The Norfolk County Council (Norwich Northern Distributor Road (A1067 to A47(T))) Order

Applicant's response to issues raised in connection with Network Rail and correction to document relating to "Applicant's Comments on Written Representation – Network Rail" (NCC/EX/28)"

Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Author: *Norfolk County Council*

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Introduction

This document provides the Applicant's responses in respect to various issues raised by the Examining Authority and Network Rail along with a correction to the Applicant's comment on Written Representations by Network Rail (Document Ref NCC/EX/28).

Applicant's response to issues raised by Examining Authority and Network Rail

Raised by Examining Authority at Issue Specific Hearing on 24 July 2014

1.1.	*What consideration has been given to the NDR going under the railway at Rackheath/Thorpe End?*

Applicant's comment

1.1.1. The potential negative environmental impacts associated with going over the railway (noise, visual impacts) led to examining the case for the NDR going under the railway instead, and a report 'Railway at Rackheath: Assessment of the 'Over' and 'Under' Options' was produced in August 2006 (Appendix A) to investigate the options.

1.1.2. The report considered a number of over and under options and concluded at paragraph 9.2

> *"The Under options. The negative environmental impacts associated with going over the railway led to examining the case for going under. However, there are high negative aspects associated with Earthworks (disposal of contaminated material) and Water Quality and Drainage (establishing a watertight key with the chalk strata). The Under options present serious technical problems requiring expensive solutions (some of which may not be feasible), and have poorer Benefit-to-Cost ratios than the Over options. Consequently, it is not considered practicable to develop these options further. It is therefore recommended that the Under options are discounted."*

1.1.3. In summary there would be a high risk of flooding and there would need to be a permanent pumping system in place.

1.1.4. Comparative order of cost estimates prepared in 2002 suggested that the under bridge options would be at least £12m more expensive than an over bridge. There is no reason that would suggest that this position has changed and if anything the comparative cost difference is likely to be greater at today's prices. That is clearly a very significant cost difference in the context of the overall scheme cost. For these reasons the Applicant has concluded that an under bridge option should continue to be discounted.

Raised by Network Rail in response to the Applicant's comments on Network Rail's Written Representations.

1.2. *Network Rail consider there to be three level crossings impacted by the proposals:*

- *LC7 (Plumstead Road)*
- *LC9 (Broad Lane)*
- *LC11 (Salhouse Road)*

Being the shortest route between the NDR and Thorpe Road, Network Rail is particularly concerned about the impact on LC7 in the event of any temporary closures of the NDR. Network Rail is also concerned that none of the traffic projections have considered the impact on LC11 (being the shortest route from the NDR to Salhouse). Network Rail considers this should have been considered as part of the Traffic Forecasting Report.

Applicant's comment

1.2.1. The Applicant has considered further the content of paragraphs 1.3.1 to 1.3.3 on page 5 of the Applicant's Comment on Written Representations by Network Rail (Document Ref NCC/EX/28) and is correcting it with the following paragraphs.

1.2.2. That document stated that there would be a slight reduction in traffic on Plumstead Road based on forecast traffic flows quoted in the Traffic Forecasting Report (Document Ref 5.6) This was taken from Point A84 in Figure I2, being the nearest assessment point on Plumstead Road to the level crossing. As a result of the forecast it was considered the potential risks at the level crossing would be reduced and not exacerbated by the NDR.

1.2.3. Traffic flows (24 hour - Annual Average Daily Traffic (AADT)) have now been extracted from the traffic model at the actual locations of the level crossings and these are shown in the following table.

Forecast Annual Average Daily Traffic (two-way)

	Base	**Do Minimum**		**Do Something**	
Year	*2012*	*2017*	*2032*	*2017*	*2032*
Salhouse Road (LC11)	1800	2200	3400	2500	3500
Plumstead Road (LC7)	6000	4600	5900	6500	6800
Broad Lane (LC9)	6600	6600	8100	0	0

1.2.4. From the table above traffic flows quoted for Plumstead Road in the Traffic Forecasting Report are different to the forecast flows taken from the traffic model at the level crossing. Although the two-way flow on Plumstead Road at the level crossing is lower than the flow at Point A84 in all assessment years, both with and without the NDR, there is an increase at the level crossing with the NDR in place compared to the Do Minimum flow (and the 2012 base year flow).

1.2.5. At Salhouse Road level crossing the traffic model forecasts an increase compared to the Do Minimum flow (and the 2012 base year flow).

1.2.6. At both the Plumstead Road level crossing and the Salhouse Road level crossing some of these increases are materially above 10% and merit further consideration.

1.2.7. At Broad Lane level crossing the traffic model forecast a 100% decrease compared to Do Minimum (and base year) flows. In reality there will be a small number of movements from the properties on Broad Lane but the traffic model is not sensitive enough to pick up these flows.

1.2.8. Each of the three level crossings have automatic half barriers with warning lights, associated signing and markings in accordance with Chapter 4 of the Traffic Signs Manual. According to the Office for Rail Regulation (ORR) publication 'Level Crossings: A guide for managers, designers, and operators' (RSP7, December 2011) in Section 6 of Table 1 (Appendix B) there is no limit to the amount of road traffic that can use such a crossing type so the increase in flows would not in themselves affect the suitability of the crossing type in these locations. Whilst the Applicant does not have access to the operational railway data which is relevant to some of the other criteria referred to in Section 6, the Applicant considers that it is reasonable to conclude they are met from the fact that NR has not taken steps to close these crossings irrespective of the NDR.

1.2.9. An option to close the Plumstead Road level crossing was discussed with NR in 2008 as part of the design work on the NDR but was not progressed at the time. Reviewing the current position the reasons for not closing the level crossing are:

- NCC has no record of any Personal Injury Accidents (PIAs) at the level crossing within the last 10 years;
- Two PIAs have recorded in the vicinity of the Plumstead Road crossing. The first of these occurred in July 1988 and involved a cyclist tail ending a car resulting in a slight injury. The other collision occurred in August 2003 and was a single vehicle motorcycle loss

of control with the rider being seriously injured after leaving the road.

- Closure and an over bridge would mean that local Plumstead Road traffic would no longer be separated from NDR traffic. This would generate unnecessary conflict at the NDR junction which would be avoided with the current scheme;
- It would require a more sinuous horizontal alignment (one design step below Desirable Minimum for a 70kph design speed (Design Manual for Roads and Bridges TD 9/93 Highway Link Design)) west of the NDR together with the need to take the road up and over the railway line on embankment up to 7.6m high before dropping down to join the NDR roundabout within a short distance. Although the alignment would comply with current design standards the combination of horizontal and vertical constraints creates a more complex alignment for Plumstead Road compared to the current scheme layout. A possible layout is shown on the plan included as Appendix C.
- It would result in potentially significant noise and visual impacts associated with embankments and associated elevated traffic close to the northern periphery of Thorpe End; and
- This option would remove the facility for pedestrians and cyclists to use the existing Plumstead Road to cross the NDR on a grade separated route due to the closure of the level crossing.

1.2.10. No PIAs have been recorded in the vicinity of the Salhouse Road level crossing since 1987, suggesting that it is performing very well in safety terms.

1.2.11. No PIAs have been recorded in the vicinity of the Broad Lane level crossing since 1987, suggesting that it is performing very well in safety terms.

1.2.12. Broad Lane level crossing is discussed in the Applicant's response to the Examining Authority's second written question Q1.6 (Document Ref NCC/EX/52)

1.2.13. In summary, all three crossings are performing well in safety terms. Of the two collisions recorded over the last 27 years, neither was recorded as linked to operation of the level crossing.

1.2.14. It is the Applicant's view that the forecast traffic flows in 2032 are not high in absolute terms for the type of roads and there is a good safety record at all three level crossing sites. It is considered that the Scheme would not result in a significant change in risk. The Applicant understands that Network Rail is in the process of undertaking its own surveys of usage of the level crossings to inform risk assessments of the crossings and the Applicant would be willing to discuss the matter of level crossing impact assessments further with Network Rail on receipt of this information should this be shown to be justified.

1.2.15. At present if there is an incident where a section of the A47, for example, needed to be closed there are a series of pre-determined temporary diversion routes that would be employed. The protocol was developed by multiple agencies including the emergency services, the Highways Agency and NCC.

1.2.16. The Applicant acknowledges that an emergency closure of all lanes of a carriageway of the NDR at the eastern end could potentially impact on the Plumstead Road crossing. As such a series of agreed temporary diversion routes designed to avoid sensitive locations such as the Plumstead Road crossing will be developed in much the same way as a protocol has been developed to deal with incidents on the A11, A12 and A47. In developing this protocol the Applicant will engage with all key stakeholders including Network Rail. The establishment of such a protocol would minimise any potential risk of temporary closure of the NDR adversely impacting on the safe operation of the Plumstead Road level crossing.

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Appendix A

Norfolk County Council
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NORWICH NORTHERN DISTRIBUTOR ROUTE

Railway at Rackheath: Assessment of the 'Over' and 'Under' Options

Prepared by Norfolk County Council

In conjunction with Mott MacDonald, August 2006

http://www.norfolk.gov.uk http://www.mottmac.com

NORWICH NORTHERN DISTRIBUTOR ROUTE

Railway at Rackheath: Assessment of the 'Over' and 'Under' Options

August 2006

Prepared by:-

Planning and Transportation
Technical Group
Norfolk County Council
County Hall
Martineau Lane
Norwich
Norfolk
NR1 2SG

If you would like this document in large print, audio, Braille, alternative format or in a different language please contact Charles Auger on 01603 223258 minicom 223833.

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Norwich Northern Distributor Route

Railway at Rackheath: Assessment of the 'Over' and 'Under' Options

Author of Report:-

(Title) Engineer

(Name) Paul Donnachie

(Sig)

Reviewed by:-

(Title) Design Manager

(Name) Charles Auger

(Sig)

Authorised by:-

(Title) Head of NATS Implementation

(Name) David Pearson

(Sig)

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Contents

Executive Summary

This report considers the options for the Norwich Northern Distributor Route (NDR) to cross the Norwich/Cromer railway line at Rackheath, either over or under. The report assesses the positive and negative aspects of each option.

The negative environmental impacts associated with going over the railway (noise, visual impacts) led to examining the case for going under. However, the two Under options present serious technical problems requiring expensive solutions (some of which may not be feasible), and have poorer Benefit-to-Cost ratios (BCR) than the Over options.

Whilst one of the two Over options (1a and 1b) could be mitigated to an acceptable level, it performed less well in traffic terms. A third Over option was therefore developed to minimise landscape impacts, whilst still providing an acceptable BCR. This third Option (1c) is recommended as the preferred way forward.

It is also recommended that a lower design speed be adopted locally to achieve further reductions in landscape impacts.

1.0 INTRODUCTION

1.1 Location

1.1.1 The village of Rackheath lies to the north east of Norwich between Wroxham Road and Plumstead Road. Joining these radials is Green Lane West and Green Lane East, the main road through the village. Rackheath is separated from the outskirts of the Norwich urban area by approximately 3km of farmland, plantations and historic parkland.

1.1.2 The Norwich to Sheringham railway line passes to the east of Rackheath, crossing Plumstead Road and Green Lane East at level crossings. This section of the railway is straight and runs roughly at ground level. There are two tracks and they are not electrified.

1.1.3 The railway carries an hourly service between Norwich and Sheringham, but is also used for freight transport.

1.1.4 The location of Rackheath is shown on Plan R1C093-R1-619 in Appendix A.

1.2 Background to the NDR

1.2.1 In October 2004, Norfolk County Council resolved to adopt a revised Norwich Area Transportation Strategy (NATS 4). A Norwich Northern Distributor Route (NDR) was included as part of this strategy.

1.2.2 On 26 September 2005, the County Council adopted a preferred route for the NDR. This would be a new 19.5km dual carriageway, which would link the A1067 Fakenham Road at Attlebridge Hills to the A47 at Postwick.

1.2.3 Near Rackheath, the NDR runs roughly parallel to Green Lane West, approximately 300m south west of the village. The route intersects both the railway and Plumstead Road immediately north east of the level crossing.

1.2.3 The stage 3 environmental assessment and detailed design will be carried out during 2006 and 2007. However, it is necessary to decide at this stage how the NDR will cross the railway in order to focus the environmental assessment on one single option in this area.

1.3 Options

1.3.1 There are four options available

1 NDR passing over the railway line
2 NDR passing under the railway line
3 Close the railway line
4 Cross the railway line at grade by means of a level crossing

1.3.3 Option 1 is feasible but concerns were raised about its environmental impacts.

1.3.4 Option 2 would significantly reduce the environmental impact, but raises other concerns about the feasibility of constructing a bridge under the railway.

1.3.2 Options 3 and 4 would not be feasible on the grounds of practicality and safety respectively.

1.3.5 This report therefore assesses option 1 and 2.

2.0 ALIGNMENT

2.1 Introduction

2.1.1 Preliminary alignment designs have been carried out based on the topographical survey for which data was received in May 2006. All options follow a common horizontal and vertical alignment up to the Railway crossing approach.

2.2 Over options

2.2.1 There are three options for passing over the railway line, as follows;

2.2.2 **Over option 1a**. This is shown in Appendix B, the horizontal alignment being the same as for the Under options. The NDR follows ground level to some 100m east of Salhouse Road, from where it rises to an embankment of maximum height 8m, crossing the railway on a structure, dropping back to a roundabout located some 6m above ground level approximately 50m south of Plumstead Road, before returning to existing ground level some 400m south of the Plumstead Road. The embankment length is some 1200m.The roundabout connects Plumstead Road to the NDR via 450m link roads (comprising a 250m link to Plumstead Road north, and a 200m link to the level crossing at Plumstead Road south).

2.2.3 However, the environmental impact of this option raised serious concerns in terms of noise, visual impact, and lighting. The requirement for lighting is laid down in the design Manual for Roads and Bridges (DMRB) Volume 6 Section 2 Part 3 TD 16/93 (Geometric Design of Roundabouts) paragraph 1.16 which states "*The provision of road lighting at roundabouts should normally be regarded as an essential safety requirement."* For the size of roundabout proposed, having a 3 lane circulatory carriageway, lighting columns 10-12m in height would be required. This would place lanterns some 16-18m above ground level raising concerns about light spill and visual impact.

2.2.4 **Over option 1b.** This is shown in Appendix C. The NDR follows ground level to some 400m east of Salhouse Road, from where it rises to an embankment of maximum height 8m, crossing both the railway and Plumstead Road on structures, dropping back to ground level some 500m south of Plumstead Road. At this point a roundabout connects Plumstead Road to the NDR via a 570m link road. The embankment length is some 1000m. To address the environmental concerns associated with Over option 1a and to cross both the railway and Plumstead road using a single structure, the NDR alignment was moved approximately 150m west. For this option the roundabout is located at ground level.

2.2.5 **Over option 1c.** This is shown in Appendix D. It was developed to overcome the environmental disadvantage of Option 1a (roundabout 6m above ground level) and the traffic disadvantage of Option 1b (longer link between Plumstead Road and the NDR) which are documented in later sections of this report. The NDR follows ground level to some 400m east of Salhouse Road, from where it rises to an embankment of maximum height 9m, crossing both the railway and Plumstead Road on structures, dropping back to ground level some 300m south of Plumstead Road. Just before this point a roundabout, up to 3m above ground level, connects Plumstead Road to the NDR via a 220m link road. The embankment length, 800m, is 400m shorter than Option 1a and 200m shorter than Option 1b. The roundabout is some 3m lower than for Option 1a. The link road between Plumstead Road and the NDR is some 350m shorter than for Option 1b.

2.2.6 The reduced embankment length was achieved by using a permissible relaxation of the visibility standard combined with a reduced decking thickness for the structure carrying the NDR over the railway.

2.3 Under options

2.3.1 **Under option 2a**. This is shown in Appendix F. Having the same horizontal alignment as Over option 1a, the NDR follows ground level to some 400m east of Salhouse Road, from where it passes under the railway in a 7m cutting. Some 200m east of the railway a roundabout connects Plumstead Road to the NDR via 450m link roads (comprising a 250m link to Plumstead Road north, and a 200m link to the level crossing at Plumstead Road south).

2.3.2 **Under option 2b**. As Under option 2a, but with different drainage arrangements (see Section 4) and a lower vertical profile to accommodate them.

3.0 EARTHWORKS

3.1 Introduction

3.1.1 A Ground Investigation was carried out in January/February 2006 where the Over/Under options cross the railway. Piezometers were installed to establish the groundwater levels. The investigation confirmed the underlying geology as Corton formation, comprising glacial deposits of intercalated, mainly unbedded clays and loamy sands. Norwich crag was also encountered, overlying an upper chalk formation around 20m below ground level. 18 boreholes and 2 trial pits were taken around the locations shown on plans S06:083/001 and S07:083/002 in Appendix G.

3.1.2 Ideally on a road scheme, an earthwork balance should be achieved, whereby the amount of material excavated where the road is in cutting is matched by the amount of fill material required where the road is on embankment.

3.1.3 The Preferred Route would pass within 300m of approximately 190 properties and relatively close to the communities of Thorpe Marriott, Rackheath, Spixworth and Thorpe End. Near these, one of the most effective forms of mitigation possible would be the construction of the road in cutting, or through the use of ground modelling where the road is near or above existing ground level., to reduce visual impacts and effects of noise and pollution.

3.2 Earthwork Quantities

3.2.1 A preliminary estimate of the earthwork quantities has been carried out, based on the preliminary alignment design described in Section 2. Calculations are based on the following assumptions:

- The road would be 26.1m wide including verges
- Side slopes would be at 1:2
- Visibility splays would be required around bends which are below desirable minimum

3.2.2 For all options, surplus earthworks materials and topsoil are available. This could be used for mitigation by modelling the ground and creating false cuttings to shield the road from nearby properties. Ground modelling requirements along the whole route have been identified, and classified as “essential” and “desirable”. This would consist of 2m high bunds having a 1:2 slope on the road side and a 1m wide top. The field side slope would vary between 1:8 (suitable for cultivation) and 1:4 (suitable for woodland planting), and 1:2 only in the case of high embankments (e.g. for the Over options at Rackheath railway).

3.2.3 Where sufficient surplus material is available, slopes on the field side of the new road could be profiled and contoured to fit in with the surrounding landscape. This would reduce the impact of the new road and enable more of the land to be returned in a useful state to its original owner.

3.2.5 Surplus material could also be used to re-profile agricultural fields if acceptable to the landowner. Any surplus material which could not be used in or around the scheme would have to be disposed of elsewhere, incurring expensive landfill tax and transport expenses.

3.2.6 Between the A1067 Fakenham Road and the C283 Salhouse Road, total cut and fill volumes are the same for all options. However, as the surplus volumes of earthworks materials and topsoil available differ for each option they are

deposited differently along the entire route. Consequently, the volume of surplus material deposited on each section will differ.

3.3 Over option 1a

3.3.1 With the NDR crossing over the railway line, the earthworks quantities are as follows;

Over Railway Option 1a						
From	To	Excavate fill	Deposit fill	Excavate Topsoil	Deposit topsoil	Deposit Surplus fill and topsoil in landscaping areas
		m^3	m^3	m^3	m^3	
A1067 Fakenham Road	C261Reepham Road	58,856	61,544	25,618	7,608	25,540
C261Reepham Road	A140 Cromer Road	109,487	32,858	38,002	10,360	39,783
A140 Cromer Road	C246 Buxton Road	225,973	78,777	48,141	13,679	47,033
C246 Buxton Road	B1150 North Walsham Rc	40,437	4,831	11,900	3,165	12,362
B1150 North Walsham Rc	A1151 Wroxham Road	66,932	38,570	21,313	6,524	21,335
A1151 Wroxham Road	C283 Salhouse Road	74,259	147,576	28,100	6,610	27,146
C283 Salhouse Road	Railway Line	5,898	103,574	9,622	4,723	7,512
Railway Line	A47 Yarmouth Road	144,805	197,613	41,912	16,050	36,481
		726,647	**665,344**	**224,608**	**68,719**	**217,192**

3.3.2 Around 217,000m^3 of surplus material is available, which would meet 45% of the essential bunding requirements.

3.4 Over option 1b

3.4.1 With the NDR crossing over the railway line and Plumstead road, the earthworks quantities are as follows;

Over Railway Option 1b						
From	To	Excavate fill	Deposit fill	Excavate Topsoil	Deposit topsoil	Deposit Surplus fill and topsoil in landscaping areas
		m^3	m^3	m^3	m^3	
A1067 Fakenham Road	C261Reepham Road	58,856	61,544	25,618	7,608	24,383
C261Reepham Road	A140 Cromer Road	109,487	32,858	38,002	10,360	37,917
A140 Cromer Road	C246 Buxton Road	225,973	78,777	48,141	13,679	45,101
C246 Buxton Road	B1150 North Walsham Rc	40,437	4,831	11,900	3,165	11,804
B1150 North Walsham Rc	A1151 Wroxham Road	66,932	38,570	21,313	6,524	20,329
A1151 Wroxham Road	C283 Salhouse Road	74,259	147,576	28,100	6,610	26,277
C283 Salhouse Road	Railway Line	7,703	94,648	10,398	3,507	8,842
Railway Line	A47 Yarmouth Road	104,672	177,893	38,320	14,058	33,250
		688,319	**636,698**	**221,792**	**65,511**	**207,903**

3.4.2 Around 208,000m^3 of surplus material is available which would meet 43% of the essential bunding requirements.

3.5 **Over option 1c**

3.5.1 With the NDR crossing the railway line and Plumstead road on a shorter embankment, the earthworks quantities are as follows;

Over Railway Option 1c						
From	**To**	**Excavate fill**	**Deposit fill**	**Excavate Topsoil**	**Deposit topsoil**	**Deposit Surplus fill and topsoil in landscaping areas**
		m^3	m^3	m^3	m^3	
A1067 Fakenham Road	C261Reepham Road	58,856	61,544	25,618	7,608	24,383
C261Reepham Road	A140 Cromer Road	109,487	32,858	38,002	10,360	37,917
A140 Cromer Road	C246 Buxton Road	225,973	78,777	48,141	13,679	45,101
C246 Buxton Road	B1150 North Walsham Rd	40,437	4,831	11,900	3,165	11,804
B1150 North Walsham Rd	A1151 Wroxham Road	66,932	38,570	21,313	6,524	20,329
A1151 Wroxham Road	C283 Salhouse Road	74,259	147,576	28,100	6,610	26,277
C283 Salhouse Road	Railway Line	4,472	146,086	11,592	4,421	9,121
Railway Line	A47 Yarmouth Road	108,012	129,847	37,108	13,030	33,065
		688,428	**640,090**	**221,774**	**65,398**	**207,998**

3.5.2 As with Option 1b, around 208,000m^3 of surplus material is available, which would meet 43% of the essential bunding requirements.

3.6 **Under option 2a**

3.6.1 With the NDR passing under the railway line (with pumped drainage system- see Section 4) quantities are as follows

Under Railway Option 2a						
From	**To**	**Excavate fill**	**Deposit fill**	**Excavate Topsoil**	**Deposit topsoil**	**Deposit Surplus fill and topsoil in landscaping areas**
		m^3	m^3	m^3	m^3	
A1067 Fakenham Road	C261Reepham Road	58,856	61,544	25,618	7,608	69,783
C261Reepham Road	A140 Cromer Road	109,487	32,858	38,002	10,360	111,113
A140 Cromer Road	C246 Buxton Road	225,973	78,777	48,141	13,679	120,891
C246 Buxton Road	B1150 North Walsham Rd	40,437	4,831	11,900	3,165	33,671
B1150 North Walsham Rd	A1151 Wroxham Road	66,932	38,570	21,313	6,524	59,799
A1151 Wroxham Road	C283 Salhouse Road	74,259	147,576	28,100	6,610	60,373
C283 Salhouse Road	Railway Line	68,354	1,583	8,825	3,742	23,045
Railway Line	A47 Yarmouth Road	225,245	82,328	41,140	15,137	99,014
		869,544	**448,068**	**223,038**	**66,824**	**577,689**

3.6.2 Around 578,000m^3 of surplus material is available, which would meet the essential bunding requirements, and meet 100,000 m^3 of the desirable bunding requirements.

3.6.3 The railway line has previously been classified in the Environmental Assessment as potentially polluted. Contamination tests were carried out on samples from three boreholes, at depths up to 1.0m , and compared with the department for Environment, Food and Rural Affairs (DEFRA) Soil Guideline Values (SGV), with all results below the acceptable threshold levels. From the borehole locations this contamination could extend up to 50m either side of the railway,

and given the permeable nature of the local soils could also extend to the full depth of excavation. In this context, assuming a corridor 100m wide, an average depth of 6m, and a skew length of 60m would require the removal of some 36,000 cum of material. The extent of contamination would need to be confirmed by further site investigation works.

3.6.4 Treatment of contaminated soil using Bio-remediation for re-use on site was considered, but is not possible due to the presence of heavy metal contaminants. Remediation could be achieved by mixing with grout to render it non hazardous at an estimated cost of £1.6m, but it is unlikely even then that such material could be incorporated within the scheme works and would still require disposal to a local landfill site, at further estimated cost of £0.4m. The least expensive option is disposal of untreated contaminated material in licensed pits at an estimated cost of £1.4m, and this amount has been included in the estimates in section 8. Further testing would be required to establish the full extent of contamination and the volume of material affected.

3.7 Under option 2b

3.7.1 With the NDR passing under the railway line (with gravity drainage system-see Section 4) quantities are as follows

Under Railway Option 2b

From	To	Excavate fill	Deposit fill	Excavate Topsoil	Deposit topsoil	Deposit Surplus fill and topsoil in landscaping areas
		m^3	m^3	m^3	m^3	
A1067 Fakenham Road	C261Reepham Road	58,856	61,544	25,618	7,608	115,303
C261Reepham Road	A140 Cromer Road	109,487	32,858	38,002	10,360	184,502
A140 Cromer Road	C246 Buxton Road	225,973	78,777	48,141	13,679	196,881
C246 Buxton Road	B1150 North Walsham Rc	40,437	4,831	11,900	3,165	55,594
B1150 North Walsham Rc	A1151 Wroxham Road	66,932	38,570	21,313	6,524	99,373
A1151 Wroxham Road	C283 Salhouse Road	74,259	147,576	28,100	6,610	94,559
C283 Salhouse Road	Railway Line	68,354	1,583	8,825	3,742	38,837
Railway Line	A47 Yarmouth Road	564,721	51,238	49,259	22,812	163,649
		1,209,019	**416,978**	**231,157**	**74,500**	**948,698**

3.7.2 Around 950,000m^3 of surplus material is available, which would meet both essential and desirable bunding requirements.

3.7.3 As with Under option 2a, disposal of contaminated land at an estimated cost of £1.4m would be required.

3.8 Conclusion

3.8.1 The Under options will yield more surplus material for bunding, but with a corresponding increase in earthworks costs. Additionally, the disposal of contaminated excavated material will be required, the full extent of which can only be determined through further investigation.

3.8.2 For the Over options, with less surplus material available only up to 45% of essential landscaping requirements can be met. However, there is scope to lower the vertical profile along certain sections of the route to mitigate landscape impacts; an initial examination indicates this would yield sufficient material to meet at least the essential landscaping needs, but with a corresponding increase in earthworks costs.

4.0 WATER QUALITY AND DRAINAGE

4.1 Introduction

4.1.1 To protect drinking water supplies, the Environment Agency has designated areas around Public Water Supplies (PWS), as Source Protection Zones (SPZs). There are no PWSs within the eastern Study Area. However, Rackheath railway crossing lies just within a Zone III (Total catchment) (defined as the total area needed to support the abstraction or discharge from the protected groundwater source) designated for PWSs to the south, and its western approach crosses a 2.5 km wide band of SPZ III, extending from PWSs in the south of Norwich, up to PWSs in the north at Belaugh.

4.1.2 In addition to the SPZs, groundwater vulnerability has been examined. The area of interest overlies a major Chalk aquifer. The predominant soil classification is Wick 2, comprised of typical brown earths. On account of its high permeability this soil type has high leaching potential, giving the Area of interest high groundwater vulnerability.

4.1.3 Fourteen licensed abstractions from groundwater lie within 2km of the area of interest, the nearest two being 600m and 900m from the proposed overbridge. (Check significance with LAB)

4.1.4 The main sources of pollutants in road runoff are vehicular although the gradual wear and tear of the road also contributes. The DMRB describes typical constituents of road runoff to include:

i) Suspended solids
ii) Hydrocarbons
iii) Metals, dissolved and insoluble including copper, zinc and iron
iv) Cyanide
v) Chlorides
vi) Sulphides
vii) PCB's and pesticides
viii) Bacteria

4.1.5 The introduction of Sustainable Drainage Systems (SUDS) is widely encouraged by the Environment Agency to retain or detain storm flows as appropriate. By the use of SUDS, storm flows are temporarily or permanently taken out of the surface water circulation and hence help to manage flooding. An additional benefit is the containment, and to some extent treatment, of pollution, thus ensuring that surface and groundwater in the area is not polluted.

4.1.6 The most appropriate SUDS options will be selected as detailed design progresses. For the purpose of this report and costing of options, piped systems in conjunction with sedimentation lagoons have been assumed. Lagoons provide detention of flood flows to allow settlement of suspended solids and removal of a large part of the main pollutants.

4.2 Over options 1a, 1b and 1c

4.2.1 Over option 1 a. Boreholes 13 to 18 on the plan in Appendix G relate to this route over the railway.

4.2.2 Over option 1b and 1c. Boreholes 2 to 12 on the plan in Appendix G relate to this route over the railway.

4.2.3 In all cases, drainage will be provided by pipes carrying surface water from the high point over the railway to lagoons.

4.3 Under options 2a and 2b

4.3.1 Boreholes 2 to 12 on the plan in Appendix G relate to the route under the railway. There are three essential requirements with respect to drainage in this context; protecting the groundwater, collection and treatment of possibly contaminated run-off water, and preventing flooding of the NDR. There are two drainage options (Pumped or gravity discharge) for achieving the last requirement, as follows;

4.3.2 Under option 2a (Pumped discharge).

4.3.2.1 This system requires an attenuation tank large enough to store water received during a design storm, which would be pumped into a soakage lagoon. 4 sets of Piezometer readings (taken between February and May 2006) from the ground investigation boreholes nearest the overbridge site indicate an average groundwater level of 17.7m AOD. However, these readings followed a winter of below average rainfall, and longer term monitoring would be required to establish a more representative water level which could reasonably be expected to be higher.

4.3.2.2 The proposed road level at the lowest point is also approximately 17.7m AOD, placing road construction below groundwater level, For the road to support loading its construction layers and supporting strata need to be effectively drained of water. With both below groundwater level, the only way to achieve this is to isolate them from the groundwater table. This has been achieved in similar circumstances by constructing a vertical “wall” around the low area, keyed into an impermeable strata to effectively create a sealed “Tank” which can be drained and into which groundwater cannot penetrate. Two options were considered for this approach:

a) Bentonite slurry wall. This would key into impermeable substrate, normally clay, to prevent water ingress. However, from borehole data the most solid available strata is chalk, 18m deep. It is highly unlikely that an effective, watertight interface could be established, and this option is therefore discounted.

b) Sheet piling. This could form a more secure interface with the chalk by driving piles several meters into the strata, for which EA consent would be required to prevent possible groundwater contamination.

4.3.2.3 The success of option b) above is dependent on establishing a watertight key with an impermeable strata. From soil sampling the chalk is class 1 porcelainious which is very strong. It is therefore unlikely that a long reach excavator could penetrate this to provide an effective key, or that sheet piles could be driven through this without being damaged. It is highly likely that the chalk strata is also fissured and permeable, although only this can only be confirmed by drilling at least four more, wide diameter boreholes to obtain chalk samples, at an estimated cost, of £20,000. Further pumping tests would also be required to more accurately determine the extent and nature of the water table, for which an EA permit would also be required.

4.3.2.4 This option would increase earthworks costs by some £1.3m, and require special drainage measures costing a further £1.3m, compared with the Over options.

4.3.3 **Under option 2b** (**Gravity discharge).**

4.3.3.1 This system requires a large underground pipe to convey water to the nearest practicable discharge point near Postwick some 3.5km south, which would also provide drainage for the NDR beyond the railway. To meet minimum gradient requirements, the pipe depth would average 10m, requiring a deep excavation. Rather than simply excavate and replace material at this depth, the opportunity would be taken to use this cutting to lower the vertical profile of the NDR between the railway and Postwick

4.3.3.2 This option would increase earthworks costs by some £2.3m, and require special drainage measures costing a further £1.3m, compared with the Over options.

4.4 Conclusion

4.4.1 Drainage for the Over options, using pipes and lagoons, is straightforward.

4.4.2 Drainage for the Under options both require “Tanking” to isolate road drainage from the groundwater. This depends on establishing a watertight key with an impermeable strata. It is highly likely that the chalk strata is fissured and permeable, although only this can only be confirmed by drilling at least four more, wide diameter boreholes to obtain chalk samples, at an estimated cost, of £20,000. Earthworks and drainage costs would be significantly higher than for the Under options.

5.0 BRIDGE DESIGN, NETWORK RAIL AND PUBLIC UTILITIES

5.1 Introduction

5.1.1 Mott MacDonald carried out preliminary designs for the Over and under railway bridge options. Their full report, "NDR Structures; Norwich to Sheringham Railway Line Bridge Proposals" is included as Appendix H.

5.1.2 Network Rail is the 'not for profit' company which owns the railway line. It is responsible for maintaining the integrity of the track and the safety of trains which use it. An initial meeting was held with on 15 December 2005 at Network Rail offices in London, where both options were outlined and neither rejected at that stage. Details of the structure described below were forwarded to Network Rail in April 2006 for approval, and are still to be reviewed by Network Rails Major Projects division.

5.1.3 Network Rail has indicated by telephone that although either option could be viable, their preference is for bridges over railways. They are reviewing policy regarding railway underbridges and may require that, where used, these are constructed only by Network Rail. They will seek ownership of underbridges as they support NR infrastructure.

5.1.4 From Utility Inquiries sent out from December 2005, the following organisations: have plant in the region of the railway/Plumstead Road:

- Anglian Water (Water main)
- British Telecom (Overhead plant)
- EDF (11kv Overhead plant)
- National Grid/Transco

The location of the plant is shown on plans in Appendices B and C. From initial discussions with EDF, BT and Anglian Water any diversion of their plant in cost terms is not considered significant. Diversion of the National Grid medium pressure gas main running along the west side of the railway would be significant, with a budget estimate provided of £420,000.

5.2 Over option 1a.

5.2.1 Two options for the Railway Overbridge were considered; a single span or a three span structure. A vertical clearance of 5.3m between rail level and the bridge deck soffit is used. Pier and abutments faces are set a minimum of 4.500m from rail tracks, to protect the overbridge from derailed trains.

5.2.2 The National Grid medium pressure gas main runs along the west side of the railway. If this main was diverted and the bridge abutments constructed closer to the railway line (but remaining outside of the railway impact hazard zone) construction costs would reduce by an estimated £250,000. However the estimated diversion cost is £420,000. There would therefore be a net saving of £170,000 by leaving the main in situ (subject to agreement with the operator, National Grid), which would also be less disruptive for construction and programming.

5.2.3 The estimated cost of the Railway Overbridge is £3m (£2.5m plus an estimating variation allowance of 20%).

5.3 Over option 1b

5.3.1 The Railway Overbridge would be the same as Over option 1a but extended to cross Plumstead Road as well as the railway via a single structure. The estimated cost of the Railway Overbridge is £3.9m (£3.25m plus an estimating variation allowance of 20%).

5.4 Over option 1c

5.4.1 The Railway Overbridge would be the same as Over option 1b but with deck thickness reduced to assist in shortening the length of embankment.

5.5 Under options 2a and 2b.

5.5.1 To minimise disruption to the railway, the Railway underbridge would be a pre-constructed reinforced concrete structure slid into position during a 72 hour railway possession. A vertical clearance of 6m between road level and the bridge deck soffit is used.

5.5.2 Two options were considered; a skewed box structure with twin portals, and a four span structure, consisting of two central spans carrying the dual carriageway with two propped cantilever side spans that act as wingwalls /embankments. The estimated cost of the Railway Underbridge is £6m (£5m plus an estimating variation allowance of 20%).

5.5.3 Drainage options are identified in Section 4. The Structures report pre-dates the Ground Investigation and does not therefore take account of the structure foundations being below the groundwater level table. A more detailed design would need to address the risk of drainage failure and suitable measures to protect the structural integrity of the Railway Underbridge.

5.5.4 At the meeting of 15 December 2005 Network Rail advised that for this option Network Rail would need to own and maintain the Railway underbridge, and consequently would require a commuted sum for future maintenance. Whilst their Major Projects division are still to quantify this sum, previous experience suggests that 50% of the estimated structure cost should be allowed. As this would be required following construction, this should be treated as a capital cost. A sum of £3m is therefore included in the estimate.

5.6 Conclusion

5.6.1 A Railway underbridge will mean that the road is constructed in a cutting. However, this option with its attendant commuted sum for maintenance is significantly more expensive than the Railway overbridge options, for which Over option 1a is least expensive. The risk of drainage failure must also be addressed to protect the structural integrity of the Railway Underbridge.

5.6.2 Both options depend on obtaining Network Rails approval as well as satisfying whatever requirements they may impose.

6.0 TRAFFIC

6.1 Introduction

6.1.1 One of the purposes of the Northern Distributor Route is to distribute traffic between the radial routes around the northern half of Norwich. For this reason junctions are proposed with most of these radial routes.

6.1.2 Both Plumstead Road and Salhouse Road are considered to be major radial routes and so it is proposed that they both should be linked to the NDR by a roundabout. Consideration was given to linking only one of these and closing or bridging the other. However, traffic modelling suggests that this would send a large volume of traffic along Green Lane East/ West which would be undesirable.

6.2 Over option 1b

6.2.1 A roundabout connects Plumstead Road to the NDR via a 570m link road. This link to Plumstead Road is significantly longer than all other options, to the extent that Green Lane will be more attractive for some local journeys than the NDR. For Over option 1b some 5-700 vehicles per hour would use Green Lane (Salhouse Road to Plumstead Road) in peak hours rather than the NDR, compared with less than 50 for all other options due to their shorter, more direct link to the NDR.

6.3 Over option 1a, Under options 2a and 2b

6.3.1 All three options have the same junction arrangements. A roundabout located some 200m east of the railway connects Plumstead Road to the NDR via 450m link roads (comprising a 250m link to Plumstead Road north, and a 200m link to the level crossing at Plumstead Road south).

6.3.2 Less than 50 vehicles per hour would use Green Lane (on the section Salhouse Road to Plumstead Road) in peak hours.

6.4 Over option 1c

6.4.1 A roundabout connects Plumstead Road to the NDR via a 220m link road.

6.4.2 Less than 50 vehicles per hour would use Green Lane (on the section Salhouse Road to Plumstead Road) in peak hours.

6.5 **Conclusion**

6.5.1 For Over option 1b some 5-700 vehicles per hour will continue to use Green Lane (Salhouse road to Plumstead road) in peak hours. The following table summarises the traffic effects on Green lane compared with the "do minimum" scenario of no NDR, where this section of Green Lane would have flows of between 800-1000 vehicles per hour. With Over option 1b traffic on Green Lane would be reduced by between 13% and 50%, on all other options it could be eliminated.

		Two-way flows on Green Lane (West of Salhouse road) compared with do-minimum			
		2012 am	2012pm	2027 am	2027pm
1	Do-minimum	800	1000	800	1000
2	Over option 1b	500	500	700	600
3	All other options	<50	<50	<50	<50

6.5.2 NATS policy 6 states that; "*Access restrictions will be introduced on minor rural and residential roads around the north of Norwich alongside an NDR Scheme. Before an NDR, restrictions on individual roads may be appropriate, based on the individual merits of each case*". The strategy is to "lock in" the benefits of a new road. Green Lane lies within the NATS Area. This approach would apply to all options, to maximise benefits to the residents of Green Lane, and to deter inappropriate use by through traffic ("rat-running"). The models shows that introducing a 20mph speed limit on Green Lane would make traffic flows there consistent across all the options (<50 vehicles per hour) including Option 1b.

7.0 ENVIRONMENT

7.1 Introduction

7.1.1 The impact of a road scheme on the environment is assessed at various stages under 12 headings as laid out in Volume 11 of the Highways Agency's Design Manual for Roads and Bridges. Baseline conditions are described in the Stage 2 Environmental Assessment report. When assessing the impact of the road at Rackheath under most of these headings, there would be very little difference in the assessment results between the under and Over options.

7.1.2 Headings where there would be a major difference in assessment results are:

- Landscape impacts
- Water quality and drainage
- Traffic noise and vibration

7.1.3 Headings where there would be a less significant difference in assessment results are:

- Disruption due to construction
- Pedestrian, Cyclists, Equestrians and Community Effects

7.1.4 The five headings identified above are considered as follows;

7.2 Landscape Impacts.

7.2.1 The area under consideration is open arable farmland with few features of interest. It could be described as 'fairly ordinary landscape' but will be of importance to local people, particularly those living along Green Lane who enjoy open views across fields from their frontages and upstairs windows. The landscape impacts of the three proposals are as follows:

7.2.2 **Over option 1a**: The main impacts will relate to the dual carriage way elevated on an approximately 1200m long embankment which rises to 8m at its highest point as it crosses the rail line. In addition a new roundabout will be located approximately 50m to the south of Plumstead Road. This will be elevated approximately 6m above existing ground level with two elevated road links from Plumstead Road. Lighting standards require the roundabout and around 60m of its associated approaches to be lit, creating a total lit length of road of approximately 330m.

7.2.3 The road embankments, approach roads and roundabout would be a dominant linear feature within the existing arable landscape and will be visible from Green Lane and Thorpe End. The lighting will add to the visual intrusion particularly at night. In addition traffic moving along the road would also be visible and road noise would be intrusive in this area of countryside.

7.2.4 Mitigation could comprise some ground modelling, tree planting and the provision of a false cutting and/or noise fencing along the NDR to reduce the visual impact of the traffic on the new road. The Streetlighting could use white light sources (for which CPRE have expressed a preference in rural "dark landscape" settings) with full cut off lanterns to reduce light spill.

7.2.5 Given the scale of the development, however, it would be difficult to mitigate the impact of this option to an acceptable level in landscape terms. The new road and roundabout would have a local **high negative** impact on the character and appearance of the surrounding landscape. The level of visual intrusion is predicted to be **high** in year one and **high** in year 15 after the road opens respectively.

7.2.6 **Over option 1b**: Here the road will be elevated on a 1000m long embankment which rises to 8m at its highest point as above and crosses the railway line and Plumstead Road on a single bridge. The new roundabout would be at ground level approximately 500m south of Plumstead Road and would be connected to it by a 570m long single carriageway link road at existing ground level. Lighting standards require the roundabouts at each end, and around 60m of their associated approaches, to be lit. However, lengths of road up to 400m between systems of lighting should also be lit. Consequently, the link road and both roundabouts would be lit, creating a total lit length of road of approximately 900m.

7.2.7 The road embankment would be a dominant linear feature within the existing arable landscape and will be visible from Green Lane and Thorpe End. The lighting on the roundabout and its approaches would add to the visual intrusion particularly at night. In addition traffic moving along the road would also be visible and road noise would be intrusive in this area of countryside.

7.2.8 Mitigation could comprise some ground modelling, tree planting and the provision of a false cutting and/or noise fencing along the NDR to reduce the visual impact of the traffic on the new road. The Street lighting could use white light sources (for which CPRE have expressed a preference in rural “dark landscape” settings) with full cut off lanterns to reduce light spill.

7.2.9 Mitigation of this option would be more successful than option 1a above on account of the fact the roundabout and approach roads would be lower and easier to screen. The residual impacts being the long elevated linear embankment and the lighting at the roundabout. Over a period of time ground modelling and planting could help reduce the impact of the road embankment. The new road and roundabout would have a local **moderate negative** impact on the character and appearance of the surrounding landscape. The level of visual intrusion is predicted to be **high** in year one and **moderate** in year 15 after the road opens respectively.

7.2.10 **Over option 1c**: The main impacts will relate to the dual carriage way elevated on an approximately 1200m long embankment which rises to 8m at its highest point as it crosses the rail line. In addition a new roundabout will be located approximately 250m to the south of Plumstead Road. This will be elevated approximately 3.5m above existing ground level on its northern side, running back to approximately ground level on its southern edge. An elevated road link would leave the north east edge of the roundabout at approximately 2.5m above ground level. This would join the Plumstead Road at a small roundabout. Lighting standards require the roundabouts at each end, and around 60m of their associated approaches, to be lit. However, lengths of road up to 400m between systems of lighting should also be lit. Consequently, the link road and both roundabouts would be lit, creating a total lit length of road of approximately 550m.

7.2.11 The road embankments, approach roads and roundabout would be a dominant linear feature within the existing arable landscape and will be visible from Green Lane and Thorpe End. The lighting will add to the visual intrusion particularly at night. In addition traffic moving along the road would also be visible and road noise would be intrusive in this area of countryside.

7.2.12 Mitigation could comprise some ground modelling, tree planting and the provision of a false cutting and/or noise fencing along the NDR to reduce the visual impact of the traffic on the new road. The street lighting could use a white light sources (for which CPRE have expressed a preference in rural "dark landscape" settings) with full cut off lanterns to reduce light spill.

7.2.13 Mitigation of this option would be more successful than option 1a on account of the fact the roundabout and approach roads would be lower and easier to screen. It would, however be more intrusive than option 1b because of the roundabouts higher position in the landscape.

7.2.14 The residual impacts of this option would be the long elevated linear embankment, the elevated roundabout and the lighting on the roundabouts and link road. Over a period of time ground modelling and planting could help reduce, but not fully remove, the impact of the road embankment and roundabout. The new road and roundabout would have a local **high negative** impact on the character and appearance of the surrounding landscape on account of the elevation of the roundabout. The level of visual intrusion is predicted to be **high** in year one and **moderate** in year 15 after the road opens respectively.

7.2.15 **Under options 2a and 2b**: Here the road lies within a 1900m long cutting falling to a maximum depth of 7m as it crosses beneath the railway. A new roundabout would be provided approximately 50m to the south of Plumstead Road up to 2m below existing ground level. Two road links in cutting would connect Plumstead Road to the new roundabout. The roundabout and its approach roads would be lit.

7.2.16 The road would be a significant linear feature within the existing arable landscape. It would be within a cutting, which would limit its intrusion when viewed from Green Lane and Thorpe End. The lighting on the roundabout and its approaches would add to the visual intrusion particularly at night. `

7.2.17 Mitigation could include tree planting and some ground modelling close to the roundabout. The Street lighting could use white light sources (for which CPRE have expressed a preference in rural "dark landscape" settings) with full cut off lanterns to reduce light spill.

7.2.18 This option would be the easiest to mitigate in landscape terms. In time, as the tree planting matures, the new road and roundabout would have a local **moderate negative** impact on the character and appearance of the surrounding landscape. The level of visual intrusion is predicted to be **moderate** year one and **low** in year 15 after the road opens respectively.

7.3 Water Quality and drainage

7.3.1 This area is addressed in Section 4.

7.4 Traffic Noise and Vibration

7.4.1 The Route affects isolated properties along the whole length. The table below shows the approximate number of properties within prescribed distances of each route option along the length where there horizontal alignments differ (ie between Salhouse Road and 200m west of Middle Road):

	Over options			Under options	
Distance to route	**Option 1a**	**Option 1b**	**Option 1c**	**Option 2a (pumped outfall)**	**Option 2b (gravity outfall)**
0-100	0	1	1	0	0
100-200	1	0	0	1	1
200-300	2	4	4	2	2

7.4.2 However, as the NDR runs parallel to Green Lane, it affects a larger volume of housing in Rackheath, situated just over 300m from the scheme on Green Lane. Noise contour modelling has been carried out to identify noise levels for each option, with drawings to illustrate these included in Appendix I. Noise contours are freefield levels at a height of 5m (representing worst-case first floor noise level). Calculations have assumed a thin surface course with a benefit of -2,5dB compared to hot rolled asphalt. For levels at the façade of a house, 2.5dB should be added. The drawings show that the following noise levels can be expected along Green Lane;

- "Do-nothing" (no NDR built) : 62.5- 65db
- Under options: 52.5 - 55dB (rising to 57.5dB near junctions at each end)
- Over option 1a: 55.0 – 57.5dB (rising to 60dB near junctions at each end)
- Over option 1b: 62.5 - 65dB (Higher than other options due to the lower traffic reduction on Green lane)
- Over option 1c: 55.0 – 57.5dB (rising to 60dB near junctions at each end)

7.4.3 Mitigation measures. Traffic noise can be reduced significantly by the choice of surfacing. Using low noise surfacing materials can bring base levels down by 3dB(A). The choice of materials open to contractors should be restricted to those meeting at least this requirement. The use of low noise surfacing is becoming best practice.

