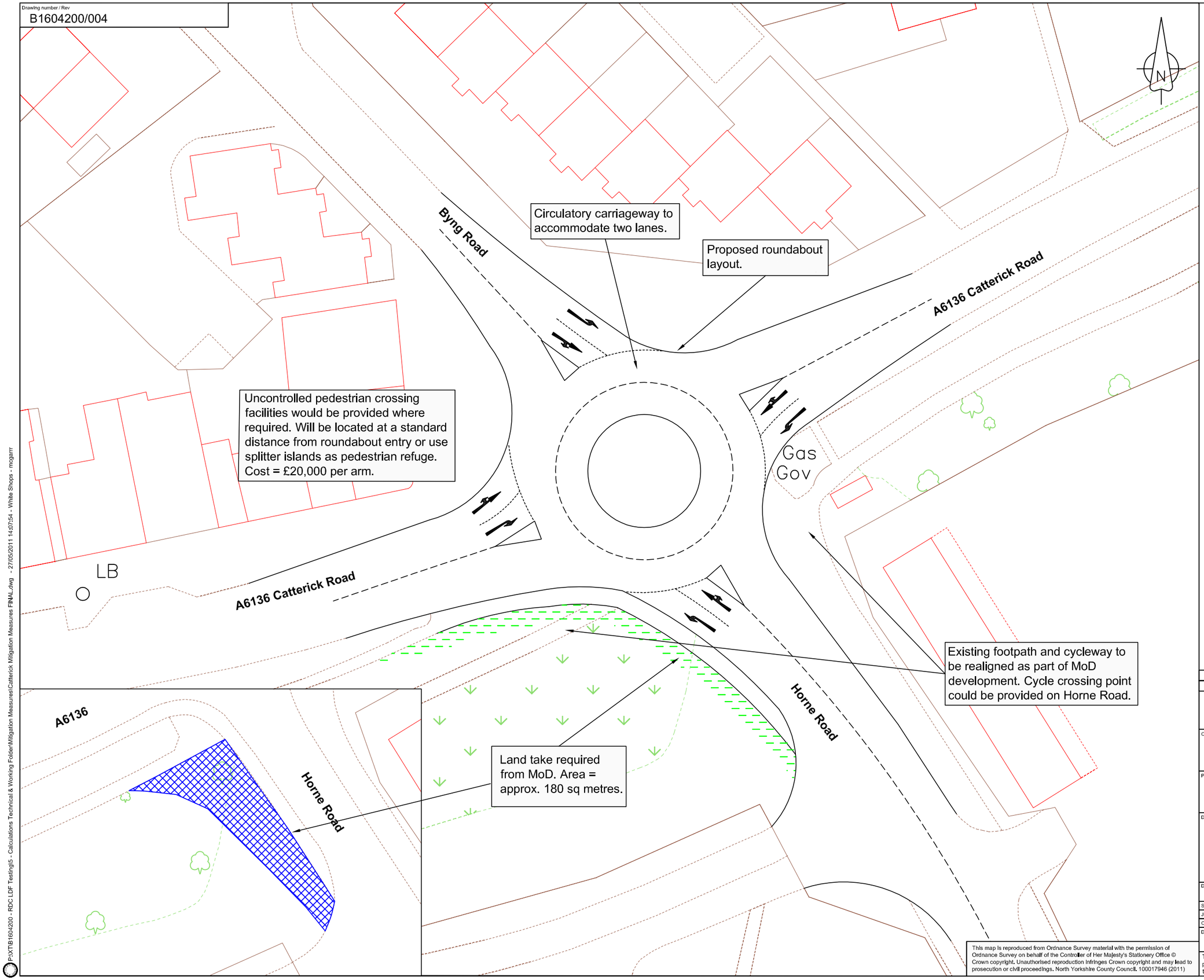
Drawing number / Rev
B1604200/004



Overall Cost = £350,000
(Including ped crossings
Estimated cost for ped crossings = £20,000 per arm).

Costs do not include any land purchase, potential utility diversions or moving statutory undertaker's equipment.

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
0	10/05/2011		CW	MG	RM	RJ

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www.jacobs.

Client
RICHMONDSHIRE DISTRICT COUNCIL

Project
RICHMONDSHIRE DISTRICT COUNCIL
LOCAL DEVELOPMENT FRAMEWORK
SCENARIO OPTION TESTING

Drawing title
JUNCTION MITIGATION MEASURES
WHITE SHOPS CROSSROADS STA

Drawing status
PRELIMINARY DESIGN

Scale	@ A3	DO NOT SCALE
Jacobs No.	B1604200	
Client no.		

Drawing number: 004
Rev: 0

P:\XTB1604200 - RDC LDF Testing\5 - Calculations Technical & Working Folder\Mitigation Measures\Catterick Mitigation Measures FINAL.dwg - 27/05/2011 14:07:54 - White Shops - mcgarrr