7.4.4 Although Bunds can be used to mitigate the effects of the Over options, they will clearly have a more intrusive effect than the Under options which are shielded by cuttings. The use of a 2m high bund on either side of the road for the Over options would result in the following noise levels along Green Lane;

- Over option 1a- Below 55dB (rising to 57.5dB near junctions at each end)
- Over option 1b- 62.5 - 65dB. The lack of difference is due to the residual traffic flow on Green Lane. However, if a 20mph limit were introduced, then noise levels would reduce to below 55dB (rising to 57.5dB near junctions at each end).
- Over option 1c- Below 55dB (rising to 57.5dB near junctions at each end)

7.4.5 For all options there would be a reduction in noise levels along Green Lane from the “do-nothing” situation (no NDR built), although it should be noted that the character of the noise would be different. For the Over options without bunding, noise levels would be higher along Green Lane than with the Under options. However, if 2m bunds were used on the Over options (in conjunction with a 20mph speed limit introduced along Green Lane) the noise levels along Green lane would be the same for all options (below 55db), being some 7.5db less than the “do-nothing” situation.

7.5 Disruption Due to Construction

7.5.1 As DMRB Volume 11 states, 'disruption due to construction' is a term which covers the effects on people and on the natural environment which can occur between the start of pre-construction works and the end of the contract maintenance period. Disruption due to construction need not be as a result of work directly on the road scheme itself, but can also arise from advance works by utilities, which may extend well beyond the highway construction site.

7.5.2 Disruption due to construction is generally a more localised phenomenon than the impacts of a scheme once it has opened to traffic and will impact most on those people living within 100m of a new route. For all options there is one property (“The railway crossing” adjacent to the Plumstead road/railway level crossing) within 100m of the route.

7.5.3 For Options 1b and 1c this property lies within 50m of the NDR; however, if the property were acquired then disruption during construction would not be a consideration. For all other options it lies within 50m of the side road tie-in connecting Plumstead road (west) to the NDR, and disruption would consequently be on a lesser scale.

7.6 Pedestrians, Cyclists, Equestrians and Community Effects

7.6.1 This assessment considers journeys made by people as pedestrians (including ramblers), cyclists and equestrians. Considerations of road safety contribute to the overall assessment of amenity. In some cases, a scheme may cause community severance – significant changes in journey lengths or travel patterns within a community. This may occur, for example, if a new road acts as a barrier which deters people from using certain facilities. If a new road diverts traffic and makes an existing road easier for people to cross, community severance may be reduced. Access along Plumstead road for pedestrians, cyclists and equestrians (between Rackheath and Thorpe End) would be easier with options 1b and 1c, which carry the NDR over Plumstead road on a bridge. All other options access would require crossing the NDR at its roundabout junction with Plumstead road.

8.0 COSTS AND ECONOMIC APPRAISAL

8.1 Introduction

8.1.1 Mott MacDonald produced an "Economic Assessment Report" in February 2005 which included a section on " Economic Performance of Options". This described how the Department for Transport's Transport User Benefit Appraisal (TUBA) software was used to calculate impacts of the NDR on Consumer Users, Business Users and Providers and Public Accounts. The appraisal was carried out by analysis of scheme costs and predicted effects on travel times and distances in the area covered by the NATS traffic model for the average hours during the AM (0730-0930) and PM (1600-1830) peak periods.

8.1.2 The capital works costs (2002 prices) and land costs (2004 prices) of scheme options, including a 15% allowance for contingencies, and maintenance costs were used in the above appraisal. The same approach has been repeated to obtain TUBA results for each of the 4 options, this time with scheme costs at 2004 (Quarter 4) prices.

8.2 **Costs.** The estimated costs for each option (only for the section beyond Salhouse Road, where they differ) are presented in Appendix J. Works and Land costs can be summarised as follows;

- **Over option 1a = £26.7m.**
- **Over option 1b = £28.4m**
- **Over option 1c= £28.1m**
- **Under option 2a = £40.8m**
- **Under option 2b = £44.3m**

8.2.1 The significant cost differences can be summarised as follows;

- **Drainage**. Under option 2b is some £1.1m more expensive than other options due to the use of a 3.5km long, 10m deep drainage pipe.
- **Earthworks**. Options 2a and2b are respectively some £2.3m and £3.9m more expensive than the Over options due to disposal of contaminated land arising from excavations beneath the railway (£1.4m), and additional excavation of material and associated deposition in landscaping areas (£0.9m for Under option 2a, and £2.5m for Under option 2b).
- **Structures**. Over options 1b and 1c are some £0.9m more expensive than Over option 1a due to increased length of structure to cross Plumstead Road as well as the railway. The Under options are some £3m more expensive than Over option 1a due to more complex structural and construction requirements.
- **Structures (commuted sum and drainage measures**). The Under options require £3m for a commuted maintenance sum, and £1.3m for additional drainage measures to protect groundwater.
- **Land**. Land costs are expected to be some £400k higher for Over options 1b and 1c to cover the likely purchase of land at residential prices.

8.3 **TUBA analysis**. This has been repeated, on the same basis as before except for the following revised assumptions:

- Roundabout Geometric Parameters have been updated to more closely match current roundabout layouts, as these affect junction capacities and consequently can influence traffic flow patterns within the SATURN traffic model. Consequently, NDR approaches to a roundabout flare from 2 lanes to 3 lanes, with other approaches flaring from 1 lane to 2 lanes.
- Buxton Road is modelled as remaining open via a bridge crossing where previous modelling had assumed its closure.
- Phasing of Costs and Profile of Maintenance Costs have been updated, as follows, to reflect the shift in scheme opening year from 2010 to 2012.

Assumed phasing of costs	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Land								25%	75%	
Preparation	10%	20%	20%	20%	15%	10%	5%			
Supervision							5%	40%	45%	10%
Construction							5%	45%	45%	5%
Assumed profile of maintenance costs	2023	2035	2046	2058	2069					
Maintenance	10%	35%	10%	35%	10%					

8.4 The TUBA Economic Assessment is summarised in the Table below. All monetary values are in £ Millions discounted to 2002, at 2002 prices. Increase in BCR compared to previous assessments could be due to reduced travel times attributed to improved junction capacities and revised junction strategies.

Scheme	PVB	PVC	NPV	BCR
Over Railway Option 1a	491.6	108.3	383.3	4.5
Over Railway Option 1b	493.5	110.4	383.1	4.5
Over Railway Option 1c	495.6	110.0	385.6	4.5
Under Railway Option 2a	491.6	124.9	366.8	3.9
Under Railway Option 2b	491.6	129.1	362.6	3.8

8.5 Conclusion

8.5.1 The TUBA appraisal shows that all Over options have the same BCR of 4.5. Although Over options 1b and 1c are respectively £1.7m and £1.4m more expensive (works and land), than Over option 1a, they are also 100m shorter on account other different horizontal alignments. In TUBA terms it can be inferred that the disbenefit of the additional cost is effectively cancelled out by the traffic benefits associated with a shorter route.

8.5.2 Under options 2a and 2b have similar BCRs of 3.9 and 3.8 respectively.

8.5.3 Although environmental impacts considered in Section 7 are not included in the TUBA appraisal, these will have a material effect when considering funding of the scheme.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 The conclusions reached in all preceding sections may be summarised in the following table, with the following colour coding applied to provide a quick relative, visual appraisal:

High positive
Low positive
Neutral
Low to moderate negative
High negative

Most significant items		Over options			Under options	
		Option 1a	Option 1b	Option 1c	Option 2a	Option 2b
Earthworks	contaminated material	Low negative			High negative (Disposal of contaminated excavated material required)	
	other material	Low negative (Less surplus material for mitigation but latitude to lower the vertical profile to counteract this at increased earthworks costs)			Neutral (Sufficient surplus material for scheme mitigation, but with a corresponding increase in earthworks costs)	
Water Quality and Drainage		Neutral (Drainage for the over options, using pipes and lagoons, is straightforward.)			High negative (Drainage requires "Tanking" to protect groundwater. Needs a watertight key with chalk strata which is expected to be fissured and permeable- further testing costing £20k to confirm)	
Bridge design, network rail, and piublic utilities		Low positive	Low negative	Low negative	Low negative (Gas main diversion required. Road in cutting but significantly more expensive. The risk of drainage failure must also be addressed to protect the structural integrity of the Railway Underbridge)	
Traffic		Neutral	Neutral (provided measures taken to deter through traffic using Green Lane (Salhouse Road to Plumstead Road))	Neutral	Neutral	Neutral
Landscape Effects *	Impact on landscape	High negative	Moderate negative	High negative	Moderate negative	
	Visual intrusion (year 1)	High negative	High negative	High negative	Moderate negative	
	Visual intrusion (year 15)	High negative	Moderate negative	Moderate negative	Low negative	
Traffic Noise and Vibration		Low positive (with bunds)	Low positive (with bunds)	Low positive (with bunds)	Low positive (with bunds)	Low positive (with bunds)
Disruption Due to Construction*		Low negative	Neutral (if railway property acquired)	Neutral (if railway property acquired)	Low negative	
Pedestrians, Cyclists, Equestrians and Community Effects		High negative	Low- Moderately positive		High negative	
Costs and economic appraisal	costs	High positive	Low positive		High negative	
	ecomomic appraisal	Low positive			Low negative	

** Option 1c (modified) (See Paragraph 9.2.4) would reduce the landscape impacts of option 1c down to a similar level to option 1b.*

9.2 **The Under options.** The negative environmental impacts associated with going over the railway led to examining the case for going under. However, there are high negative aspects associated with Earthworks (disposal of contaminated material) and Water Quality and Drainage (establishing a watertight key with the chalk strata). The Under options present serious technical problems requiring expensive solutions (some of which may not be feasible), and have poorer Benefit-to-Cost ratios than the Over options. Consequently, it is not considered practicable to develop these options further. It is therefore **recommended** that the Under options are discounted.

9.3 **The Over options.** It is possible to mitigate the effects of Over options but the environmental impacts will be greater than for Under options. The Over options do, however, perform better in terms of disposal of contaminated material and Water Quality and Drainage (see Paragraph 9.2), and have better BCR which are equal for all options.

9.3.1 Option 1a, whilst providing an acceptable BCR, performed worst in landscape terms and is the most difficult to mitigate, and is therefore **recommended** that this option be discounted.

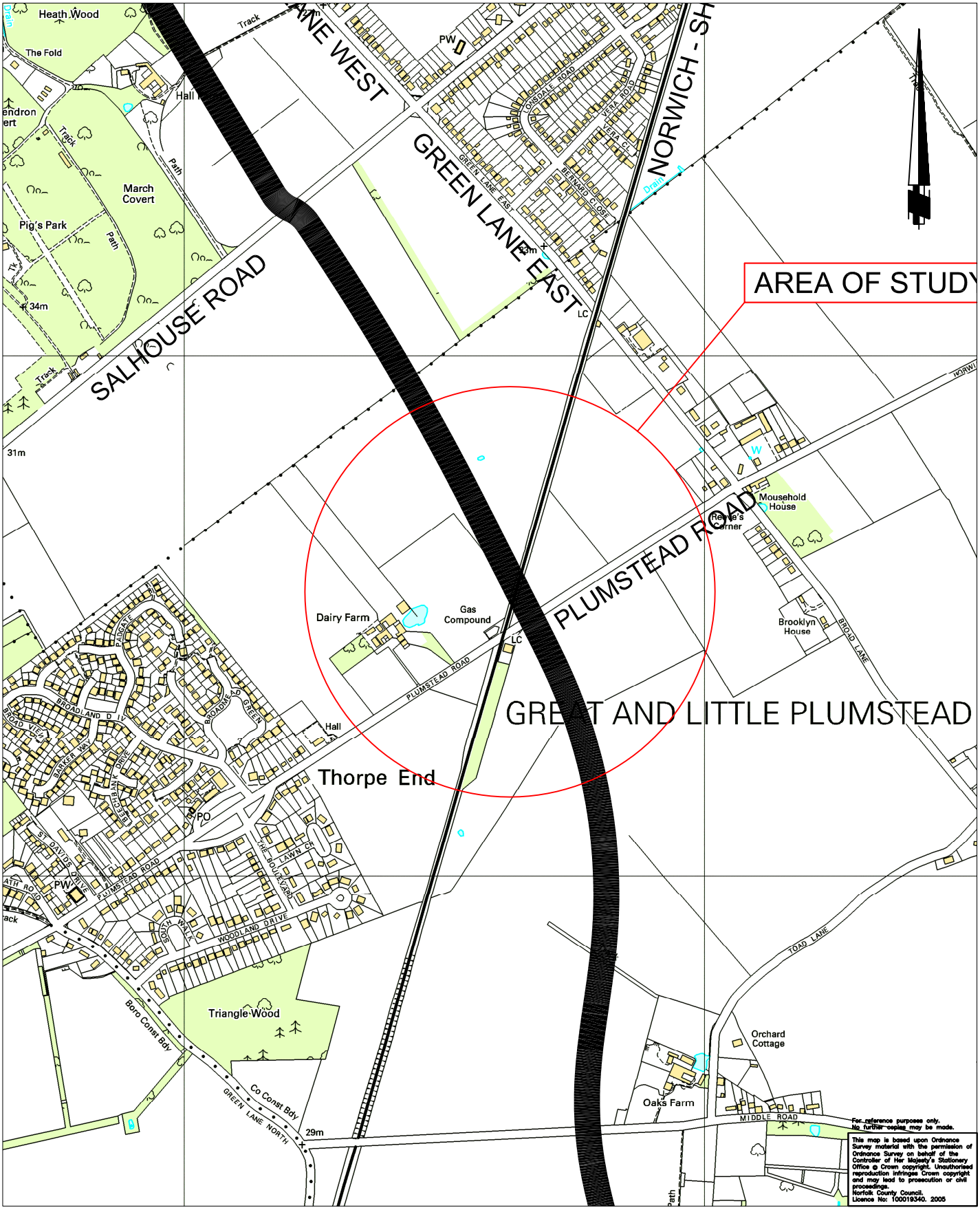
9.3.2 Whilst the assessment shows the landscape impacts for Option 1c are slightly worse than Option 1b, it provides a solution which can be mitigated to an acceptable degree. It also has the following benefits:

- reduced travel distance from Plumstead road to the NDR
- reduced length of embankment
- reduced length of lit link road.

9.3.3 The scheme design speed is 120kph. A reduction to 100kph would allow a change in geometric design standards, enabling a reduction in embankment length, roundabout height, and associated landscape impacts and costs. DMRB Design Standard TD 9/93("Highway Link Design") requires design speed to be "*consistent with the anticipated vehicle speeds on the road*", and TD 16/93 ("Geometric design of roundabouts") requires roundabout design to be "*related to the design speed of the approach roads irrespective of speed limits*". The section between the roundabouts on Salhouse Road and Plumstead Road, which crosses the railway line, is 1200m long. From discussions with the Traffic Safety section, it is considered that the 85% speed would not exceed 100kph on this section (although this would need to be verified after scheme opening, with appropriate measures such as additional advance signing added as required), and that this would consequently be an appropriate design speed to apply for this section only, in order to minimise environmental impacts. Subject to detailed design, it is considered that this change would reduce the landscape impacts of Option 1c down to a similar level to Option 1b.

9.3.5 It is therefore **recommended** that a 100kph design speed is applied to the section between Salhouse and Plumstead roads, to further reduce impacts and costs, and that Option 1c be chosen as the preferred option, with a modified vertical profile based on a 100kph design speed. This layout is shown in Appendix E.

Appendix A



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DRAWING TITLE

NORTHERN DISTRIBUTOR ROUTE
RAILWAY CROSSING
SITE LOCATION PLAN

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY	NCC	2005
DRAWN BY	DB	01/06
CHECKED BY		

DRAWING No. R1C093-R1-619

PROJECT TITLE
NORWICH NORTHERN DISTRIBUTOR ROUTE

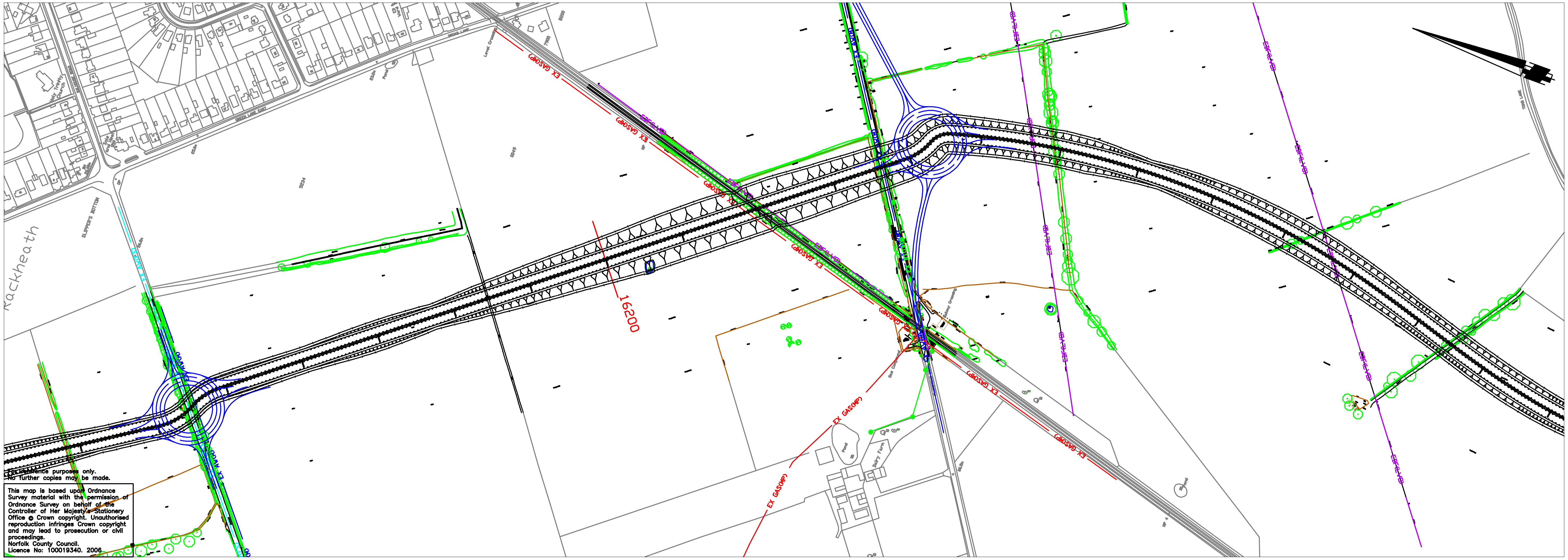
SCALE 1:20,000

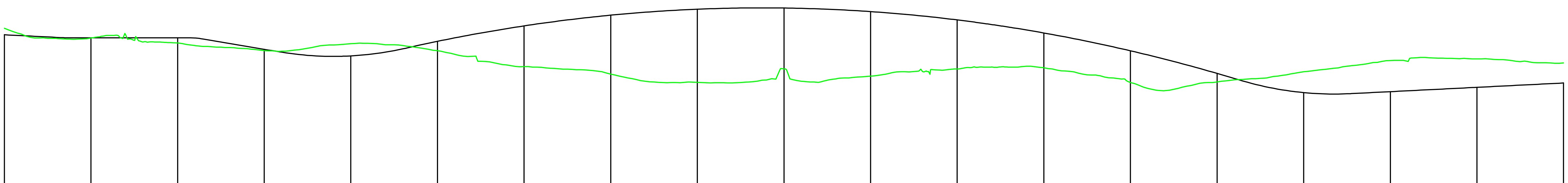
FILE No. R1C093

ORIGINAL SIZE: A4

BIL 19/09/05

Appendix B





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EXISTING LEVELS	30.00	28.87	28.30	27.43	28.21	27.41	25.57	24.70	23.76	25.30	24.47	25.30	25.45	23.74	23.80	24.98	26.28	26.46	25.99
CHAINAGE	15500	15600	15700	15800	15900	16000	16100	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100	17200	17300

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Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

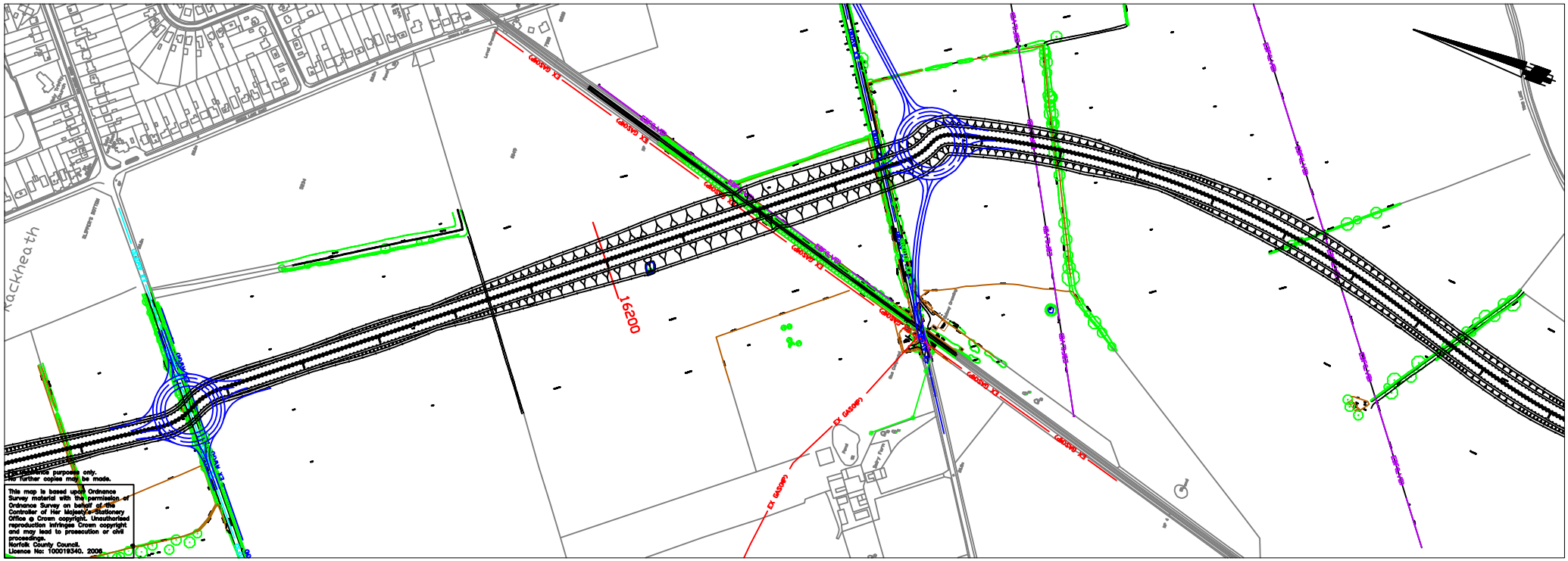
DRAWING TITLE
NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
RACKHEATH OVER OPTION 1A

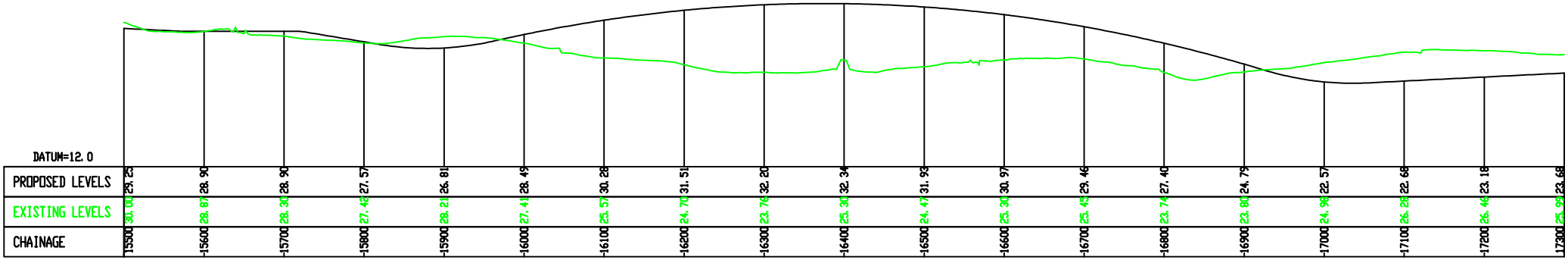
REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	PD	08/06
DRAWN BY	DB	08/06
CHECKED BY	PD	08/06

DRAWING No. R1C093-R1-707
PROJECT TITLE Norwich : Northern Distributor Road (over railway line option)
SCALE 1:5000/500
FILE No. R1C093

ORIGINAL SIZE: A3





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EXISTING LEVELS	30.00	28.87	28.30	27.42	28.21	27.41	25.57	24.70	23.76	25.30	24.47	25.30	25.45	23.74	23.80	24.98	26.28	26.46	25.93							
CHAINAGE	15500	15600	15700	15800	15900	16000	16100	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100	17200	17300							

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Director of Planning and Transportation
Norfolk County Council
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DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
RACKHEATH OVER OPTION 1A

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	PD	08/06
DRAWN BY	DB	08/06
CHECKED BY	PD	08/06

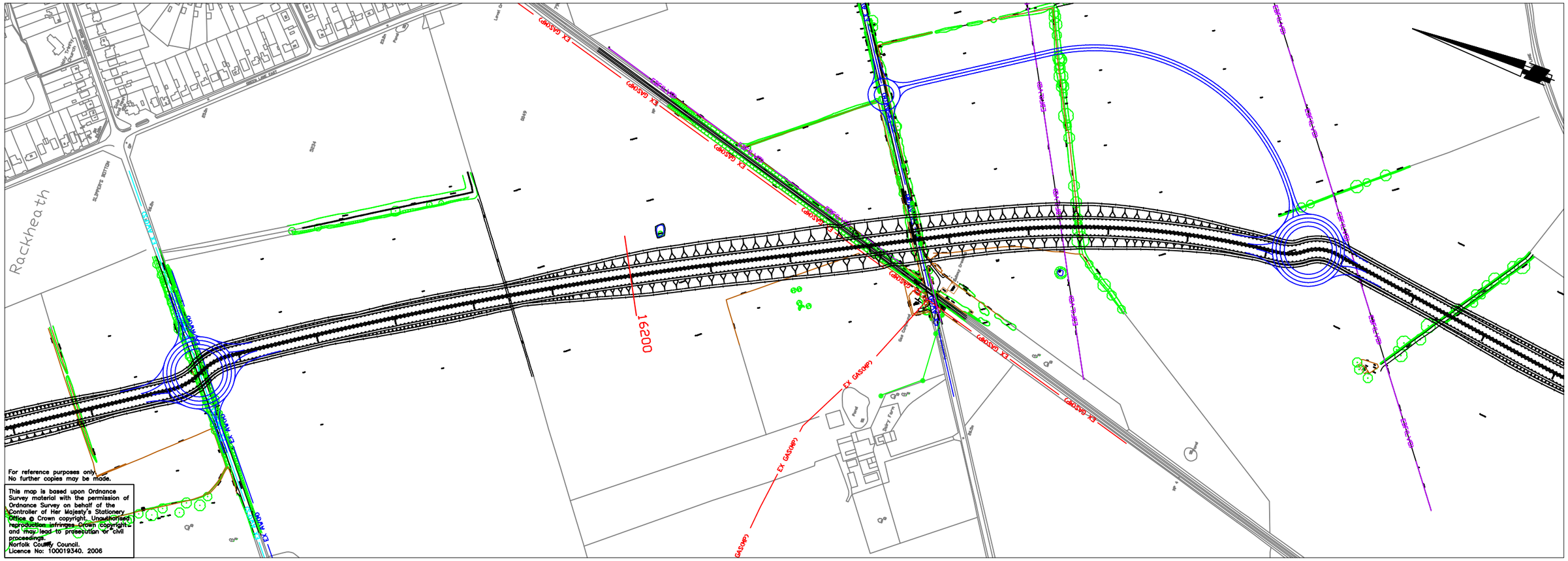
DRAWING No. R1C093-R1-707

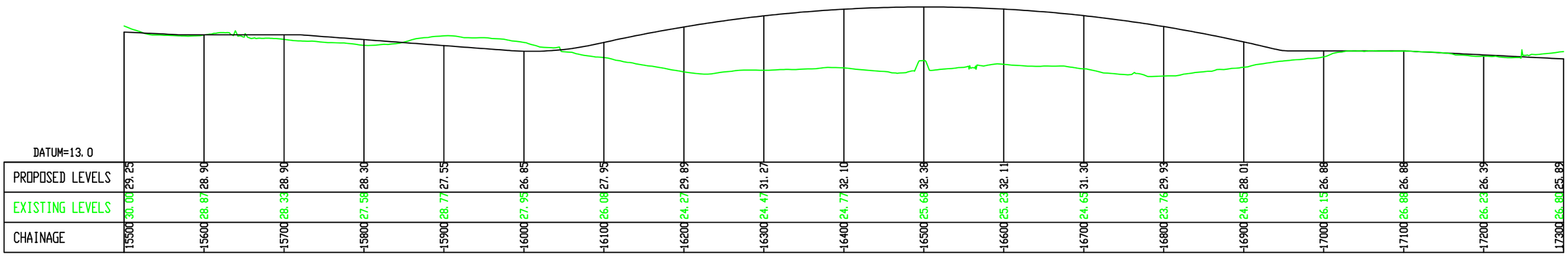
PROJECT TITLE
Norwich : Northern Distributor Road
(over railway line option)

SCALE 1:5000/500

FILE No. R1C093

Appendix C





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Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
RACKHEATH OVER OPTION 1B

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	GWD	05/06
DRAWN BY	DB	07/06
CHECKED BY	PD	07/06

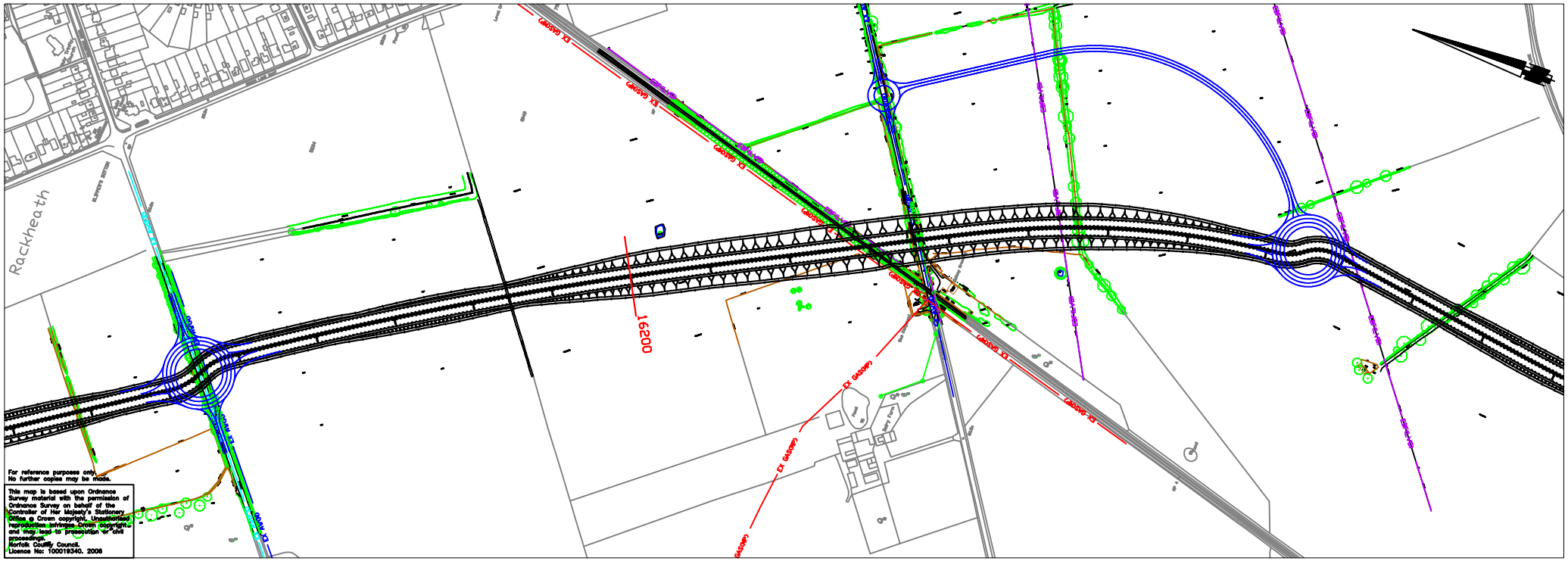
DRAWING No. R1C093-R1-697

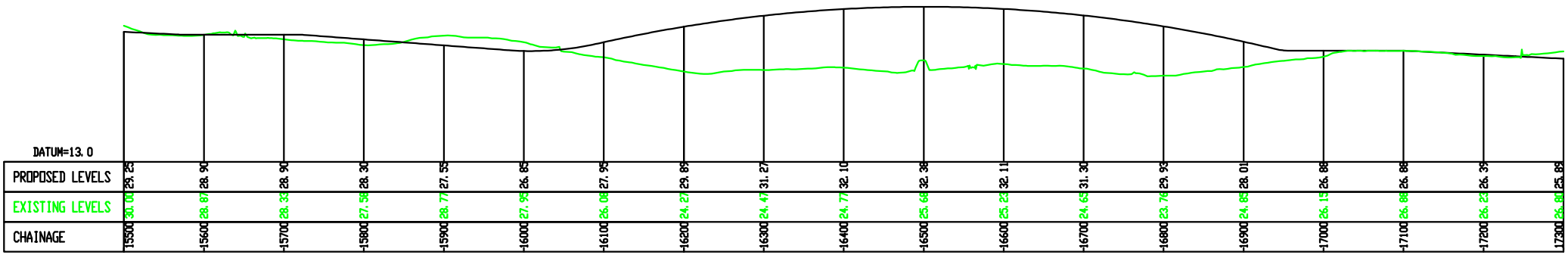
PROJECT TITLE
Norwich : Northern Distributor Road
(over railway line option)

SCALE 1:5000/500

FILE No. R1C093

ORIGINAL SIZE: A3





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CHAINAGE	15500	15600	15700	15800	15900	16000	16100	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100	17200	17300
PROPOSED LEVELS	29.25	28.90	28.90	28.30	27.55	26.85	27.95	29.89	31.27	32.10	32.38	32.11	31.30	29.93	28.01	26.88	26.88	26.39	25.89
EXISTING LEVELS	30.00	28.87	28.33	27.58	28.77	27.95	26.06	24.27	24.47	24.77	25.68	25.23	24.65	23.76	24.85	26.15	26.88	26.23	26.80

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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
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DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
RACKHEATH OVER OPTION 1B

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	GWD	05/06
DRAWN BY	DB	07/06
CHECKED BY	PD	07/06

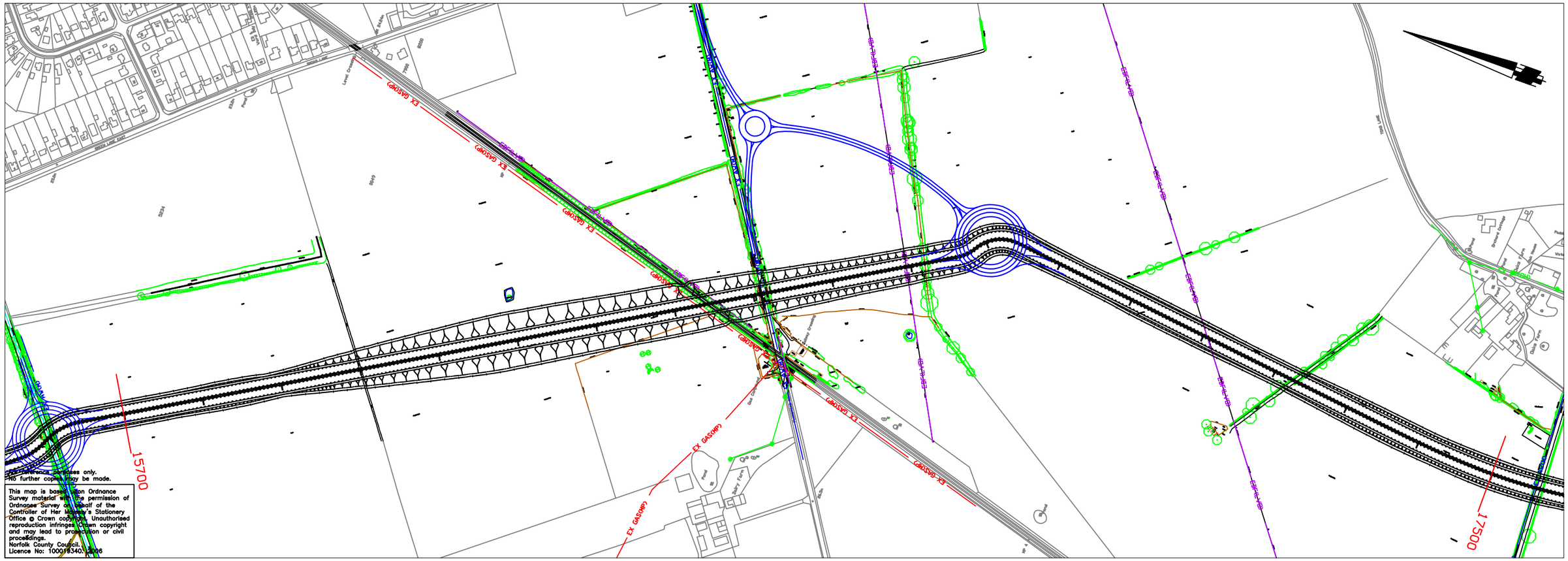
DRAWING No. R1C093-R1-697

PROJECT TITLE
Norwich : Northern Distributor Road
(over railway line option)

SCALE 1:5000/500

FILE No. R1C093

Appendix D



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15800	27.74	28.22
15900	29.26	28.78
16000	31.94	27.49
16100	33.70	25.21
16200	34.47	24.27
16300	34.23	24.63
16400	33.22	24.31
16500	31.66	24.71
16600	29.69	25.04
16700	27.69	23.97
16800	26.39	23.78
16900	25.70	24.93
17000	26.20	26.57
17100	26.52	26.90
17200	26.29	26.17
17300	25.79	26.96
17400	25.29	26.66
17500	24.85	26.51

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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
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DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT- RACKHEATH OPTION 1C

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	07/06
DESIGNED BY	GWD	07/06
DRAWN BY	GWD	07/06
CHECKED BY	PD	07/06

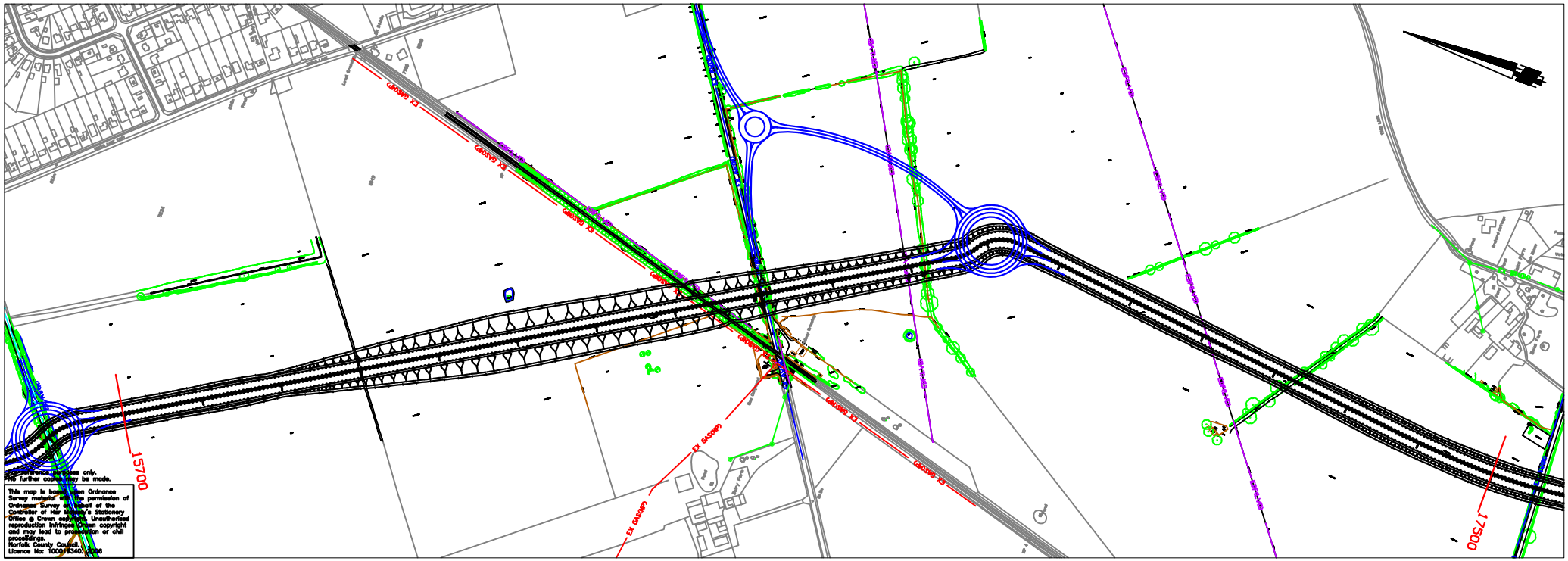
DRAWING No. R1C093-R1-692

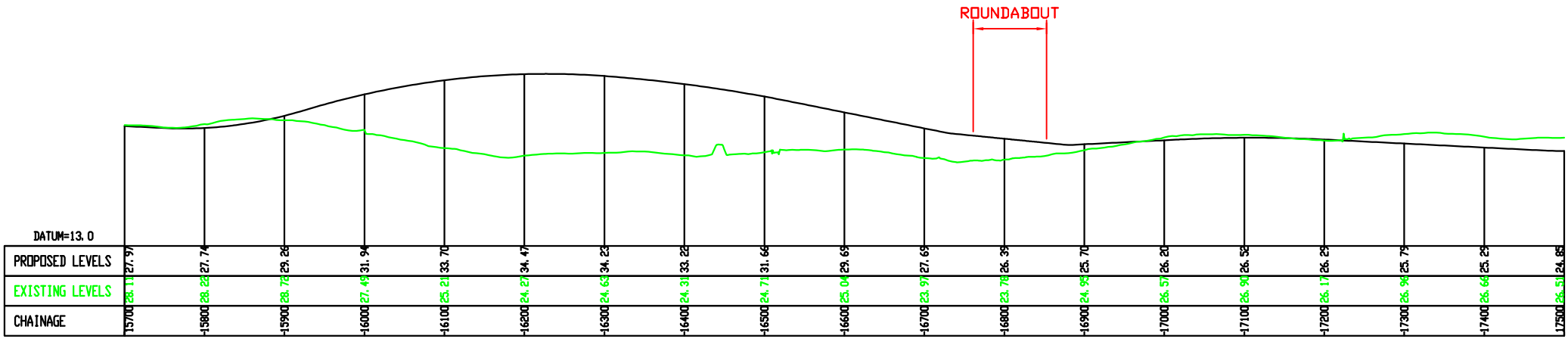
PROJECT TITLE
Norwich : Northern Distributor Road
(under railway line option)

SCALE 1:5000/500

FILE No. R1C093

ORIGINAL SIZE: A3





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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT- RACKHEATH OPTION 1C

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	07/06
DESIGNED BY	GWD	07/06
DRAWN BY	GWD	07/06
CHECKED BY	PD	07/06

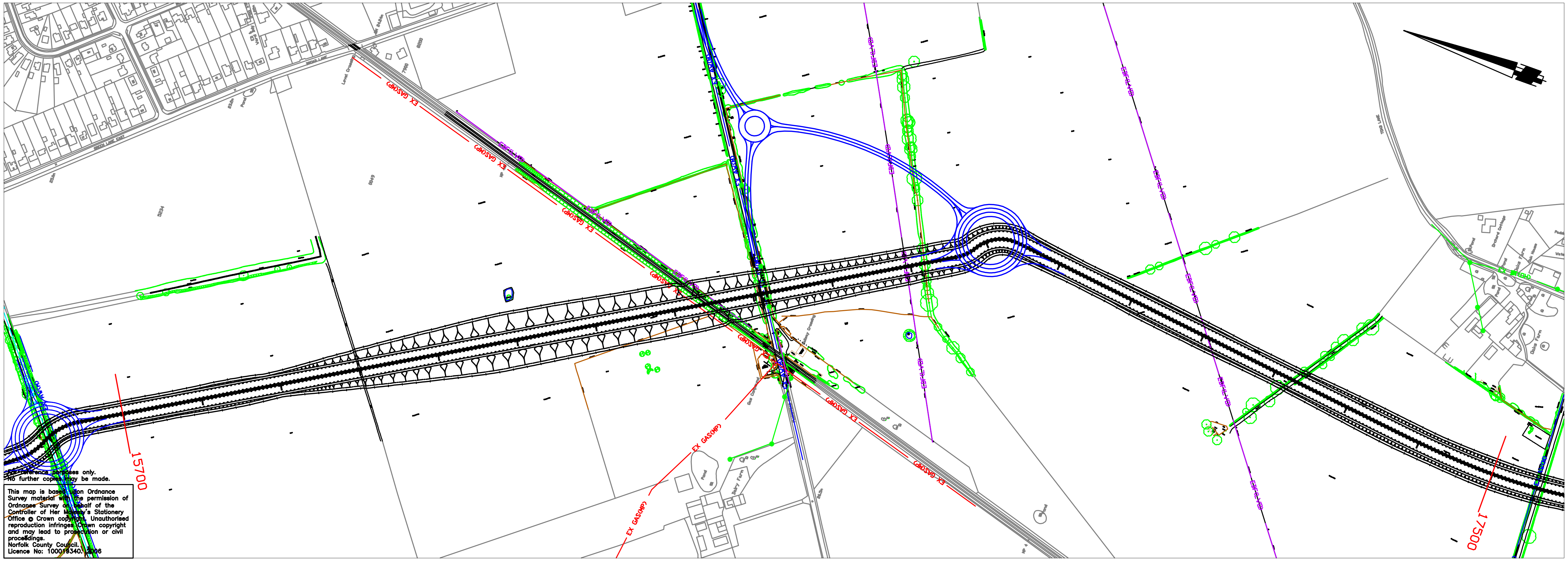
DRAWING No. R1C093-R1-692

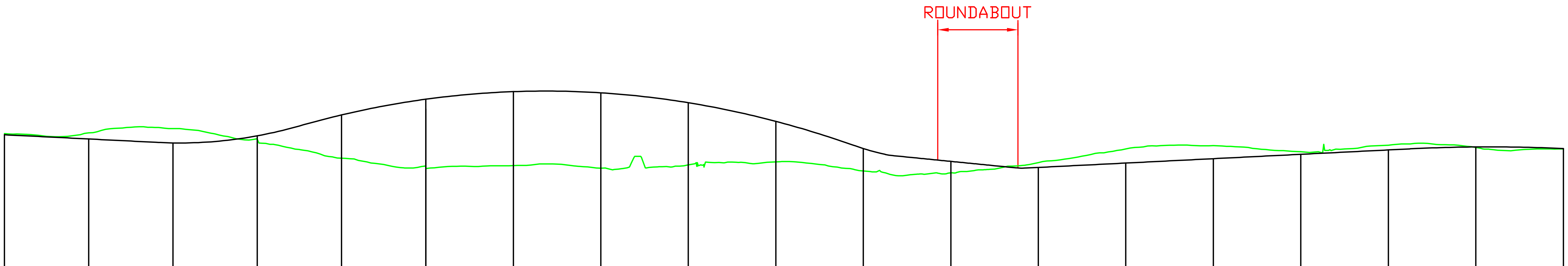
PROJECT TITLE
Norwich : Northern Distributor Road
(under railway line option)

SCALE 1:5000/500

FILE No. R1C093

Appendix E





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EXISTING LEVELS	28.11	28.20	28.71	27.46	25.20	24.26	24.61	24.30	24.68	25.04	23.99	23.77	24.94	26.50	26.88	26.19	26.94	26.68	26.51
CHAINAGE	15700	15800	15900	16000	16100	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100	17200	17300	17400	17500

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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
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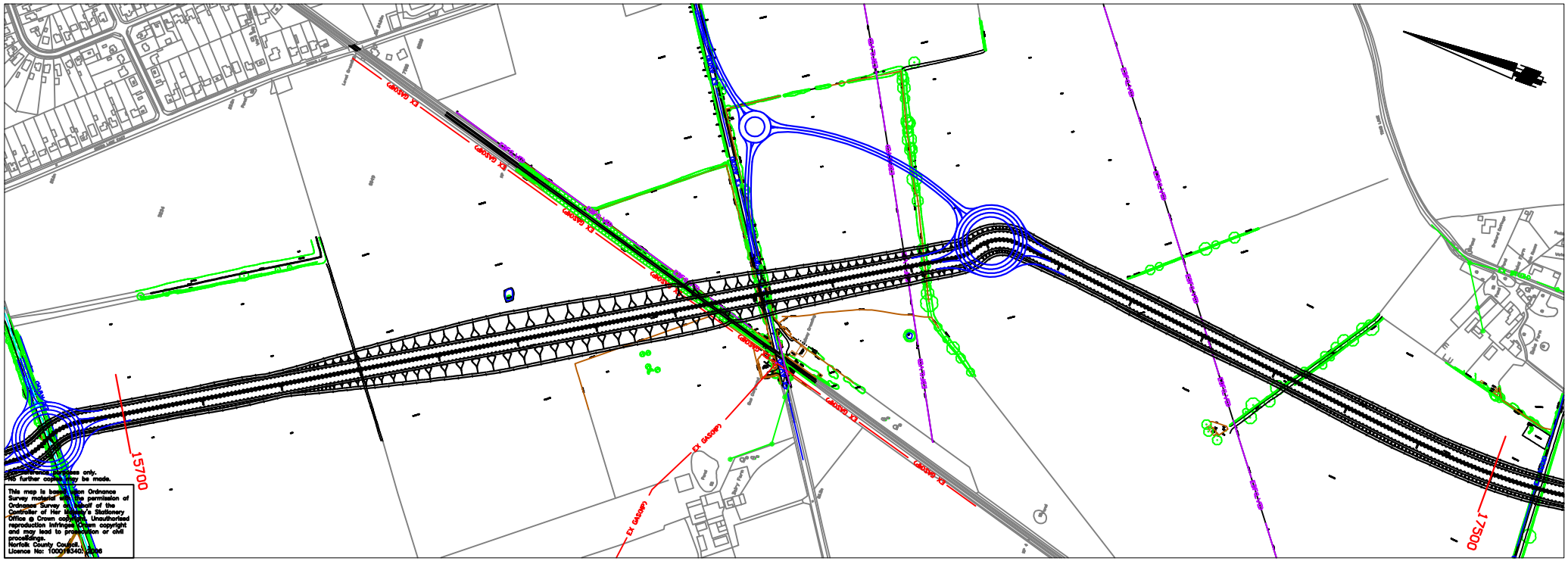
DRAWING TITLE
NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT- RACKHEATH OPTION 1C (MODIFIED)

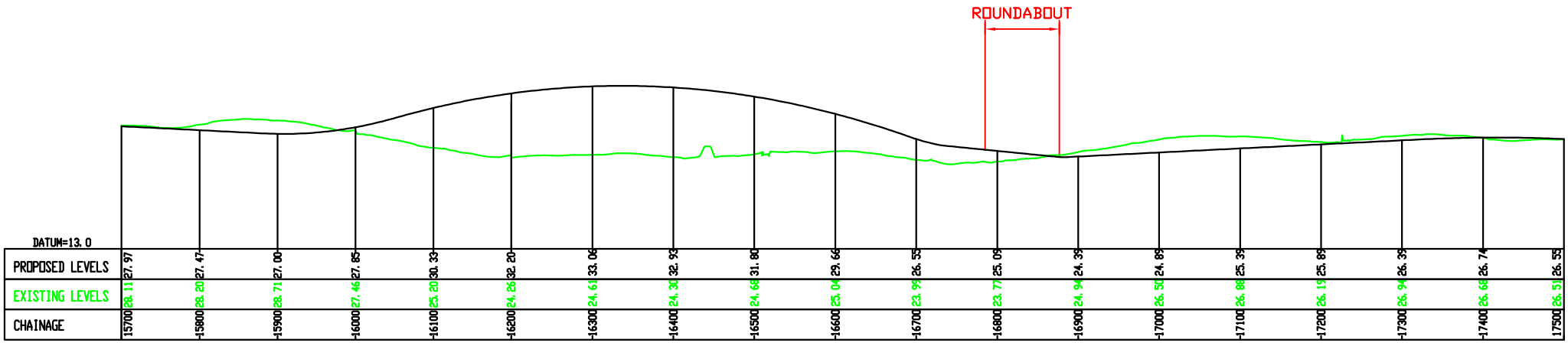
REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	07/06
DESIGNED BY	GWD	07/06
DRAWN BY	GWD	08/06
CHECKED BY	PD	08/06

DRAWING No. R1C093-R1-708
PROJECT TITLE Norwich : Northern Distributor Road
SCALE 1:5000/500
FILE No. R1C093

ORIGINAL SIZE: A3





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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT- RACKHEATH OPTION 1C (MODIFIED)

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	07/06
DESIGNED BY	GWD	07/06
DRAWN BY	GWD	08/06
CHECKED BY	PD	08/06

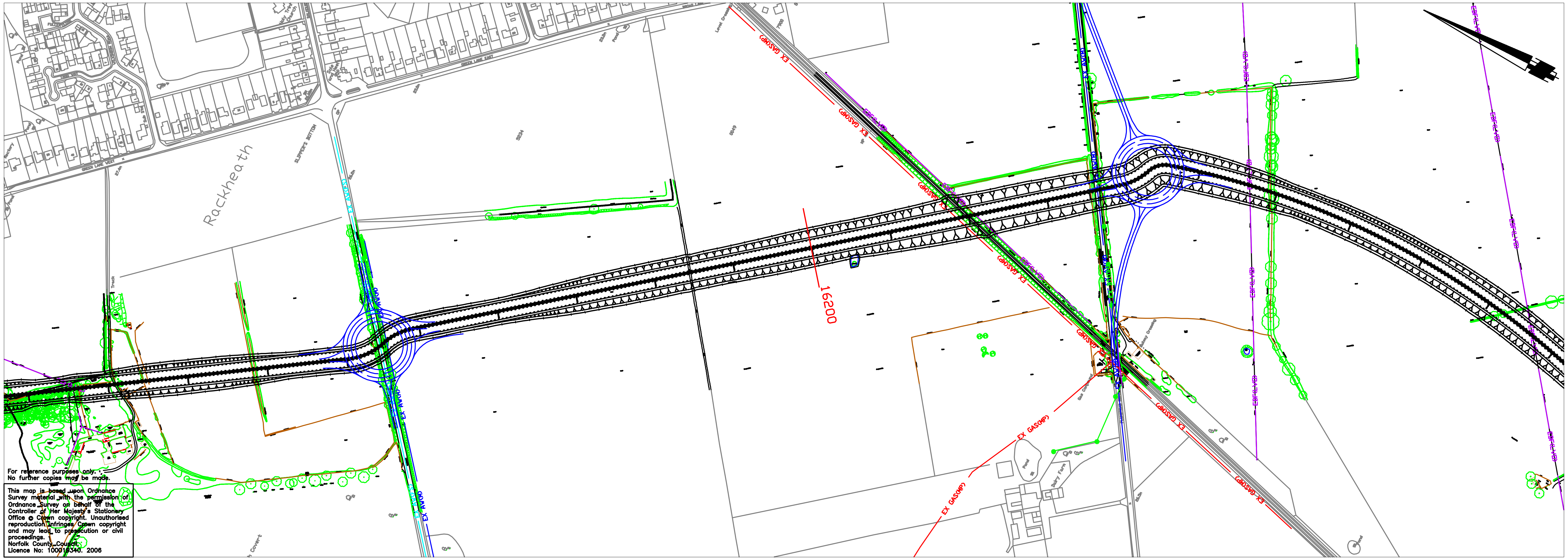
DRAWING No. R1C093-R1-708

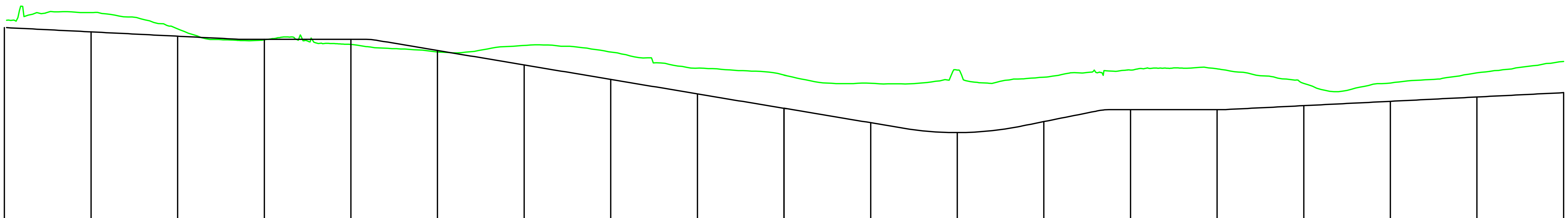
PROJECT TITLE
Norwich : Northern Distributor Road

SCALE 1:5000/500

FILE No. R1C093

Appendix F





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EXISTING LEVELS	31.11	32.00	30.00	28.87	28.30	27.42	28.21	27.41	25.57	24.70	23.76	25.30	24.47	25.30	25.45	23.74	23.80	24.98	26.28
CHAINAGE	15300	15400	15500	15600	15700	15800	15900	16000	16100	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100

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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

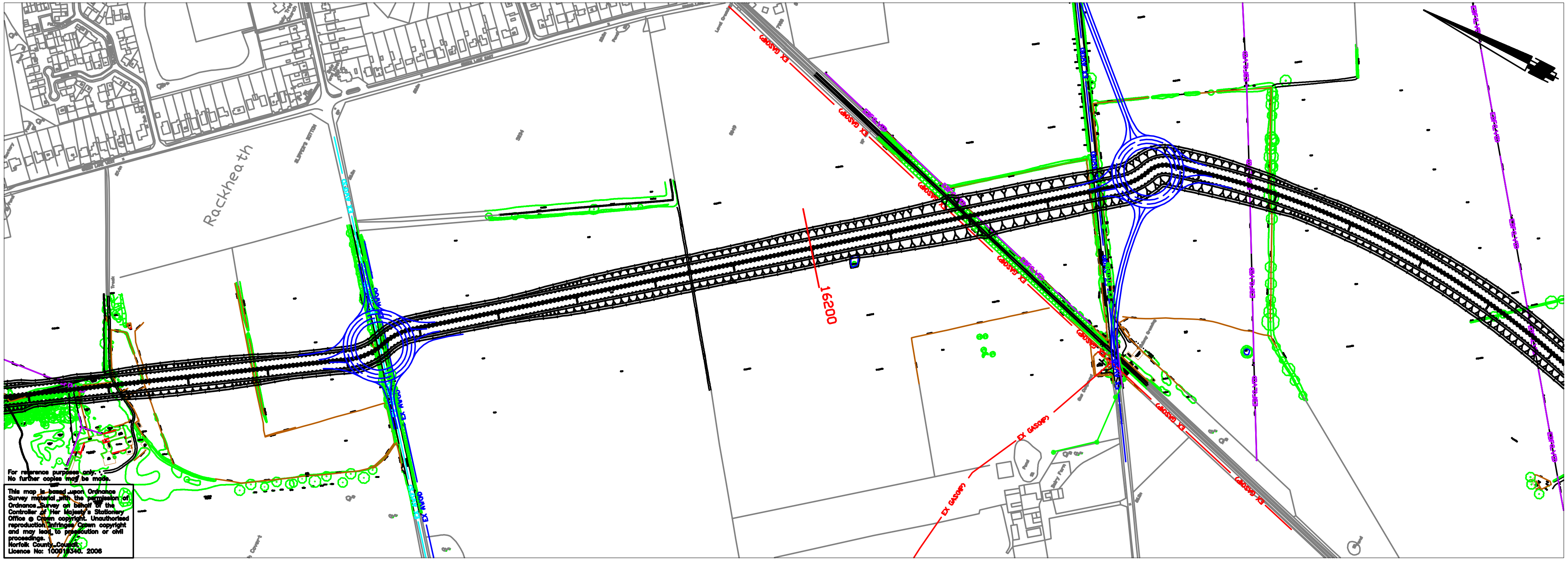
DRAWING TITLE
NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
UNDER OPTION 2A AND 2B

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	GWD	05/06
DRAWN BY	DB	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093-R1-698
PROJECT TITLE Norwich : Northern Distributor Road (under railway line option)
SCALE 1:5000/500
FILE No. R1C093

ORIGINAL SIZE: A3



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EXISTING LEVELS	31.11	32.00	30.00	28.87	28.30	27.42	28.21	27.41	25.57	24.70

CHAINAGE	16300	16400	16500	16600	16700	16800	16900	17000	17100
PROPOSED LEVELS	19.21	18.06	19.34	20.72	20.72	21.18	21.68	22.18	22.68
EXISTING LEVELS	23.76	25.30	24.47	25.30	25.45	23.74	23.80	24.98	26.28

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Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT
UNDER OPTION 2A AND 2B

REV.	DESCRIPTION	CHECKED	DATE

	INITIALS	DATE
SURVEYED BY	OS	2006
DESIGNED BY	GWD	05/06
DRAWN BY	DB	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093-R1-698

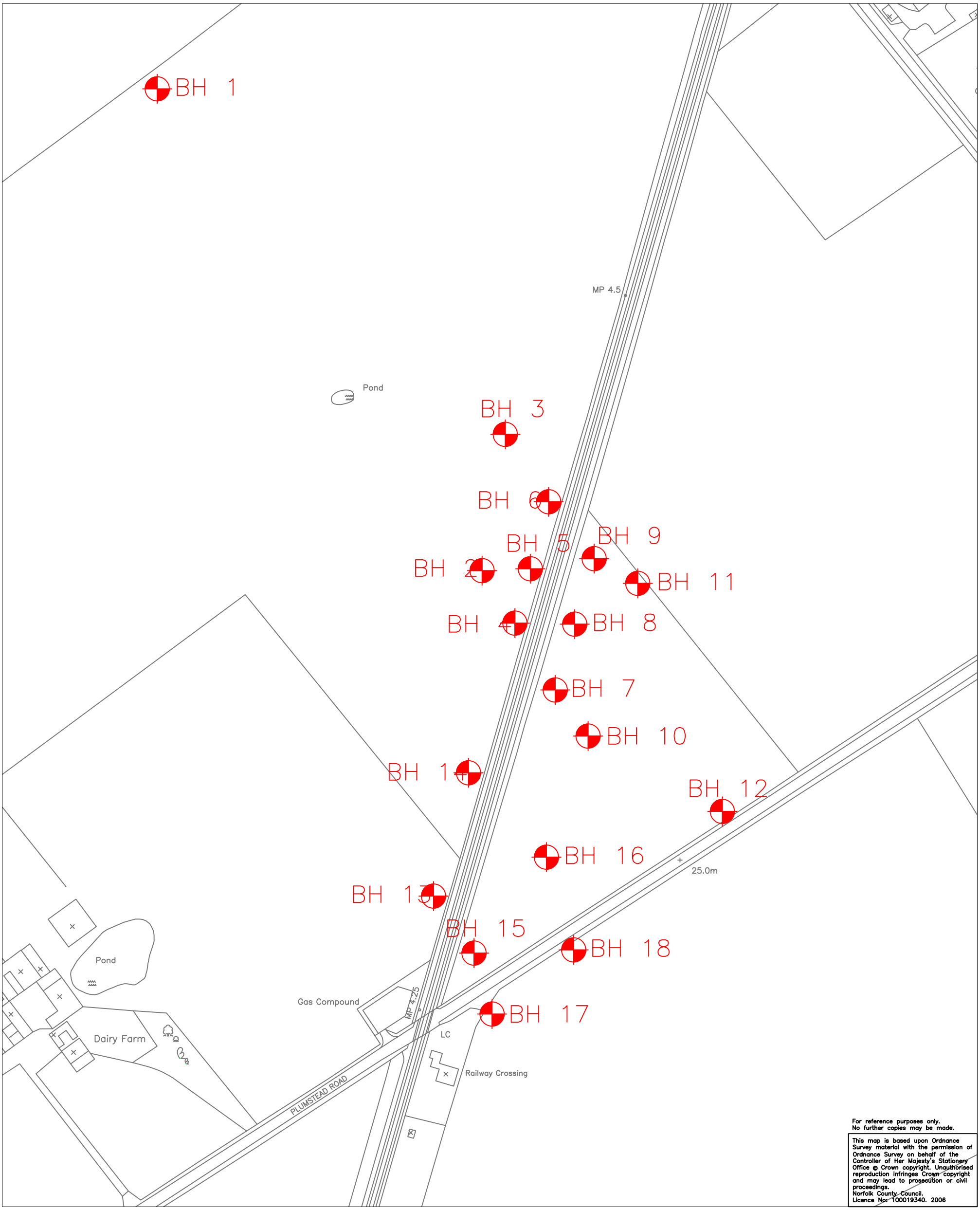
PROJECT TITLE
Norwich : Northern Distributor Road (under railway line option)

SCALE 1:5000/500

FILE No. R1C093

ORIGINAL SIZE A3

Appendix G



Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

Borehole location plan
Plumstead road bridge
Northern Distributor Route

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY		
DESIGNED BY		
DRAWN BY	SS	25/05/06
CHECKED BY		

DRAWING No. S06:083/001
PROJECT TITLE Plumstead road bridge N.D.R
SCALE 1:2000
FILE No. S06:083

ORIGINAL SIZE: A3

BIL 23/05/06

Trial pit 1
GL–450 Orange/brown firm silts and clay
450–1045 Orange fine silts and sands, occasional meduim flint gravel
N.B 225mm Gas main located at 1.25m BGL, 2.2m from the fence line

Trial pit 2
G.L–300 Dark brown clayey topsoil
300–1500 grey,brown fine silts, some fine sand lenses
N.B 225mm Gas main located at 1.5m BGL, 1.9m from fence line

Pond
MP 4.5
Pond
Dairy Farm
Gas Compound
MP 4.25
LC
Railway Crossing
PLUMSTEAD ROAD
25.0m
26.5m
Pond

Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

Gas main location plan
Plumstead road bridge
Northern Distribution Route

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY		
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DRAWN BY	SS	30/05/06
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DRAWING No. S07:083/002
PROJECT TITLE Plumstead road bridge N.D.R
SCALE 1:2000
FILE No. S07:083

ORIGINAL SIZE: A3
BIL 23/05/06

Appendix H

NDR Structures

Norwich to Sheringham Railway Line

Bridge Proposals

July 2005

Norfolk County Council
County Hall
Martineau Lane
Norwich, NR1 2SG

Tel : 01603 222143
Fax : 01603 222240
www.norfolk.gov.uk

Mott MacDonald
Moore House
75 Prince of Wales Road
Norwich, NR1 1DG

Tel : 01603 767530
Fax : 01603 767463
www.mottmac.com

NDR Structures

Norwich to Sheringham Railway Line

Bridge Proposals

Issue and Revision Record

Rev	Date	Originator	Checker	Approver	Description
A	July 2005	J Pattinson	M Frith	G Kelly	First Issue

List of Contents

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Chapters and Appendices

1 Introduction

1.1 Background

The proposed routes for the Norwich Northern Distributor Route (NDR) have identified the need for the road to cross the existing Norwich to Sheringham railway line in the area of Thorpe End to the east of Norwich. The railway line consists of twin non-electrified tracks. The NDR is expected to handle some 35,000 vehicles per day at this section with the Norwich to Sheringham railway line currently carries approximately 35 services per day. In addition, there are train movements to the gas condensate handling depot at North Walsham. The North Walsham depot receives gas condensate by pipeline from the Bacton Gas Terminal and transfers it to railway wagons for transport to the Port of Harwich. In order to construct the NDR it would be necessary for the NDR to cross the existing railway line. This would be achieved by using either a railway “Underbridge” or “Overbridge”.

1.2 The Brief

It is the aim of this report to examine possible solutions and comment on the most suitable.

The scope of this report is as follows:

- Examine options for constructing a Railway Underbridge
- Examine options for constructing a Railway Overbridge
- Comment on the options proposed

2 Options

2.1 Introduction

The exact road alignment in relation to the railway line has not been formally confirmed, therefore for the purposes of this exercise they have been assumed to cross with a skew angle of 45°, as indicated on the current draft Site Location and Layout Plans in Appendix A.

The most appropriate form of bridge construction, in terms of cost and practicality of construction, to enable the NDR and the Norwich to Sheringham railway line to cross at this location, would be affected by the geology and topography of the area as well as the environmental concerns, including visual impact on the surrounding area.

The composition of the ground in the vicinity of the proposed bridge structure is identified as being “Norwich Brick Earth”, this is a form of Cromer Till and is composed of a mixture of clay, sand and silt. This soil is highly laminated and subsequently has poor drainage properties and a low bearing capacity. Any designs for either Underbridge or Overbridge structures would have to include for ground stabilisation and strengthening as well as de-watering and storm drainage. The provision for ground stabilisation and strengthening, and de-watering and storm drainage would be required whatever form of bridge is chosen as they would also be required for the road construction, therefore these elements and their associated costs have been excluded from this report.

2.2 Railway Underbridge

The long term closure of the railway in order to construct a new railway underbridge is not considered to be a feasible proposal, this therefore excludes the use of traditional bridge building techniques whereby the bridge is constructed from the ground upwards. The technique of construction for the railway underbridge option therefore consists of pre-constructing the bridge and sliding it into position.

The Network Rail Group Standard (NRGS), GC/RC 5510 – “Recommendations for the Design of Bridges”, states that for new bridges over public roads the headroom provided should be at least 5.70m, for the purpose of this proposal the clearance between the level of the surface of the carriageway and the bridge deck soffit has been assumed to be 6.00m.

The design and construction of the bridge and its jacking into position would require the input from a specialist sub-contractor, experienced in the design, construction and undertaking of bridge sliding operations.

2.2.1 Type of Underbridge

The underbridge would be a pre-constructed reinforced concrete structure. There are two principal forms of design under consideration, a skewed box structure with twin portals and the four span structure, consisting of two central spans carrying the dual carriageway with two propped cantilever side spans that act as wingwalls / embankments, which is being considered here (see drawing 219738-AA05-1-001). The central spans of the bridge would each be 20.140m skew (15.400m square) and the side spans of the bridge would each be 16.350m skew (12.500m square). The bridge deck would be monolithic, cast in-situ using a polystyrene void former to form the deck.

2.2.2 Construction Process and Method of Placement

The construction process for the underline bridge would be as follows:

- Undertake excavation of the cuttings for the road either side of the railway line. Ensuring all embankments are appropriately stabilised using techniques such as reinforced earth and soil nailing / anchoring as required. (Works to be undertaken by the main contractor)

- Undertake ground stabilisation / strengthening for carriageway approaching the bridge, propose a technique such as stone columns or vibrated concrete columns. A layer of reinforced earth would be created above the columns to act as a base for construction. This base may need additional foundation support using such measures as stone or concrete columns. (Works to be undertaken by the main contractor)

- Construction of guide raft (on which the bridge structure is to be built), including for shear keys and pilling to provide reaction force for jacking operation. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Construct the base slab for bridge with membrane to reduce friction between guide raft and base slab. The base slab acts as a raft foundation for the bridge structure, the design is to also include for the installation of wire strands for jacking and bentonite injection system (used as lubricant) within channels cast into the base of the slab. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Construct piers and side spans. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Construct bridge deck. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Pre-construct transfer slabs. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Fit railings to spans of bridge and lay ballast for track bed on bridge. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Install all jacking and bentonite pumping equipment to undertake the bridge slide. (Works to be undertaken by the specialist sub-contractor)

The construction process would be envisaged as lasting approximately 8 months on site. The placement of the bridge would be carried out under a 72 hour possession.

The process for moving the bridge structure into position would be as follows:

- Receive possession of track from Network Rail.

- Temporarily support any Signalling and Telecommunications equipment. Remove tracks and store for reinstatement later. (Network Rail contractor)

- Excavate embankments with arisings being placed in temporary stockpile on site. (Main contractor)

- Slide bridge into position. (Specialist sub-contractor)

- Fill gaps around sides of the structure with concrete and pressurised grout, place pre-constructed transfer slabs. (Works to be undertaken by the main contractor and specialist sub-contractor)

- Reinstate tracks, top up ballast and carryout tamping. (Network Rail contractor)

- Reinstate and test Signalling and Telecommunications equipment. (Network Rail contractor)

- Hand back tracks and structure to Network Rail.

Once the structure is in place the carriageway construction can be undertaken.

The processes detailed above are for the construction of a four span structure, the use of a more conventional skewed box structure with backfilled sides would follow a similar construction and placement process. Consultation with a specialist contractor has indicated that there would be no tangible benefits either in terms of time or cost by using a skewed box structure over the four span structure.

2.3 Railway Overbridge

There are two principal options for the Overbridge structure. These are either a single span structure or a three span structure. In both cases the bridge would be required to meet the design requirements of Network Rail. The two key aspects that affect the design are the vertical clearance and the Hazard Zone.

NRGS GE/GN 8573 – “Guidance on Gauging”, states that for routes not electrified using Overhead Line Equipment (OLE) a minimum vertical clearance of 4.325m

Above Rail Level (ARL) is recommended. However, a minimum vertical clearance of 5.200m ARL is recommended for non-OLE routes where there is a requirement to allow for future overhead line electrification. For the purposes of this study and based on previous experiences a vertical clearance of 5.200m ARL is to be used. In order to protect overbridge's from derailed trains NRGS GC/RG 5510 defines the Hazard Zone as extending 4.500m from the running edge of the nearest rail and states that "wherever reasonably practical, supports carrying bridges over or alongside railway tracks should be placed outside the hazard zone." Therefore for the purposes of this study the face of any piers and abutments are to be placed a minimum of 4.500m from the running edge of the nearest rail.

BA 57/01 and BD 57/01 – "Design for Durability", states that bridges with lengths not exceeding 60m and skews not exceeding 30º, shall be designed as being integral. However, the assumed skew for this bridge is 45º, therefore it would require to be supported on bearings at any supports or abutments. It would be proposed that the beams are set into elastomeric bearings with a set of fixed / guided bearings at the centre of the abutment.

2.3.1 Type of Overbridge

Single Span

The single span structure would consist of a single deck being simply supported on abutments, the bridge would have a skew span of approximately 20.465m (14.470m square). See drawings 219739-AA05-1-002, and 219739-AA05-1-003.

Three Span Structure

The three span structure would consist of a central main span supported on two piers with two smaller side spans which would span between the piers and bank seat abutments. The central span would have a skew span of approximately 20.890m (14.770m square) with the two side spans each being approximately 8.345m skew (5.900m square). See drawing 219739-AA05-004.

There are two options for the form of construction of the bridge deck and superstructure, these are:

- Steel and Concrete Composite Deck
- All Concrete Deck

The use of a steel and concrete composite deck would see longitudinal steel plate girders spanning between the bearings at the abutments / piers, the girders would be equally spaced, say 2.500m centres, with transverse cross beams / bracing located at the supports and intermediate spacings, as dictated by the detailed design. The top flange of the girders would be fitted with shear studs to enable the beams to act compositely with a cast in-situ composite slab, constructed using a technique such as permanent formwork e.g. pre-cast concrete deck planks. In order to minimise maintenance the girders would either be fabricated from steel and then painted or alternatively fabricated from Weathering Steel.

The use of a concrete deck would use pre-cast pre-stressed concrete bridge beams, for example using “M5” type beams. These would be supported on the bearing surfaces at the abutments / piers, the deck slab would then be cast in-situ.

The substructure of the single span bridge would be formed by reinforced concrete abutments (not constructed closer than 4.500m from the nearest running rail), founded on piles. The approach embankments to the bridge would be proposed to be constructed using a technique such as reinforced earth.

For the three span structure the main central span would be supported on piers (not constructed closer than 4.500m from the nearest running rail), the piers would be founded on piles with the beams supported on the pier crossheads. Behind the piers, supporting the side spans, would be the abutments. These would be of a bank seat construction supported on piles. The approach embankments to the abutments would also be proposed to be constructed using a technique such as reinforced earth.

2.3.2 Construction Process

The construction process would be relatively similar irrespective of whether a concrete of steel and concrete composite superstructure is chosen. The process for the single span bridge would be as follows:

- Establish site fencing on site to designate the Green and Red Zones for working on or adjacent to Network Rail property and infrastructure.
- Undertake pilling for construction of the abutments and wingwalls.
- Construct the reinforced concrete abutments and wingwalls.
- Build up bridge approach embankments using a technique such as reinforced earth or similar. Ensure embankments have suitable capacity to support cranes during lifting operations.
- Pre-cast edge beams / parapet cantilever sections.
- During track possessions place all beams, edge beams / cantilevers and bracings.
- During track possessions place permanent formwork if using steel beams or seal gaps between beams if using pre-cast pre-stressed concrete beams.
- Fix steel reinforcement and erect formwork for the construction of the deck slab.
- Under track possession fix all parapets and remove any temporary works.
- Pour the concrete for the deck slap (this may need to carried out under a track possession).

- Apply waterproofing system to the bridge deck and install bridge deck joints.
- Carry out surfacing of the bridge and its approach embankments.
- Open carriageway to traffic.

If the bridge was to be constructed as a three span structure it would require an additional phase of construction, for the piling and construction of the piers.

3 Discussion

The crossing point between the existing Norwich to Sheringham railway line and the proposed Norwich Northern Distributor Route would provide challenges in design and construction in order to mitigate its effects on a variety of key elements. These include issues such as:

- Disruption to the railway during construction
- Constructability and Cost
- Impact on the Environment:

    Effects on Flora and Fauna

    Visual Impact

    Noise and Pollution

The land on which the NDR would be constructed is of low bearing strength with poor drainage. Any construction works for the road would require an element of ground stabilisation, say in the form of stone or concrete columns or reinforced earth. Therefore the cost of this work has not been included in this report as it is considered that this would be covered as part of the main highway scheme. Likewise the costs for the provision of drainage, lagoons etc., and emergency storm pumping for the highway should be considered as part of the main highway scheme.

The land on which the road is proposed to be constructed is farm land of a relatively flat topography, with an open aspect to the areas of housing of Rackheath and Plumstead to the north and south respectively. The alignment and level of the railway is to remain unaffected by the construction of the bridge, therefore the construction of either an overbridge or underbridge would require the construction or excavation of either approach embankments or cuttings respectively. The cost of undertaking this work would be similar for either option and would be considered to be part of the main highway contract so has been omitted from this study.

The proposal for the construction of an underbridge relies on the pre-construction of a reinforced concrete bridge structure which is built off-line before being slid into its new desired position. Once the cuttings have been dug for the road and ground stabilisation measures put in place, including for railway embankments, the guide raft for the construction of the bridge would be cast. This would also act as the reaction point for the jacking operations, its design would therefore include shear keys it may also have large diameter piles supporting it, depending on the ground conditions. The bridge would be built on top of the guide raft using a membrane to ensure that the base slab and the bridge base are two independent structures. These works would all be carried out without disruption to the Norwich to Sheringham railway line. However, when the bridge was ready for sliding into position a Possession and Blockade of the track would be required. It would be proposed that the bridge is slid into position over the course of a 72 hour railway Possession.

The process for the bridge sliding operation would entail the removal of the track and supporting of any Signalling and Telecommunications equipment before a section of the embankment beneath the railway is removed by excavation. Whilst the embankment is being excavated the bridge slide operation would be initiated. This involves the bridge structure being pulled forwards by means of steel wires which are anchored into the bridge structure and the guide raft and are pulled through large strand jacks. In order to reduce the friction between the surface of the guide raft and the base of the bridge a bentonite slurry would be pumped between the surfaces to lubricate them and enable the bridge to slide more freely on the membrane between the two surfaces. The process of the bridge slide would be monitored closely using specialist survey equipment with several reference targets for a Laser EDM to survey and therefore adjudge when the bridge is in its final position and make any adjustments to the jacking procedure as it progresses. Once the bridge is in its final position the embankments beneath the wingwalls would be reinstated with concrete and the ballast and track of the railway reinstated. Finally the track and Signalling and Telecommunications equipment would be tested before being handed back to Network Rail, for scheduled rail services to resume at the end of the Possession within the 72 hour time frame.

The base slab of the bridge structure has several functions. In addition to being the base for the construction of the bridge it also serves as a raft foundation and thus the size of the base slab would be increased until the weight of the whole bridge can be sufficiently borne by the bearing pressure of the earth on which it is built. The base slab also offers a rigid base for the bridge during the bridge sliding operation. The use of an all concrete structure for the bridge has the advantages that it is a low maintenance option which is durable and can be designed with a variety of finishes and appearances.

Two overbridge span arrangements have been considered, with two forms of bridge deck construction. These are the use of either single or three span structures with the bridge super structure being constructed either as a steel and concrete composite bridge deck or as an all concrete monolithic bridge deck. Before the bridge construction can begin it would be necessary to construct the approach embankments for the bridge to enable the road to pass over the bridge.

In order to reduce the requirements for designing for train derailments the bridge abutments or piers would sited such that they are not closer than 4.500m from the running edge of the nearest rail to the face of the abutment or pier, and thus outside of the “Hazard Zone” as defined by Network Rail. Before any works commence on site a site boundary fence would be erected 3.000m from the edge of the nearest rail to act as the boundary for “Green and Red Zone” working. Once these measures are in place construction works could begin with the pilling operations adjacent to the railway line for the construction of the abutments or piers. The construction process would then see the construction of the bridge’s sub-structure, when the substructure is complete the bridge deck would be constructed. The lifting of the bridge beams would require to be undertaken during a possession of the railway line, as no working over the live railway would be allowed. It would be considered more prudent for this operation to be done during a daytime possession of the railway line, as the possession would be over a longer period it would enable more beams to be placed

with greater safety for the operatives than if the works were to be undertaken in a series of night time possessions. When all the beams have been placed the steel bridge deck option would require the installation of formwork for the concrete deck, if pre-stressed pre-cast concrete bridge beams were to be use the gaps between the bottom flanges of the beams would require sealing with a foam backing strip to ensure that no concrete leaks out from between the beams when the deck is concrete is being poured.

The edge beams and cantilevers / parapet beams would be proposed to be pre-constructed, this would have the advantages that it would help to minimise the works over the railway line, it would also mean that it was not necessary to construct any temporary works over the railway line for the construction of the of the cantilevers / parapet beams. This would have benefits in terms of both safety and also reducing the number of possessions required as it would not be necessary to install and remove the temporary works for the construction of the cantilevers / parapet beams. The bridge parapets would be added before the bridge deck had been completed as they would afford edge protection to workers on the bridge deck and enable works such as the fixing of steel for the deck slab to be carried out without disruption to the railway. The pouring of the bridge deck slab would be undertaken under a possession due to the risks associated with any concrete spilling on to the tracks and also the use of mobile concrete pumps.

The use of a steel and concrete composite superstructure would have the advantage of having a lower self weight than a wholly concrete bridge deck, this would result in a less substantial sub-structure with resultant savings on the foundations. Steel can be used successfully to produce a smaller construction depth than required for a concrete bridge deck. Steel would be considered to have a greater maintenance cost, e.g. for repainting or access for inspection of beams, however the maintenance requirements can be reduced with the use of long life paint coatings or weathering steel. The soil type and underlying geology of the area indicate that the overbridge would require pilled foundations for the abutments and also the intermediate piers, if the three span option were to be selected. The abutments, wingwalls and piers (if used) would be constructed out of reinforced concrete, there is scope for several different designs in terms of aesthetics, appearance, surface finishes and pier arrangements.

The estimated costs for the different structure options are as follows:

Type of Structure	Estimated Cost
Four Span Reinforced Concrete Underbridge	£5,000,000
Single Span Steel / Concrete Composite Overbridge	£1,650,000
Single Span Concrete Overbridge	£1,725,000
Three Span Steel / Concrete Composite Overbridge	£2,500,000

The estimates have included for the costs of construction, though they have not included for any earth works, ground stabilisation or drainage as it is considered that

these costs should be borne as part of the overall cost for the whole road scheme. The costings also include an estimate for obtaining the necessary approvals and permissions from Network Rail for the construction of the bridge, as well as the costs associated with track Possessions / Blockades during the construction of the bridge. Also included in the estimated costs is an allowance for the design fees for the new bridge structure. However, it should also be considered that estimates for civil engineering works are generally +/- 20%. The cost estimates given here are based on a basic component sizing exercise, a more accurate and detailed costing can only be produced after a more detailed design process has been undertaken which also allows for the results from a detailed ground investigation.

The construction programmes for both bridges would be around 8 months. However, the requirements for booking of disruptive railway Possessions / blockades typically require bookings to be placed with Network Rail a minimum of 12 months ahead and ideally 18 months or longer in advance in order to reduce the cost. Overnight track possessions lasting a few hours are typically booked a minimum of 16 weeks in advance.

Along the route of the NDR at this location the topography is relatively flat with the land being open and used for farming. To the north and south of the site there are populations of housing, and consequently any structure in this area would have some effect on the landscape. It is considered that the underbridge proposal would have the lesser impact on the landscape as the road would be located in a cutting to pass beneath the railway, with the elevation of the railway not changing. The biggest impact of the underbridge on the landscape is likely to be the lagoons and storm drainage system as the bridge is likely to attract more ground water and surface water when it rains.

The overbridge option would require approach embankments for the carriageway, these coupled with the bridge structure itself would have a much more significant impact on the landscape. The required elevation of the carriageway would result in the level of the roadway being at a height approximately 7.000m above the level of the railway line and the surroundings. The three span option for the overbridge was included in addition to the single span option as it is considered that the more open appearance of this structure may have a lesser visual impact on the landscape. A further aspect of the use of an overbridge is the height of the vehicles using it, thus making it even more visually intrusive. The use of an overbridge in preference to an underbridge would also result in an increased level of noise and light pollution from vehicles and also possibly from street lighting, this may be required due to the proximity of the proposed roundabout at the intersection with Plumstead Road. The use of an underbridge would mitigate for the effects of any light pollution. Equally, by sitting the road in a cutting it would reduce the potential effects of noise pollution in comparison to the use of an overbridge.

4 Conclusion

This report has considered both underbridge and overbridge options for the crossing of the existing Norwich to Sheringham railway line by the proposed Norwich Northern Distributor Route. The estimated costs range from £1,650,000 for the steel and concrete composite overbridge, to £5,000,000 for the pre-constructed reinforced concrete underbridge which is slid into position.

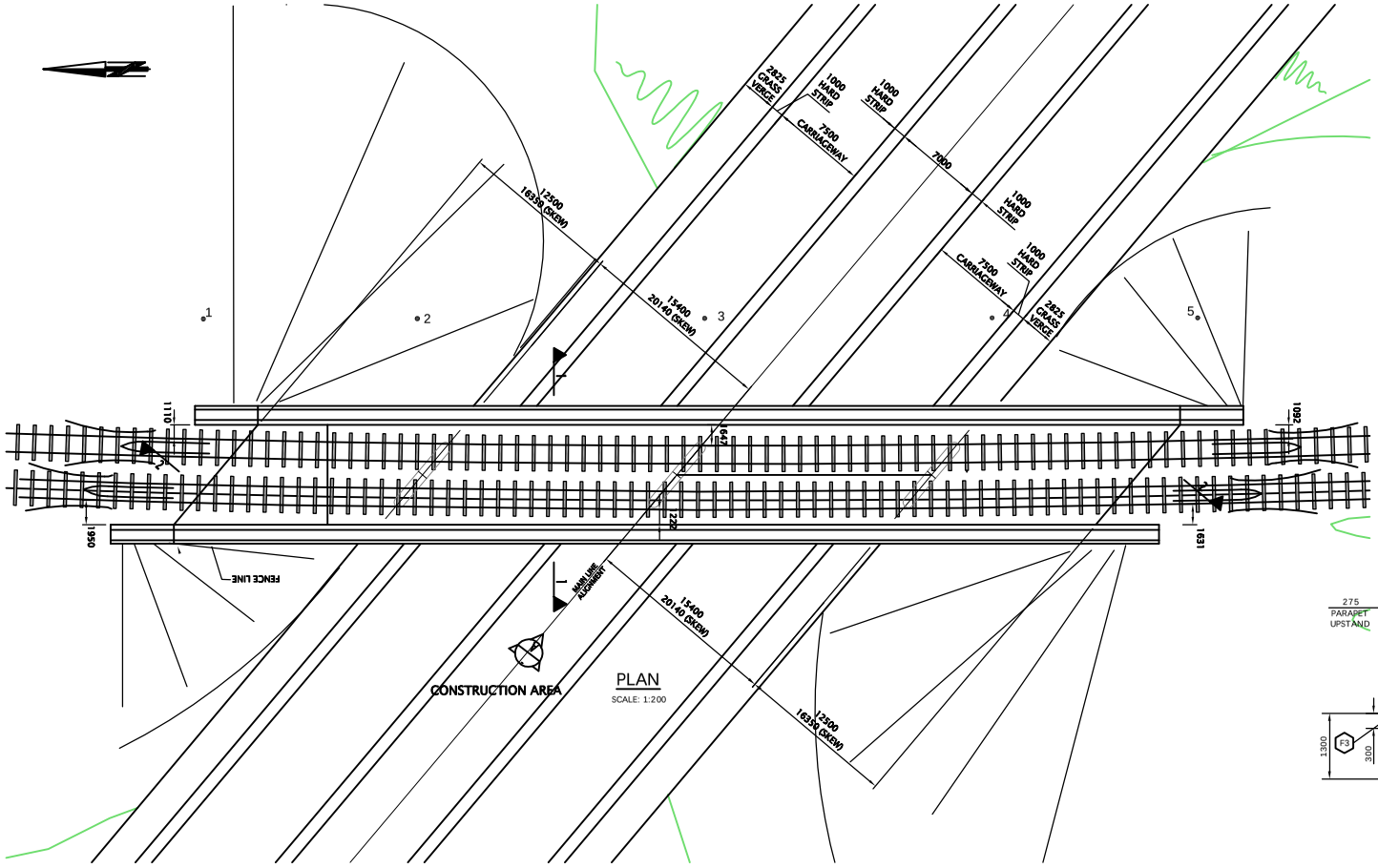
The choice of design for the structure would depend largely on the allowable impact on the environment, not only in terms of visual impact but also in terms of noise and light pollution. The use of the underbridge would mean that the road is constructed in a cutting and as a result this may minimise the visual impact of the road on its surroundings, in addition to noise and light pollution. However, it should also be considered that this option is significantly more expensive than the overbridge options. If the cheaper option of an overbridge is to be selected, whilst being cheaper than the alternative underbridge this would also have a greater visual impact on the surroundings as the road would have to be elevated by approximately 7.00m in order that it is able to adequately clear the railway line. This would not only be intrusive on the surroundings, but would also contribute to both noise and light pollution.

At this stage it would be prudent to make an informal approach to Network Rail in order to seek their feedback with regard to the proposed options and any related issues raised therein.

In summary the environmental benefits of the underbridge have to be weighed against the cost benefits of the overbridge.

Appendix A Design Drawings

Drawing No.	Title
219738-AA05-1-001	Underbridge Option
219738-AA05-1-002	Overbridge – Single Span Steel & Concrete Deck
219738-AA05-1-003	Overbridge – Single Span Concrete Deck
219738-AA05-1-004	Overbridge – Three Span Steel & Concrete Deck



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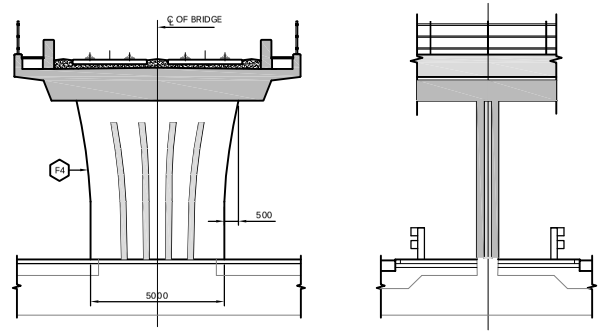
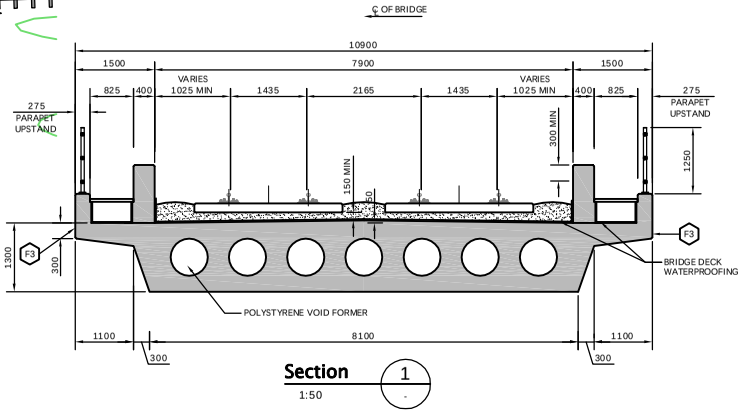


FRONT ELEVATION OF PIER
SCALE 1:100

SIDE ELEVATION OF PIER
SCALE 1:100



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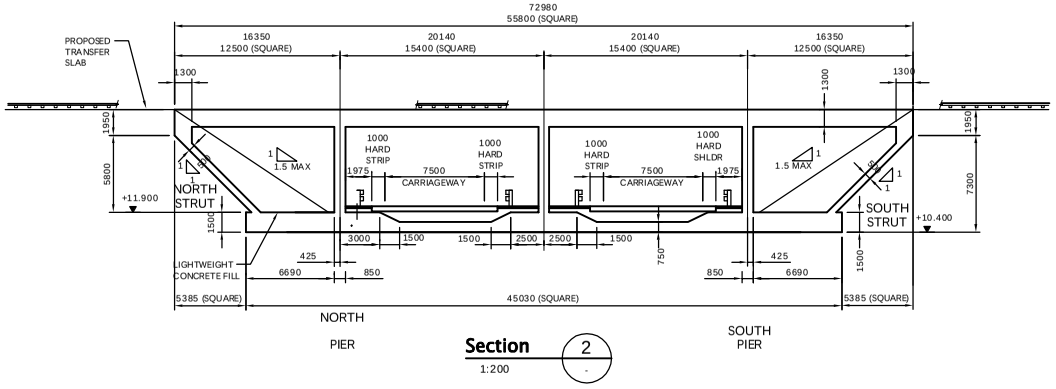

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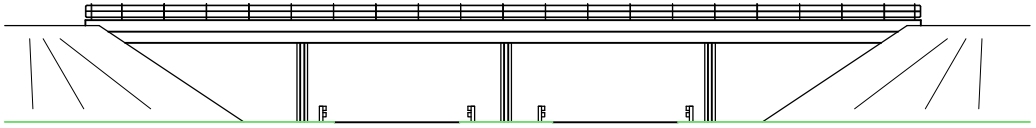

ELEVATION A
SCALE 1:200

CONSTRUCTION SEQUENCE

1. A king post wall is installed to maintain the slope of 1:2 between the bridge and the rail.
2. The guiding slab is constructed.
3. The base slab and tail is constructed.
4. The piers are constructed.
5. The struts are constructed.
6. The deck is constructed.
7. The Cables are installed.
8. The rails and embankment are removed and the bridge is jacked into position. The ground in front of the bridge to be prepared according to Contractors requirements.
9. The gap between the earth and the struts is concreted from the top.
10. The ballast and rails are replaced and the earthworks is completed to the final slopes. The rail line is open to traffic.
11. The roadworks are completed through the structure.

Norfolk County Council
Sam Ralph C.Eng. MICE, MIHT
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

Mott MacDonald
Moore House
75 Prince of Wales Road
Norwich
NR1 1DG
Tel 01603 767 530
Fax 01603 767 463
Web www.mottmac.com

PROJECT TITLE
Norwich Northern Distributor Route
Norwich Sheringham Railway Crossing

DRAWING TITLE
General Arrangement for Proposed
Four Span Underbridge Option

REVISION	DESCRIPTION	CHECKED	DATE
PRE	Preliminary Design	JP	10-06-05

	Sig	INITIALS	DATE	
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DESIGNED BY		JP	06/05	CADFILE
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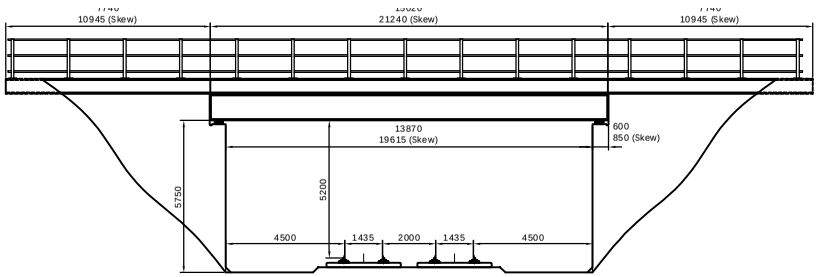
CHECKED BY		JP	06/05	



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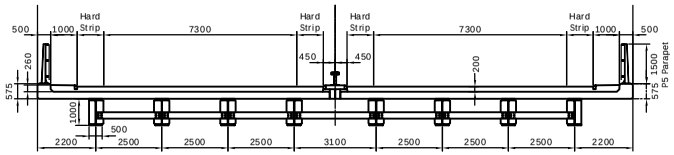

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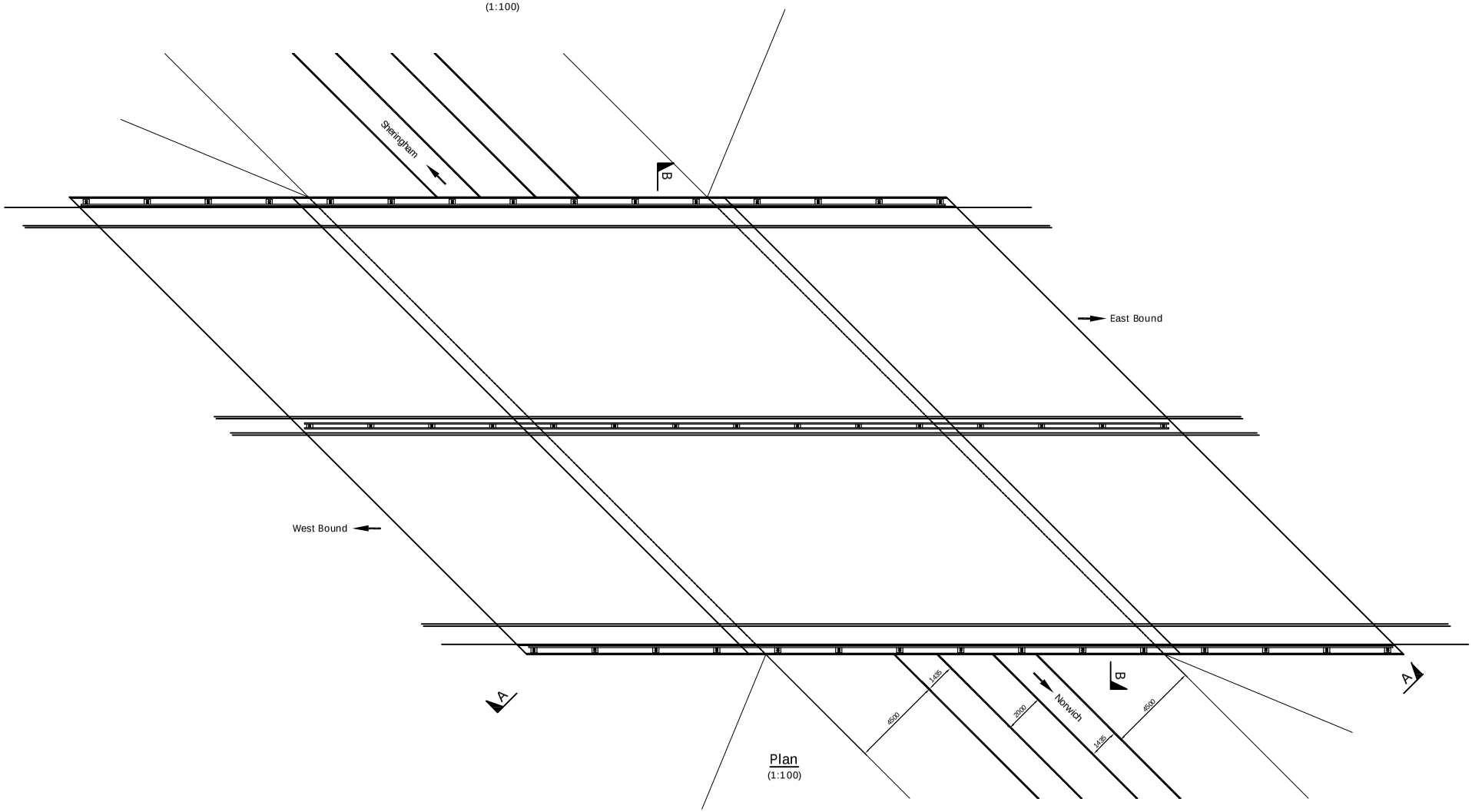

Plan
(1:100)

Norfolk County Council
Sam Ralph C.Eng, MICE, MIHT
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

Mott MacDonald
Moore House
75 Prince of Wales Road
Norwich
NR1 1DG
Tel 01603 767 530
Fax 01603 767 463
Web www.mottmac.com

PROJECT TITLE
NDR Structures
Norwich to Sheringham
Railway Line

DRAWING TITLE
Overbridge Options
Single Span - Steel & Concrete Deck

REVISION	DESCRIPTION	CHECKED	DATE
PRE			

	Sig	INITIALS	DATE	
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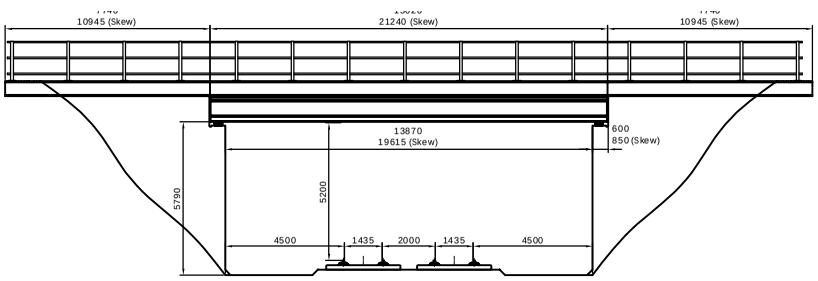
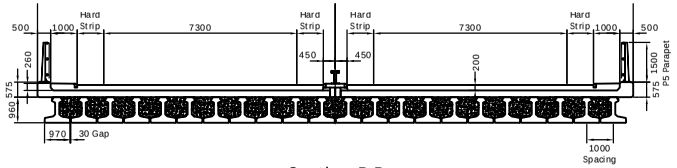
CHECKED BY		JP	06/05	



Elevation A-A
(1:100)



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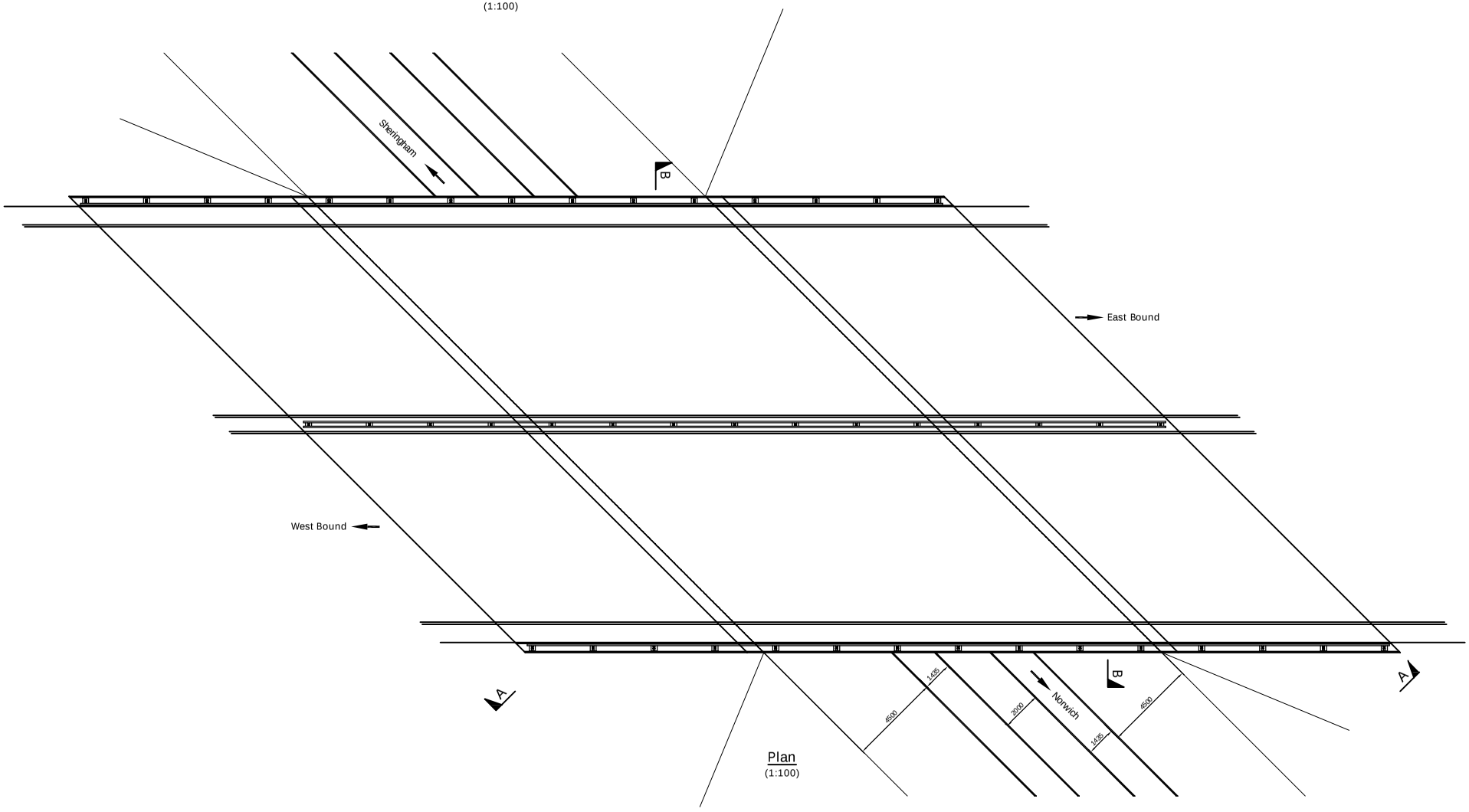

Plan
(1:100)

Norfolk County Council
Sam Ralph C.Eng, MICE, MIHT
Director of Planning and Transportation
Norfolk County Council
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Martineau Lane
Norwich NR1 2SG

Mott MacDonald
Moore House
75 Prince of Wales Road
Norwich
NR1 1DG
Tel 01603 767 530
Fax 01603 767 463
Web www.mottmac.com

PROJECT TITLE
NDR Structures
Norwich to Sheringham
Railway Line

DRAWING TITLE
Overbridge Options
Single Span - Concrete Deck

REVISION	DESCRIPTION	CHECKED	DATE
PRE			

	Sig	INITIALS	DATE	
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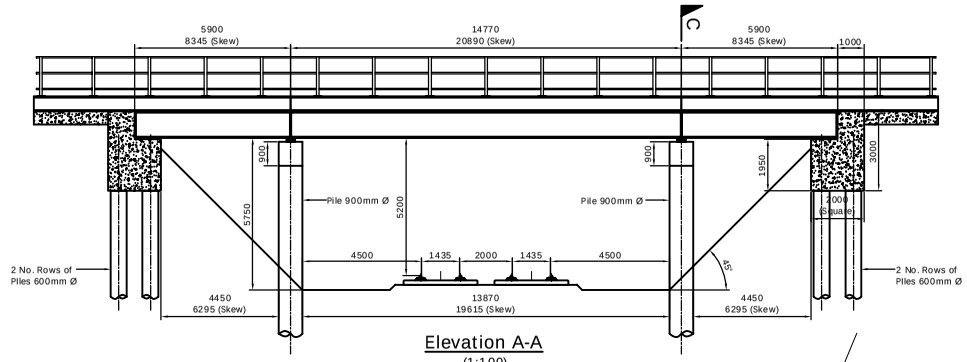
CHECKED BY		JP	06/05	



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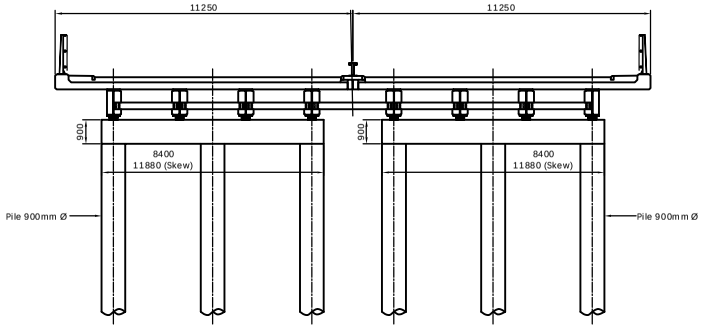

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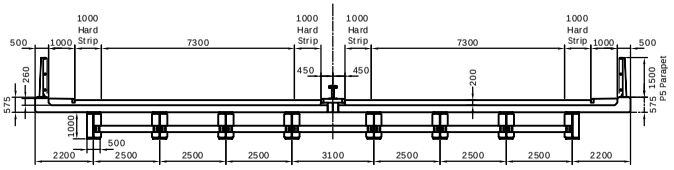

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Plan
(1:100)

Norfolk County Council
Sam Ralph C.Eng, MICE, MIHT
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

Mott MacDonald
Moore House
75 Prince of Wales Road
Norwich
NR1 1DG
Tel 01603 767 530
Fax 01603 767 463
Web www.mottmac.com

PROJECT TITLE
NDR Structures
Norwich to Sheringham
Railway Line

DRAWING TITLE
Overbridge Options
Three Span - Steel and Concrete Deck

REVISION	DESCRIPTION	CHECKED	DATE
PRE			

	Sig	INITIALS	DATE	
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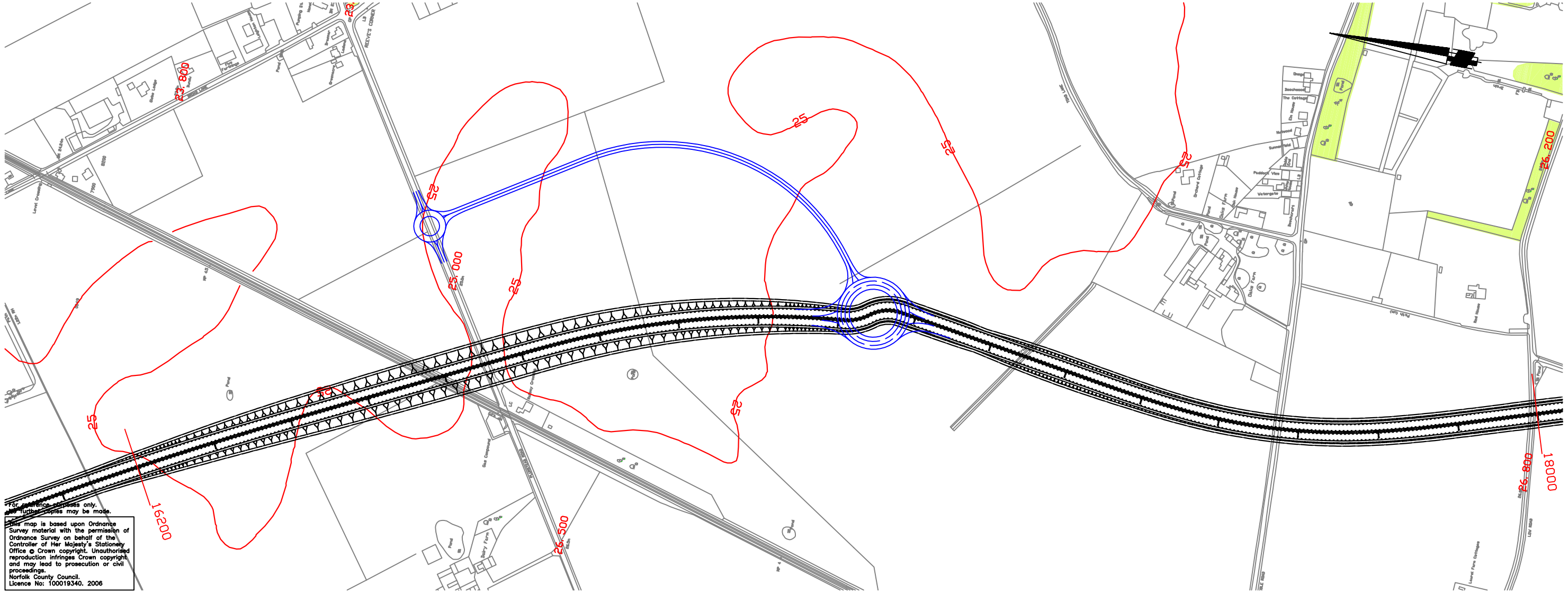
CHECKED BY		JP	06/05	

Appendix B Site Location Plan – Proposed Road Levels and Alignment



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DATUM=13.0

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16200	25.14	26.77
16300	25.00	28.70
16400	25.00	30.33
16500	25.00	31.41
16600	25.00	31.94
16700	25.00	31.92
16800	25.00	31.35
16900	25.00	30.24
17000	25.00	28.57
17100	25.00	26.36
17200	25.00	26.00
17300	25.36	25.36
17400	25.43	23.95
17500	25.00	24.22
17600	25.00	24.72
17700	25.41	25.22
17800	25.99	25.72
17900	26.44	26.21
18000	26.61	26.33

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MAY GURNEY

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE
NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT (over railway line option)
SHEET 10 OF 11

REV.	DESCRIPTION	CHECKED	DATE
A	Junction layouts amended & horizontal alignment amended	CA	04/01/06

	INITIALS	DATE
SURVEYED BY	OS	2005
DESIGNED BY	GWD	Nov. '05
DRAWN BY	GWD	Nov. '05
CHECKED BY	CA	8/11/05

DRAWING No. R1C093-R1-610/10A
PROJECT TITLE Norwich : Northern Distrbutor Road (over railway line option)
SCALE 1:5000/1:500
FILE No. R1C093

ORIGINAL SIZE: A3

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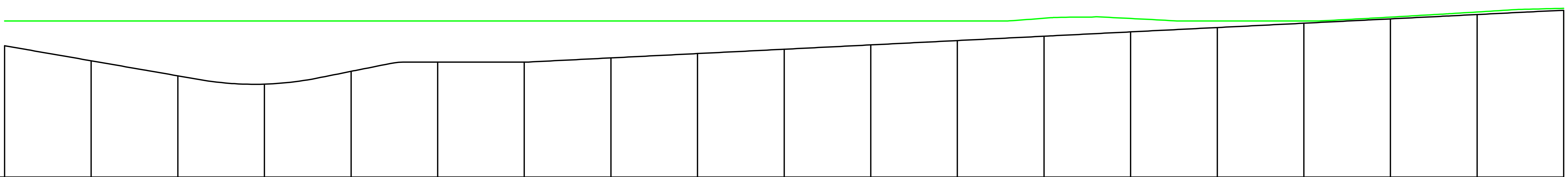

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EXISTING LEVELS	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.31	25.29	25.00	25.00	25.45	26.04	26.46
CHAINAGE	16200	16300	16400	16500	16600	16700	16800	16900	17000	17100	17200	17300	17400	17500	17600	17700	17800	17900	18000

Norfolk County Council working with Mott MacDonald, MAY GURNEY

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

DRAWING TITLE
NORWICH : NORTHERN DISTRIBUTOR ROAD
ENGINEERING LAYOUT (under railway line option)
SHEET 10 OF 11

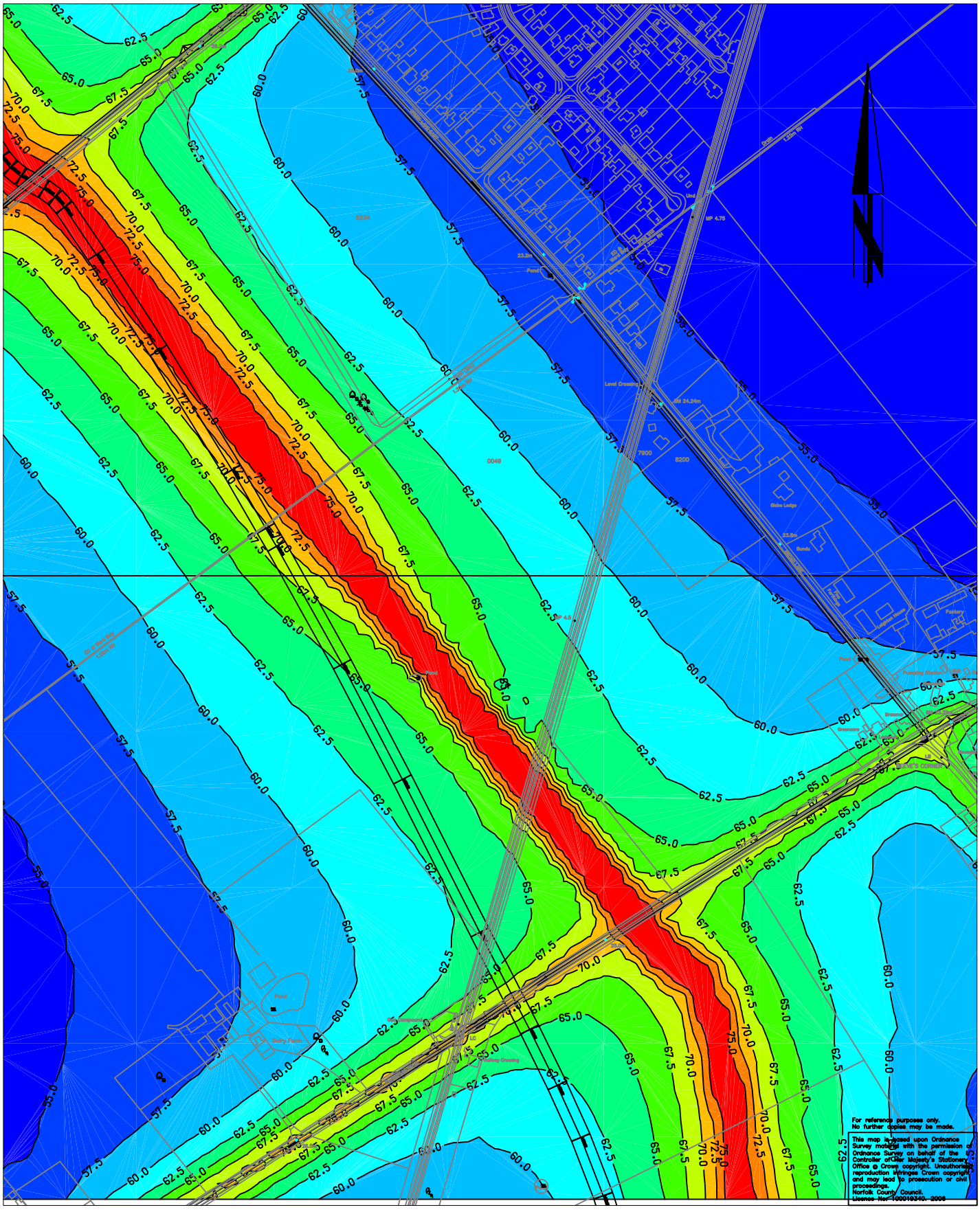
REV.	DESCRIPTION	CHECKED	DATE
A	Junction layouts amended & horizontal alignment amended	CA	04/01/06

	INITIALS	DATE
SURVEYED BY	OS	2005
DESIGNED BY	GWD	Nov. '05
DRAWN BY	GWD	Nov. '05
CHECKED BY	CA	8/11/05

DRAWING No. R1C093-R1-611/10A
PROJECT TITLE Norwich : Northern Distributor Road (under railway line option)
SCALE 1:5000/1:500
FILE No. R1C093

ORIGINAL SIZE: A3

Appendix I



Norfolk County Council
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MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OVER OPTION 1A
WITH NO BUND
NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

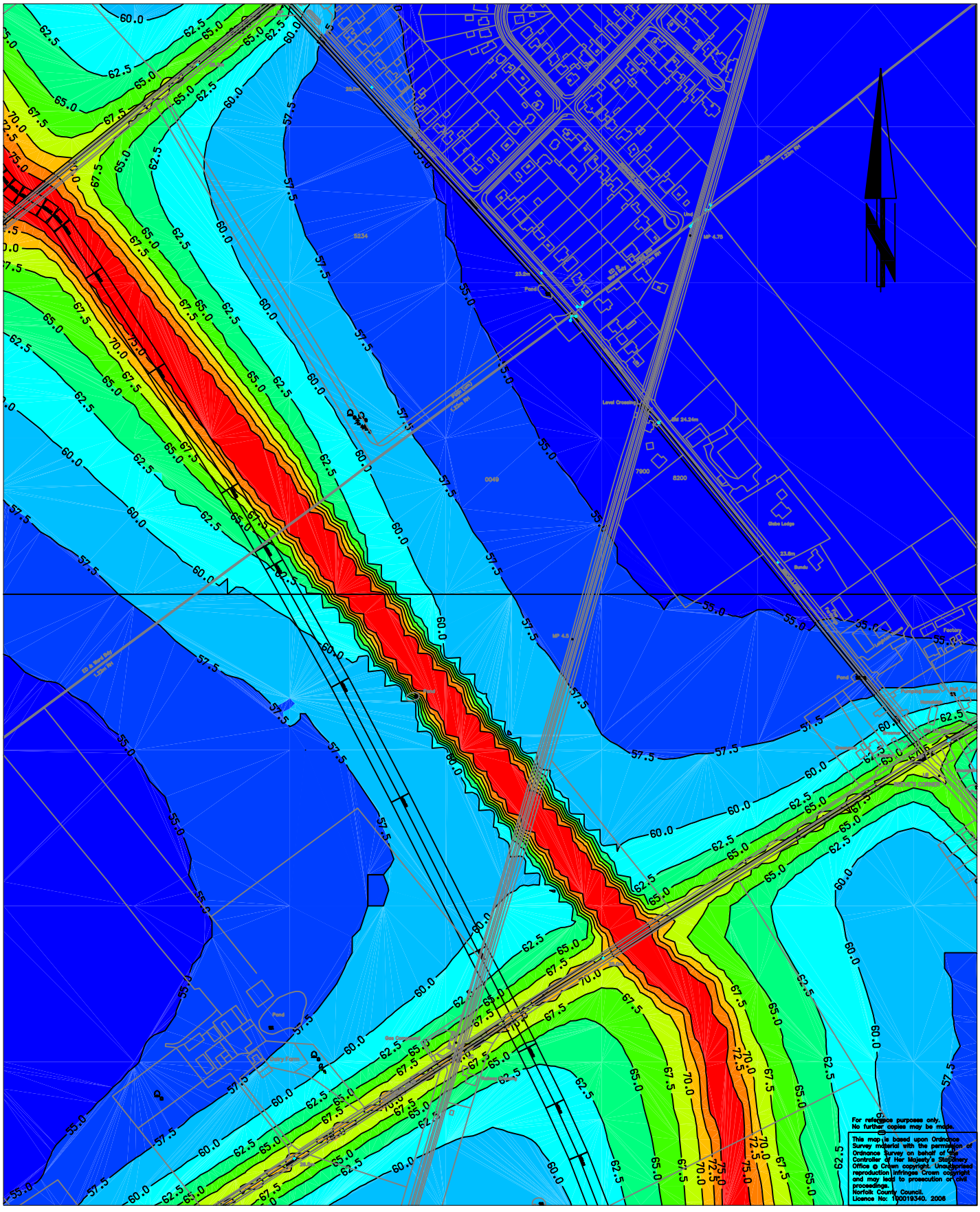
REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY		
DRAWN BY	JGK	06/06
CHECKED BY	PD	06/06

DRAWING No. R1C093-R1-672
PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
SCALE 1: 5000
FILE No. R1C093

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
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Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OVER OPTION 1A WITH 2m BUND NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE	DRAWING No. R1C093–R1–673	
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DESIGNED BY				
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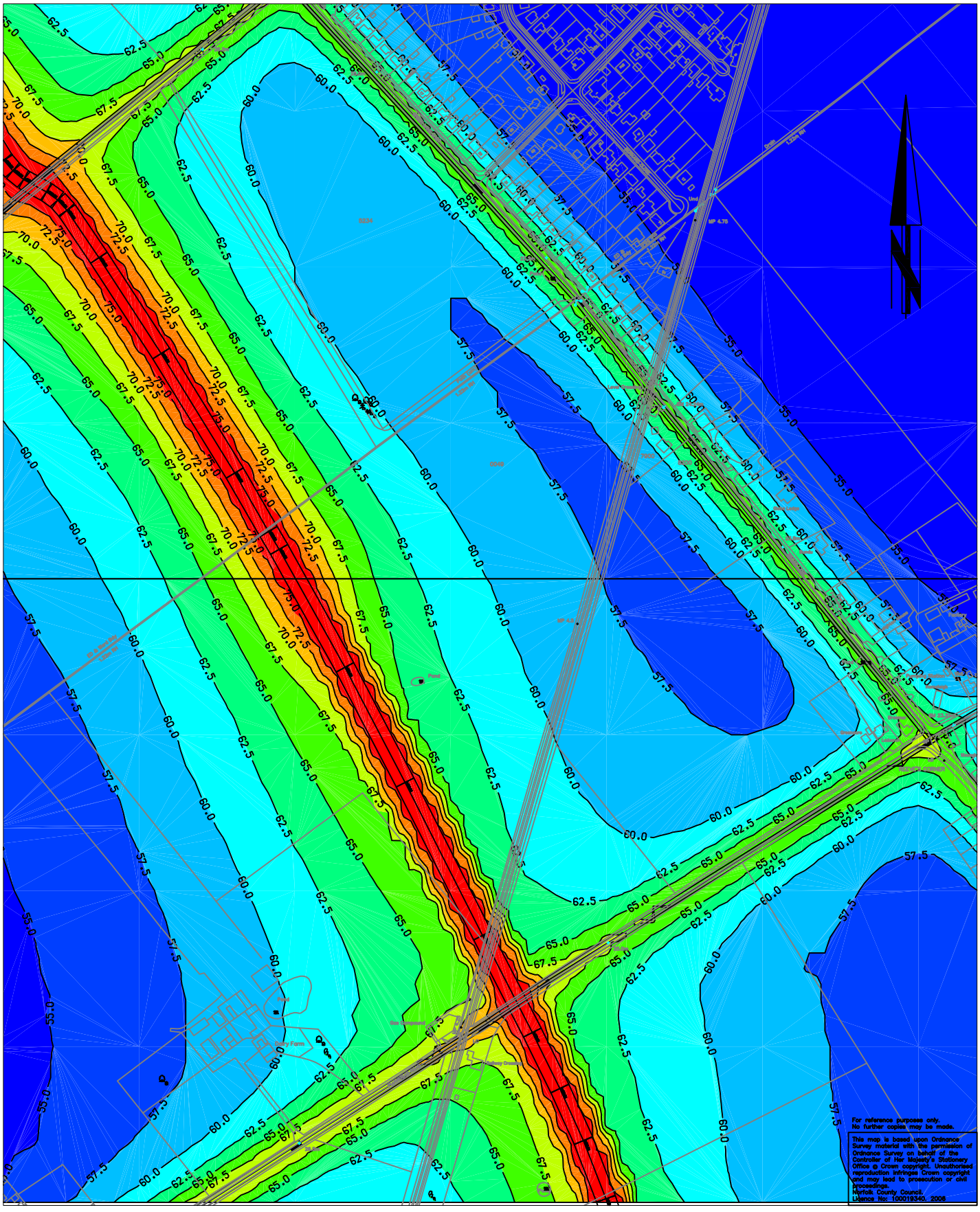
CHECKED BY	PD	06/06		

ORIGINAL SIZE: A4

BIL 23/05/06



Norfolk County Council
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Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OVER OPTION 1B (NO BUND)
NOISE CONTOURS

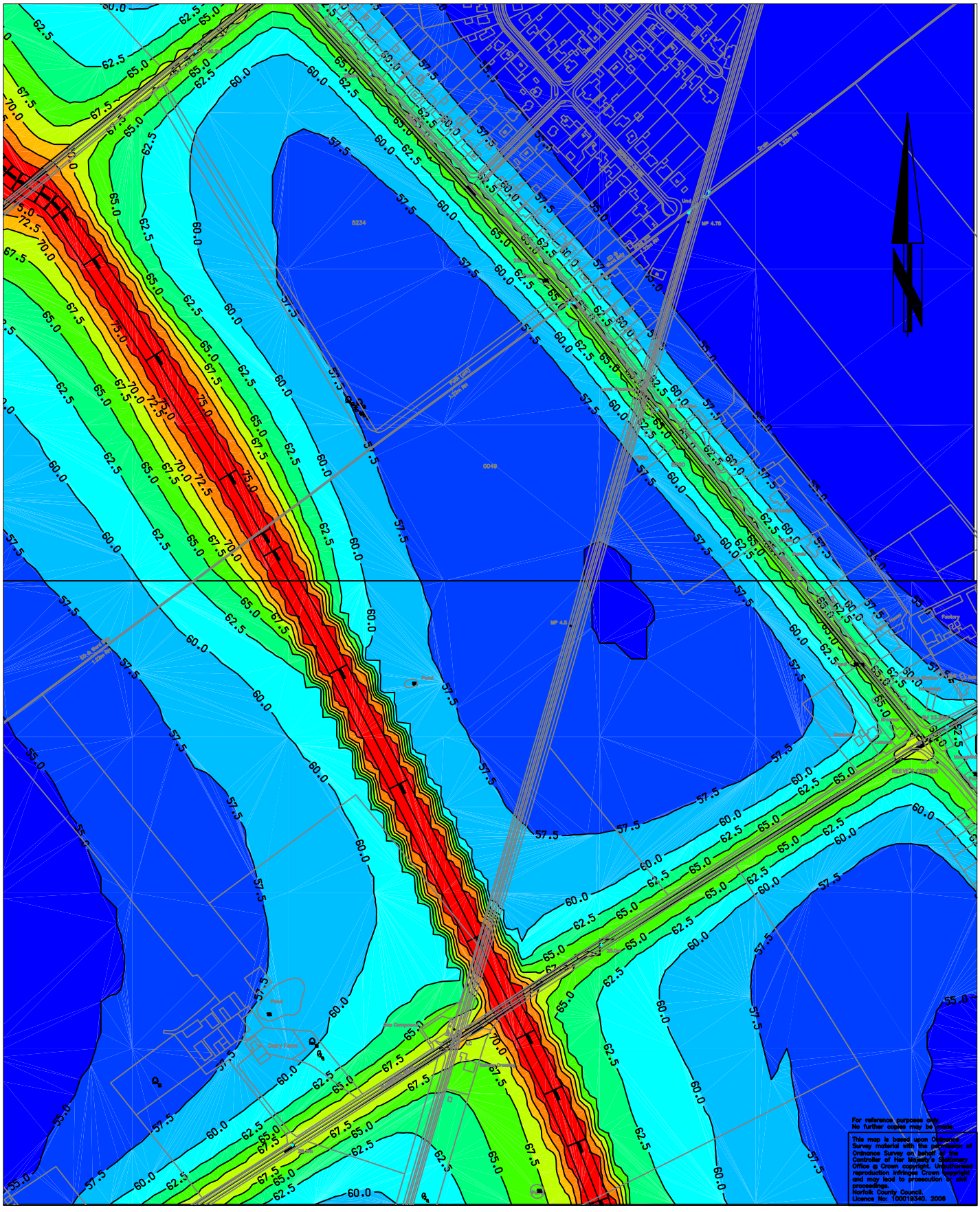
Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE	
SURVEYED BY	OS		DRAWING No. R1C093–R1–674
DESIGNED BY			PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
DRAWN BY	JGK	06/06	
CHECKED BY	PD	06/06	SCALE 1: 5000 / FILE No. R1C093

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OVER OPTION 1B WITH 2m BUND OPTION
NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE	DRAWING No. R1C093–R1–675	
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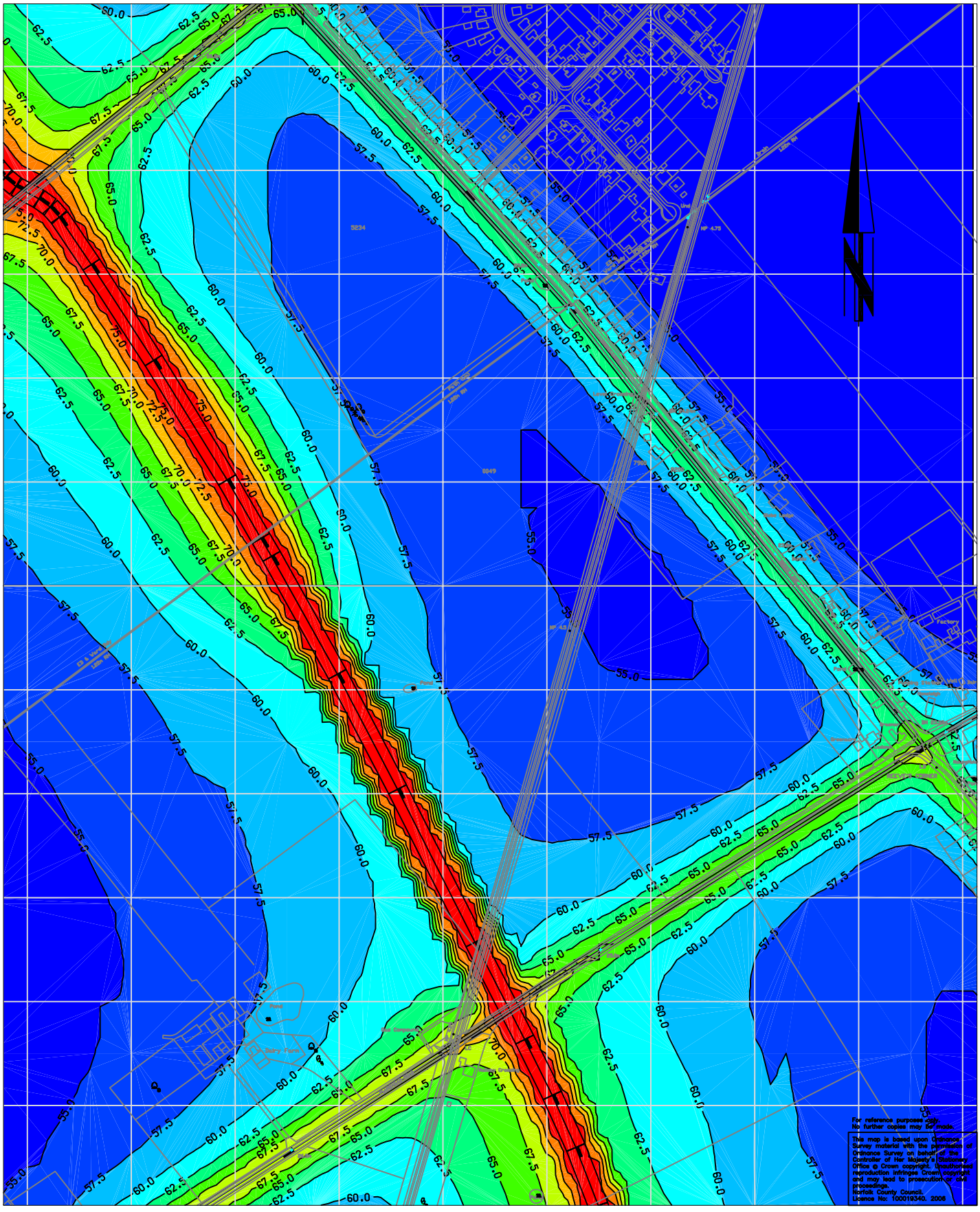
CHECKED BY	PD	07/06		

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OVER OPTION 1B WITH 2m BUND AND 20MPH LIMIT ON GREEN LANE NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

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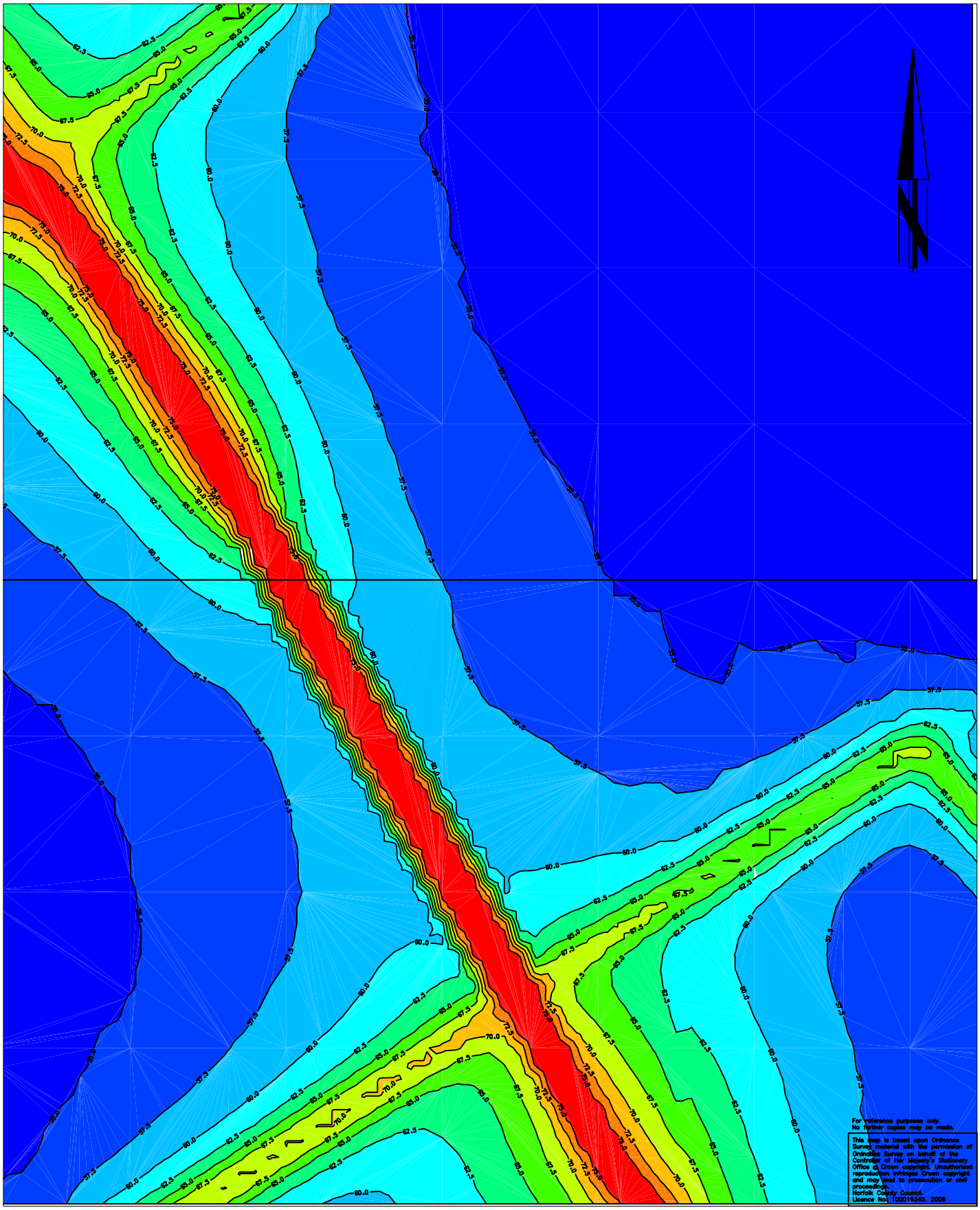
CHECKED BY	PD	06/06		

ORIGINAL SIZE: A4

BIL 23/05/06



Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OPTION 1C WITH BUNDS AND 20mph LIMIT ON GREEN LANE NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

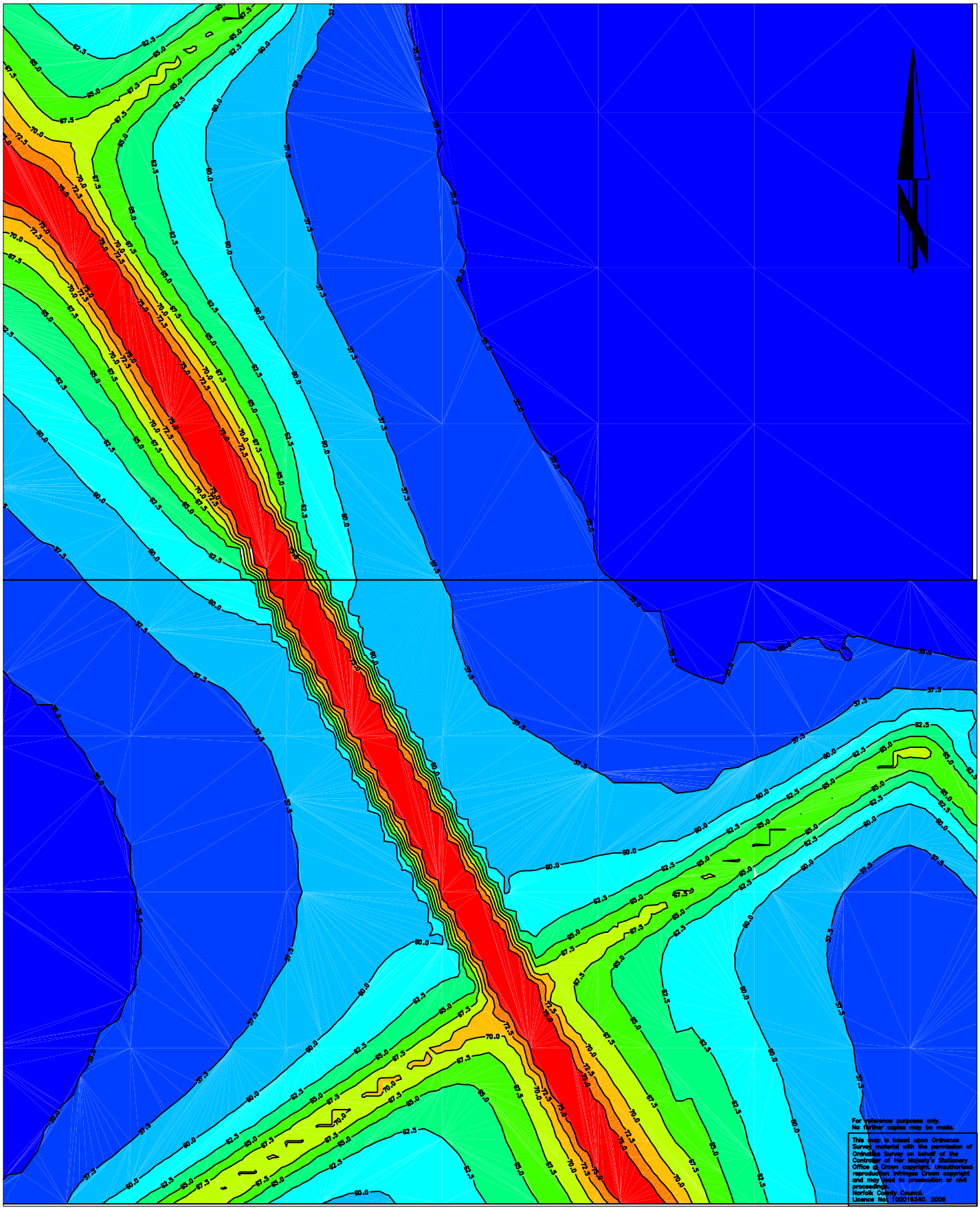
REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY		
DRAWN BY	JGK	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093–R1–701
PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
SCALE 1: 5000
FILE No. R1C093

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
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MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OPTION 1C WITH BUNDS NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY		
DRAWN BY	JGK	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093–R1–700
PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
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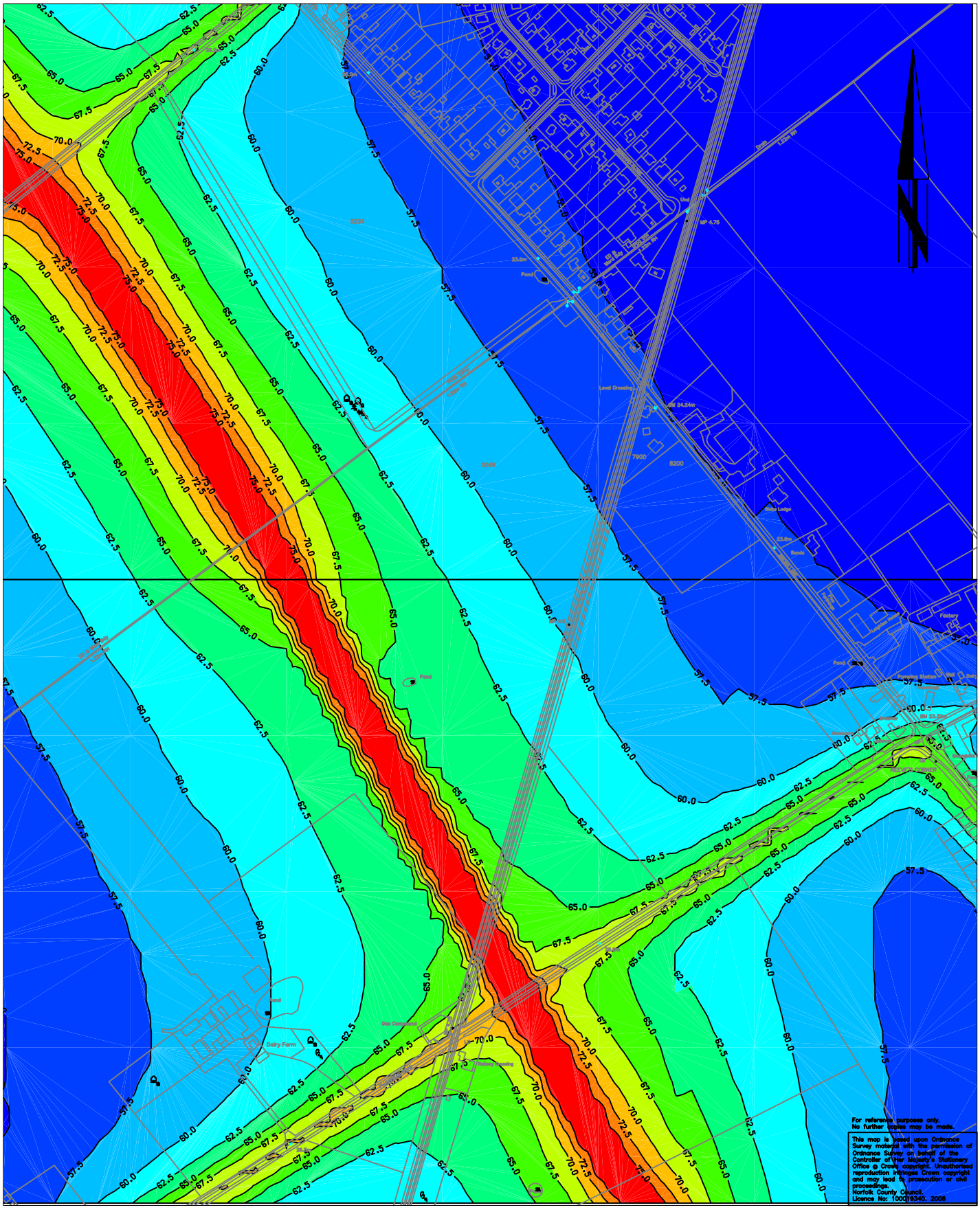
ORIGINAL SIZE: A4

BL 23/05/06



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MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY OPTION 1C
NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

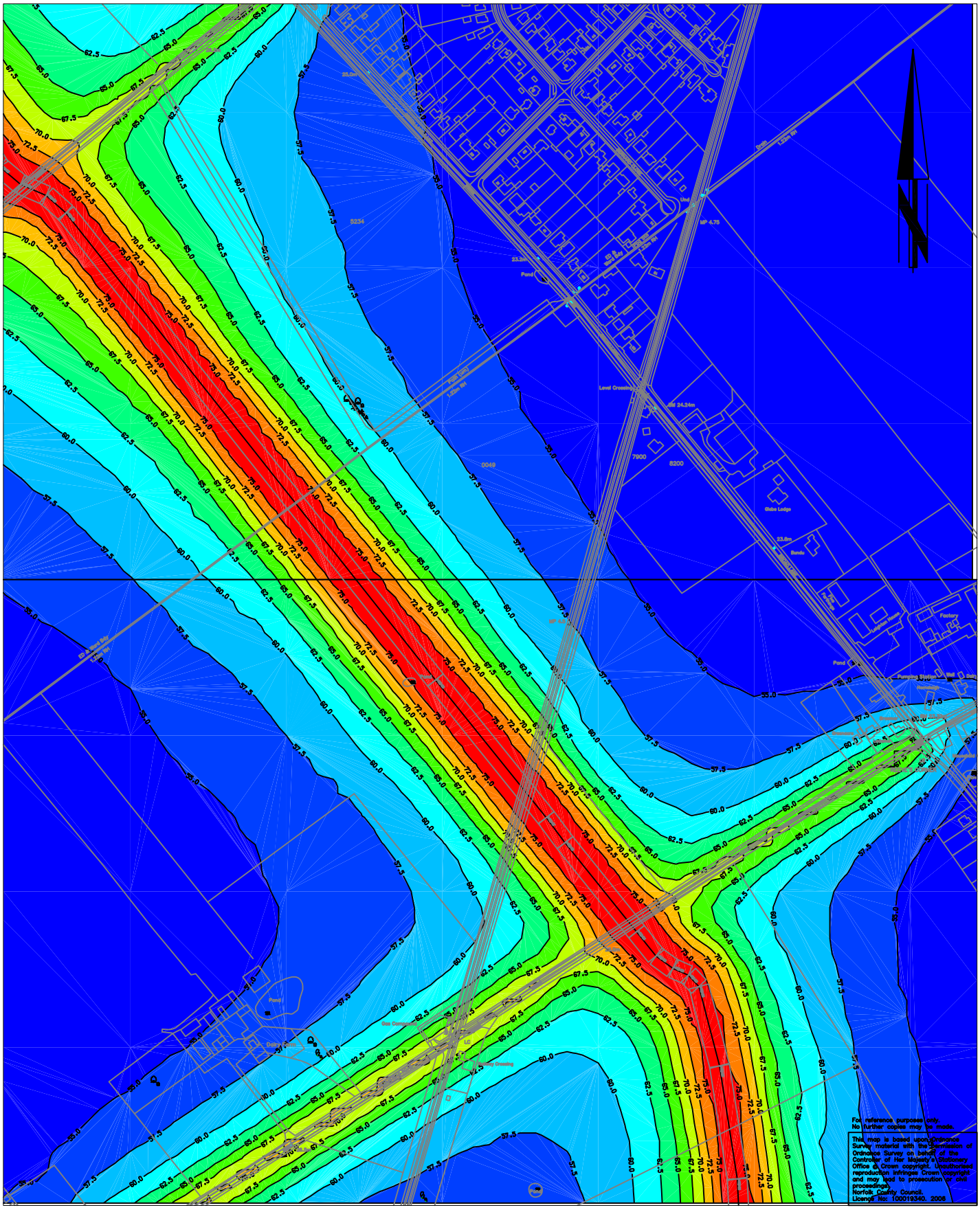
REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY		
DRAWN BY	JGK	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093–R1–699
PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
SCALE 1: 5000
FILE No. R1C093

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
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Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY UNDER OPTION 2A/ 2B
NOISE CONTOURS

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE	DRAWING No. R1C093–R1–677
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DESIGNED BY			
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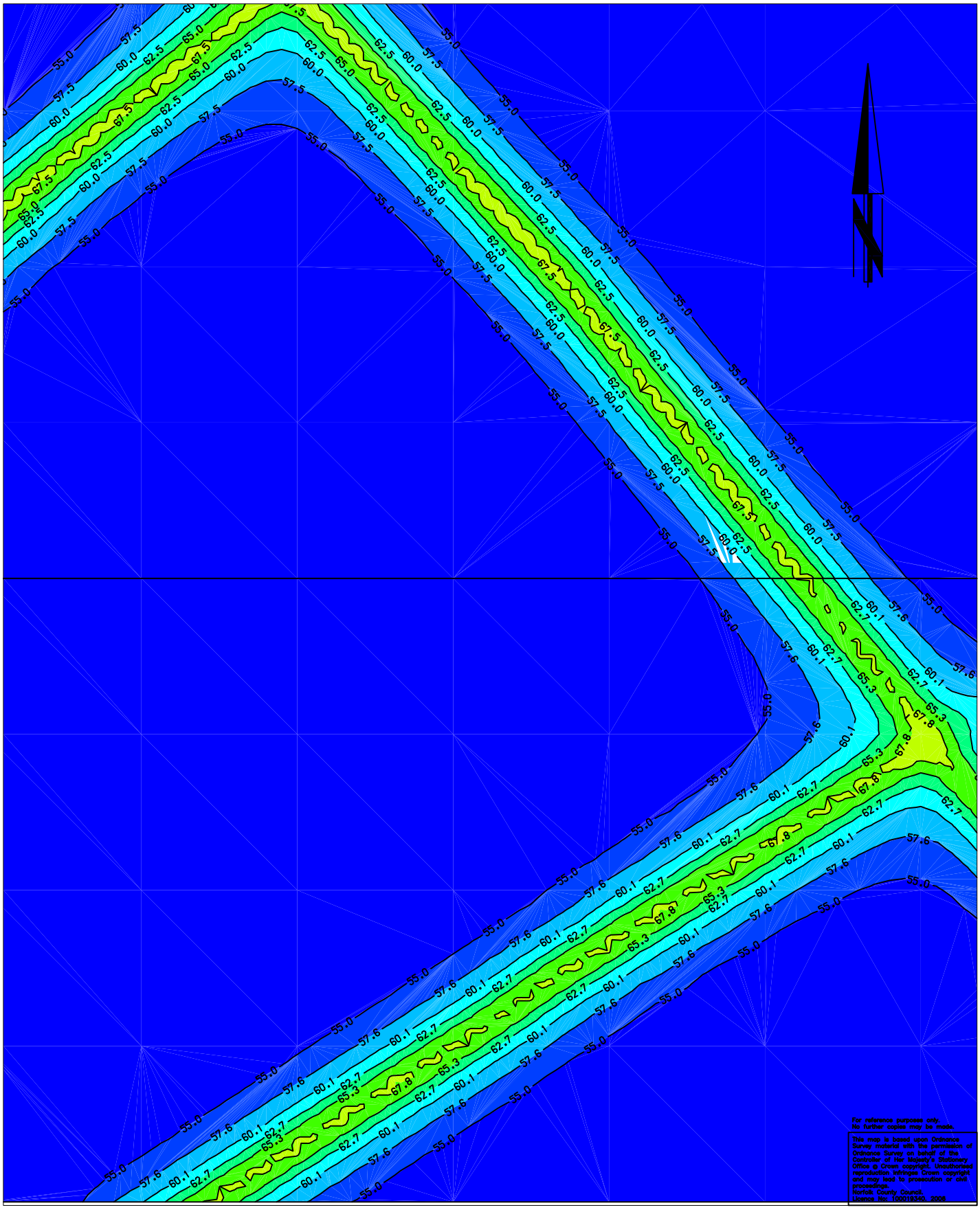
CHECKED BY	PD	07/06	

ORIGINAL SIZE: A4

BL 23/05/06



Norfolk County Council
working with
Mott MacDonald
MAY GURNEY

DRAWING TITLE

RACKHEATH RAILWAY
DO–MINIMUM SITUATION

Mike Jackson
Director of Planning and Transportation
Norfolk County Council
County Hall
Martineau Lane
Norwich NR1 2SG

REV.	DESCRIPTION	CHECKED	DATE

	INIT.	DATE
SURVEYED BY	OS	
DESIGNED BY		
DRAWN BY	JGK	07/06
CHECKED BY	PD	07/06

DRAWING No. R1C093–R1–702
PROJECT TITLE NORWICH NORTHERN DISTRIBUTOR ROAD
SCALE 1: 5000
FILE No. R1C093

ORIGINAL SIZE: A4

BL 23/05/06

Appendix J

	Over options			Under options	
	Option 1a	**Option 1b**	**Option 1c**	**Option 2a**	**Option 2b**
1. Preliminaries	£4,034,444	£4,240,058	£4,203,099	£6,203,934	£6,655,166
2. Site Clearance	£11,037	£10,154	£10,128	£10,602	£12,366
3. Fencing	£101,465	£99,108	£99,108	£101,465	£101,465
4. Safety Fencing	£280,973	£266,605	£262,176	£227,191	£220,863
5. Drainage	£1,090,062	£1,063,604	£1,065,592	£1,098,984	£2,180,400
6. Earthworks	£1,095,899	£966,290	£971,186	£2,605,125	£3,380,480
6A. Earthworks on other parts of scheme resulting from surpluses in this section				£750,000	£1,500,000
7. Pavements	£3,609,521	£3,525,676	£3,525,676	£3,609,521	£3,609,521
8. Kerbs & footways	£525,889	£520,218	£508,782	£474,554	£448,699
9. Signs & lines	£139,439	£136,200	£136,200	£139,439	£139,439
10. Lighting	£121,911	£132,734	£126,668	£121,911	£121,911
11. Structures	£3,014,550	£3,915,000	£3,915,000	£6,068,250	£6,068,250
11a. Commuted sum for Network Rail Structure	£0	£0	£0	£3,034,125	£3,034,125
11b. Drainage measures for Network Rail structure	£0	£0	£0	£1,316,832	£1,316,832
12. Junctions	£6,325,000	£6,520,000	£6,385,000	£6,325,000	£6,325,000
13. Landscaping	£83,215	£78,554	£78,440	£81,318	£89,001
14. Accommodation Works	£326,315	£343,112	£340,110	£502,660	£539,187
15. Statutory Services	£815,787	£857,779	£850,276	£1,256,650	£1,347,968
16. Contingencies	£3,236,326	£3,401,264	£3,371,616	£4,976,634	£5,338,601
Works Costs	***£24,811,833***	***£26,076,356***	***£25,849,059***	***£38,904,195***	***£42,429,273***
Land Costs	*£1,899,898*	*£2,290,117*	*£2,290,117*	*£1,899,898*	*£1,899,898*
Works & Land costs	***£26,711,732***	***£28,366,473***	***£28,139,176***	***£40,804,093***	***£44,329,172***
Maintenance Costs (60 years)	*£2,710,618*	*£2,691,873*	*£2,678,306*	*£2,695,545*	*£2,695,545*
Works; land; maintenance costs	**£29,422,350**	**£31,058,346**	**£30,817,482**	**£42,749,638**	**£45,524,717**

Appendix B

OFFICE OF RAIL REGULATION

Level Crossings: A guide for managers, designers and operators

Railway Safety Publication 7

December 2011

Contents

Foreword

What is the purpose of this guide?

1. The Office of Rail Regulation (ORR) has issued this guidance after extensive consultation. It provides general guidance on the safe management, operation, modification and use of Britain's level crossings. It also provides detailed information on the level crossing order making process which is managed by ORR. It updates earlier guidance (RSPG2E), in particular to align it with developments in industry standards and with recommendations from the Rail Accident and Investigation Branch (RAIB).

2. Please note that it is intended to be used as **guidance.** Following the guidance is not compulsory and you are free to take other action. The guidance aims to help people involved in the management and operation of level crossings to understand the associated risks and responsibilities

3. We expect level crossing risks to be controlled to the appropriate degree. If innovative or alternative ways of doing things emerge as ways of properly controlling risk, then this guidance should not hinder their introduction.

4. ORR wants its advice on level crossing safety to be accessible to everyone who has a role to play in making level crossings safer and more efficient.

Who is this guide for?

5. This document is for people who design, install, maintain and operate level crossings. It may be of interest to others who use or are affected by the use of level crossings.

6. Interested parties may include any of the following:

(a) railway infrastructure managers;

(b) highway authorities;

(c) road authorities;

(d) planning authorities;

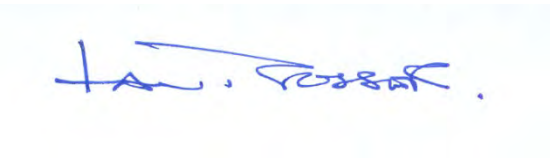
(e) train and station operators;

(f) landowners

(g) level crossing users, including groups representing motorists, cyclists, ramblers and persons with reduced mobility.

7. This guidance does **not** apply to tramways, as the characteristics of tramway crossings and the principles of tramway operation are different.

8. If in doubt, you should contact ORR for advice about how to interpret and apply this guidance to particular circumstances. The guidance will be regularly updated and the version on the ORR website shows the date of the latest update.



Ian Prosser

Director, Railway Safety

Introduction

Why is managing level crossing risk important?

1. Level crossings account for nearly half of the catastrophic train accident risk on Britain's railways. ORR believes that the safe design, management and operation of level crossings can reduce the risks, have a positive effect on user behaviour and so reduce the number of fatal and serious incidents.

What is ORR's policy on level crossings?

2. ORR seeks to influence duty holders and others to reduce risk at Britain's level crossings. It does this through a variety of means ranging from advice to formal enforcement action. ORR checks that preventive and protective measures are implemented in accordance with the principles of prevention set out in the Management of Health and Safety at Work Regulations 1999. Risk control should, where practicable, be achieved through the elimination of level crossings in favour of bridges, underpasses or diversions. Where elimination is not possible, ORR aims to ensure that duty holders reduce risk so far as is reasonably practicable and in accordance with the principles of protection.

3. As the safety regulator for Britain's railways, ORR's role is to provide clear advice and enforce relevant legislation – including that which relates to level crossings. We also exercise the powers of the Secretary of State in making level crossing orders under the Level Crossings Act 1983. The Agency Agreement made between the Secretary of State for Transport and the Office of Rail Regulation relates to functions which ORR has agreed to perform on behalf of the Secretary of State. The Agreement is on ORR's website at http://www.rail-reg.gov.uk/upload/pdf/mou_ORR_DfT.pdf

4. ORR believes that it is neither effective nor efficient for only rail companies to be responsible for managing safety at level crossings. Decisions about level crossings should involve rail companies, traffic authorities and other relevant organisations as early on as possible. Relevant authorities should recognise the wider benefits that safety improvements at level crossings (for example, replacing them with bridges) can bring about, particularly for road users. If wider benefits can be achieved, the appropriate funding bodies should agree on how the costs of making safety improvements will be met.

5. ORR is also committed to helping people understand the importance of the safe use of level crossings. The 'Using Level Crossings Safely' guidance is available on ORR's website.

1. The legal framework

Overview

1.1 The law relating to level crossings is not straightforward as there is a need to balance the interests of road and rail, and take account of the impact of local circumstances that affect the use of the crossing.

1.2 The law applying to level crossings has evolved over the past 160 years. No single government department controls all level crossing legislation. Currently, laws relating to the highways, railways and health and safety apply.

1.3 The Law Commission for England and Wales and the Scottish Law Commission are undertaking a joint review of the existing law governing level crossings. Check their website for the latest position at: http://www.lawcom.gov.uk/level_crossings.htm

1.4 Duties are placed on a number of bodies and individuals including:

(a) railway infrastructure managers;

(b) level crossing operators;

(c) highway, road and traffic authorities;

(d) employers and employees;

(e) train and freight operators;

(f) land owners;

(g) road users; and

(h) other crossing users

1.5 ORR is the enforcing authority for railway health and safety legislation.

1.6 The key pieces of legislation that operators and users of level crossings should be familiar with are:

- Health and Safety at Work etc. Act 1974 is the primary piece of legislation covering occupational health and safety in Great Britain. It requires undertakings to manage and control risks arising from their work activities in connection with level crossings, so far as is reasonably practicable. It also gives ORR inspectors the powers to inspect and enforce safety at level crossings.
- The Management of Health and Safety at Work Regulations 1999 require employers to carry out risk assessments, make arrangements to implement necessary measures, appoint competent people and arrange for appropriate information and training.
- Level Crossings Act 1983 enables the Secretary of State for Transport to make orders that take account of both safety and convenience aspects of crossings. The order can specify the protection arrangements required at certain types of crossing. Detailed advice on the level crossing order process can be found in Chapter 3.

- Transport and Works Act 1992 enables the Secretary of State for Transport to make orders that authorise the construction of a railway in England, including allowing it to cross the highway by means of a level crossing. The authorisation of railway schemes wholly in Wales is by way of an order made by Welsh Ministers. Cross-border rail schemes are authorised by orders made by the Secretary of State subject to the agreement of Welsh Ministers. For Scotland, the Transport and Works (Scotland) Act 2007 enables Scottish Ministers to make orders that authorise the construction of a railway in Scotland, including allowing it to cross the highway by means of a level crossing. Prior to these Acts being made, crossings would have been authorised either by orders made under the Light Railways Act 1896 or under Private Acts.
- Level Crossings Regulations 1997 make it an offence for a crossing operator to fail to comply with a level crossing order.
- Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS), as amended by The Railways and Other Guided Transport Systems (Safety) (Amendment) Regulations 2011, require all infrastructure managers to have a safety management system that enables them to control risk – including risk arising from level crossings. ORR's published guidance on ROGS is at: http://www.rail-reg.gov.uk/upload/pdf/rogs-guidance-may11.pdf
- The Traffic Signs Regulations and General Directions 2002 contain requirements for road signs, including carriageway markings. These are supported by the Traffic Signs Manual found on DfT's website at:http://www.dft.gov.uk/pgr/roads/tss/tsmanual/
- The Private Crossings (Signs and Barriers) Regulations 1996 prescribe the types of signs that may be used on or near private level crossings.
- The Equality Act 2010 places duties on designers and managers to ensure that facilities at crossings do not cause an unnecessary barrier to access across the railway for those with disabilities.
- The current Railway Group Standard relating to level crossings (GK/RT0192, Level Crossing Interface Requirements, Issue 1) defines the requirements for level crossings systems at the interface between the mainline infrastructure manager and railway undertakings. GK/RT0192 can be found at: http://www.rgsonline.co.uk/Railway_Group_Standards/Control%20Command%20and%20Signalling/Railway%20Group%20Standards/GKRT0192%20Iss%201.pdf

Highways and planning law

1.7 A process for involving affected local authorities in level crossing protection arrangements is in place.

1.8 The modifications to the Level Crossings Act 1983, introduced by the Road Safety Act 2006, formalised existing good practice in securing consultation on changes to level crossings in advance of formal circulation of a draft level crossing order. The changes also permit the order to require both the operator of the crossing and the local traffic authority to provide, operate and maintain any protective equipment (including barriers and traffic signs) specified in the order.

1.9 Local traffic authorities and level crossing operators may agree a long term strategy for each crossing. Where appropriate, consideration should be given to what action may be required by each party, to permit the crossing to be closed in the long term.

1.10 Finally, there is a requirement in planning legislation for planning authorities to consult the Secretary of State and the operator of the network where a proposed development materially affects traffic over a

level crossing. For example, a new housing development near a crossing may cause traffic levels over the crossing to increase greatly and mean that existing protection arrangements at the crossing are no longer adequate.

2. Managing risks at level crossings

Introduction

2.1 This part of the guidance provides advice for those involved in the design, supply, installation and maintenance, and continued assessment of level crossing suitability. It revises and updates the advice previously given in Railway Safety Principles and Guidance, part 2, section E, 'Guidance on Level Crossings'.

Applying the guidance

2.2 This document does not set mandatory standards, though it does describe certain essential principles and features, such as interlocking and prescribed road signs and markings. It gives examples of established good practice which, if followed, are likely to be in accordance with the law.

2.3 ORR encourages innovative solutions to level crossing problems. In all cases a risk assessment will need to show that due consideration has been given to safety and that risks have been reduced so far as reasonably practicable. Innovative proposals may be constrained, to some extent, by the need for consistency for example for road signs.

2.4 The guidance is produced to help those who are responsible for providing and maintaining the protection arrangements at level crossings. This includes highways and road authorities, who should find the guidance helpful in so far as it deals with the roadway aspects of the protection arrangements. We hope that others, such as planning authorities, who may be consulted on proposed modifications to level crossings, will also find this document helpful.

2.5 Level crossings take many forms depending on whether they are on a public or private road, or for vehicle, horse or pedestrian use. The protection arrangements which are appropriate at level crossings will vary, depending upon the crossing location, for example proximity to road junctions, the level of usage and the nature of railway traffic.

2.6 An important factor in assuring the safety of level crossings is providing, so far as circumstances permit, a consistent appearance for road and rail users of any crossing. To help achieve this, several level crossing types have been developed over the years. Detailed protection arrangements for each type are described later.

2.7 The guidance applies when the protection arrangements at existing crossings are reviewed. It will also apply when new crossings are created. Arrangements at a level crossing on a road to which the public has access may be subject to an order, made by the Secretary of State, to provide for the protection of those using the crossing. Level crossing orders, made under the Level Crossings Act 1983, usually specify the protection arrangements at public vehicular crossings.

2.8 Where level crossings cannot be eliminated but are being renewed or altered, every effort should be made to improve the crossing and reduce risk to both crossing and railway users. Certain types of crossing design, particularly automatic types, whilst fit for purpose when road and rail traffic densities were lower, have been found to be prone to misuse with potentially high consequences when collisions occur. Given the high cost when crossings are installed and their long service life, ORR expects that the safest suitable crossing for the site-specific risks will be selected when renewing a crossing.

Effects on existing level crossings

2.9 This guidance sets out examples of good practice appropriate for today's world. It is relevant to existing crossings where protection arrangements require improvement. Factors affecting the continued suitability of arrangements might include increased traffic levels and speeds (road and rail), new road lay-outs, and any history of misuse or near-misses. Where protection arrangements are specified in a level crossing order, the crossing operator is required to ensure that the order is complied with. In addition to this, however, crossing operators have general duties under the Health and Safety at Work etc. Act 1974 to ensure, so far as is reasonably practicable, the safety of all those using or affected by a level crossing. In effect, this means that crossing operators need to monitor regularly the suitability of arrangements and make changes when necessary. Where the crossing is subject to a level crossing order, such changes should prompt the crossing operator to request a new or amended order to reflect these changes. The level crossing order making process is described in detail in Chapter 3.

Operating conditions

2.10 Level crossing type and design will depend on the operational requirements of the railway and road usage.

2.11 To ensure that the level of protection at the crossing remains adequate and appropriate, assess the suitability of the type of crossing when circumstances at the crossing change. This includes railway factors (for example rolling stock, signalling, electrification, speed, etc) and those of the local environment (such as housing or industrial developments, changes to road traffic conditions etc).

2.12 It is important to take into account:

(a) normal railway operating conditions;

(b) degraded conditions where any component or part of the railway system has failed;

(c) foreseeable abnormal conditions to which the system may be subjected;

(d) usage, including consideration of altered or increased usage due to incident or regular occurrences and events; and

(e) emergency situations.

Design and installation

2.13 Clients, designers, suppliers, contractors and installers have responsibilities under the Construction (Design and Management) Regulations 2007 in relation to level crossings.

2.14 Similarly, equipment at level crossings may be subject to other specific regulations, for example, the Electricity at Work Regulations 1989 and the Provision and Use of Work Equipment Regulations 1998 (PUWER).

2.15 Where reference is made in this document to the Traffic Signs Regulations and General Directions 2002 or to the Private Crossings (Signs and Barriers) Regulations 1996 they will be quoted as the 2002 Regulations and the 1996 Regulations respectively. References to sign diagram numbers are to diagrams in those Regulations.

Structure of the guidance

2.16 This part of the guidance:

(a) suggests the crossing types appropriate to the prevailing conditions;

(b) provides general guidance applicable to all types of crossing;

(c) gives specific details of types of crossing; and

(d) provides guidance on carriageway aspects and crossing equipment.

Terminology

2.17 Throughout the document, verbs with specific meanings are used:

should - the primary verb for statements of guidance;

may - where the guidance suggests options;

must - only used where there is a legal/statutory requirement for the measures described to be employed. Reference to the Act or Regulations will be provided;

is (are) required - having decided upon a particular option or arrangements, some consequential choices stem from that first decision. This expression is used to indicate those consequential choices and where firmer guidance is considered appropriate.

2.18 Some terms that relate specifically to level crossings have a special meaning and where these terms are first mentioned in the text they are italicised and a cross reference to the definition in Appendix A is provided.

2.19 Throughout this document speeds are given in miles per hour as this is the convention for UK highway signage and the majority of UK railway signage. Conversions to kilometres per hour should use the metric equivalent specified in relation to the relevant imperial unit in the third column of the Schedule to the Units of Measurement Regulations 1995.

Level crossing types – basic protection and warning arrangements

Figure 1

Protection from train movements	Crossing confirmed clear	Warning arrangements	Full barriers/gates	Half barriers	No barriers	Telephone "protection"
Protected	By signaller or crossing keeper		MCG			
			MCB			
			MCB (CCTV)			
	By obstacle detector		CB-OD			
	By driver			ABCL		
					AOCL	
	By train crew/other		TMO			
Unprotected		Approaching Train		AHB		
					UWC (MSL)	
					FP (MSL)	
		Telephone				UWC (T)
		Line of Sight			OC	
					UWC	
					FP/BW	

MCG: manually controlled gated crossing
MCB: manually controlled barrier crossing
MCB (CCTV): manually controlled barrier crossing with closed circuit television
CB-OD: controlled barrier crossing with obstacle detection
ABCL: automatic barrier crossing locally monitored
AOCL: automatic open crossing locally monitored
TMO: train crew (or other peripatetic railway staff) operated crossing
AHB: automatic half barrier crossing
UWC (MSL): user worked crossing with miniature stop lights
FP (MSL): footpath crossing with miniature stop lights
UWC (T): user worked crossing with telephone
OC: open crossing
UWC: user worked crossing
FP/BW: footpath or bridleway crossing

Protection from train movements ensures that trains are not authorised to pass over the crossing until the crossing is closed and the crossing area has been checked to be clear.

Unprotected crossings depend on a warning being given to crossing users of an approaching train so that they can be clear before the train arrives. It is unlikely that the train can be stopped if the crossing is not clear.

Telephones are fitted to several crossing types for a range of purposes. At a UWC (T) the warning of an approaching train is achieved by contacting the signaller. For this to be effective the user must make the call and the signaller must be able to advise how close the nearest train is.

Assessing suitability

2.20 Selecting the most suitable type of level crossing depends on various factors, one of which may be traffic volume. Table 1 gives guidance on the factors to be considered for any given location. In deciding which type of level crossing to install, consider likely road traffic delays. Determine the protection provided at a level crossing by undertaking a suitable and sufficient risk assessment. The following table is a general summary of the different crossing types. For further details see relevant sections in this chapter.

Table 1

Section	Type of crossing	Key features
4	**Gated crossings operated by railway staff**	**The *traffic moment* (see Appendix A) and *actual daily road vehicle usage* (see Appendix A) should be low.** **Railway signals interlocked with the gates are required so that it is not possible to clear the signals unless the road is fully closed by the gates, nor is it possible to open the road unless the signals are at Stop and free of *approach locking* (see Appendix A).**
5	**Barrier crossings operated by railway staff**	**Generally suitable for any situation.** **Railway signals interlocked with the barriers are required so that it is not possible to clear the signals unless the road is fully closed by the barriers, nor is it possible to open the road unless the signals are at Stop and free of approach locking.**
5A	**Barrier crossings with obstacle detection**	**This type of crossing is protected by road traffic light signals and lifting barriers on each side of the railway. An audible warning to pedestrians is also provided. The crossing is designed to operate automatically.** **Railway signals, which provide full protection to the crossing, are required on all railway approaches. These signals must be interlocked with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, nor should it be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossing.**

Section	Type of crossing	Key features
6	Automatic half barrier crossings (AHBC)	The speed of trains over the crossing should not exceed 100 mph. There should not be more than two running lines. Appropriate means to stop any train approaching the crossing in an emergency situation are required where reasonably practicable and before a train has passed the last protecting signal. Trains should not normally arrive at the crossing in less than 27 seconds after the amber lights of the road traffic light signals first show. At least 95% of trains should arrive within 75 seconds and 50% within 50 seconds. The carriageway on the approaches to the crossing should be sufficiently wide to enable vehicles to pass safely. There is no limit to the amount of road traffic, but the road layout, profile and traffic conditions should be such that road vehicles are not likely to become grounded or block back obstructing the railway. Good road profile is particularly important at this type of crossing. Not suitable where pedestrian usage is high.
7	Automatic barrier crossings, locally monitored (ABCL)	The speed of the trains over the crossings will be determined by the traffic moment but should not exceed 56 mph at any time. There should not be more than two running lines. The carriageway on the approaches to the crossing should be sufficiently wide to enable vehicles to pass safely. The road layout, profile and traffic conditions should be such that road vehicles are not likely to ground or regularly to block back obstructing the railway.
8	Automatic open crossings, locally monitored (AOCL)	The speed of the trains over the crossings will be determined by the traffic moment but should not exceed 56 mph at any time. There should not be more than two running lines. The limits on the road and rail traffic are defined in Appendix B. The carriageway on the approaches to the crossing should be sufficiently wide to enable vehicles to pass safely. The road layout, profile and traffic conditions should be such that road vehicles are not likely to ground or regularly to block back obstructing the railway.
9	Open crossings	The speed of trains over the crossing should not exceed 10 mph. There should not be more than one line over the crossing. The maximum daily traffic moment should not normally exceed 2000 or the peak hour traffic moment 30. The actual daily road vehicle usage should not exceed 200. The 85th percentile road speed at the crossing should be less than 35 mph. The road layout, profile and traffic conditions should be such that road vehicles are not likely to ground or regularly to block back obstructing the railway.

Section	Type of crossing	Key features
10	User worked crossings (UWCs) for vehicles	The speed of the trains over the crossing should not exceed 100 mph unless additional protection is provided. These crossings should only be used on private roads. There should not normally be more than two lines over the crossing. Where no additional protection is provided, such as miniature stop lights, the warning period (i.e. arrival time of the train from the first sighting) should be greater than the time required by users to traverse the *crossing length* (see Appendix A) by not less than 5 seconds.
11	Footpath and bridleway crossings	The speed of trains over the crossing should not exceed 100 mph unless additional protection is provided. There should not normally be more than two lines over the crossing. The *warning time* (see Appendix A) should be greater than the time required by users to traverse the crossing surface between the *decision points* (see Appendix A) at either end of a footpath crossing on foot, or on horseback at a bridleway crossing, unless additional protection is provided. Where miniature stop lights are provided, the warning period should be greater, by not less than 5 seconds, than the time required by users to traverse the crossing surface between the decision points at either end of a footpath crossing on foot, or on horseback at a bridleway crossing.
12	Foot crossings at stations	This type of crossing should only be considered for lightly used stations where line speed does not exceed 100 mph and no alternative arrangements are available.

General guidance

2.21 This section gives general guidance on positioning and equipment at all types of crossings.

Positioning signalling and other railway infrastructure relative to level crossings

2.22 During normal working, no part of a stationary train should obstruct a level crossing. Where a level crossing is near a station, special arrangements may be necessary.

2.23 Determine by risk assessment where any protecting signals will be sited relative to a level crossing. Assess the likelihood and consequences of trains passing the signals without authority. If it is not possible to optimise the positions of signals, take appropriate measures to reduce the risk so far as is reasonably practicable.

2.24 Provide additional measures to protect road users where a road crosses electrified railway lines. See Section 19 for further advice.

Equipment at level crossings

2.25 Consider the likely impact of future uses of both the land and the railway (for example changed line speeds) on sighting and safety before land adjacent to crossings is let or sold off by railway duty holders and apply appropriate restrictive terms.

2.26 Install all crossing equipment clear of the railway structure gauge and the edge of the carriageway. Ensure that it does not obstruct sighting.

2.27 Provide an alternative power supply at all automatic crossings, including those with miniature stop lights, to allow the crossing equipment to function normally in the event of a main power supply failure.

2.28 It may be necessary, where trains run after dark, to illuminate the crossing to enable its safe operation. If the roads to a crossing are lit, the crossing should be illuminated to at least the same standard. Any lighting should not cause glare to either road users or train drivers, interfere with the visibility of railway signals or cause avoidable annoyance to local householders.

2.29 Additional lighting may be necessary at crossings which are locally monitored by the driver of the approaching train. This is to enable the train driver to see that the crossing is unobstructed from the point at which they may have to brake the train.

2.30 Any failure or damage to the equipment at a level crossing, which may lead to incorrect or unsafe operation, should be evident to the *control point*, the driver of an approaching train, or the user of the level crossing within a reasonable time of the event occurring.

Gated crossings operated by railway staff

General description

2.31 This type of crossing is protected by gates, on both sides of the railway, which complete the fencing of the railway when closed across the road or the railway. The crossing is manually operated by railway staff who close the gates alternately across the road or the railway.

2.32 The normal position of the gates, either across the road or railway, may be specified in the legislation authorising construction of the line. Changes may be authorised by direction under the Road and Rail Traffic Act 1933. Directions may be issued by ORR on behalf of the Secretary of State. Where the gates do not completely fence in the railway when open to road traffic, cattle-cum-trespass guards may be required (described later in Section 14 ‘Additional measures to protect against trespass’).

2.33 Road traffic light signals may be provided to assist with the safe operation of the gates. Where they are not provided, red lamps and red retro-reflective targets mounted on the gates, which show towards approaching road traffic when the gates are across the road, should be provided.

Method of operation

2.34 The gates may be operated by either:

(a) infrastructure manager staff, who are permanently stationed at a control point, sufficiently close to have a clear view to enable safe operation of the crossing; or

(b) one of the crew of an approaching train (or other peripatetic staff) at a control point adjacent to the level crossing, after the train has been stopped short of the crossing.

2.35 The person operating the gates should have a good view of the whole crossing area and, unless road traffic light signals are provided, approaching road traffic.

2.36 Road traffic light signals, where provided, should be activated before any attempt is made to close the gates to road traffic. The lights should continue to show until the gates are fully closed across the railway.

2.37 The crossing operator should have an appropriate indication of the approach of trains and clear instructions as to when the gates should be closed to road traffic.

2.38 Where the crossing is operated by a member of train crew, the train must stop short of the crossing to allow the person to close the gates to road traffic. The train may then only proceed over the crossing when the train driver receives the authority from the person operating the gates. When the train has cleared the crossing the gates should be reopened to road traffic.

Railway signalling and control

2.39 Provide railway signals which afford full protection to the crossing on all railway approaches. These signals should be interlocked with the gates so that it is not possible to clear the signals unless the road is fully closed by the gates, nor should it be possible to open the gates unless the signals are set at Stop and free of approach locking, or the train has passed the signal and cleared the crossing.

2.40 Where road traffic light signals are provided, a train passing a protecting railway signal at Stop should immediately cause the intermittent road traffic light signals to flash red, omitting the steady amber phase. Where a protecting railway signal is very close to a level crossing, this emergency warning to road users may be very short. Additional measures may be necessary, therefore, to ensure that the crossing is closed to road traffic before the train reaches the immediate vicinity of the crossing. Such additional measures may be specified in a level crossing order.

2.41 Where trains are required to stop short of the crossing, interlocking between signalling and gates is not required. Instead, provide a warning board at full service braking distance to remind the train driver to stop short of the crossing and a Stop board at the stopping point. The Stop board should not normally be less than 50 m before the crossing.

Barrier crossings operated by railway staff

General description

2.42 This type of crossing is protected by road traffic light signals and lifting barriers on both sides of the railway. An audible warning to pedestrians is also provided. The barriers are normally kept in the raised position and, when lowered, extend across the whole width of the carriageway on each approach.

2.43 The crossing is operated by infrastructure manager staff who start the road traffic light signal sequence and then lower the barriers. The lowering and raising cycles may be initiated automatically.

2.44 Road traffic light signals may not be necessary where the barriers are normally in the lowered position and are clearly visible from an appropriate distance to approaching road traffic. Where no road traffic light signals are provided, the number of road vehicles during the peak hour should not exceed 20 and the permissible speed of the railway should not exceed 100 mph.

2.45 Telephones for public use are not normally required.

Method of operation

2.46 This type of crossing may be operated:

(a) by infrastructure manager staff stationed at a control point adjacent to the crossing when the line is open to rail traffic;

(b) by infrastructure manager staff stationed at a control point remote from the crossing using closed-circuit television (CCTV), whenever the line is open to rail traffic;

(c) by infrastructure manager staff at a control point adjacent to the crossing after an approaching train has been stopped short of the crossing.

2.47 For all methods of operation the person operating the crossing equipment should have a clear and full view of the crossing (including the barriers) from the control point, either directly or by CCTV.

2.48 Where the barriers are normally raised, the sequence of events to close the crossing to road traffic, once the lowering cycle has been initiated either manually or automatically, is:

(a) the amber light on each of the road traffic light signals immediately shows and the audible warning begins. The amber lights should show for approximately 3 seconds (up to 5 seconds to suit road conditions);

(b) immediately the amber lights are extinguished, the intermittent red lights should show;

(c) approximately 4 to 6 seconds later the barriers should start to descend. Where pairs of barriers are provided, the *right-hand side* (see Appendix A) barriers should not begin to descend until the *left-hand side* (see Appendix A) barriers are fully down. The time for each barrier to reach the lowered position should normally be 6 to 10 seconds. At skew crossings, where the crossing distance is greater, barrier timings may need to be lengthened accordingly. The closure sequence should be monitored by the operator, particularly if queuing vehicles or heavy usage by pedestrians is likely to increase risk;

(d) the audible warning for pedestrians should stop when all the barriers are fully lowered;

(e) the intermittent red lights should continue to show; and

(f) the crossing should be viewed carefully to ensure that there are no persons or obstructions present, before ‘crossing clear’ is confirmed and railway signals cleared for the passage of trains

2.49 The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated either manually or automatically, is:

(a) all the barriers begin to rise simultaneously and should normally rise in 4 to 10 seconds; and

(b) the intermittent red lights should be extinguished as the barriers rise.

2.50 Where barriers lower automatically, they should not lower unless at least one red light in all the road traffic light signals is shown in each direction from which users may approach the crossing. If CCTV monitoring is provided, initiation of automatic lowering should switch on the CCTV monitor and give an audible indication at the control point.

2.51 Where automatic lowering is used, provide two barriers on each approach to avoid road users becoming trapped on the crossing.

2.52 Once the barriers have started to descend, the lowering cycle is completed in the normal sequence even if all the red road traffic light signals facing in one direction fail. The barriers may then be raised when it is safe to do so. Where, in these circumstances, the barriers have not started to descend, they should remain in the raised position.

2.53 Barriers should rise as soon as practicable after all trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing.

Railway signalling and control

2.54 Provide railway signals, to fully protect the crossing, on all railway approaches. Interlock these signals with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers. It should not be possible to raise the barriers unless the signals are set at Stop and are free of approach locking, or the train has passed the signal and traversed the crossing.

2.55 Where the barriers are power operated, there should be controls at the control point to raise, stop, and lower the barriers. It should not be possible to clear any protecting signals until a further control to confirm 'crossing clear' has been operated with the barriers down.

2.56 If a train passes a protecting signal at Stop, the road traffic light signals should immediately show an intermittent red light (omitting the steady amber phase), and the audible warning should start. The barriers should not be lowered as this may strike or trap crossing users.

2.57 If the crossing is operated by one of the crew of an approaching train (or other peripatetic staff), after the train has been stopped short of the crossing, interlocking between the signalling and barriers is not required. Instead, a warning board is to be provided at full service braking distance from a stop board placed at a suitable point, not normally less than 50 m, before the crossing to remind the train driver to stop short of the crossing. The control point should be placed adjacent to the crossing..

2.58 To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point should confirm that the equipment is powered and functioning correctly.

Barrier crossings with obstacle detection

General description

2.59 This type of crossing is protected by road traffic light signals and lifting barriers on each side of the railway. An audible warning to pedestrians is also provided. The barriers are normally kept in the raised position, and when lowered, extend across the whole width of the carriageway on each approach. (*Obstacle detection equipment* (see Appendix A) may be appropriate to reduce risk at other types of level crossing).

2.60 The crossing normally operates automatically. The closure sequence, described below, is initiated by approaching trains. Confirmation that the crossing is clear, and that railway signals may be cleared for the passage of trains, is provided automatically following a thorough scan for any significant obstruction, by obstacle detection equipment.

2.61 Telephones for emergency public use should be provided.

2.62 Equipment provided should enable the crossing to be operated manually, for example from a remote control point using CCTV. Manual operation may be necessary when a persistent obstruction is detected, when obstacle detection equipment is not in use, and for periodic monitoring of crossing usage and suitability.

2.63 This type of crossing may be suitable at sites where road traffic flows freely, road lay-out is simple and there is no significant history of misuse. Risk assessment should, in particular, consider how the risks from blocking-back of road traffic and high or problematic pedestrian usage will be controlled.

Method of operation

2.64 The sequence of events to close the crossing to road traffic, once the lowering cycle has been initiated, is:

(a) the amber light on each of the road traffic light signals immediately shows and the audible warning begins. The amber lights show for approximately 3 seconds (up to 5 seconds to suit road conditions);

(b) immediately the amber lights are extinguished, the intermittent red lights should show;

(c) approximately 4 to 6 seconds later the left-hand barriers should start to descend. Once the left-hand side barriers are lowered, a scan of the crossing area is performed by the obstacle detector. If the crossing is clear, the right-hand barriers will begin to descend immediately. If an obstacle is detected, and in order that it may clear the crossing, there will be an interval before the right-hand side barriers may begin to descend. The time for each barrier to reach the lowered position should normally be 6 to 10 seconds. At skew crossings, where the crossing distance can be greater, barrier timings may need to be lengthened accordingly;

(d) it should not be possible to lower the barriers unless at least one red light in each road traffic light signal facing approaching road traffic is working;

(e) once the barriers have started to descend, the lowering cycle should be completed in the normal sequence even if all the red lamps in any one of the road traffic light signals facing approaching road traffic fail. The barriers may then be raised when it is safe to do so. Where, in these circumstances, the barriers have not started to descend, they should remain in the raised position;

(f) the audible warning for pedestrians should stop when all the barriers are fully lowered;

(g) the intermittent red lights should continue to show; and

(h) the crossing is again scanned by the obstacle detector. A clear scan, confirming ‘crossing clear’, is required before railway signals can be cleared for the passage of trains.

2.65 Barriers should rise as soon as practicable after all trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing.

2.66 The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated or maintained is:

(a) all the barriers begin to rise simultaneously and should normally rise in 4 to 10 seconds; and

(b) the intermittent red lights should be extinguished as the barriers rise.

Railway signalling and control

2.67 Provide railway signals, to fully protect the crossing, on all railway approaches. Interlock these signals with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, nor should it be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossings.

2.68 It should not be possible to clear any protecting signals until ‘crossing clear’ is confirmed either automatically by obstacle detection equipment, or manually when that equipment is not being used.

2.69 Provide discrete function controls at the control point for use when obstacle detection equipment is not being used.

2.70 If a train passes a protecting signal at Stop, the road traffic light signals should immediately show an intermittent red light (omitting the steady amber phase) and the audible warning should start. The barriers should not be lowered as this may strike or trap crossing users.

2.71 To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point should confirm that the equipment is powered and functioning correctly.

Automatic half barrier crossings (AHBC)

General description

2.72 This type of crossing is protected by road traffic light signals and a lifting barrier on both sides of the railway. Audible warning to pedestrians is also provided. Lifting barriers are normally kept in the raised position and pivoted on the left-hand side of the road. When lowered, the barriers only extend across the entrances to the crossing leaving the exits clear.

2.73 The crossing equipment is activated automatically by an approaching train. The lowering of the barriers is preceded by the display of road traffic light signals. The period between the initial display of the road traffic light signals and the arrival of the fastest train should be sufficiently long to enable road vehicles and pedestrians to clear the crossing.

2.74 Telephones for public use, including those who are required to phone for permission to cross, are normally provided near each road traffic light signal on the right-hand side of the road. The telephones are connected to a *supervising point* (see Appendix A), which must always be open when the railway line is open.

2.75 The supervising point should have appropriate means to stop any train approaching the crossing, and means of communicating with railway staff operating the crossing equipment locally at the crossing in an emergency or abnormal situation.

Method of operation

2.76 Provide equipment to initiate crossing operation on each track and for each direction that trains may approach. The crossing equipment is activated automatically by a train as it approaches the crossing.

2.77 The time between the amber light on each of the road traffic light signals starting to show and the train arriving at the crossing should be at least 27 seconds. The train should pass as soon after 27 seconds as possible. At least 95% of trains should arrive within 75 seconds and 50% within 50 seconds, once the closing sequence has begun. Where the crossing length is longer than 15 m, the 27 seconds should be increased by 1 second for every additional 3 m of crossing length.

2.78 In certain circumstances at *predictor crossings* (see Appendix A) in abnormal circumstances an accelerating train could arrive at the crossing slightly sooner than 27 seconds after initiation of the amber road traffic light signal. This may be acceptable at crossings where it can be shown that the likelihood of an ‘early arrival’ is very low. No trains should arrive at a crossing in less than 22 seconds after initiation of the road traffic light signals. If ‘early arrival’ is foreseeable, for example for trains accelerating from a station, arrangements should be modified accordingly.

2.79 The sequence of events to close the crossing to road traffic is:

(a) the amber light on each of the road traffic light signals immediately shows and an audible warning for pedestrians begins. The lights should show for approximately 3 seconds (up to 5 seconds to suit road conditions, which will lengthen the time between amber light and train arrival);

(b) immediately the amber lights are extinguished the intermittent red lights should show; and

(c) approximately 4 to 6 seconds later the barriers should start to descend and take a further 6 to 10 seconds to reach the lowered position. At skew crossings, where the crossing distance can be increased greatly, barrier timings may need to be lengthened accordingly to enable slow-moving road users to clear the crossing.

2.80 Barriers should rise as soon as practicable after the train has passed unless another approaching train is so close that a minimum of 10 seconds *road open time* (see Appendix A) cannot be achieved. In this situation the barriers should remain lowered and the intermittent red lights should continue to flash. The audible warning should change in character after the first of the trains arrives at the crossing. The change in character should be timed so as to be detectable by pedestrians at the crossing.

2.81 Both barriers should begin to rise simultaneously. This should normally take 4 to 10 seconds to reach the raised position. The intermittent red traffic light signals should continue to show and the audible warning for pedestrians continue to sound, until the barriers begin to rise.

2.82 If both intermittent red lights in any of the road traffic light signals fail, the barrier should remain lowered. If there is a total power failure, the barriers should fall and remain lowered. If either barrier fails to reach the lowered position, neither barrier should rise until both have been fully lowered. If either barrier fails to rise from the lowered position, the intermittent red traffic light signals should continue to show.

Railway signalling and control

2.83 Appropriate means are required to stop trains approaching the crossing in an emergency situation.

2.84 Should a train pass a signal at Stop located between a *strike-in point* (see Appendix A) and the crossing, the road traffic light signals should immediately show an intermittent red light, omitting the steady amber phase. The audible warning for pedestrians should begin and the barriers start to lower.

2.85 Where trains may be required to stop because railway signals or stations lie within or close to the strike-in points, the sequence of events to close the crossing to road traffic may be initiated:

(a) automatically by an approaching train where stopping times of trains at a station can be predicted reasonably accurately and the time taken for trains to arrive at the crossing are within those indicated in paragraph 77;

(b) by a means that is only effective when the presence of a train is detected, for example a train crew-operated plunger linked with the train detection system. (This may be used where stopping times of trains cannot be reasonably predicted); or

(c) automatically by an approaching train where a Stop signal is provided between the strike-in point and the crossing, and is interlocked with the signalling system using a ‘stopping/non-stopping’ control.

2.86 Provide arrangements for local operation of the crossing equipment, with effective means to prevent unauthorised use.

2.87 To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point should confirm that the equipment is powered and functioning correctly.

Automatic barrier crossings locally monitored (ABCL)

General description

2.88 This type of crossing appears, to the road user, to be similar to an automatic half barrier crossing. It is protected by road traffic light signals and a single lifting barrier on both sides of the railway. Audible warning to pedestrians is also provided. Lifting barriers are normally kept in the raised position and pivoted on the left-hand side of the road. When lowered, the barriers only extend across the entrances to the crossing leaving the exits clear. The period between the initial display of the road traffic light signals and the arrival of the fastest train should be sufficiently long to enable road vehicles and pedestrians to clear the crossing.

2.89 The crossing equipment is normally initiated automatically by an approaching train. The operation of the crossing equipment and the absence of obstruction on the crossing are monitored by the driver of an approaching train.

2.90 Train drivers are required to stop their trains short of the crossing unless they have received an indication that the crossing equipment is functioning correctly and have observed that the crossing is clear.

2.91 Consider providing telephones for public use. Where provided these should be connected to a supervising point which is always open when the railway line is open. Where no telephones are provided, provide signs on each side of the crossing, giving the name of the crossing and the public telephone number of a supervising point, which is always open when the railway line is open.

2.92 Staff at a supervising point should have:

(a) control of all train movements over the crossing;

(b) a means to communicate with railway staff operating the crossing equipment locally at the crossing:

(i) in an emergency; or

(ii) in an abnormal situation; and

(c) a means of communicating with the train driver approaching the crossing.

Method of operation

2.93 The crossing equipment is activated automatically by a train as it approaches the crossing. The sequence of events to close the crossing to road traffic is:

(a) the amber light on each of the road traffic light signals immediately shows and an audible warning for pedestrians begins. The lights should show for approximately 3 seconds (up to 5 seconds to suit road conditions);

(b) immediately the amber lights are extinguished the intermittent red lights should show; and

(c) approximately 4 to 6 seconds later the barriers should start to descend and take a further 6 to 10 seconds to reach the lowered position.

2.94 At least 95% of trains should arrive within 75 seconds and 50% within 50 seconds, once the sequence of events to close the crossing to road traffic has begun.

2.95 Train drivers must be able to bring their train to a stand short of the crossing from the point where they can observe the crossing to be clear and observe an indication that the crossing equipment is functioning

correctly. Consider whether crossings longer than 15m might require an extended sequence to ensure that the crossing is clear before the train reaches the point where the driver has to start braking.

2.96 Barriers should rise, the road light signals should cease to show, and the audible warning should stop immediately, unless another approaching train is so close that a minimum of 10 seconds road open time cannot be achieved. In this situation the barriers should remain lowered and the intermittent red lights should continue to flash. The audible warning should change in character after the first of the trains arrives at the crossing. The change in character should be timed so as to be detectable by pedestrians at the crossing.

2.97 Both barriers should begin to rise simultaneously. This should normally take 4 to 10 seconds to reach the raised position. The intermittent red traffic light signals should continue to show and the audible warning for pedestrians continue to sound, until the barriers begin to rise.

2.98 Trains normally approach the crossing at a steady speed, known as the crossing speed, so that they can be halted short of the crossing from the point at which it clearly comes into the train driver's view. Preferably, trains should not stop before passing over a crossing unless it is not practicable to arrange otherwise, for example where a crossing lies immediately beyond a station platform.

2.99 If both intermittent red lights in any of the road traffic light signals fail, the barriers should continue to operate normally. If there is a total power failure, the barriers should remain in the raised position.

2.100 If the crossing remains closed for longer than could be caused by passing trains, it should automatically reopen to road traffic. The indication to the train driver that all the crossing equipment is functioning correctly should be extinguished at least 30 seconds before the road traffic light signals cease to flash and the barriers start to rise. An automatic reset function should be provided.

2.101 In the event of a failure of the main power supply (other than a momentary loss), the indication to the train driver that all the crossing equipment is functioning correctly should not be displayed. The road traffic light signals and the barriers should continue to operate normally.

Railway signalling and control

2.102 The indication that the crossing equipment is functioning correctly should only be displayed when the barriers have begun to descend, and at least one of the intermittent red lights of each road traffic light signal is lit, and the main power supply is functioning normally (other than a momentary loss).

2.103 The indication must be visible to approaching train drivers when they reach the decision point (marked by a special speed restriction board) where braking needs to commence, if it is necessary to stop short of the crossing.

2.104 Any railway signals which lie between the strike-in point and the crossing should not give information which conflicts with the indication given to the train driver that the crossing equipment is functioning correctly. On a double-track line, bi-directional control to initiate the crossing equipment is normally required.

2.105 Where trains are not required to stop before passing over the crossing, the sequence of events to close the crossing to road traffic should be initiated automatically by approaching trains.

2.106 A special speed restriction board is required at the point from which the crossing speed begins. This board may display different *crossing speeds* for different types of trains.

2.107 An advance warning board is required at a distance from the special speed restriction board which enables trains to slow down to the crossing speed. If the crossing speed is the same as the line speed, the advance warning board should normally be 100 m on the approach to the special speed restriction board.

2.108 Where all trains are required to stop at a station between the strike-in point and the crossing, a stop board should be located at least 50 m from the crossing and an advance warning board or fixed distant signal erected at the service braking distance from the stop board. The sequence of events to close the crossing to road traffic may be initiated either:

(a) automatically by an approaching train, where stopping times of trains at a station can be predicted reasonably accurately and the times taken for trains to arrive at the crossing are within those indicated in paragraph 2.94; or

(b) by a means that is only effective when the presence of a train is detected, for example a train crew-operated plunger linked with the train detection system.

2.109 Where not all trains are required to stop at a station between the strike-in point and the crossing, the sequence of events to close the crossing to road traffic may be initiated either:

(a) automatically by an approaching train where a Stop signal is provided between the strike-in point and the crossing, and is interlocked with the signalling system using a 'stopping/non-stopping' control; or

(b) automatically by an approaching train where stopping times of trains at a station can be predicted reasonably accurately and the times taken for trains to arrive at the crossing are within those indicated in paragraph 2.94.

2.110 Provide arrangements for local operation of the crossing equipment, with effective means to prevent unauthorised use.

Automatic open crossings locally monitored (AOCL)

General description

2.111 This type of crossing has no barriers but is protected by road traffic light signals and an audible warning for pedestrians. The period between the initial display of the road traffic light signals and the arrival of the fastest train should be sufficiently long to enable road vehicles and pedestrians to clear the crossing.

2.112 The crossing equipment is normally initiated automatically by an approaching train. The operation of the crossing equipment and the absence of obstruction on the crossing are monitored by the driver of an approaching train.

2.113 Train drivers are required to stop their trains short of the crossing unless they have received an indication that the crossing equipment is functioning correctly and have observed that the crossing is clear.

2.114 Provide signs on each side of the crossing, giving the name of the crossing and the public telephone number of a supervising point, which is always open when the railway line is open. Telephones for public use are not normally provided.

2.115 Staff at a supervising point should have:

(a) control of all train movements over the crossing;

(b) a means to communicate with railway staff operating the crossing equipment locally at the crossing.

(i) in an emergency; or

(ii) in an abnormal situation; and

(c) a means of communicating with the train driver approaching the crossing.

Method of operation

2.116 The crossing equipment is activated automatically by a train as it approaches the crossing. The sequence of events to close the crossing to road traffic is:

(a) the amber light on each of the road traffic light signals immediately shows and an audible warning for pedestrians begins. The lights should show for approximately 3 seconds (up to 5 seconds to suit road conditions); and

(b) immediately the amber lights are extinguished the intermittent red lights should show.

2.117 At least 95% of trains should arrive within 75 seconds and 50% within 50 seconds, once the sequence of events to close the crossing to road traffic has begun.

2.118 Train drivers must be able to bring their train to a stand short of the crossing from the point where they can observe the crossing to be clear and observe an indication that the crossing equipment is functioning correctly. Consider whether crossings longer than 15m might require an extended sequence to ensure that the crossing is clear before the train reaches the point where the driver has to start braking.

2.119 The road traffic light signals should cease to show and the audible warning should stop immediately, unless another approaching train is so close that a minimum of 10 seconds road open time cannot be achieved. In this situation the intermittent red lights should continue to flash. The audible warning should change in character after the first of the trains arrives at the crossing. The change in character should be timed so as to be detectable by pedestrians at the crossing. Consider whether other means of warning such as flashing signs showing the words ‘Another train coming’ might also be required.

2.120 Trains normally approach the crossing at a steady speed, known as the crossing speed, so that they can be halted short of the crossing from the point at which it clearly comes into the train driver’s view. Preferably, trains should not have to stop before passing over a crossing unless it is not practicable to arrange otherwise, for example if a crossing lies immediately beyond a station platform.

2.121 If the crossing remains closed for longer than could be caused by passing trains, it should automatically reopen to road traffic. The indication to the train driver that all the crossing equipment is functioning correctly should be extinguished at least 30 seconds before the road traffic light signals cease to flash. An automatic reset function should be provided.

2.122 In the event of a failure of the main power supply (other than a momentary loss), the indication to the train driver that all the crossing equipment is functioning correctly should not be displayed. The road traffic light signals should continue to operate normally.

Railway signalling and control

2.123 The indication that the crossing equipment is functioning correctly should only be displayed when at least one of the intermittent red lights of each road traffic light signal is lit and the main power supply is functioning normally (other than a momentary loss).

2.124 The indication must be visible to approaching train drivers when they reach the decision point (marked by a special speed restriction board) where braking needs to commence if it is necessary to stop short of the crossing.

2.125 Any railway signals which lie between the strike-in point and the crossing should not give information which conflicts with the indication given to the train driver that all the crossing equipment is functioning correctly. On a double-track line, bi-directional control to initiate the crossing equipment is normally required.

2.126 Where trains are not required to stop before passing over the crossing, the sequence of events to close the crossing to road traffic should be initiated automatically by approaching trains. A special speed restriction board is required at the point from which the crossing speed begins. This board may display different crossing speeds for different types of trains.

2.127 An advance warning board is required at a distance from the special speed restriction board which enables trains to slow down to the crossing speed. If the crossing speed is the same as the line speed, the advance warning board should normally be 100 m on the approach to the special speed restriction board.

2.128 Where all trains are required to stop at a station between the strike-in point and the crossing, a stop board should be located at least 50 m from the crossing and an advance warning board or fixed distant signal erected at service braking distance from the stop board. The sequence of events to close the crossing to road traffic may be initiated either:

(a) automatically by an approaching train where stopping times of trains at a station can be predicted reasonably accurately and the time taken for trains to arrive at the crossing is within those indicated in paragraph 117; or

(b) by a means that is only effective when the presence of a train is detected, for example a train crew-operated plunger linked with the train detection system.

2.129 Where not all trains are required to stop at a station between the strike-in point and the crossing, the sequence of events to close the crossing to road traffic may be initiated either:

(a) automatically by an approaching train where a Stop signal is provided between the strike-in point and the crossing, and is interlocked with the signalling system using a ‘stopping/non-stopping’ control; or

(b) automatically by an approaching train, where stopping times of trains at a station can be predicted reasonably accurately and the time taken for trains to arrive at the crossing are within those indicated in paragraph 2.117.

2.130 Additionally, where the station is between the strike-in point and the crossing, and a Stop signal is not provided between the station and the crossing, the sequence of events to close the crossing to road traffic may be initiated automatically by an approaching train if:

(a) the railway is a single line;

(b) the actual daily road vehicle usage is less than about 2000;

(c) not more than 10% of trains stop at the station; and

(d) station stops are of short duration.

2.131 Provide arrangements for local operation of the crossing equipment, with effective means to prevent unauthorised use.

Open crossings

General description

2.132 This type of crossing does not have barriers or road traffic light signals. Only road traffic signs are provided. **Road users must give way to trains at the crossing.** Road users can see approaching trains in sufficient time for them to be able to cross the railway or stop safely. Train drivers are required to stop trains short of the crossing unless they have observed that the crossing is clear. Train drivers are also required to sound the train's horn as appropriate.

2.133 Telephones for public use are not necessary. Provide signs on each side of the crossing, giving the name of the crossing and the public telephone number of a supervising point, which is always open when the railway line is open.

Method of operation

2.134 Trains normally approach the crossing at a steady speed, known as the crossing speed, so that trains can be halted short of the crossing from the point at which it clearly comes into the train driver's view. Preferably, trains should not have to stop before passing over a crossing unless it is not practicable to arrange otherwise.

2.135 Trains are required to stop before proceeding over the crossing where:

(a) road users cannot see approaching trains across the viewing zones (defined in Appendix C); or

(b) the train driver cannot see the crossing from the point at which the brake should be applied to stop short of the crossing.

2.136 Trains are not required to stop again before proceeding over the crossing where:

(a) the train has stopped at a station platform on the approach to the crossing; or

(b) the train has already stopped for other reasons at a point from which the train driver can see the crossing.

Railway signalling and control

2.137 Where trains are not required to stop before passing over the crossing, a combined speed restriction and whistle board should be provided at a point from which the crossing speed begins. This board displays the crossing speed of 10 mph for all types of trains.

2.138 An advance warning board is required at the distance from the combined speed restriction and whistle board which enables trains to reduce their speed to the crossing speed. If the crossing speed is the same as the line speed, the advance warning board should normally be placed 100 m on the approach to the special speed restriction board.

2.139 Where all trains are required to stop before passing over the crossing, a stop board should be located at least 25 m from the crossing and an advance warning board or fixed distant signs erected at the service braking distance from the stop board.

User worked crossings (UWCs) for vehicles

General description

2.140 This type of crossing is normally protected by gates, or lifting barriers on both sides of the railway. The gates, normally closed across the road and hung so as to open away from the railway, are operated by the users. Barriers are normally closed across the road. Signs explaining how to use the crossing safely, including when to use any telephones, are displayed to road users on each side of the crossing.

2.141 When designing and operating any type of user worked crossing it is essential that the actual use of the crossing, the type of vehicles, equipment and activities and the frequency are properly understood. This will normally require effective dialogue with the crossing users during design and at appropriate intervals to ensure that the crossing remains suitable. Joint risk assessment with users may be appropriate.

2.142 Users should have sufficient time from first seeing an approaching train, or otherwise being made aware of the approach of a train with the aid of additional protective equipment, to cross safely. The decision point should be at least 3 m from the nearest running rail.

2.143 Additional protective equipment may not be required if the minimum warning time is available. The minimum warning period should be determined by risk assessment of crossing usage and be at least 5 seconds longer than the time required to cross. Assessments should involve the crossing users and be recorded.

2.144 In assessing the time required to cross, consider:

(a) the type and characteristics of vehicles, equipment or animals likely to go over the crossing;

(b) the surface of the crossing and its immediate approaches; and

(c) the position at which a vehicle, after going over the crossing, would be clear of the railway or gate on the far side.

‘Example:

Crossing distance (from decision point to decision point) 12 m

Longest/slowest vehicle likely to use the crossing 18 m at 1.5 m per second

Total distance = crossing distance + vehicle length (to ensure vehicle clear of crossing) In this case the total distance is 30 m

Crossing time at 1.5 m/s = 20 seconds

Add to this the 5 second safety margin and the minimum warning period for the crossing in this example is 25 seconds

2.145 Additional protective equipment that may be provided includes:

(a) miniature stop lights, as described in Section 18, on both sides of the crossing, especially where:

(i) the minimum warning time of trains cannot be obtained and the actual daily road vehicle usage exceeds 100; or

(ii) the provision of a telephone is impractical because it is difficult to provide reliable information concerning the whereabouts of trains, or the information supplied would be so restrictive that it would be likely to cause the user to become unduly impatient and to cross without permission; or

(iii) use of a telephone would cause excessive workload for the crossing operator; or

(iv) the line speed exceeds 100 mph.

(b) subject to the limitations noted above, telephones, on both sides of the crossing and connected to a supervising point, which is always open when the railway line is open, where:

(i) the minimum warning time of trains cannot be obtained;

(ii) there is known regular use by animals on the hoof;

(iii) fog is prevalent.

(c) audible warnings of the trains (preferably generated at the crossing itself). Where train speeds are low and the service infrequent, whistle boards positioned not more than 400 m from the crossing may help give warning of a train's approach.

2.146 To achieve the required warning time, it may be necessary to reduce the train speed over the crossing.

2.147 Telephones are not a preferred option. Where telephones are provided, vehicle drivers must follow instructions given. In some circumstances, it may also be necessary for other types of user, for example pedestrians, to telephone before crossing. Signs should make this clear.

2.148 Where miniature stop lights are provided, clear instructions should be provided for users. If lights are defective, users should be instructed to telephone the crossing operator and a contact number should be provided if there is no crossing telephone.

Footpath and bridleway crossings

General description

2.149 This type of crossing is found where the railway crosses a footpath or bridleway. Footpaths and bridleways are those which:

(a) are shown on definitive maps and statements maintained under Part III of the Wildlife and Countryside Act 1981; or

(b) have come into being following public path creation agreements or public path creation orders under Part III of the Highways Act 1980; or

(c) otherwise exist as either public or private rights of way.

2.150 Users are expected to use reasonable vigilance to satisfy themselves that no trains are approaching before they start to cross the line. They should cross quickly and remain alert whilst crossing. Users should have sufficient time from first seeing, or being warned of, an approaching train to cross safely.

2.151 Footpath crossings should be protected by a stile or self-closing wicket gate on both sides of the railway. They should not have a gate on one side and a stile on the other, nor different widths or types of gates. Stiles and kissing gates may not be appropriate at crossings where the use of bicycles, pushchairs, wheelchairs, etc. is foreseeable.

2.152 Bridleway crossings should be protected by a self-closing wicket gate on both sides of the railway. Unless required to dismount, it should be possible for a mounted horse rider to open the gates without dismounting.

2.153 Riders may be required to dismount because of the presence of overhead live conductors. Otherwise, assume that horse riders will remain mounted while crossing. Make allowances for young or inexperienced riders to lead their mounts. Consider whether cyclists use the crossing. Where appropriate, take measures to encourage cyclists to dismount.

2.154 At bridleway crossings, the gate should be at the decision point . Where this is not practicable, there should be sufficient space to allow a person on horseback to make a decision from a place of safety.

2.155 A sign explaining how to cross safely should be displayed at the decision point on each side of the crossing. For footpath crossings this should be not less than 2 m from the nearest running rails or 3 m where the line speeds are higher than 100 mph. For bridleway crossings this should not be less than 3m from the nearest running rail.

2.156 Where this type of crossing passes over multiple tracks and space between tracks exists so that a fenced, safe waiting place can be created for users, the crossing on each side of the safe waiting place should be treated as a separate crossing. A chicane may be provided on the crossing to make the position of the safe waiting place clear. Appropriate instructions to the users must be provided at appropriate points.

2.157 The minimum width between fences guiding users to the decision point or safe waiting area should be 1 m for footpath crossings. For bridleway crossings the minimum width should be 3m. These widths may need to be increased depending on user requirements.

2.158 Care should be taken not to provide misleading displays to crossing users. Where, for instance, miniature stop lights are provided on one part of a multiple track crossing, they should be provided on all parts of the crossing.

2.159 At a user worked crossing which is subject to additional footpath or bridleway crossing rights, stiles or separate gates for use by the pedestrians or riders should be provided. Vehicular gates may be locked shut and restricted to authorised private usage.

Method of operation

2.160 The warning time should be greater than the time required by users to cross between the decision points at either end of a crossing. In assessing how quickly users will cross, take account of the mobility of likely users and the type of crossing surface.

2.161 As a guide, a walking speed of 1.2 metres per second (m/s) may be used where the surface is level and close to rail level. In other cases 1 m/s may be more appropriate. Increase the calculated time to cross to take account of foreseeable circumstances such as impaired mobility of users, numbers of pushchairs and bicycles or where there is a slope or step up from the decision point.

2.162 Where the warning time is insufficient, additional protective equipment should be provided and may include:

(a) miniature stop lights as described in Section 18;

(b) telephones provided on both sides of the crossing and connected to a supervising point, which is always open when the railway line is open; or

(c) audible warnings of trains (preferably generated at the crossing itself). Where train speeds are low and the service infrequent, whistle boards positioned not more than 400 m from the crossing may help give warning of a train's approach.

2.163 Where whistle boards are considered, take account of:

(a) the speed of sound (330 m/s) and the speed of the train;

(b) the possibility that train drivers will not sound the horn, especially at certain times of the day or night;

(c) the possibility that train horns may be inaudible at the crossing because of background noise; and

(d) the possible impact of train horn noise on nearby residents.

2.164 Where whistle boards are provided, they are normally required on all railway approaches. The time between first hearing a horn and arrival of a train should be the same for trains travelling in either direction.

Foot crossings at stations

General description

2.165 This type of crossing is found between platforms at stations and may be the only route between platforms or the only practicable route for people who cannot use steps.

2.166 Only consider this type of crossing for lightly used stations where line speed does not exceed 100 mph and no alternative arrangements are available.

Method of operation

2.167 Where passengers are always escorted by railway staff, an established form of protection is a white light, extinguished 40 seconds before the arrival of trains. A sign reading "Caution – Cross only when light shows" is placed adjacent to the white light.

2.168 Where unescorted passengers may cross, miniature stop lights are the preferred protection method. The red light should show 40 seconds before the arrival of any train. An audible warning should be provided. Where the warning is for two or more trains approaching, the character or tone of the warning sound should change distinctively after the first train arrives at the crossing. Appropriate instructions should be provided.

Provision for pedestrians at public vehicular crossings

2.169 Appropriate provision should be made for pedestrians, taking account of the number and frequency of pedestrians and trains, at all public vehicular level crossings.

2.170 Where the approach roads are provided with a footway on either or both sides of the road, a footway or footways of adequate width should continue over the crossing. There should be sufficient space, taking into account the volume and nature of the users, for pedestrians to pass each other without the need to use part of the carriageway reserved for road vehicles. Allowance should be made for the needs of those with pushchairs and in wheelchairs.

2.171 Any footway should be made up to the level of the carriageway and maintained in a good and even condition.

Road markings

2.172 Provide longitudinal road markings along each edge of any footway, to delineate the required width and define the safe route for pedestrians walking over the crossing.

2.173 Clearly mark out a safe place for pedestrians to stand when crossings are closed to road traffic on any footways approaching an automatic or open crossing.

Audible warnings

2.174 Provide audible warning devices at all automatic crossings and barrier crossings operated by railway staff, so that pedestrians on or approaching the crossing are given adequate warning of the closure of the crossing. Devices should be capable of volume adjustment to suit local requirements.

2.175 Where road traffic light signals are provided, the warning sound should begin when the amber lights first show. At all automatic open or half barrier crossings, the warning sound continues until the intermittent red lights are extinguished. At barrier crossings operated by railway staff, the warning sound stops when the barriers are fully lowered.

2.176 At automatic open or half barrier crossings where two trains can arrive at the crossing without providing the minimum road open time, the character of the warning sound should change distinctively after the first of the trains arrives at the crossing.

2.177 At simple, un-automated, open crossings, the audible warning may be provided by horns from approaching trains.

Pedestrian signals

2.178 Traffic signals for pedestrians (Diagram 4006 in the 2002 Regulations) may be provided at crossings, particularly where the volume of pedestrians is high or vulnerable groups use the crossing regularly. The pedestrian traffic signal may be especially helpful at skewed automatic half barrier crossings, at full barrier crossings on one way streets and at auto-lower full barrier crossings.

2.179 Pedestrian signals should face outwards from the crossing towards approaching pedestrians. Pedestrian signals are not normally considered necessary at gated crossings operated by railway staff.

Tactile thresholds

2.180 Provide a suitable *tactile threshold* (see Appendix A) across each footway approaching a level crossing. Tactile thresholds are not required on roads where there is no footway.

2.181 Tactile thresholds should be placed before pedestrian stop markings across the footway on approach to the crossing. The purpose of the tactile threshold is to provide blind and partially-sighted people with an indication of the direction of the footway as well as the line behind which they should wait while the crossing is closed. See the Department for Transport's guidance on use of tactile paving surfaces.

Means to control the flow of pedestrians

2.182 Where vulnerable or large numbers of pedestrians regularly use a crossing, consider appropriate means to deter them from walking on the carriageway such as guard rails on approach. Guard rails should be provided only where the footway is sufficiently wide and does not create a bottleneck.

2.183 Where pedestrians in significantly large numbers cross from one side of the road to the other while the road is closed to allow a train to pass over the crossing, consider providing a double row of non-reflecting road studs to indicate the safe place to cross.

2.184 Where a crossing lies adjacent to a railway station and the entrance or exit to the station is via the platform ramp, pedestrians should be directed from the platform to the road and vice versa so that they are protected by the crossing after leaving or before joining the train.

Pedestrian categories

2.185 The volume of pedestrian and train flow may be determined by the train pedestrian value (TPV) which in turn defines the pedestrian categories. The TPV is the product of the maximum number of pedestrians and the number of trains passing over the crossing within a period of 15 minutes. A detailed method of calculation can be found in Appendix D. Pedestrian categories are given in Table 2.

Table 2 Pedestrian categories

Pedestrian category	Train pedestrian value (TPV)
A	**more than 450**
B	**151-450**
C	**150 or less**

Pedestrian provisions

2.186 As with all aspects of level crossing risk, the precautions for pedestrians should be determined by risk assessment. To guide that process, Table 3 suggests precautions which may be appropriate for these pedestrian categories.

Table 3 Pedestrian provisions

Pedestrian category	Width of footway (metres)	Road markings	Audible warnings*	Pedestrian signals	Tactile threshold*	Guard rails
A	**2 or more**	**YES**	**YES**	**YES**	**YES**	**tt**
B	**1.8 or more**	**YES**	**YES**	**tt**	**YES**	**tt**
C	**1.5 or more t**	**YES**	**YES**	**tt**	**tt**	**tt**

Table 3 Pedestrian provisions
*** Not required at gated crossings operated by railway staff** **ŧ A reduced width of 1 m or lack of approach funnel is normally restricted to those crossings with a daily pedestrian usage of less than about 25** **ŧŧ Yes if necessary**

2.187 At any crossing where the number of pedestrians or the size of the vulnerable group is exceptionally large, automatic crossings may not be suitable and a barrier crossing operated by railway staff may have to be provided.

Additional measures to protect against trespass

2.188 Cattle-cum-trespass guards and fencing protection will normally be required to discourage trespass by pedestrians and, where relevant, animals straying onto the railway.

Cattle-cum-trespass guards

2.189 Guards should be provided where there is movement of animals over the crossing, or where there is a significant risk of trespass by pedestrians.

2.190 Guards should be provided at all types of crossings on third rail electrified railways, except at a gated crossing operated by railway staff, where the gates when across the railway completely fence off the road and any footway from the railway.

2.191 The guards should be adjacent to the footway at the edge of, and level with, the surface of the carriageway. They should extend the full length of the crossing between the boundary fences for a distance of at least 2.6 m in any direction from the edge of the carriageway.

2.192 The guards may consist of arris rails running parallel with the running rails or some other similarly effective system. Arris rails which are triangular in section with the vertical sides approximately 115 mm high, at approximately 150 mm pitch, and with a clear space between them not exceeding 35 mm are considered to be effective.

Fencing

2.193 Provide fencing:

(a) around barrier mechanisms unless protected in other ways; and

(b) to ensure the effectiveness of any cattle-cum-trespass guards.

2.194 At footpath crossings and bridleway crossings, consider whether additional fencing may be required between the boundary fence and the decision point. Where the gate or stile is at the decision point rather than in the boundary fence, provide additional fencing to connect the boundary fence to the decision point..

2.195 Where the road is unfenced and the adjacent land is used for grazing, and crossing gates are not provided, provide a standard highway-type cattle-grid in the roadway.

The crossing

Vertical profile

2.196 The profile over any vehicular crossing should have no sudden changes of vertical curvature. The profile over an automatic half barrier or user worked crossing is critical to safety. At other types of crossing it is less critical because these crossings are either manually operated by railway staff, or locally monitored by the drivers of trains travelling at restricted speeds such that they can stop short of the crossing.

2.197 The profile over automatic half barrier or user worked crossings should not cause a vehicle, such as a low-loader or a tractor and trailer, to become grounded and obstruct the railway. The likelihood of grounding depends on the characteristics of the road surface at the crossing and any potentially low-clearance vehicles that might use the crossing.

Measurement of safe profiles

2.198 Safe profile is determined by considering the wheelbase and ground clearance of road vehicles which might foreseeably use the crossing. The maximum permitted profile hump anywhere on the road surface, over the longest foreseeable wheelbase length, is 75mm.

2.199 At automatic half barrier (AHB) crossings, the safe profile may be defined by the vehicle category, which is in turn determined by the road and rail traffic density. It is defined in Table 4 below.

2.200 Traffic data should be established by census. Take into account the likely increase in road usage following automation of a crossing, as well as other factors, such as the proximity of heavy plant operator premises, which may necessitate a flatter profile. It is important to note that Table 4 below sets minimum requirements. Local information on actual usage may well mean that the profile at a particular crossing needs to be flatter than traffic data alone would suggest.

Table 4 Measuring safe vertical profiles

Actual daily road vehicle usage	or	Daily traffic moment	Vehicle category	Theoretical wheelbase length	
				(metres)	**(feet)**
More than 2000		**More than 80000**	**1**	**15.3**	**50**
2000 or less		**80000 or less**	**2**	**9.75**	**32**
600 or less		**25000 or less**	**3**	**8.5**	**28**

2.201 Provide “risk of grounding” signs as described in Section 19 for crossings with vehicle categories 2 and 3, where the profile does not meet the category 1 standard.

2.202 The profile should be maintained across the full width of the carriageway and the approaches. The approaches extend for a minimum of 20 m from the nearest rail for vehicle category 2 and 3 crossings, and up to 30 m for vehicle category 1 crossings.

2.203 Road approaches to crossings should be regularly inspected by the crossing operator (as well as the traffic authority or private road owners). The profile should be checked when road defects are noted or when track alterations are undertaken. Remedial works on approach roads should be undertaken as required.

2.204 At user worked crossings, determine with the users the types of vehicle or equipment likely to go over the crossing before designing the vertical profile. Once this is determined, use the maximum wheelbase length to design the safe profile based on the same maximum permitted hump of 75 mm. Determine the gradient of the approaches to the crossing in conjunction with the vertical profile required for the type of traffic using it.

2.205 Providing telephones at a user worked crossing does not reduce the need to maintain appropriate profile conditions.

Crossing surface

2.206 The surface of the carriageway over a crossing and on its immediate approaches should be properly maintained and have a skid resistance comparable to that of the road approaches. Consider a higher degree of skid resistance where road speeds are high, the visibility of a crossing is limited or the road slopes downhill towards the crossing. Appropriate measures should be discussed with the traffic authority. The surface should be free from pot-holes, running rails proud of the surface, depressed areas or major undulations. Any timbers or panels used in the surface should be firmly fixed. Flangeway gaps should be kept to a minimum, particularly at skew crossings, to reduce the risk of small or narrow wheels becoming trapped.

2.207 At vehicular crossings with gates which completely fence in the railway when closed to the road or where there is no footway adjacent to the carriageway, the ground at the edges of the carriageway over the crossing should be made up to the same level as the carriageway for at least 1 m.

2.208 At user worked crossings, a satisfactory road surface, appropriate for the type of traffic using them, and adequate approaches should be provided and maintained. Where timbers are used for the crossing surface, they should be securely fixed in position and provide a clear flangeway. Where the surface is predominantly made up of ballast, it should be contained to ensure that the surface is at, or almost at, rail level and the flangeway is maintained.

2.209 At footpath crossings and bridleway crossings, the surface provided between the decision points should be unobstructed. An appropriate level crossing surface should be provided in all but remote rural locations. There should be no movable signalling or track equipment (such as sets of points) on the surface or close by, that might create a hazard. The surface should be maintained in a good and even condition at rail level with suitable non-slip properties.

2.210 The type of surface should be in keeping with, but not necessarily the same as, the surface provided on the approaches to the crossing immediately outside the railway boundary.

2.211 Where the track ballast shoulder is high, either steps or ramps for footpath crossings and ramps for bridleway crossings should be maintained to give access to the surface. Ramps are preferable but where it

is not reasonably practicable, provide steps. On steep slopes, consider whether hand-rails may be needed in addition to steps or ramps.

2.212 Where the surface is other than ballast or stone chippings, provide a non-slip surface. Where the surface is made up to rail level and stone is used as in-fill, provide a means to retain the stone.

2.213 At bridleway crossings, make the surface up to rail level.

2.214 At footpath crossings, make the surface up to rail level, where:

(a) the crossing is in a location where housing, factories, shops etc adjoin or are close to the railway, and the crossing provides an attractive or convenient link between them;

(b) any of the approaches on the path are metalled; or

(c) there is heavy regular use.

Crossing width

2.215 At all crossings, the width of the carriageway over the crossing and on the approaches should, where practicable, be constant. It should be possible for traffic to pass safely on the approaches and the crossing itself should not form an isolated passing place.

2.216 At automatic crossings, the carriageway width over the crossing should be maintained on each approach for the distances shown in Table 5. It may be necessary to increase these distances depending on the types of vehicle using the crossing.

Table 5 Crossing width

Actual daily road vehicle usage	or	Daily traffic moment	Distances measured from the stop line (metres)	
			AHBC and ABCL	AOCL
More than 2000		**More than 80000**	**21**	**21**
2000 or less		**80000 or less**	**14**	**14**
600 or less		**25000 or less**	**14**	**7**

2.217 The carriageway width over an automatic half barrier crossing should normally be at least 6.1 m. A narrower carriageway, to a minimum of 5 m, may be acceptable on less busy roads. As a guide in this instance, a less busy road may be considered to be one with a daily road vehicle usage of less than 4000.

2.218 The carriageway width over a locally-monitored automatic barrier crossing (ABCL) should not normally be less than 5 m. Existing level crossings being upgraded to ABCL may be less than 5 m in width.

2.219 The carriageway width over a locally-monitored automatic open crossing should not be less than 5 m where the actual daily road vehicle usage is greater than 600 or the peak hour traffic moment is greater than 120.

2.220 At user worked crossings, the road surface should be at least as wide as the distance between the gate posts. The width of the crossing should not exceed 5 m to allow the use of single-leaf gates.

2.221 At footpath crossings, the width of the surface should not be less than 1 m, and at bridleway crossings, the width of the surface should not be less than 3 m.

Provision of lay-bys

2.222 Consider whether lay-bys may be required at automatic half barrier crossings so that vehicles, whose drivers are required to telephone before using the crossing, can be parked clear of the carriageway.

Crossing alignment

2.223 At user worked crossings, the alignment of the crossing over the tracks should enable the time required to cross to be kept to a minimum.

2.224 Footpath crossings and bridleway crossings should, where possible, be at right angles to the railway line. Where necessary seek clarification from Rights of Way Officers when determining exact routes and opportunities for diversion. Where it is proposed to divert a public footpath or bridleway crossing, consult closely with the local Rights of Way Officer.

Crossing approaches

2.225 At user worked crossings, the alignment of the immediate approaches to the crossing should be in line with the alignment of the crossing itself. Light sources from road vehicles or equipment should not be allowed to cause confusion with railway signals.

Gates, wicket gates and barrier equipment

Gates

2.226 The gateway should be the full width of the carriageway plus at least 450 mm clearance on each side and the clearance between gate posts should be of equal width at both sides of the railway. Means should be provided to retain the gates in both open and closed positions.

2.227 When closed, the gates should extend over the full width of the carriageway. Unless legally specified otherwise, the normal position of the gates is across the road.

2.228 Consider installing power operated gates at user worked crossings . These avoid the need for multiple crossings in order to open and close gates.

2.229 At crossings on public roads, the gates should be painted white and carry red retro-reflective targets to face outwards when the gates are across the road. Additionally, consider mounting red lamps on the gates which show towards approaching road traffic when the gates are across the road.

2.230 At gated crossings operated by railway staff, the gates should be lockable when closed across the road or railway and should be conspicuous to the drivers of approaching trains when closed across the railway.

Wicket gates

2.231 Where wicket gates for pedestrians are provided, they should be on the same side of the carriageway and open away from the railway. Wicket gates for footpath crossings and gated crossings operated by railway staff should not be less than 1 m wide. Wider gates may be required in accordance with local user needs. Wicket gates for bridleway crossings should not be less than 1.5 m wide.

2.232 All wicket gates should be easy to open from either side and be self-closing. Latches are not normally provided on gates. Where it is appropriate to provide latches, however, they should be easy to operate and not prevent easy egress from the railway. Where wicket gates are provided across the footway at gated crossings operated by railway staff, they should be lockable.

Barriers

2.233 The tops of the barriers when lowered should be at least 900 mm above the road surface at the centre of the carriageway. The clearance between the bottom edge of the lowered barrier and the road surface at the centre of the carriageway should not exceed 1000 mm unless a skirt is fitted. Barriers that are designed to fall under gravity as part of their method of operation should be inclined towards the carriageway at an angle of between 5º and 10º from the vertical.

2.234 When raised no part of the barrier below 5 m should be within 450mm of the edge of the carriageway. Where the barriers cover a footway, no part of the raised barrier less than 2 m above the footway, should be within 150 mm horizontally from the outer edge of the footway.

2.235 The barriers should be as close as convenient to the railway, but no part of the equipment should be within the standard structure gauge.

2.236 Barriers should be at least 125 mm deep at their mid-points and at least 75 mm deep at their tips. Each barrier should display on both sides red and white bands about 600 mm long to the full depth of the barrier. A strip of retro-reflective material not less than 50 mm deep should be provided along the full length of each band.

2.237 Dangerous moving parts of the barrier mechanism, excluding the boom and any skirt, should be guarded effectively.

2.238 Two electric lamps (three on barriers longer than 6 m) of adequate luminous intensity should be fitted to each barrier which, when illuminated, show a red light in each direction along the carriageway. The lamps should be evenly spaced along the barriers with one lamp within 150 mm of the barrier tip. The lamps should show except when the barriers are fully raised. It may be appropriate at some user worked crossings to omit these lamps.

2.239 At barrier crossings operated by railway staff, each road approach should be protected by barriers which, when lowered, extend across the full width of the carriageway and any footway.

2.240 At barrier crossings operated by railway staff and user worked crossings, skirts should be fitted to the barriers where there is a significant risk of pedestrians deliberately passing under the lowered barriers. Where cattle or sheep are regularly walked over the crossing, skirts should be fitted. The skirts should be of a light colour, light construction and fence in the space between the lowered barriers and the road surface. Skirts are not required at automatic crossings with half barriers.

2.241 At user worked crossings, the barriers may be hand-operated and counter-weighted to fall when released. Such barriers should be linked so that they can be raised or lowered together from either side of the crossing.

Single barriers

2.242 Where single barriers are provided they should preferably be pivoted on the left-hand side of the road. On one-way roads or on two-way roads with central reservations where special provision can be made for pedestrians, barriers may be provided on the approach to the crossing only.

Half barriers

2.243 At automatic crossings with half barriers, the barriers should be pivoted on the left-hand side of the road on each approach.

2.244 On skew crossings with half barriers where the tip of the barrier points towards the railway, the point of intersection of the line extended through the barriers and the outer edge of the road, including any footway, should not be within 1000 mm of the nearest rail.

2.245 When lowered, the half barriers should extend to between 150 mm and 450 mm of the centre of the carriageway, but not over the centre line. On carriageways between 5 m and 5.7 m wide, the barriers should extend to within 800 mm of the centre line so as to leave a clear exit of at least 3 m in width. On carriageways narrower than 5 m, shorter barriers may be necessary in order to provide off-side clearance of at least 3 m.

Barriers on lines electrified on the overhead system

2.246 If the railway is electrified with overhead conductors and a barrier, if displaced, could come closer than 150 mm to the conductors, the barrier should either be made of metal or be provided with a continuous conducting strip. The metal barrier or conducting strip should be connected to earth in such a manner as to ensure that inadvertent contact with the overhead conductors causes any controlling circuit-breaker to interrupt the electric traction supply. Consider whether it may be appropriate to sheath the return conductor at any crossing.

Telephones and telephone signs

2.247 Telephones are not normally necessary at barrier crossings operated by railway staff, locally-monitored automatic open crossings or open crossings. At locally-monitored automatic barrier crossings consider providing telephones for public use so that equipment malfunctions can be reported.

2.248 At barrier crossings operated by a member of the train crew, or other railway staff, signs to Diagram 785 giving the telephone number of a supervising point which is always open when the railway line is open should be displayed at each side of the crossing. The name of the crossing should also be shown immediately below each sign.

2.249 Where telephones are provided as part of the safety arrangements, calls should always be routed to a suitable staffed railway location and a definite message as to whether or not it is safe to cross given.

At automatic crossings with half barriers

2.250 Telephones for public use at automatic crossings with half barriers should be suitably weatherproof or housed in cabinets and connected directly to the supervising point. A two-way calling facility should be provided.

2.251 The power supply to the telephones should be suitably backed up so that they remain available if the main power supply fails. Faults on individual telephones or the failure of a user to replace a handset should not prevent the correct operation of the remaining telephones.

2.252 The telephone symbol to Diagram 787 (2002 Regulations) should be displayed on or adjacent to each telephone/cabinet and on two other faces. The telephones should be clearly visible from the crossing. If the telephones are not clearly visible to a person at the location of the sign to Diagram 784.1, signs to Diagram 788 are required directing potential users to the telephones.

2.253 Clear and simple instructions, which are also legible at night, should be provided for users needing to contact the supervising point. The user should not have to dial a telephone number.

2.254 In case the telephone at the crossing is out of order, the name of the crossing, its grid reference and the public telephone number of a continuously staffed supervising point should be clearly displayed.

2.255 When calls are received in the supervising point, a distinctive warning should be sounded, accompanied by a visual indication. These calls should take priority over any other calls on the telephone system and the warning should sound even if the system is currently in use.

2.256 If the railway is not open for 24 hours a day, a means to notify users of the times between which trains do not travel over the crossing should be provided. This may be in the form of a notice which is legible at night or a recorded announcement. It is essential that information given is correct and fully up to date.

2.257 The telephone system should have a facility which records that calls have been made from the crossing during periods when the railway and supervising point are closed. When the supervising point reopens, a visual and audible indication should be given that calls from the crossing have been made during the period of closure.

At user worked crossings and bridleway crossings

2.258 Telephones, where provided, should be positioned adjacent to the gates or barriers on each side of the crossing, mounted in a suitable place, at heights appropriate to the users of the crossing. The telephones should be suitably weatherproof or housed in cabinets and connected directly to a supervising point. A two-way calling facility should be provided.

2.259 The telephone symbol to Diagram 787 should be displayed on or adjacent to the cabinet/telephone. Telephones should be seen readily from the crossing or signs to Diagram 788 provided.

2.260 Clear and simple instructions to direct users to contact the supervising point should be provided. These should also legible at night. The telephone user should not have to dial a telephone number.

2.261 The name of the crossing and its grid reference should be displayed followed by the telephone number of a continuously staffed supervising point in case the telephone at the crossing is out of order.

2.262 Evidence shows that many users fail to use telephones. Telephones create potential for human error during communications, and may distract the signaller from other tasks. Even where telephones are fitted, maintaining adequate *sighting distances* (see Appendix A) at the crossing can still reduce risk to users and the railway.

Miniature stop lights (MSL)

General description

2.263 Miniature stop lights (previously known as miniature warning lights) consist of red and green lights. They can be used at user worked crossings, footpath crossings and bridleway crossings. In some instances it may be appropriate for the warning system to be activated by the user on arrival before using the crossing. The green light normally shows, but an approaching train automatically changes the lights to red. Signs to Diagram 107 in the 1996 Regulations (see Figure 8) instructing users to cross only when the green light shows should be provided.

2.264 MSL alone may not be suitable where livestock or large or slow moving vehicles or equipment cross the railway. Additional arrangements may need to be made as determined in the risk assessment process.

Positioning of MSL

2.265 The MSL should be located so that they face towards an approaching user. They should be clearly visible to the crossing users when operating the gates or barriers. MSL may be mounted in the sign to Diagram 107 (1996 Regulations). At crossings not provided with a telephone, the public telephone number of a continuously staffed supervising point should be displayed, so that users may enquire about crossing safely (and report MSL failure). Use of signs to Diagram 108 should be avoided.

2.266 MSL should normally be placed on the near side of the railway, facing users approaching the crossing unless siting them at the far side is more effective at conveying the message.

MSL equipment

2.267 The red and green lights should be sufficiently bright to be clearly seen by users at the decision point. Light emitting diodes (LED) lamps are brighter and more reliable than traditional filament lamps. Low energy solutions such as flashing or on-call displays might be appropriate in certain locations. Lamps should be fitted with hoods (to aid viewing in bright sunlight) where necessary. Care should be taken to ensure that hoods do not restrict the visibility of MSL for users, including pedestrians operating gates or barriers.

Associated signs

2.268 Traffic signs associated with the use of MSL are shown in Figure 8 of Section 19. These signs are in addition to those required at user worked crossings, footpath crossings and bridleway crossings. These signs are in accordance with the 1996 Regulations.

2.269 At user worked crossings the signs to Diagrams 109 or 110 should be mounted with the MSL on the near side of the crossing facing approaching users.

2.270 At footpath or bridleway crossings the signs to Diagram 114 should be mounted with the MSL on the near side of the crossing facing approaching users. Where a footpath or bridleway is routed over a user worked crossing, care should be taken in the placement of signs (to Diagrams 109/110 and 114) so that instructions to drivers and instructions to pedestrians/riders are not confused.

Railway signalling and control equipment

2.271 MSL should be operated automatically by approaching trains, in accordance with the warning period required for the particular crossing.

2.272 The minimum warning period should be determined by risk assessment of crossing usage and be at least 5 seconds longer than the time required to cross.

2.273 The green light should show until the red light appears. As soon as the train is clear of the crossing, the red light should be extinguished and the green light should appear unless the red light is required to show for another train.

2.274 Bi-directional controls should be provided.

2.275 Consider whether special controls might be required, for example where signals or station platforms lie between the strike-in point and the crossing.

Traffic signals, traffic signs and road markings

2.276 The requirements for road signs, including carriageway markings, are contained in the 2002 Regulations. These are supported by guidance in the Traffic Signs Manual (chapters 4 and 5) and information available via the Department for Transport website. Signs for use at private crossings are described in the 1996 Regulations.

Road traffic light signals

2.277 The construction and specification of road traffic light signals used at level crossings are required to comply with Diagram 3014. The reverse of the backing board should be coloured grey. Lamps to the current European standard should be used.

2.278 A primary road traffic light signal should be located on the left-hand side of the carriageway, on each road approach, as close as possible to the crossing. At crossings where there are barriers, it should be located not more than 1 m before the barrier and adjacent to the barrier machine where this is on the left-hand side.

2.279 A duplicate primary road traffic light signal should be located on the right-hand side of the carriageway on each approach. Consider providing one or more additional road traffic light signals where neither the primary nor the duplicate primary signal can be seen from a side approach. Secondary road traffic light signals, located on the far side, should not be used at crossings.

2.280 No road traffic light signal should be located on the approach side of the vehicular stop line or an extension from it. Drivers stopped at the crossing need to see the road traffic light signals.

2.281 At *acute skew crossings* (see Appendix A and figure 9(b)), the duplicate primary signal may be placed in line with the vehicular stop line to shorten the length of the crossing.

2.282 At *obtuse skew automatic crossings* (see Appendix A), the duplicate primary signal may be placed closer to the railway than normal, provided that a vehicle stopped in line with the signal is not foul of the railway structure gauge. In the risk assessment consider whether special arrangements for pedestrians may be necessary (see Section 13 and Figure 9 (a) at the end of this section).

2.283 Where the normal post mounting of a road traffic light signal is impracticable, it may be mounted over the carriageway provided that no part of the horizontal structure or the signal is less than 5.5 m above the road surface.

2.284 Where a road traffic light signal is mounted over the carriageway and the railway is electrified with overhead conductors and the structure and signal, if displaced, could come closer than 150 mm to the overhead conductors, the structure and the signal should either be made of metal or be provided with a continuous conducting strip. The metal structure and signal or the conducting strip should be connected to

earth in such a manner as to ensure that inadvertent contact with the overhead conductors causes controlling circuit-breaker(s) to interrupt the electric traction supply.

2.285 In exceptional cases, for example where the central reservation is narrow or where, at very acute skew crossings, the duplicate primary road traffic light signal would encroach on the overhang clearance above the carriageway, a special design of the restricted width signal in accordance with the relevant Department for Transport's drawing may be used. Using this restricted width signal requires special authorisation from the Department.

2.286 Where mounted at the side of the road, no part of the road traffic light signal below 5 m should be within 450mm of the edge of the carriageway. This is to minimise the likelihood of damage to the sign from passing vehicles, especially vehicles with large mirrors or overhanging loads. Where the road has a steep camber, the clearance may need to be increased to 600 mm. Offset traffic signal head mounting brackets (or cranked poles) may be needed to ensure that the horizontal clearance is maintained. The centre of the road traffic light signal lens nearest the carriageway should at least 810 mm, but not more than 1500 mm, measured horizontally from the carriageway edge.

2.287 Where the signals are above a footway, a minimum headroom from the lower edge of the signal backing board of 2100 mm should be maintained.

2.288 The distance from which it is desirable that the intermittent red lights and amber lights can be seen varies according to the speed value of the road. The speed is taken as the 85th percentile of the observed speeds of approaching vehicles. Recommended minimum visibility distances are shown in Table 6. If these minimum visibility distances cannot be achieved, consider further measures for example the provision of additional advance warning signs, countdown markers etc.

Table 6: Recommended minimum visibility distances

85th percentile speed of road vehicles		Minimum visibility distance (metres)
kilometres per hour (km/h)	miles per hour (mph)	
50	**30**	**70**
65	**40**	**90**
80	**50**	**150**
95	**60**	**220**
115	**70**	**300**

2.289 Where a crossing is close to a road junction controlled by traffic light signals, consider linking the two sets of road traffic light signals. The results of this consideration should be documented in the risk

assessment. Where they are linked, seek special authorisation from the local traffic authority for the connection between them.

Pedestrian signals

2.290 Pedestrian light signals used at level crossings must comply with Diagram 4006 (2006 Regulations), appropriately positioned to maximise visibility.

2.291 The red figure on the pedestrian signal should be illuminated on commencement of the crossing closure sequence and should flash while the intermittent red lights of the road traffic light signals are lit. The rate of flashing should be the same as that of the intermittent red lights in the road traffic light signal.

Traffic signs

2.292 Appropriate traffic signs should be provided on each road approach. Examples of the layouts are given in Figures 2 to 7 and 9. Details of the signs for use with MSL are shown in Figure 8.

2.293 At automatic crossings with half barriers, signs to Diagram 784.1 should be appropriately positioned on approach to the crossing to suit the road speed (see Figure 4). A sign to Diagram 786 should be provided in association with 784.1 and on the nearside, facing vehicles leaving the crossing.

2.294 Where lay-bys are provided and a Traffic Regulation Order is in force limiting the parking at lay-bys to 'Large or slow vehicles only', the permitted variant to the sign to Diagram 660 should be provided and the road marked in accordance with Diagram 1028.3.

2.295 At automatic crossings and open crossings, signs to Diagram 775 reading 'Keep crossing clear' should be provided on each primary and duplicate primary road traffic light signal post to face traffic approaching the crossing. At open crossings they should be mounted on both sides of the road on or near the posts carrying the St Andrew's Cross signs (Diagram 774).

2.296 Signs to Diagram 775 may be provided at gated and barrier crossings operated by railway staff where standing traffic is a problem.

2.297 At automatic crossings on double-track lines, where two trains can arrive at the crossing without providing the minimum road open time, signs to Diagram 777 reading 'Another train coming if lights continue to show' should be provided on or near each duplicate primary road traffic light signal facing outwards from the crossing.

2.298 At locally-monitored automatic open crossings on double-track lines, where two trains can arrive at the crossing without providing the minimum road open time, signs to Diagram 776 reading 'Another train coming' should be provided on the left-hand side of the road, normally 2 m on the railway side of each primary road traffic light signal and directed towards drivers of vehicles halted at the stop lines. These signs should flash at the same rate as the road traffic light signals.

2.299 Where the width of the road is less than 4 m and the number of vehicles going over the crossing during the peak hour exceeds 120, a Priority Order should be considered and signs to Diagram 615 and 811 provided accordingly.

2.300 At automatic crossings and open crossings, where the road crosses the railway at a skew angle or there are bends on one or both approaches, bend and chevron signs and count-down markers may be required. Consider also whether additional reflecting road studs along the edges of the carriageway may be required to direct drivers along the road.

2.301 Wherever the form of protection at a crossing has been altered, a new educational sign to Diagram 790 reading ‘New level crossing control ahead’ is required to be displayed for a period of not more than 3 months (see Direction 37.1 in the 2002 Regulations).

2.302 At user worked crossings, footpath crossings and bridleway crossings, a sign explaining to the user how to cross safely for example ‘Stop, Look, Listen’ or ‘Cross only if green light shows’ or ‘Stop, always telephone before crossing’, should be provided facing the user at the decision point or at the telephone if provided. It is important that appropriately worded signs are provided whether or not they appear in the 1996 Regulations.

2.303 Information including the name of the crossing, location reference and contact number should also be provided at level crossings. A contact number for the railway operator should also be provided.

2.304 Signs specified in the 1996 Regulations may be placed by a crossing operator on or near a private road or path. It is an offence for a user to fail to comply with any requirement, restriction or prohibition conveyed by a crossing sign lawfully placed on or near a private road or path’ (Transport and Works Act 1992 and Transport and Works (Scotland) Act 2007). A public footpath or bridleway is clearly not a ‘private road or path’, but, where they convey an appropriate message, signs from the 1996 Regulations are commonly used. At footpath, bridleway and private crossings, other suitable signs may be used to inform users, clearly and simply, how to use the crossing safely.

Related to electrified lines

2.305 Where the railway is electrified with overhead conductors, signs to Diagram 779 should be provided with an appropriate plate (Diagram 780A). At user worked crossings, suitable signs warning of the danger from bare electrical conductors such as ‘Danger, overhead live wires’ should be provided and face towards the user approaching the decision point.

2.306 Overhead conductors at level crossings should be at the greatest height practicable. Signs to Diagram 780A should show a safe height which allows for suitable safe clearance under the overhead conductors.

2.307 Where currently overhead conductors at level crossings are not at maximum practicable height, steps should be taken to remedy this situation, so far as is reasonably practicable. In the interim, signs to Diagrams 779 and 780A should be provided at the last available alternative route before the crossing.

2.308 At any crossing where, currently, overhead conductors are not at the maximum practicable height, a height gauge to Diagram 781 should be erected at the ‘safe height’. Signs to Diagram 780.2A should show a safe height which allows for suitable safe clearance under the overhead conductors. At user worked crossings suitable warning signs should be displayed.

2.309 In calculating the ‘safe height’, allowance should be made for the effect of the vertical profile of the carriageway on a road vehicle and its load.

2.310 At crossings where the gradient of the approaches is such that vehicles with large overhangs or conveying a large overhanging load could touch or come dangerously close to the overhead line equipment, even though they are lower than the ‘safe height’ shown on the sign to Diagram 780A or 780.2A, an additional sign depicting the hazard, such as ‘Danger, overhanging load may foul live wires’ should also be provided.

2.311 At crossings where the railway is electrified with a conductor rail, warning notices depicting the hazard, such as ‘Do not touch the live rail’ should be provided.

Related to risk of grounding

2.312 Where there is a risk that vehicles may become grounded on the crossing, signs to Diagram 782 should be erected on the immediate approaches. Advance warning signs to Diagram 782 with distance information to Diagram 573 should be provided at the last available alternative route before the crossing.

2.313 Where telephones are provided at the crossing, signs to Diagram 783 should be mounted beneath signs to Diagram 782 on the approaches. Where telephones are not provided at the crossing, signs to Diagram 785.1 (large) should be provided on the approaches and signs to Diagram 785.1 (small) at the crossing itself.

Road markings

2.314 Road markings should be provided at level crossings in accordance with the 2002 Regulations taking into account guidance in the Traffic Signs Manual.

2.315 Road markings are not normally provided at gated crossings operated only by railway staff, unless the crossing is also signalled.

Transverse and associated road markings

2.316 Transverse road markings should extend across the left-hand half of each two-way carriageway, or across the full width of a carriageway which is either one-way or has no centre line marking.

2.317 Where road traffic light signals are installed, transverse Stop lines to Diagram 1001 should be provided at right angles to the carriageway on each approach approximately 1 m before the primary road traffic light signal. At locally-monitored automatic open crossings (AOCLs) increase this to 2 m. The 300 mm size variant is recommended.

2.318 At open crossings, Give Way lines to diagram 1003 should be provided at right angles to the carriageway on each approach to the crossing, but not less than 2 m from the running edge of the nearest rail. Give Way signs to diagram 602 should also be provided. The triangular road marking to diagram 1023 should be provided in advance of the Give Way lines.

2.319 At user worked crossings on private roads, carriageway markings are not normally used. However, where a STOP sign to diagram 601.1 is provided, a transverse Stop line to diagram 1002.1 and the word STOP to diagram 1022 should also be provided unless the road surface is unsuitable. If the private road is one to which the public has access, these markings must be used, utilising a short length of road surfacing if necessary.

2.320 At automatic crossings and open crossings, a pedestrian Give Way line to diagram 1003.2 should be provided across any footway. It should also be extended across the right-hand side of a carriageway marked with a centre line, unless there are guard rails between the carriageway and the footway. Do not use it at crossings where the full width is controlled by barriers.

2.321 The pedestrian Give Way line should be at right angles to the carriageway. It should be located approximately 1 m on the approach side of any road traffic light signal, except at open crossings where it should be in line with the Give Way markings on the left-hand side of the carriageway. No part of the line should be less than 2 m from the running edge of the nearest running rail.

2.322 At obtuse skew crossings, the pedestrian Give Way line should be provided in conjunction with a pedestrian signal. The end of this pedestrian line at the edge of the carriageway should be located not less than 2 m from the nearest running rail. In these cases the pedestrian Give Way line on the approach side of the road traffic light signal may then be omitted (see Figure 9).

Longitudinal road markings

2.323 The type of longitudinal road marking to use generally depends on the width of the carriageway.

2.324 Where the road passes over the crossing a continuous line to diagram 1012.1 should be provided along each edge of the carriageway. Line widths are detailed in table 4-5 in Chapter 5 of the Traffic Signs Manual. A 100 mm wide line should also be provided along the back edge of each footway and, if separated from the main carriageway, along the front edge. The markings should be continued as necessary on each approach to clearly define the footway.

2.325 Where the width of the carriageway over the crossing is less than 5 m, centre line markings will not normally be provided.

2.326 Where the width of the carriageway over the crossing is between 5 and 5.5 m, the centre of the carriageway between the Stop or Give Way lines should be marked with the appropriate longitudinal warning line to diagram 1004, 1004.1, 1008 or 1008.1. The warning line should extend back from each Stop line for at least the minimum number of marks indicated in table 4-3 of the Traffic Signs Manual Chapter 5, or for at least 6 m if beyond that distance the carriageway is less than 5 m wide.

2.327 Where the width of the carriageway on the immediate approaches is 5.5 m or more, the centre of the carriageway over the crossing should be marked with a double continuous white line to diagram 1013.1A. The lines should be continued along the approaches where justified by the normal visibility criteria for double white lines. At automatic half barrier crossings extend the double continuous white lines for at least 12 m back from the Stop line. Unless the double continuous line extends further back from each Stop line than the distance indicated in table 7, precede it by a double white line to diagram 1013.1D, with the continuous line nearer to drivers approaching the crossing.

2.328 The minimum length of double white lines depends on the 85th percentile speed of cars using the road, and on the general width of the carriageway, excluding any part of the crossing or approaches which may have been specially widened. Recommended overall lengths of the marking to diagram 1013.1A, or a combination of that marking and diagram 1013.1D, are shown in table 7. Where the carriageway is wider than 7.3 m the lengths in table 7 may be increased by up to 50%, but the double lines should not extend beyond the position of the sign to diagram 784.1, where this is used, unless a lay-by is provided.

Table 7: Lengths of double white lines

85th percentile speed	Recommended length of double lines measured from the Stop line
Miles per hour (mph)	metres
up to 30	**up to 30**
31 to 40	**30 to 45**

Table 7: Lengths of double white lines	
over 40	**45 to 60**

2.329 At least one deflection arrow to Diagram 1014 must be provided on each approach to the double centre carriageway markings at crossings. It is normal for two such arrows to be used on each approach. Where a driver's forward view is limited, as at a crest, a third arrow may be necessary to give adequate forewarning. Arrows should be positioned in accordance with part 5 of the Traffic Signs Manual Chapter 5, summarised in Table 8 below.

Table 8: Location of deflection arrows				
Speed limit (mph)	Length of arrow (m)	Distance of tip of arrow from the start of the unbroken line		
		First arrow	Second arrow	Third arrow
30	**4.5**	**13.75**	**43.75**	**79.75**
40	**4.5**	**19.75**	**55.75**	**109.75**
50	**6**	**21**	**66**	**138**
60	**6**	**30**	**84**	**165**

Road studs

2.330 Double continuous white lines must be supplemented by a single row of white road studs. The studs should be white bi-directional reflecting and laid at intervals of between 3 and 4.5m. Any stud within 2 m of a running rail should be made of plastic.

Yellow box markings

2.331 Yellow box markings to diagram 1045 should be provided at automatic half barrier crossings where road traffic flow in any one direction exceeds the guideline figures in table 9 below. A yellow box marking might be appropriate at any type of crossing where blocking by queuing road traffic is foreseeable, regardless of the table 9 figures.

Table 9: Yellow box markings	
Overall width of carriageway (metres)	Yellow box to be provided if vehicle numbers in any one hour in either direction exceed
5.0 to 5.9	**500**
6.0 to 7.4	**600**

Table 9: Yellow box markings	
7.5 and over	**750**

2.332 Where a long yellow box is required the marking should be extended using additional diamond shaped units on the approach side and additional diagonal crosses on the trailing side of the crossing. The maximum permitted length of a yellow box is 30 m.

Figure 2: Typical layout of barrier crossing (with additional risks)

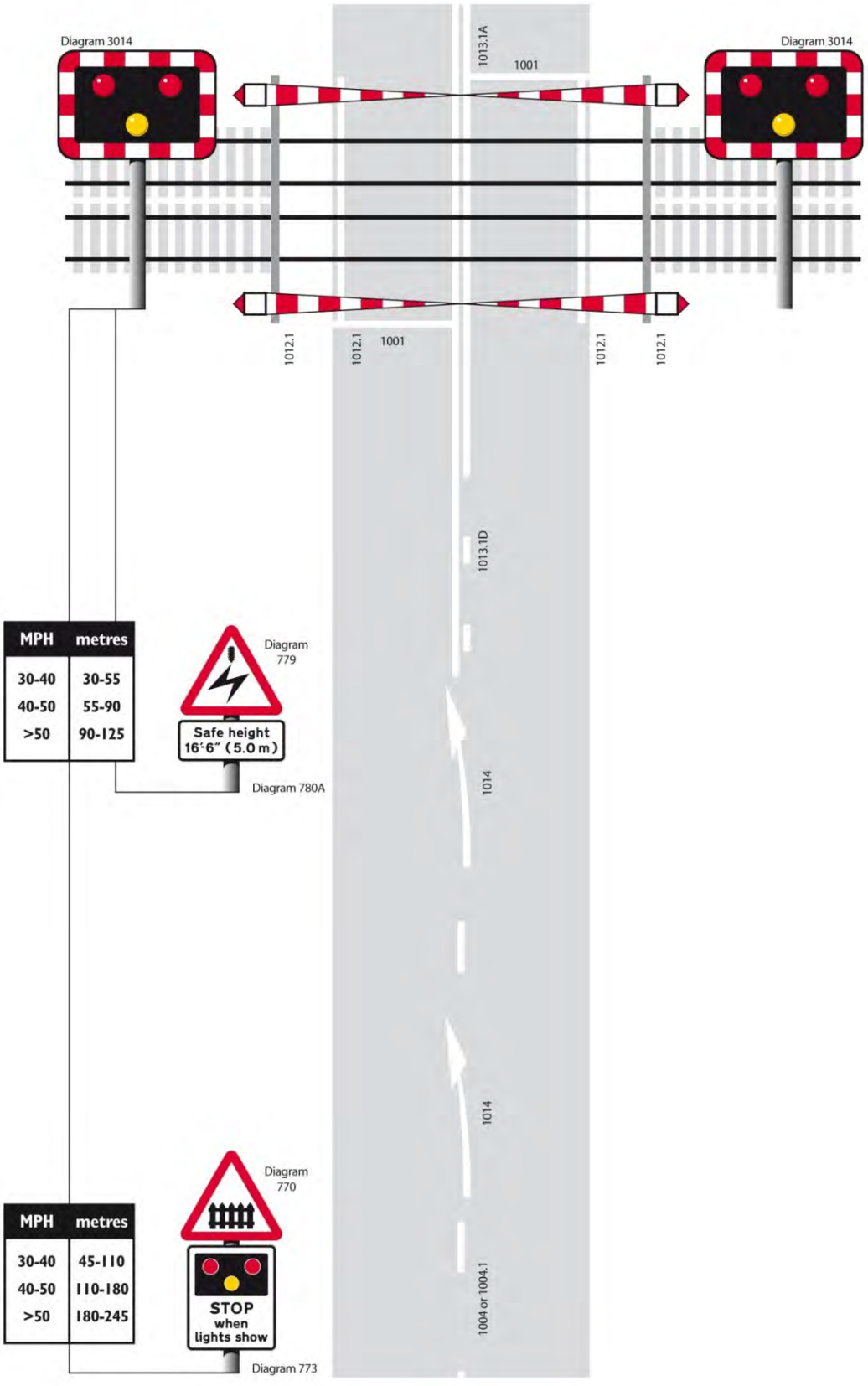


Figure 3: Typical layout of automatic half barrier crossing or automatic barrier crossing (locally monitored)

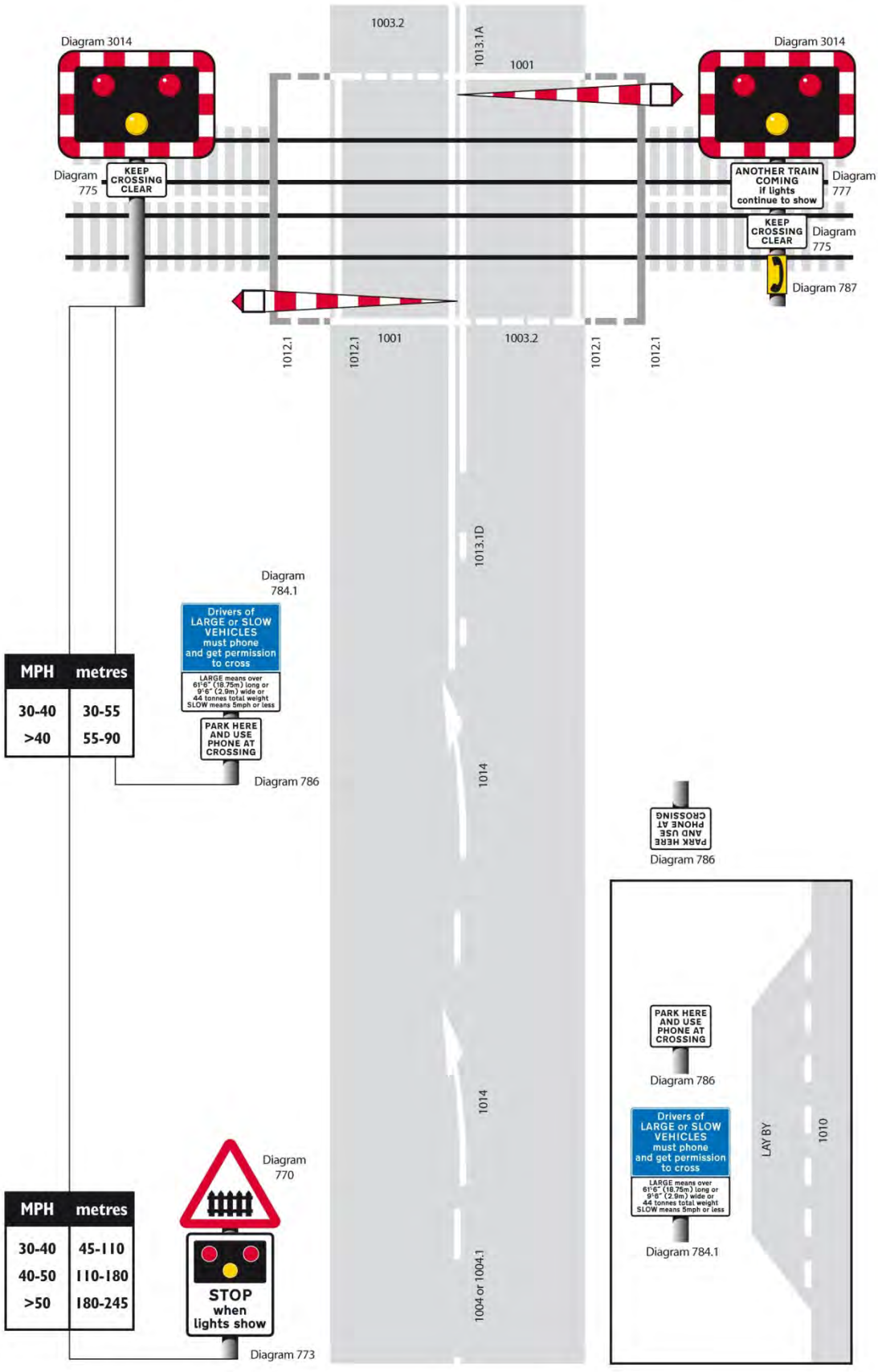


Figure 4: Typical layout of automatic half barrier crossing or automatic barrier crossing (locally monitored) (with additional risks)

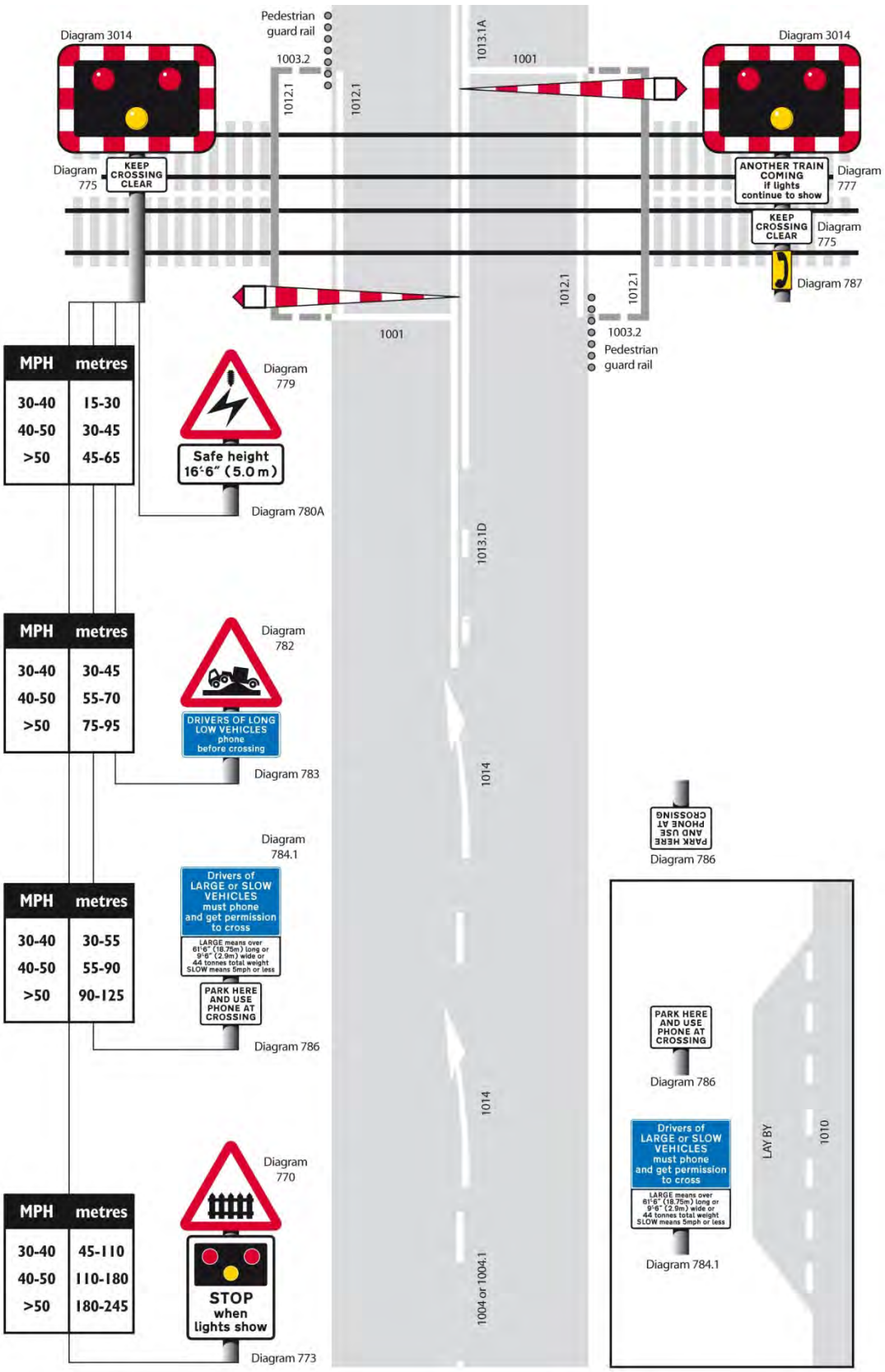


Figure 5: Typical layout of automatic open crossing (with additional risks)

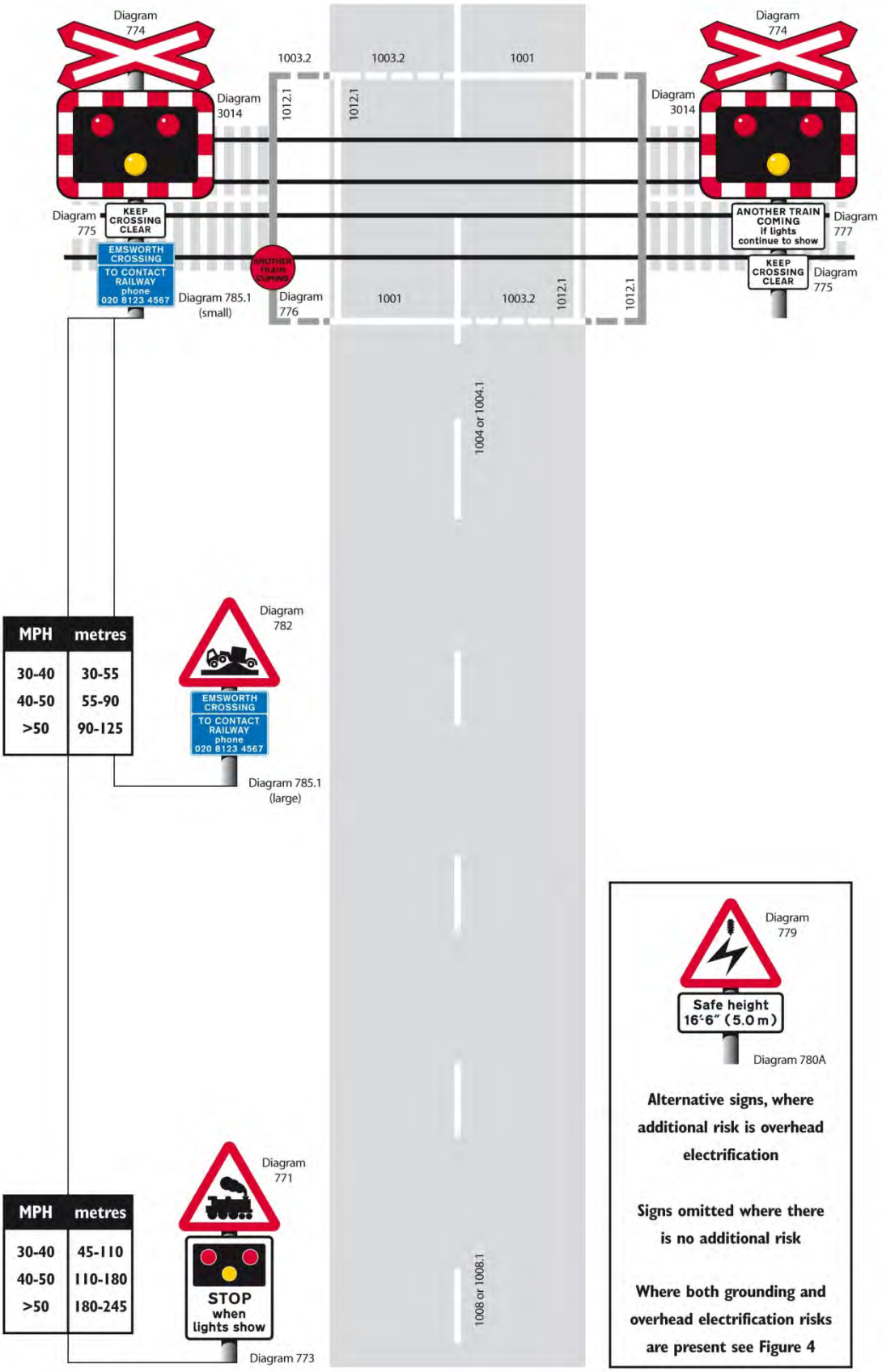


Figure 6: Typical layout of an open crossing

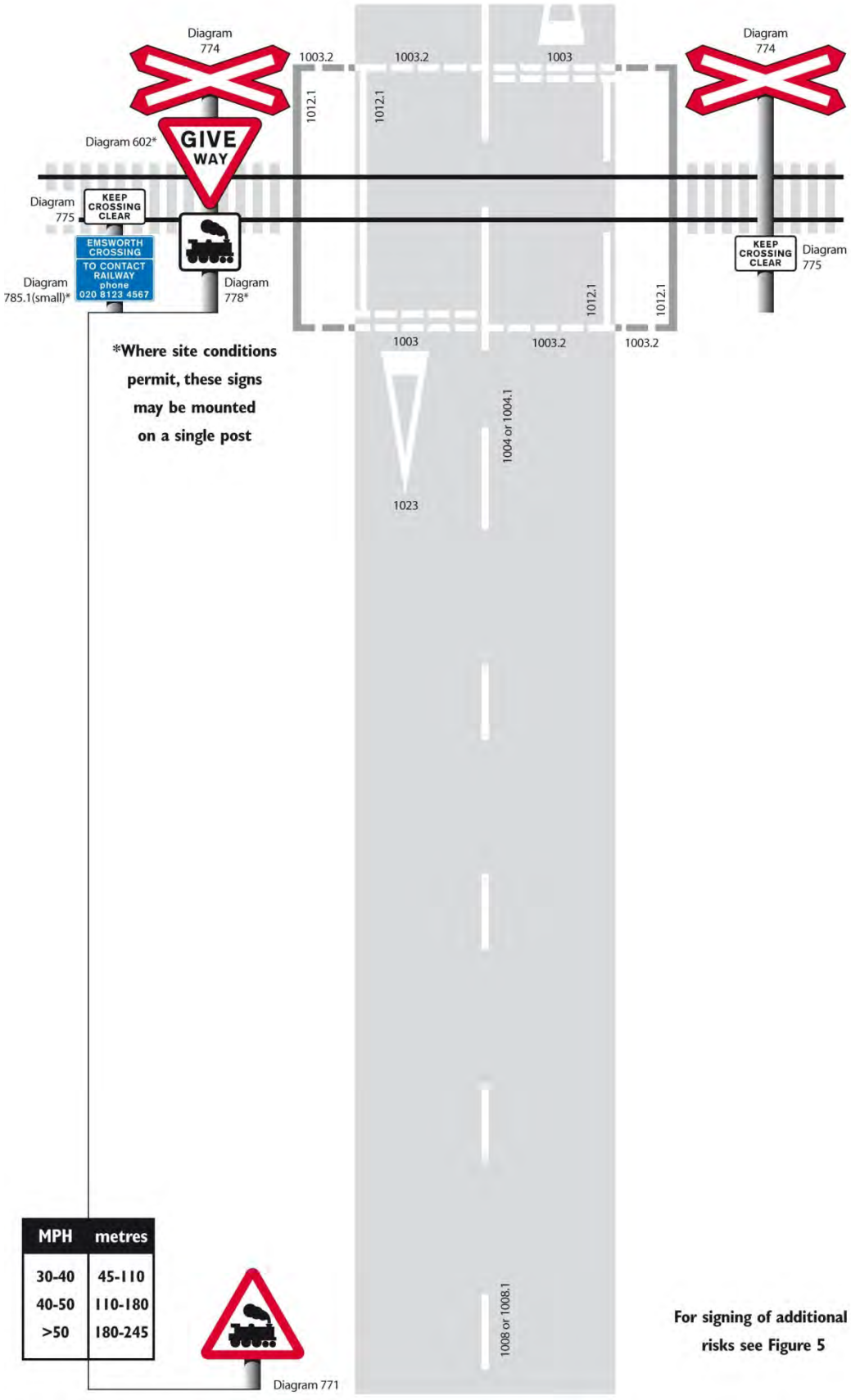


Figure 7: Typical layout of user worked crossing with adjacent footway or bridleway

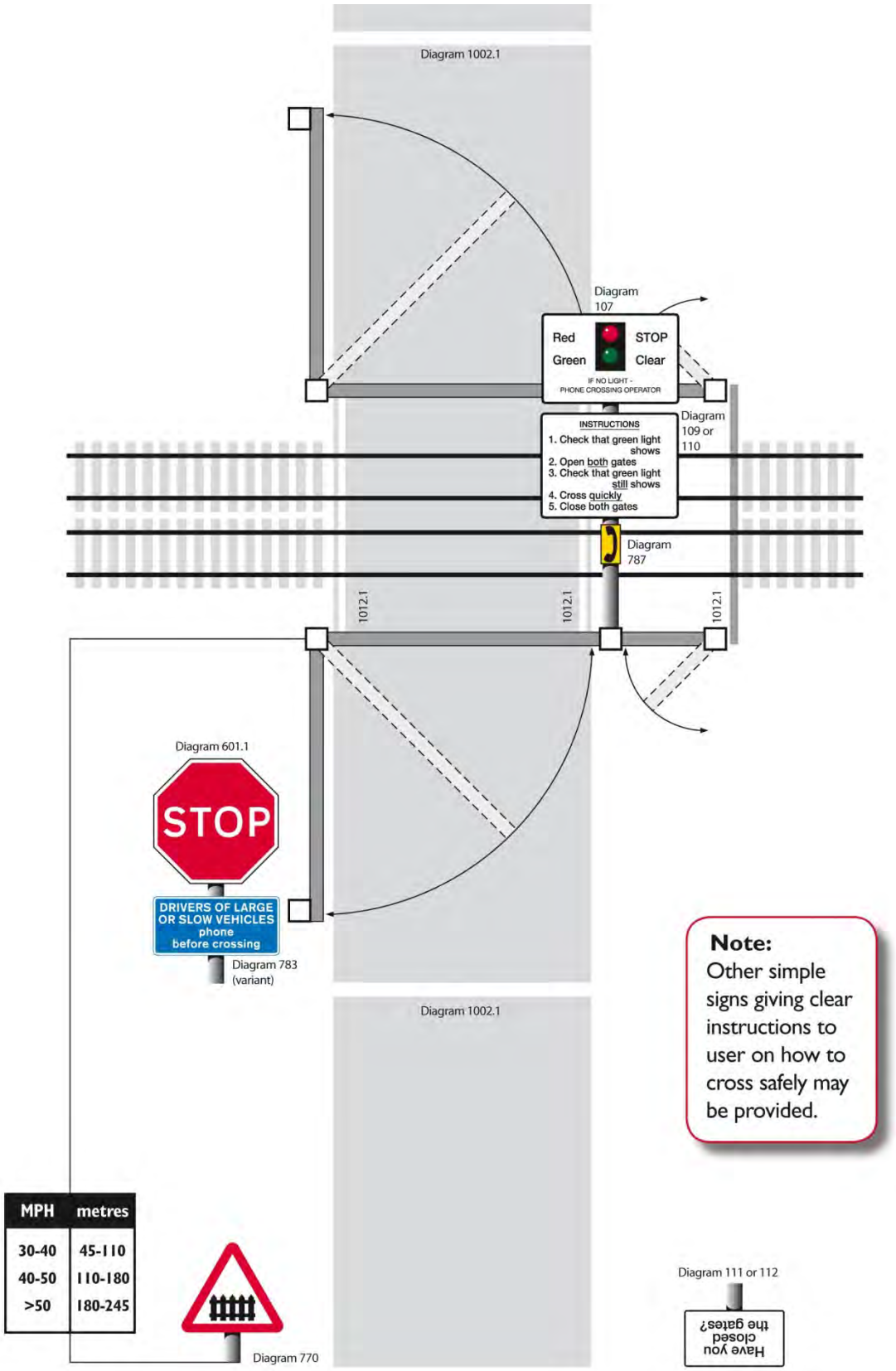


Figure 8: Special signs for use with MSL

Diagram 107

Preferred – provide telephone number if necessary

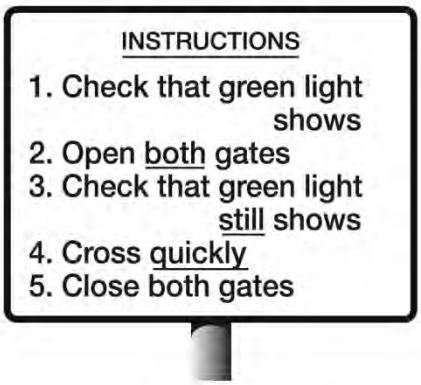


Diagram 109

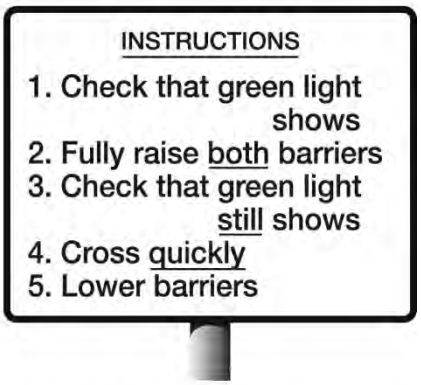


Diagram 110

Diagram 111

Diagram 112

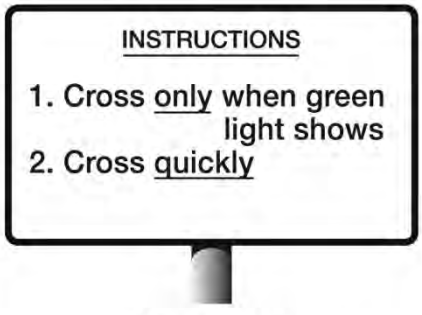
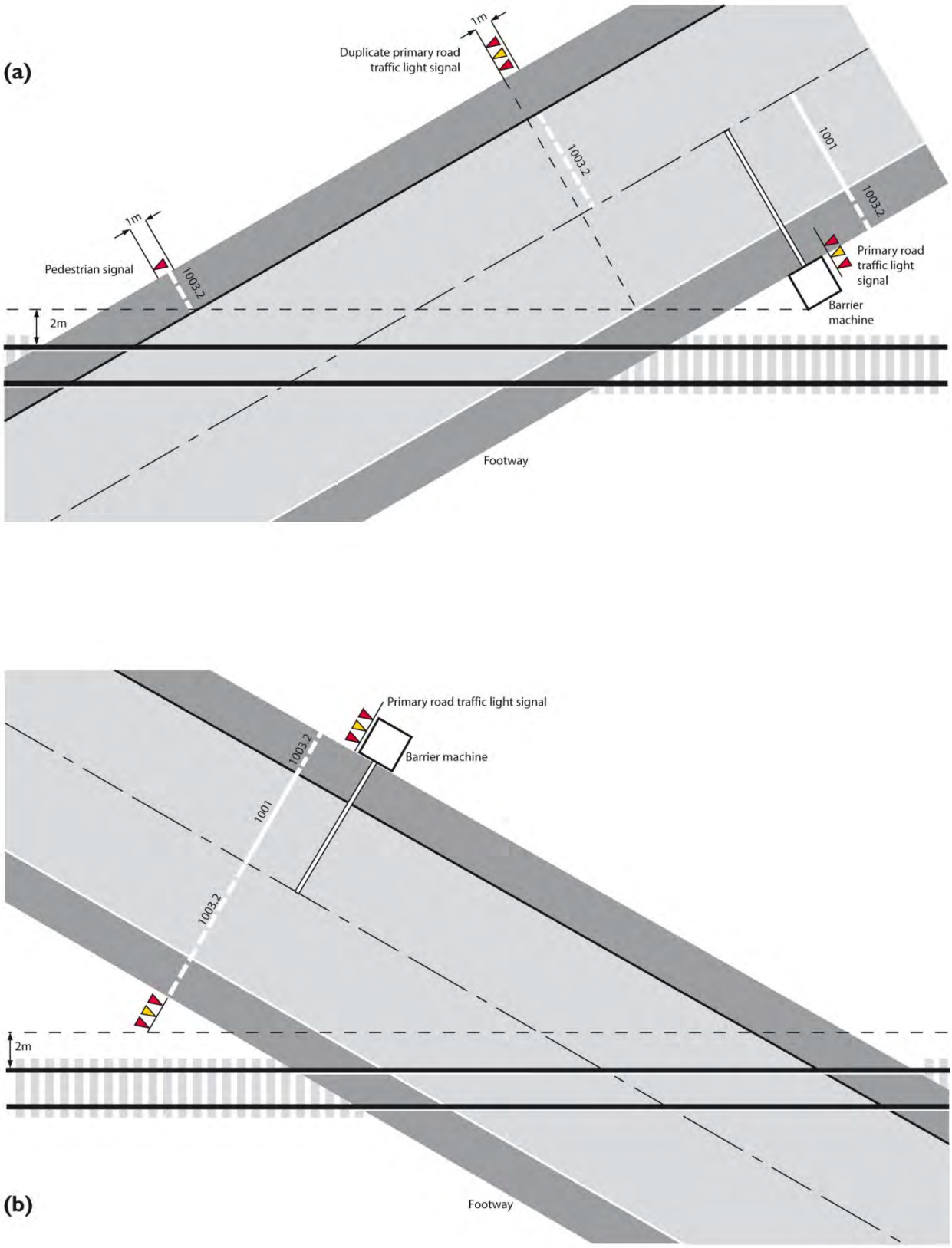


Diagram 114

Figure 9: typical layout of an obtuse skew crossing (a) and an acute skew crossing (b) indicating the arrangement of the transverse road markings and road traffic light signals (not to scale)



Notes to Figure 9

A pedestrian stop line is to be provided across the footway whenever a pedestrian signal is provided. The pedestrian stop line shall be approximately 1 m in advance of the pedestrian signal. This pedestrian stop line shall be positioned in such a manner that the end of the line at the edge of the carriageway is not less than 2 m from the nearest running rail.

The provision of a pedestrian signal may be appropriate at skew crossings with significant pedestrian usage.

In the case of an extremely obtuse skew crossing, like the one in Figure 9, the following arrangement may be considered as an alternative:

(a) the omission of the pedestrian stop line and the pedestrian signal on the right-hand side footway; and

(b) the duplicate primary road traffic light signal and the pedestrian stop line across the footway and across the right-hand side of the carriageway may be positioned closer than the minimum 2 m from the nearest running rail.

3. Level crossing order submissions

Overview and introduction

3.1 When the construction of railways was authorised, mainly in the 19th century, the individual enabling Act of Parliament specified how the railway was to cross other ways (for example roads and footpaths), either by bridge or on the level. Where the crossing was on the level, the arrangements for protecting the users, both railway and highway, were specified.

3.2 Since initial construction, use of the roads and railway has changed considerably, as has the cost of and delay caused by level crossings, and from the 1950s level crossings have been modernised to permit remote or automatic operation with lifting barriers and/or road traffic signals.

3.3 In order to permit the railway operator to change the protective arrangement specified in the original Act, a legal process was introduced which empowered the Secretary of State for Transport to make statutory orders specifying the new or updated arrangements at individual crossings to which the public has access. This process is currently authorised through provisions in the Level Crossings Act 1983.

3.4 This order making process is managed by ORR on behalf of the Secretary of State for Transport. The process is normally initiated by the operator of a level crossing, and requires consultation with the local traffic authority. An order provides for the protection of those using a level crossing and may place duties on both the crossing operator and local traffic authority. An order may make such provision as the Secretary of State considers necessary for the safety or convenience of crossing users.

3.5 This guide is intended to be an *aide-memoire* to assist railway level crossing operators in making level crossing order submissions to ORR for consideration. It also provides information for statutory consultees on the process, together with other background information. It takes account of the changes introduced in the Level Crossings Act 1983 by the Road Safety Act 2006.

The order making process in outline

3.6 The process is normally initiated by the crossing operator proposing a new or amended order. The local traffic authority and the ORR must be consulted. A request and draft order is then submitted and there is a statutory consultation period for the local traffic authority to make representations. On behalf of the Secretary of State, ORR considers any representations, and then decides whether to make the order, with or without amendments. The order is made to come into force when the relevant work is completed.

3.7 This Chapter includes advice on managing of level crossings, what an order should contain, and on the process for requesting, considering and making an order. It also includes contact details (Appendix E) and the wording of the Level Crossings Act 1983, as amended (Appendix F).

Background and other information on level crossing management

Modernisation of existing level crossings

3.8 The primary objective should be to close level crossings permanently, following the closure or diversion of a highway, road or by the provision of a bridge or under-pass. As a secondary objective, it may be practicable to reduce the status of the crossing, for example from vehicular to footpath or bridleway only. Simple renewal and retention of existing crossings should be seen as a last resort. Crossing renewals

should not introduce new risks to the railway or users. In determining whether reasonably practicable solutions exist, other than renewing an existing crossing, the operator should take into account the whole-life costs of installing and maintaining level crossings.

Authorisation of level crossings

3.9 Level crossings on public highways normally need to be authorised by statutory means to establish the rights and obligations of road and rail users. An order under the Level Crossings Act 1983 does not authorise a crossing, but does provide the means for any changed protective arrangements at that crossing to be effectively placed, recorded and enforced.

New level crossings

3.10 Except in exceptional circumstances, ORR does not support the creation of any new level crossings, of any type. A new public highway level crossing in England and Wales may require a Transport and Works Act Order[11] or other appropriate statutory authorisation to create 'the right to cross the railway on the level'. In Scotland an order under the Transport and Works (Scotland) Act 2007 may be required. ORR is consulted on such proposals and may object during any relevant consultation exercise. Normally, any new road required to cross a railway should do so by a bridge or underpass.

3.11 Where a new level crossing is authorised under the Transport and Works Act 1992 or similar legislation, a level crossing order (obtained by the processes outlined in this document) may be needed to specify the necessary protective arrangements.

Temporary vehicular level crossings and temporary increased use

3.12 Bringing into use temporary level crossings, (excepting those for sole use by employees of the relevant transport undertaking) for instance to enable construction works to take place, must comply with the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended. This also applies in the case of temporary increased use of private level crossings.

3.13 If the crossing is one to which the public has access, and the protection arrangements need to be altered from those specified in the authorising Act (for example manual gates to remotely operated full barrier CCTV), a level crossing order is the most appropriate mechanism for sanctioning the relevant changes.

Change in line speeds

3.14 Any project involving a change to line speeds over a length of route will require reassessment of risk and operational requirements at all crossings. Closure, where possible, should be pursued. Where a private user worked crossing is one to which the public has access, any significant changes may make it appropriate for all protection arrangements to be recorded in a level crossing order.

Level crossing orders: scope, content and format

3.15 A level crossing order details the protective arrangements at a level crossing. A new or amended order may bring about changes to those protective arrangements. Orders can revoke earlier orders, disapply requirements under other legislation (for example the authorising Act, a Light Railway Order or an order made under the Transport and Works Act 1992) and enable road traffic signs (including signals and road markings) to be placed (and have legal effect) upon a highway or other road to which the public has

[1] See Section 1 & Schedule 1 of the Transport and Works Act 1992. Transport and Works Act Orders are dealt with by the Transport and Works Act Unit, Dept for Transport, Great Minster House, 76 Marsham Street, London, SW1P 4DR

access. It may place duties on both the level crossing operator and the local traffic authority, in relation to the safety or convenience of users of the crossing.

3.16 In England and Wales any level crossing on a "highway[2] or other road to which the public has access" may be subject to a level crossing order made under the Level Crossings Act 1983, though in many cases this will not be necessary. "Access" includes pedestrian, vehicular or on horseback, and is not restricted to a public right of way. It is a matter of fact, rather than right. Thus an order may be made for a "private" crossing if the public has access to it, even though there are no public rights of way over it or over the road up to the crossing. In Scotland the law, and in particular the definition of a 'road', is a little different. The effect is that in Scotland a level crossing order can only be made for a crossing if it is on a road to which the public has a *right* of access.

3.17 Level crossing orders may normally only be requested by the operator of the crossing (defined in relation to a level crossing as the person carrying on an undertaking which includes maintaining the permanent way at the crossing[3]). However, the Secretary of State may make an order without the request of an operator, and ORR may, by serving notice on an operator, require the operator to request an order.

3.18 The level crossing order specifies how the crossing shall be operated and the protective equipment (which includes barriers, traffic signs, signals and road markings) to be provided at the crossing by both the operator and local traffic authority.[4] The type of level crossing should normally conform with one of the types described in this guidance document. The level crossing order consideration process takes account of the safety and convenience of users, road and rail, and the status of the crossing. Where necessary and appropriate to particular circumstances at individual crossings, protective arrangements may be varied from the standard guidance.

3.19 Orders normally contain several parts. The order itself contains the citation, principal duties, revocation of earlier orders and other details. It records who applied for the order in its title, though this does not affect the validity of the order if the operator subsequently changes. It may also explicitly or implicitly disapply parts of earlier legislation applying to the crossing.

3.20 There are three supporting Schedules, which contain details of:

- The location of the crossing (in both road and railway terms), together with a record of the local traffic authority and, if appropriate, the status of the crossing for which the protection is provided (Schedule 1);
- What equipment the operator must provide (Schedule 2 part 1);
- How the operator must operate the crossing (Schedule 2 part 2);
- What the local traffic authority must provide (Schedule 3 part 1); and
- How the local traffic authority shall conduct its undertaking in relation to the level crossing (Schedule 3 Part 2).

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[2] See definition in the Level Crossings Act 1983, inserted by the Level Crossing Regulations 1997 and the Highways Act 1980

[3] See section 1(11) Level Crossings Act 1983

[4] See the amendments made to section 1(20(a) of the Level Crossings Act 1983 by section 50(2) of the Road Safety Act 2006

3.21 Orders for each type of crossing are made to a standard format, for which templates are available from ORR on application. However, where particular features, requirements or equipment need to be included, any proposed additional wording should be discussed with ORR at an early stage. Templates normally contain a number of options or alternative paragraphs (dealing with yellow box markings or centre of carriageway markings, for instance).

3.22 Any change that affects, or alters, the content of a level crossing order (including variation, amendment and revocation orders) requires statutory consultation (see timescales below). There is no mechanism for exemption from statutory consultation, nor can the minimum consultation and two-month period for representations be reduced. Level crossing orders can amend or vary earlier orders, and can revoke an earlier order completely.

3.23 Amendment or variation orders can be used to amend or vary individual words or paragraphs. Variation and amendment orders that affect an earlier order must explicitly provide for the earlier order to remain in force. ORR will not normally progress a variation or amendment order, and will require the submission of a new, complete draft order:

- where there are significant changes to any existing order;
- where a change of level crossing type is proposed;
- where there are already three or more existing amendments or variations to an original order;
- where the traffic sign numbering within an existing order relates to other than the current edition of the 2002 Regulations; or
- where significant time (more than two years) has elapsed since consultation, commissioning has been delayed, or circumstances have changed significantly since the original consultation.

3.24 New orders other than variation and amendment orders should explicitly revoke all earlier orders together with any amendment or variation orders that have not previously been revoked. Where an earlier order is revoked, the correct, full citation as quoted (This order may be cited as…) in the earlier order itself must be used.

Level crossing order request and consideration process

3.25 A “flow chart” outlining the order making process can be found at Figure 10. It is intended to be illustrative rather than prescriptive. In general, the earlier matters are discussed and resolved, the less scope there is for unforeseen timescale and resource problems to affect implementation of the proposed works.

Initial proposals

3.26 Level crossing modernisation project teams should make ORR aware of their proposals 12-24 months or more in advance of the proposed commissioning date so as to allow time to discuss the engineering aspects and the draft level crossing order with ORR. At this stage it is important to resolve issues of principle, such as the risk assessment to inform to what extent the crossing should meet current standards, or whether renewal as a different type of crossing will be appropriate. The proposed use of any novel equipment may require special consideration and should be discussed with ORR at this stage.

3.27 Consider whether a public consultation meeting will be needed (see public meetings below). Either at this stage or as part of the initial consultation with ORR and the local traffic authority, a site visit by interested parties should normally be arranged.

Consultation with local traffic authority and ORR

3.28 New consultation provisions were introduced by the Road Safety Act 2006[5]. Before submitting a request for an order to the Secretary of State, an operator must consult both ORR and the local traffic authority about the draft order he intends to submit to the Secretary of State, and must allow a reasonable period for them to make representations. The purpose is to permit any matters of concern to be raised and resolved in advance of the Secretary of State's formal consideration of the order. The 2006 Act also amended the Level Crossings Act 1983 to permit level crossing orders to place requirements on local traffic authorities[6].

3.29 Clearly, the proposed content of an order, in particular the schedules placing duties on the local traffic authority, needs to be discussed at as early a stage as possible, and particular attention should be given to the first consultation under the new arrangements with each local traffic authority. Attention should also be given at this stage to establishing an agreed status of the crossing, particularly where private vehicular rights are involved. Ideally, all matters should be resolved at this time, and the statutory consultation process should not raise any further issues or matters of comment.

3.30 As a minimum, the crossing operator must consult with the local traffic authority in the area the crossing is situated, and ORR. There is no longer a statutory duty to consult with the planning authority, but ORR considers that it is good practice to continue to do so. The crossing operator should consider consulting on as wide a basis as is felt necessary, for instance with planning authorities, parish and community councils. In the case of crossings with private rights, consider consulting the authorised users and the owner of the private road. Consider also consulting the authorised users, if the crossing is an accommodation or occupation crossing with public footpath or bridleway rights. Where operation of the crossing involves a train operator, such as for train crew operated crossings or automatic crossings initiated by station staff, the relevant train and station operators should be consulted. Responses to this consultation should be directed to and be considered by the crossing operator.

3.31 There is no statutory guidance on the process required or how far in advance of the draft order circulation date this consultation should be carried out. However, it will need to include a written summary of the proposal, a preliminary draft of the proposed order and an outline layout, and may, where appropriate and practicable, include a site visit. A record should be kept of issues raised and the considerations and decisions arising from them.

3.32 Evidence that consultation has been carried out, how it was done, what responses were received and what action has been taken should accompany the later draft order submission.

Public meetings

3.33 Although not a statutory requirement, "public" consultation meetings should also be considered and held with relevant local authorities and other relevant bodies as part of this consultation process where there are significant changes to the method of operation planned (for example conversion of manual gates to automatically controlled barriers). Such meetings within the local community, to describe the railway operator's proposals, will give advance warning of local concerns and allow time to consider any objections raised by the communities concerned.

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5 See the new sections 1(8) and 1(8A) to the Level Crossings Act 1983 introduced by section 50(7) of the Road Safety Act 2006

6 See the new section 1(2)(a) to the Level Crossings Act 1983 introduced by section 50(2) of the Road Safety Act 2006

3.34 The organisation and cost of such meetings are the railway operator's responsibility. ORR has, in the past, chaired such meetings in an independent capacity, and is prepared to continue doing so when requested, provided sufficient advance warning is given. Minutes should be kept and distributed to the communities concerned and ORR. Such meetings should be held as early as possible (12-24 months in advance). Local representatives such as the highway and planning authorities, town, parish and community councils, police (local as well as British Transport Police), other emergency services, National Farmers Union and any other significant local users should be invited as appropriate.

3.35 The railway operator should be prepared to give a brief presentation explaining the operation of the proposed level crossing and should be able to answer technical and any other questions. ORR will be pleased to explain the legislation and order making process to those present. A record should be kept of items raised at these meetings.

3.36 Any undertakings made to local communities should be carefully considered before being given, as failure to honour undertakings can lead to such issues being raised again during the formal consideration of the order, thus possibly delaying the making of the order.

Draft order submission and supporting information required

3.37 A list of supporting documents and information required to accompany order requests is provided in Appendix G. Here you will also find guidance on making and recording the results of a 'suitable and sufficient' risk assessment. Which documents need to be provided will depend on the particular circumstances of each level crossing; the list is for guidance and is neither exhaustive nor prescriptive. Where there are deviations from established guidance or practice, these should be justified. Evidence of the legal status of the crossing should be provided, if necessary.

3.38 If you have any doubts on what information is required, please contact ORR before making your submission. The information provided should come from one single point of contact in the relevant part of the organisation.

3.39 After consulting ORR and the local traffic authority about the draft order, the crossing operator must give them written notice of his intention to make a request for an order to the Secretary of State. That notice must specify a period (of at least two months) within which ORR and the local traffic authority can make representations to the Secretary of State, and must be accompanied by a copy of the draft order that is being requested.

3.40 The consultation letter to the local traffic authority and ORR should include an end date for consultation (at least two months), and a proposed or likely commissioning date for the new arrangements. Responses or objections from consultees at this stage should be directed to the Secretary of State for Transport c/o Level Crossing Team, ORR, One Kemble Street, London, WC2B 4AN.

3.41 The crossing operator should ensure that it can demonstrate delivery of these notification documents to the consultees. Copies of such letters should accompany the request to the Secretary of State. Details of any responses to the initial consultation process, and any action taken should also be included.

Draft order consideration and order making

3.42 Correspondence to the Secretary of State for Transport and the Office of Rail Regulation should be addressed to: The Secretary of State for Transport, c/o, Level Crossing Team, ORR, One Kemble Street, London, WC2B 4AN.

3.43 The draft order will be considered, taking into account guidance, relevant standards and the particular circumstances at the crossing. The primary considerations are whether the proposal is adequately safe and represents an appropriate balance between safety and convenience for all crossing users, road and rail.

3.44 Where relevant issues are raised concerning matters other than the safety or convenience of users, such as rights of way over a crossing, or the convenience of road users other than those using a crossing, these will be taken into account in ORR's assessment of the draft order. However, the draft order may in these circumstances need to be referred to the Secretary of State for a decision.

3.45 It is at this stage that minor amendments to the proposed order, such as correcting dimensions in the original draft, are incorporated. More significant additions may be made, for instance where the assessment process has identified the need to better address particular risks at the crossing.

3.46 Consultation responses are also considered, and if appropriate the order may be modified to take account of these matters.

3.47 If there are public rights of way/convenience issues raised by the consultation, ORR may seek guidance from the Department for Transport. In some cases ORR is not empowered to make an order on behalf of the Secretary of State, and in such cases the draft order will be referred to the Secretary of State with a recommendation. ORR will inform the railway operator as soon as it becomes aware of any issues likely to delay the making of an order that might affect a proposed commissioning date.

Inspection of level crossings subject to orders

3.48 Implementing the arrangements specified in an order remains the responsibility of the crossing operator and local traffic authority. All level crossing works are subject to inspection at ORR's discretion. Variation or amendment orders, detailing minor changes only, may not necessitate inspection.

3.49 The inspection should normally be arranged shortly after the revised arrangements have been brought into use. Consultees, including a representative of the relevant traffic authority, should be invited by the railway operator to join the inspection. Any deficiencies identified should be corrected and the action taken confirmed in writing.

3.50 Failure to implement properly the arrangements specified in an order will be considered using ORR's established enforcement decision making process. Formal enforcement, including notices and prosecution, may be used.

Traffic Signs Authorisations

3.51 Traffic Signs Authorisations are required if the railway operator wishes to place a sign on a public highway that is not shown within the 2002 Regulations, or wishes to place a sign from the 1996 Regulations on a public highway (including a public footpath) or road or other highway to which the public has access. Such requests should be made to ORR along with details of the size of the sign/signal, colour, size of lettering/numerals, etc. A detailed explanation of why the sign is required and copies of any supporting correspondence from local authorities (such as Police, Traffic authority) should be provided. Two copies of a map (minimum scale 1:2500) should be supplied, one showing the position of the proposed sign(s) marked with a cross, the other unmarked. ORR will progress the request on behalf of the railway operator.

Timescales

3.52 Where order requests are incomplete or inaccurate, the timescales indicated below will be extended. Where assessment of an application reveals that it is incomplete, then further assessment may be delayed

until the relevant information is provided. Where a request is grossly deficient ORR may recommend the Secretary of State declines to make an order, and the consultation cycle will need to be restarted from the initial consultation phase. To avoid wasted effort by operators, local authorities and ORR's inspectors, the crossing operator should liaise with ORR at an early stage to ensure all necessary information will be available when required.

Consultation

3.53 Before submitting a request for an order, the crossing operator must formally advise and consult ORR and the local traffic authority of his intention to do so (section 1(8A) of the Level Crossings Act 1983). Consulting the local planning authority is also good practice, even though there is no longer a statutory requirement to do so. The timescales are not set down, but this should be undertaken at the earliest opportunity. Sufficient time should be allowed for a public meeting if necessary and, once the consultation is started, sufficient reasonable time should be allowed for responses to be made and considered. Two months may be considered as an absolute minimum for this to be done effectively. If adequate time is not allowed, or the consultation is otherwise ineffective, it may result in comments being made and needing to be considered after the statutory consultation. If consultation is not effectively carried out, the subsequent draft order submission might be legally challenged.

Circulation of draft order

3.54 The last date for comments should be included in the letter accompanying the draft order. Note that new level crossing orders, and variations or amendments to existing orders, however minor the changes, all have to go through a statutory consultation process in full. There is no power in the Level Crossings Act to shorten or waive the minimum consideration period.

Consideration of draft order together with any consultation responses

3.55 Considering draft orders and making a recommendation for signature cannot take place until the consultation period has ended. The recommendation can be that the order is made as submitted, that an order is not made, or that an amended order is made. In practice the majority of orders made fall into the last category.

3.56 Crossing operators are therefore advised to allow a minimum of four months between circulation of the draft order and the proposed commissioning date. The level crossing is required to comply with the level crossing order at all times and, therefore, the crossing operator must ensure that the new order is dated to 'come into force' on the commissioning date.

3.57 The earlier a crossing operator makes the application for an order, the less likely there will be timescale problems. While ORR will make every attempt to meet reasonable project timescales, it cannot deal with last-minute applications unless there are exceptional circumstances. Poor planning will not be considered as an exceptional circumstance.

3.58 The required "coming into force" date should normally be confirmed to ORR. Cancellation or postponement of a planned commissioning should be advised to ORR at the earliest opportunity. Once made, an order cannot easily be revoked.

Information for local traffic and planning authorities

3.59 A process for making orders in relation to level crossing protection has been in place since the late 1950s, and local authorities have, since that time, been part of that process. Even before level crossing modernisation began, local highway authorities had responsibility for traffic signs on the road approaches to level crossings, and this responsibility has not changed.

3.60 The modifications to the Level Crossings Act 1983 introduced by the Road Safety Act 2006 formalised good practice in consulting on changes to level crossings in advance of formal circulation of a draft order. The changes also permit the order to record and clarify the local traffic authority's responsibility for the approaches to the crossing. Where new traffic control measures are required (such as a centre-carriageway "median strip" to prevent "zig-zagging" around half barriers) the responsibility for provision and maintenance should be agreed through consultation and incorporated in the draft order. The final division of responsibilities will be made clear in the level crossing order. As a general principle, it may be considered appropriate for the party introducing any increased risk to bear the responsibility for controlling it. Where there is any failure to provide or maintain any traffic signs required by the order, ORR will consider whether formal enforcement is appropriate.

3.61 Where traffic signs on the approach to a crossing need to be changed, for example if a local traffic authority wishes to introduce one way traffic flow, proposals must be discussed and agreed with the railway operator in ample time for any necessary revision to the level crossing order to be made. This will determine when revised arrangements may be brought into force.

3.62 New orders may record the need for local traffic authorities and level crossing operators to agree a long term strategy for each crossing. Where appropriate, consideration should be given to what measures may be required, by each party, to permit the crossing to be closed in the long term.

3.63 New orders may also specifically require the local traffic authority and the crossing operator to co-operate in the joint management of risk at the crossing. This will require the local traffic authority to make the crossing operator aware of any significant temporary or permanent changes affecting the nature and characteristics of road traffic approaching the crossing. Such changes might include a revised road layout, traffic calming measures or a change in permissible road speed.

Planning decisions affecting level crossings

3.64 There is a requirement in planning legislation[7] for planning authorities to consult the Secretary of State for Transport and /or the railway operator where development materially affects traffic over any type of level crossing. In Scotland, the requirement is for the planning authority to consult Network Rail Infrastructure Limited or any other railway undertakers likely to be affected where the development is likely to result in a material increase in the volume or material change in the character of traffic using a level crossing over a railway. ORR acts on behalf of the Secretary of State in these matters, and can offer guidance at an early stage as to what might be material in the particular circumstances of individual crossings. Any impact on safety will depend on the type of level crossing involved. Existing protection may no longer be adequate.

3.65 Planning authorities should take careful note of comments from crossing operators. Consideration should be given to opportunities for closure of the level crossing concerned in favour of bridge underpass or diversionary routes. If a planning decision necessitates a change in level crossing protection, consideration should be given to the funding of the changes and to the timescales for implementation consistent with the requirements of the level crossing order making process. Changes in level crossing protection may well incur additional costs for local traffic authorities as well as the crossing operator.

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[7] Town and Country Planning (General Development Procedure) Order 1995 SI 1995 No 419; Regulation 25 and Schedule 5 of the Town and Country Planning (Development Management Procedure) (Scotland) Regulations 2008 as amended

Requiring a request for a level crossing order

3.66 The Level Crossings Act 1983 section 1(6A) gives ORR, where it is of the opinion that an order is required, the power to issue a written notice to the operator of a crossing to require the operator to request a level crossing order. The notice will contain details of the reasons for the opinion, and places a statutory duty on the operator to request an order.

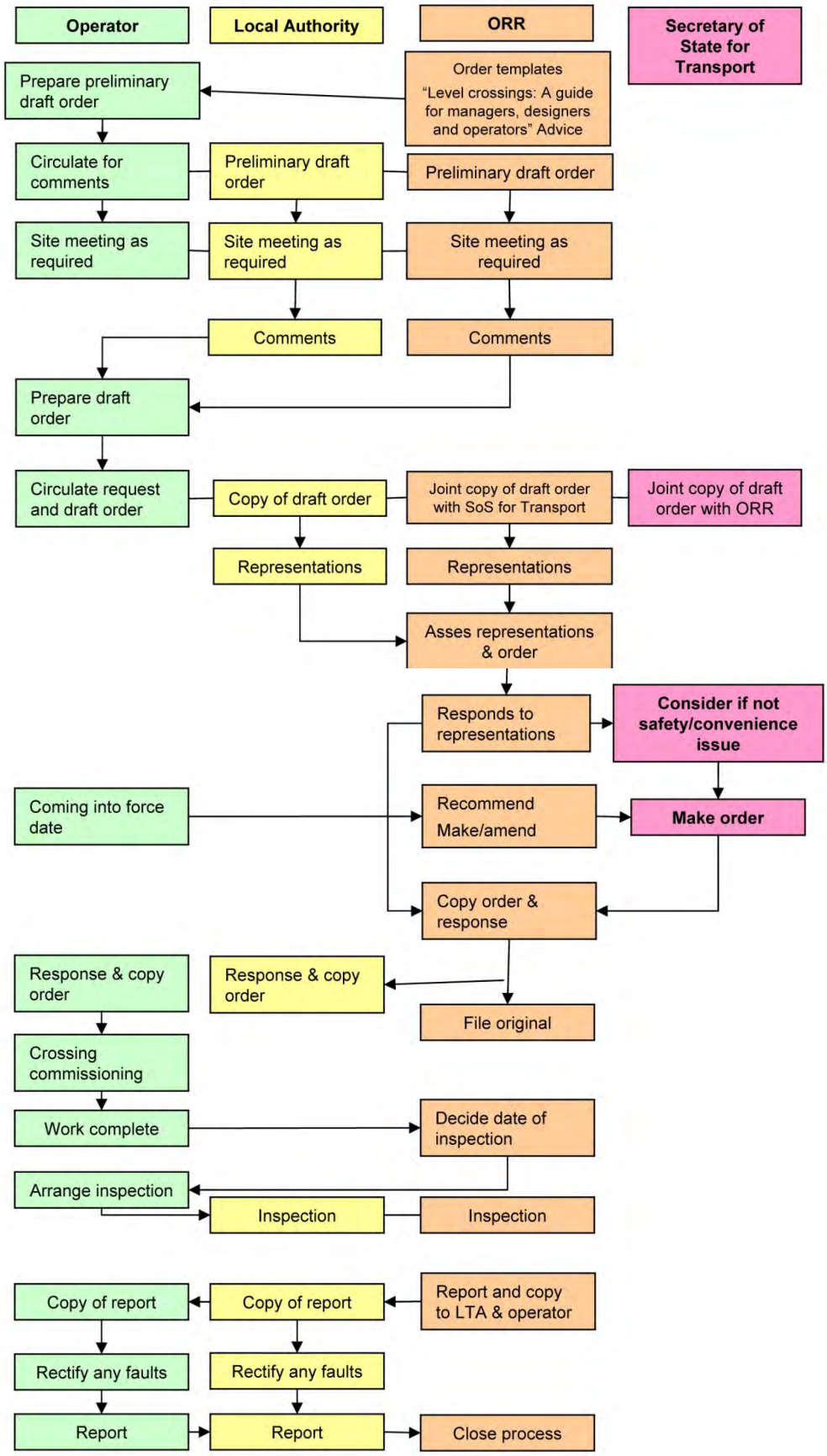
3.67 The subsequent request for an order will be considered by ORR as normal, but making the order is not delegated to ORR in these circumstances. In such cases the order is made by the Secretary of State, taking into account any recommendation from ORR.

3.68 If the operator declines to make a request for an order, the Secretary of State can be advised to make an order without a request. Alternatively, ORR may serve an improvement notice, under the Health and Safety at Work etc Act 1974, requiring an operator to request an order. Failure to comply with such a notice can lead to prosecution.

Relevant legislation and publications

3.69 The most relevant legislation is the Level Crossings Act 1983 (as amended by the Level Crossings Regulations 1997 and the Road Safety Act 2006). Operators should also be familiar with the Health and Safety at Work etc Act 1974, the Railways and Other Guided Transport Systems (Safety) Regulations 2006 as amended and the Traffic Signs Regulations and General Directions 2002. See Appendix H.

Figure 10: Level crossing order process



Appendix A - Common terms

Where possible the document has been written in plain English and the use of technical expressions or jargon has been avoided.

The following explains what is meant by certain terms used within the document that relate specifically to level crossings:

'Actual daily road vehicle usage' means the number of road vehicles passing between 06.00 and 24.00 averaged over a 9-day period.

'Acute (skew) crossing' is a crossing at which the angle measured in an anticlockwise direction from the road to the running rail is less than a right angle.

'Approach locking' is a feature of the signalling interlocking. In the context of a level crossing it should prevent the crossing opening to road traffic after protecting signals have been placed to danger if there is a risk of an approaching train not having received a complete warning sequence of signals.

'Control point' is a location from which the equipment at a crossing is controlled.

'Crossing length' applies to any vehicular crossing. At a crossing equipped with gates or full barriers it is the distance between the gates or barriers measured across the railway. At an open crossing or one equipped with half barriers it is the distance measured from the give way or stop line to a point at which a road vehicle would be clear of the railway or crossing equipment on the far side.

'Crossing speed' applies to locally-monitored crossings and open crossings. It is the maximum speed at which trains are allowed to travel from a point (indicated by the position of a special speed restriction board) on the approach to a crossing until the front of the train arrives at the crossing.

'Decision point' applies to user worked crossings, footpath crossings and bridleway crossings. It is a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety.

'Left-hand side' means the left-hand side of the road or carriageway as it would appear to a person approaching the crossing along that road or carriageway.

'Obstacle detection'**:** An obstacle detector is a device or system for proving a level crossing is clear, as part of the closure sequence. An obstacle detector may comprise one detector or a system of obstacle detectors, for example a primary high-integrity obstacle detector to detect any obstruction capable of derailing a train, together with a lower-integrity Complementary obstacle detector to detect possibly low-lying, obstructions not capable of derailing a train.

'Obtuse (skew) crossing' is a crossing at which the angle measured in an anticlockwise direction between the road and the running rail is greater than a right angle.

'Predictor crossing' is a crossing at which the likely arrival time of trains is calculated automatically by the equipment at crossing. The timing of closure sequence is thus set according to the approach speed of trains

'Right-hand side' means the right-hand side of the road or carriageway as it would appear to a person approaching the crossing along that road or carriageway.

'Road open time' is the time after the road traffic light signals have ceased to show and any barriers are clear of the road, before the road traffic light show again for another train.

'Sighting distance' is the distance measured along the railway from a decision point to the point at which an approaching train becomes visible in any direction from which a train may approach.

'Strike-in point' is the position on the track at which the presence of a train is detected and the operating sequence of the crossing is initiated.

'Supervising point' is the location from where the crossing is supervised. Most commonly this is either a local or remote signal-box but can be another location.

'Tactile threshold' is an area of tactile paving slabs laid in a specific pattern for the guidance of visually-impaired pedestrians.

'Traffic moment' is the number of road vehicles using the crossing multiplied by the number of trains passing in a given period.

'Warning time' is the shortest possible time for trains to travel the sighting distance or, where whistle boards are provided, the shortest time between the sound being heard at the crossing and the train arriving at the crossing. In calculations of warning time the highest attainable train speed should be used.

Appendix B - Limitation on road and rail traffic at AOCL

1 Actual daily road vehicle usage is converted to effective daily road vehicle usage using Table 10 because the relationship between the accident probability and the actual road traffic volume is not linear. Converting the actual road traffic volume to the effective figure will give the same accident probability if the probability:traffic flow relationship is a straight line. (For a detailed explanation, see the report 'Automatic open level crossings - A review of safety' by Professor P F Stott, published in 1987 by HMSO, ISBN 0 11 5508317).

2 The effective daily road vehicle usage is then multiplied by the daily number of trains to give the effective traffic moment and hence the maximum permitted crossing speed which can be derived from Table 11.

Table 10	
Actual daily road vehicle usage	Effective daily road vehicle usage
250	**230**
500	**425**
750	**580**
1000	**705**
1250	**810**
1500	**890**
1750	**955**
2000	**1010**
2500	**1080**
3000	**1115**
3500	**1115**
4000	**1080**
4500	**1040**

Table 10	
5000	**990**
6000	**885**
7000	**765**
8000	**650**
9000	**540**
10000	**475**

Table 11	
Effective traffic moment	Maximum permitted crossing speed
	miles per hour (mph)
4000	**55**
4600	**50**
5400	**45**
6500	**40**
8200	**35**
10130	**30**
13100	**25**
15000	**less than 25**

Appendix C - Definition of viewing zone at open crossings

The viewing zone (the shaded region as shown in Figure 11) is defined by lines connecting points ‘X’ and ‘Y’ given in Table 12.

Figure 11: Definition of viewing zone at open crossings

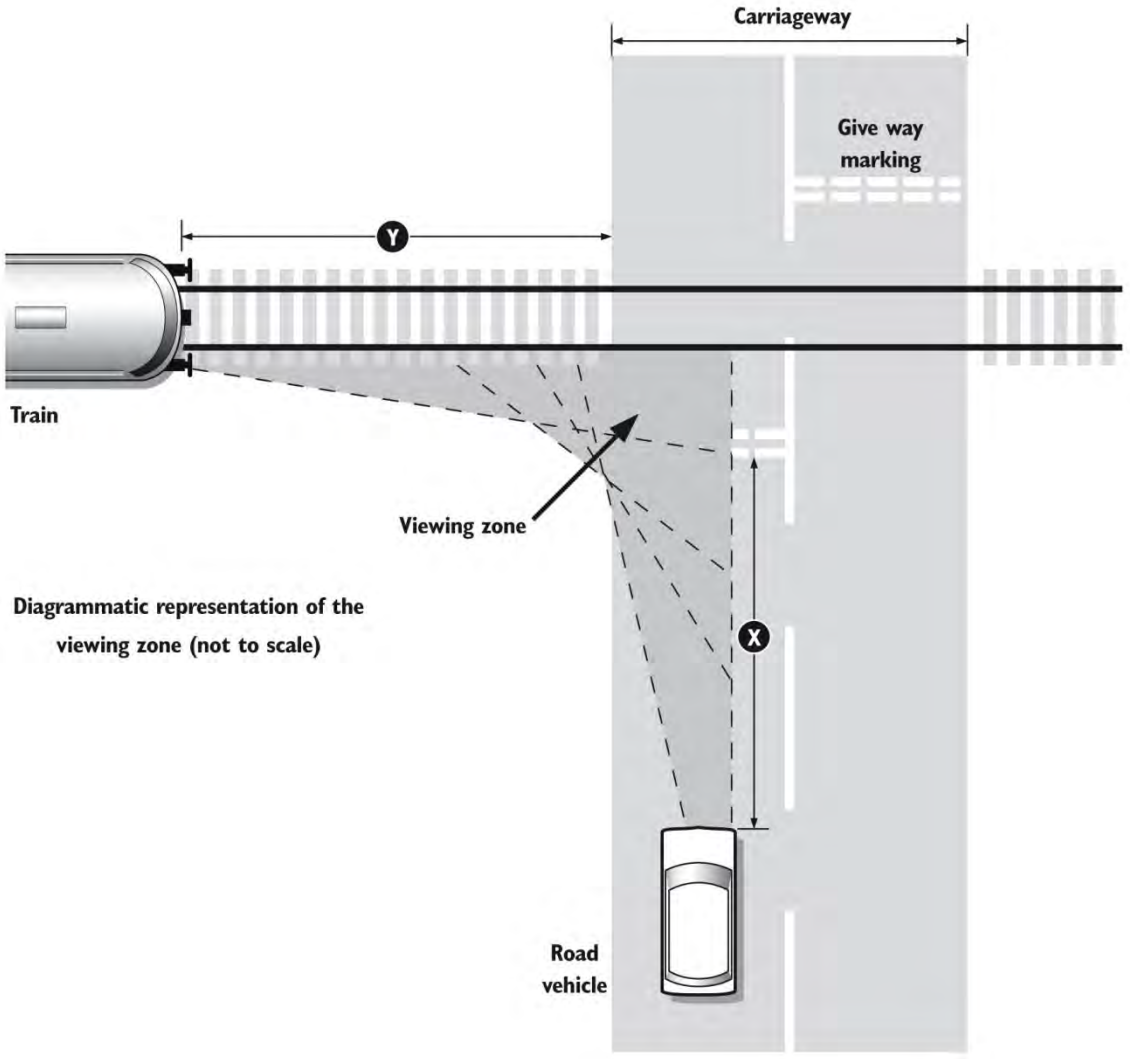


Table 12: Viewing zones			
Distances 'x' (metres)	Distances 'y' (metres) for crossing lengths of:		
	7 m	**14 m**	**21 m**
2	**140**	**170**	**200**
10	**40**	**45**	**55**
20	**25**	**30**	**35**
40	**20**	**25**	**30**

Distance 'X' is the distance of road vehicle users from the 'give way' line on the approach. Distance 'Y' is the distance of an approaching train from the crossing. A crossing which crosses the railway at right angles over a single line is normally considered to be 7 m long, but at longer crossings it should be possible to see trains earlier. Where road gradients are steep, distances 'X' should be varied accordingly. Where the 85th percentile road speed is less than 15 mph (25 km/h), the maximum value of 'X' may be 20 m.

Appendix D - Train pedestrian value (TPV) calculation

1 TPVs are calculated by multiplying the number of pedestrians who pass over the railway by any route at the crossing within any period of 15 minutes by the number of trains passing over the crossing in the same period.

2 Normally a census should be taken over a nine day period, between the hours 06.00 and 24.00, particularly where high volumes or vulnerable groups of pedestrians are involved. Where the number of pedestrians is low, the actual number may be determined by an estimate. Where there are regular events which boost pedestrian usage, these should be included in the census.

3 Where the data are obtained from a census, only the maximum number of pedestrians in any period of 15 minutes in the day needs to be established. Where an estimate is accepted, the number of pedestrians used in calculating TPV should be deemed to be 75% of the largest hourly value to obtain an equivalent maximum figure for a period of 15 minutes to cater for the non-uniform distribution of pedestrian flow.

4 The number of trains should be deemed to be 25% of those passing over the crossing in a period of one hour. This hour should be either:

(a) the same hour used to give the estimated hourly value of numbers of pedestrians; or

(b) the hour which includes the 15 minutes when the pedestrian number is established by census.

5 The number of trains should be rounded up to the next integer and should not normally be less than one

Appendix E - ORR level crossings team – Contact details

The ORR Level Crossings Team can be contacted at the Office of Rail Regulation, 3rd Floor, One Kemble Street, London, WC2B 4AN
Telephone: 0207 282 2000.

All submissions (both consultation and requests for orders) should be made to this address rather than direct to any out-based office or inspector. Core operating times are Monday to Friday, 09:00-17:00, though some staff may be available both before and after these times via ORR switchboard telephone number 020 7282 2000.

In addition, a number of local inspectors, working in the Network Rail routes or the heritage sector, take a significant role in the assessment of schemes. These inspectors may be used as the first point of contact for day-to-day enquiries.

Appendix F - Level Crossings Act 1983

Level Crossings Act 1983, as amended by the Transport and Works Act 1992, Level Crossings Regulations 1997, Railways Act 2005 and Road Safety Act 2006

1 -(1) Subject to the following provisions of this section, the Secretary of State may, in relation to any place where a railway crosses a road on a level (in this section referred to as a "level crossing"), by order provide for the protection of those using the level crossing.

(1A) Subsection (1) above applies whether or not the crossing is in use when the order is made; and if it is not in use when the order is made the order shall be made so as to come into force when it is in use.

(2) An order under this section may make such provision as the Secretary of State considers necessary or expedient for the safety or convenience of those using the crossing; and, in particular –

(a) may require the operator of the crossing or the local traffic authority (or both) to provide at or near the crossing any protective equipment specified in the order and to maintain and operate that equipment in accordance with the order; and
(b) may impose on the operator requirements as to the operation of the railway at or near that crossing.

(3) While an order is in force under this section in relation to a level crossing –

(a) (repealed)

(b) subject to any exceptions specified in the order, any provision made by or under any enactment as to the crossing (or level crossings including that crossing) and imposing requirements as to protective equipment at or near the crossing, the supervision of the crossing (including the provision of buildings for the purposes of supervision) or the operation of the railway at or near the crossing shall not apply in relation to the crossing.

(4) Nothing in subsection (3)(b) above affects any provision as to traffic signs made under the Road Traffic Regulation Act 1967; but a traffic sign placed on or near a road in pursuance of an order under this section shall be treated for the purposes of section 54(4) of that Act as having been placed as provided by that Act.

(4A) Nothing in subsection (3)(b) above affects any provision made by or under Part 1 of the Health and Safety at Work etc. Act 1974.

(5) An order under this section –

(a) may be varied or revoked by a subsequent order under this section; and

(b) may impose requirements as to protective equipment provided before the making of the order.

(6) The Secretary of State may make an order under this section in respect of a level crossing on being requested to do so by the operator of the crossing or without a request by the operator.

(6ZA) The Secretary of State may not make an order without a request by the operator unless:

(a) he has consulted the Office of Rail Regulation and the local traffic authority about the order he proposes to make; and

(b) having done so, he has sent to the operator, the Office of Rail Regulation, and the local traffic authority a copy of a draft order he proposes to make and a notice specifying the period (not being less than two months) within which they may make representations to him in respect of his proposal to make the order.

(6A) Where the Office of Rail Regulation gives written notice to an operator of a crossing that in its opinion a request should be made to the Secretary of State to make an order under this section in respect of that crossing and the notice states the reasons for that opinion, the operator shall be under a duty to make such a request.

(7) Where the operator of a crossing requests the Secretary of State to make an order under this section, the request shall be accompanied by a draft of the order which the operator is requesting the Secretary of State to make.

(8) Before making a request the operator–

(a) must consult the Office of Rail Regulation and the local traffic authority about the draft order he intends to submit to the Secretary of State; and

(b) having done so, must give written notice to the Office of Rail Regulation and the local traffic authority of his intention to make a request.

(8A) A notice given under subsection (8)-

(a) must be accompanied by a copy of the draft order which the operator intends to submit to the Secretary of State; and

(b) must specify the period (not being less than two months) within which the Office of Rail Regulation and the local traffic authority may make representations to the Secretary of State in respect of the request.

(9) The Secretary of State shall consider any representations made to him pursuant to subsection 6ZA or 8A above if they have been made within the period specified in the notice referred to in the subsection concerned and may then, if he decides to make the order, make it in accordance with the draft sent to persons pursuant to the subsection concerned or with such modifications as he thinks fit.

(10) This section applies where a Government department is operating a railway at a level crossing as it applies in other cases.

(10A) Any order made under section 124 of the Transport Act 1968 or section 66 of the British Transport Commission Act 1957 and in force immediately before 1st April 1997, including any requirements or conditions laid down under the order, shall have effect as if it had been made under this section.

(10B) In performing his functions under this Act the Secretary of State shall take account of any advice given to him with respect thereto by or on behalf of the Office of Rail Regulation.

(11) In this section –

"barrier" includes gate;

“local traffic authority”, in relation to a crossing, means the authority which for the purposes of the Road Traffic Regulation Act 1984 is the local traffic authority for the road crossed by the railway at the crossing;

"operator", in relation to a crossing, means any person carrying on an undertaking which includes maintaining the permanent way;

"protective equipment" includes barriers, lights, traffic signs, manual, mechanical, automatic, electrical, telephonic or television equipment or other devices;

"road" means any highway or other road to which the public has access; and

"traffic sign" has the same meaning as in the Road Traffic Regulation Act 1984.

2.- (1)This Act may be cited as the Level Crossings Act 1983.

(2) This Act shall come into force at the end of the period of three months beginning with the day on which it was passed.

(3) This Act does not extend to Northern Ireland.

Appendix G - Supporting documentation - level crossing order assessment checklist

Items on this list will normally be required, but you will need to consider the particular circumstances at each individual level crossing to determine whether all the items listed are required, or whether additional documentation may be needed to support your assessment.

Major works at existing level crossings, including change in protection method, complete renewal or major modernisation

1) An outline project description and risk assessment, together with justification that the type of protection proposed is suitable for current or foreseeable road and rail traffic levels. As a minimum, to be suitable and sufficient, the risk assessment process will need to:

- Identify all the hazards at the crossing for each type of user. Consider all possibilities including foreseeable misuse, seasonal variations and abnormal working. Design should eliminate risk where reasonably practicable.

- Evaluate the risks posed to all users, road and rail, by the identified hazards. Consider the likelihood of an accident and the probable results. Level crossing accidents are usually serious, and have the potential to be catastrophic.

- Consider how risks might arise or change over the expected life of the crossing.

- Identify how, and to what extent, the chosen measures control risk. Taking into account the important issue of road-user convenience, all reasonably practicable steps to reduce risk should be taken. Explain how the chosen risk control measures will maintain or, preferably, improve on previous safety arrangements.

- Identify any residual risks and be able to justify why no further action is warranted.

- Be recorded and clearly reflected in the design and installation of the Crossing.

Practical guidance on recording assessment findings

Regulation 3 of the Management of Health and Safety at Work Regulations 1999 requires the making of a ‘suitable and sufficient’ health and safety risk assessment for the purpose of identifying the measures that need to be taken to comply with the relevant law. The *significant findings* of the assessment should be recorded.

i. The simple purpose of all this is to help dutyholders make good decisions in compliance with the law. The record of assessment will set out the reasoning behind those decisions. A written record will also be a convenient means for showing others that a proper process has been followed. The selection of protection arrangements should be based on the findings of the risk assessment.

ii. In making decisions about risk reduction, regard must be given to the 'general principles of prevention' set out in schedule 1 of the above Regulations, whereby avoidance of risk is the first choice and issuing instructions is the last. A reference to the approved code of practice and guidance to the Management of Health and Safety at Work Regulations 1999 can be found in Appendix H – Publications.

iii. There is no single 'right way' of setting out assessment findings. There is no set style or length, though railway infrastructure managers may find it helpful to develop their own standardised formats. In most cases it should be possible to present the significant findings of assessment in a concise manner. There is much up to date information freely available on the topic of safety at level crossings. Railway infrastructure managers should be quite capable of undertaking, in-house, risk assessments and presenting their findings to a good standard. They will, of course, need to take into account the advice, and responsibilities, of other stakeholders, such as local traffic authorities.

iv. The record of assessment should be presented as a single, identifiable, document or bundle of information. Where necessary, and to avoid duplication, reference should be made to other documents such as ground plans, census results, published safety statistics, etc. In many cases a quantitative risk modelling process is used in support of the assessment. This is good, though care needs to be taken to ensure that the workings, sensitivities and limitations of any such process are understood by all concerned.

v. The record of assessment should:

- Describe when and how the assessment was undertaken and who was involved, i.e. the users of user worked crossings;
- Make clear what input data was used and confirm steps taken to ensure its accuracy;
- Explain how assessment findings have been interpreted and 'sense checked' by competent persons;
- Record the arrangements put in place to control risk, providing the reasoning for their selection or, in the case of measures not used, rejection. In determining the cost-effectiveness of new safety measures, pricing should be in line with the competitive market;
- Give proper consideration to the needs of crossing users whether in vehicles or not and whether at public or private.

2) Ground plans showing the level crossing at a scale of 1:50 or 1:100.

3) A plan, at a suitable scale, showing the highway approaches and positions of all proposed signs and road markings and a sketch showing the position of road traffic signals and barriers.

4) For all automatic crossings, half barrier crossings (not locally monitored) and relevant vehicular user worked crossings, a scale drawing detailing the category of road profile proposed, and showing the vertical road profile across the full width of carriageway over the crossing and on all approaches along the length of

the carriageway for a distance of 30 m from the nearest rail. The drawing should demonstrate that the claimed profile is achieved. (Items 3, 4 and 5 can be presented on one drawing).

5) As appropriate to the submission, signalling scheme plans (or relevant parts) showing:

a) for Automatic Half Barrier Crossings (AHBC)

'Strike-in points', control tables for protecting signals if there are station controls or similar within the scheme, distance of protecting signals from the crossing and line speeds and calculations relating to the acceleration of trains, where required.

b) for Automatic Half Barriers Locally Monitored (ABCL) and Automatic Open Crossings Locally Monitored (AOCL)

The position of stop boards, special speed restriction boards (SSRB), advance warning boards (AWB), 'strike-in points', details of the calculations and standards used to position the boards and strike-in points, gradients and line speeds (please contact ORR in advance of making any AOCL or ABCL submission if other signalling alterations are proposed in the vicinity of the level crossing).

c) for Automatic Open Crossings Locally Monitored (AOCL)

A robust, comprehensive, risk assessed justification for the continued provision of AOCL type crossing equipment (or Manually Operated Crossings Locally Monitored) rather than any form of barrier crossing will be required in all cases. Orders for new AOCL crossings will not normally be considered.

d) for Open Crossings (OC)

The position of stop boards, special speed restriction boards (SSRB), advance warning boards (AWB), calculations and standards used to position the boards, gradients, line speeds and details of the viewing zone proposed.

e) for Manually Controlled Barriers with CCTV (MCB CCTV) and for Manually Controlled Barriers (MCB)

The position of protecting signals and control tables, the position of 'strike-in points', if authority for auto-lowering is sought, gradients and line speeds.

f) for Miniature Stop Light crossings (MSL)

'Strike-in points', control tables for protecting signals if there are station controls or similar within the scheme, distance of protecting signals from the crossing, line speeds and details of authorised usage of the crossing.

6) A detailed road traffic census (covering all user types) covering a minimum of a representative 9-day period between 0600-2400 hours to accompany all automatic crossing submissions, particularly AOCL, and at MCB CCTV crossings, if authority for auto-lowering is sought. Seasonal variation in traffic levels should be addressed in any supporting census analysis. Permitted and normal road traffic approach speeds should be included. Rail traffic census details should also be supplied. Recent (less than 18 months old) traffic census information should be available if requested for other submissions. (A project may be delayed

if this information has not been taken into account.) Anticipated barrier down-time should be considered if significant changes are proposed, for example conversion from AHB to MCB.

7) Photographs of the existing level crossing from all road and rail approaches.

8) For new MCB CCTV level crossings or where the signaller's control arrangements are changed, an ergonomics/human factors report on the proposed signaller control functions, workload and furniture layout is required.

9) A statement of the status of the crossing, for example 'private road with public bridleway and footpath' and, if a public vehicular crossing, reference to the authority under which the railway is permitted to cross the road on the level - the original railway Act.

10) A draft level crossing order (or draft variation order) and a request addressed to the Secretary of State for Transport for consideration of the draft, along with copies of the covering letters sent to the statutory consultees.

11) Confirmation of the consultation with local authorities and ORR, with details of any matters raised and resultant changes.

Minor works at existing level crossings

12) A statement of compliance with standards and regulations signed by a competent person within the crossing operator's organisation.

13) An outline description and risk assessment of the proposed work.

14) A draft level crossing order (or draft variation order) and a request addressed to the Secretary of State for Transport for consideration of the draft, along with copies of the covering letters sent to the statutory consultees.

15) Confirmation of the consultation with local authorities and ORR, with details of any matters raised and resultant changes.

16) Items 3-9 above, as appropriate.

Appendix H - Legislation and publications

Legislation

The Railway Clauses Consolidation Act 1845 and the Railways Clauses Consolidation (Scotland) Act 1845

Road and Rail Traffic Act 1933

The Electricity at Work Regulations 1989 (Statutory Instrument No 1989/635)

New Roads and Street Works Act 1991

Transport and Works Act 1992

The Town and Country Planning and General Development Procedure Order 1995 (Statutory Instrument No. 1995/419)

The Private Crossings (Signs and Barriers) Regulations 1996 (Statutory Instrument No1996/1786)

Railway Safety (Miscellaneous Provisions) Regulations 1997
(ISBN 0-7176- 1262-7)

The Provision and Use of Work Equipment Regulations (PUWER) 1998 (Statutory Instrument No 1998/2306)

Railway Safety Regulations 1999 (ISBN 0-7176-2442-0)

The Management of Health and Safety at Work Regulations 1999 (Statutory Instrument No 1999 3242)

Level Crossings Act 1983 (as amended by the Level Crossings Regulations 1997 and the Road Safety Act 2006)

The Railways and Other Guided Transport Systems (Safety) Regulations (ROGS) 2006 (Statutory Instrument No. 2006/599) as amended by The Railways and Other Guided Transport Systems (Safety) (Amendment) Regulations 2011

The Construction (Design and Management) Regulations 2007 (Statutory Instrument No 2007/320)

The Traffic Signs Regulations and General Directions 2002 (as amended by the Traffic Signs (Amendment) Regulations and General Directions 2008 -Statutory Instrument No 2008/2177)

The Equality Act 2010

Publications

A guide to the Level Crossing Regulations 1997 L97 (ISBN 0 7176 1261 9)

Approved Code of Practice: Safe use of work equipment. Provision and use of work equipment regulations 1998 L22 HSE Books 2008 ISBN: 9780717662951

The Traffic Signs Manual, Chapters 4/5, (ISBN 978 0 11 552411 0 and ISBN 0 11 5524797), found on DfT's website at: http://www.dft.gov.uk/pgr/roads/tss/tsmanual/

Installation of Traffic Signals and Associated Equipment (ISBN 0 11 552008 2)

Safety at Street Works and Road Works, Code of Practice
(ISBN 0 11 551958 0)

Railway Group Standards and Network Rail Line Standards and Codes of Practice

Guidance on the use of Tactile Paving Surfaces (rev June 2007) found on DfT's website at:
http://www.dft.gov.uk/transportforyou/access/peti/guidanceontheuseoftactilepav6167

Prevention of Trespass and Vandalism on Railways - a good practice guide
(ISBN 0 7176 1661 4)

Appendix C

Key

- Northern Distributor Road
- Indicative Woodland creation
- Indicative Grassland creation
- Indicative Scrubland creation
- Existing Woodland
- Existing pond, lake or river
- Proposed Site Compound
- Proposed Temporary Topsoil Storage area
- Proposed Temporary Traffic Diversion (to complete tie-in)
- Proposed Culverts
- Proposed Drainage Lagoons
- Proposed Bat Gantry
- Existing Footpaths
- Existing Restricted Byways (RB) and Bridleways (BR)
- Proposed Cycle Tracks (with right of way on foot)
- Proposed Footways/Cycleways
- Proposed Bridleways
- Proposed Private Means of Access (PMA)
- Proposed Turning Heads (some with combined Field Access)
- Proposed Swales
- Proposed Ditches
- Chainage

Plan to be read in conjunction with the Development Consent Order. Regulation 5(2)(o)

Metres 5 0 5 10 15 20 25 30 35 40 45 50 Metres

Approx extents of project topographical survey

Alternative alignment over Railway Lines. Based on previous Value Engineering Drg R1C093-R1-1138, with amended minimum clearance between rail levels and proposed road levels of 6.9m

Present Design Proposals

Railway Bridge

Plumstead Rd

Plumstead Rd Junction

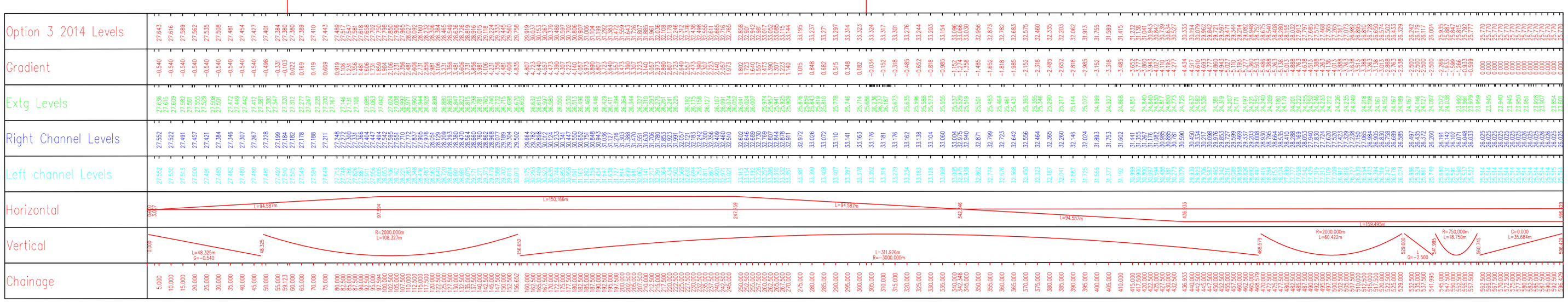
6.9m

Railway Lines at approx ch 306.5m (Northbound west rail)

Existing Levels between ch00 - 360 are beyond extents of project topographical survey and are estimated only.

Scales:
1:1000 horiz.
1:100 vert.

Level Datum =22.000



Norfolk County Council
Mott MacDonald
Birse Civils

Tom McCabe
Interim Director of Environment
Transport and Development
Norfolk County Council
County Hall, Martineau Lane
Norwich NR1 2SG

DRAWING TITLE

Norwich Northern Distributor Road
Plumstead Rd Land Owner Design Issues
Alternative Crossing over Railway (Option3 from 2007)

REV.	DESCRIPTION	CHECKED	DATE
A	Alternative option 3 over Rail Lines at Rackheath	MK	07/14

	INITIALS	DATE
SURVEYED BY	OS	2013
DESIGNED BY	DJB	07/14
DRAWN BY	DJB	07/14
CHECKED BY	MKu	07/14

DRAWING No. R1C093-R1-1138A
PROJECT TITLE: Norwich Northern Distributor Road
SCALE 1:1000 @ A1
FILE No. R1C093

ORIGINAL SIZE: A1

BIL 06/08/12