

Norfolk Boreas Offshore Wind Farm

Appendix 24.33

A47 Substation Access Clarification Technical Note

Environmental Statement

Volume 3

Applicant: Norfolk Boreas Limited
Document Reference: 6.3.24.33
RHDHV Reference: PB5640-006-2433
Pursuant to APFP Regulation: 5(2)(a)

Date: June 2019
Revision: Version 1
Author: Royal HaskoningDHV

Photo: Ormonde Offshore Wind Farm

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Norfolk Vanguard Offshore Wind Farm Substation Access Briefing Note

Applicant: Norfolk Vanguard Limited
Document Reference: ExA; ISH1; 10.D4.2
Deadline 4

Date: March 2018

Photo: Kentish Flats Offshore Wind Farm



Note / Memo

**HaskoningDHV UK Ltd.
Transport & Planning**

To: Highways England
From: Norfolk Vanguard Ltd
Date: 12 March 2019

Our reference: T&PPB4476N007D.1
Classification: Project related

Subject: Norfolk Vanguard, A47 Substation Access Clarification Technical Note

1 Introduction

This A47 Substation Access Clarification Technical Note (SACTN) has been prepared on behalf of Norfolk Vanguard Ltd in relation to the Norfolk Vanguard Offshore Windfarm Project ('the Project') to respond to Highways England's review of the A47 Substation Access Technical Note (SATN), (Royal HaskoningDHV, March 2018)

The SATN (**Appendix A** refers) contains a review of five access options for the following project infrastructure sites (Note, these options cover both construction and operational accesses):

- Onshore Project Substation;
- Mobilisation Area 1 (MA1a); and
- National Grid Substation Extension (NGSE).

AECOM, on behalf of Highways England, reviewed the findings of the SATN and formally responded in a series of technical notes setting out the requirements to secure 'Agreement in Principle' (see **Table 2.1** below and **Appendix B**). Final technical approval would be secured post consent through the submission of a detailed Access Management Plan (in accordance with Requirement 22).

As a precursor to addressing Highways England's comments, an A47 Substation Access Briefing Note (SABN), (Royal HaskoningDHV, December 2018) was issued and followed up with a meeting with Highways England with the objective of agreeing the scope of further technical work to satisfy Highways England's requirements. This SACTN provides the outputs of that agreed technical work and includes clarifications and updated Project information.

2 Consultation

A summary of the recent consultation feedback received from Highways England specific to the A47 accesses is contained within **Table 2.1**.

Table 2.1 A47 Substation Access Consultation Feedback

Date	Engagement Method	Summary
17.05.2018	Briefing Note 03 – A47 Substation Access Technical Note Review produced by Aecom.	Response to Norfolk Vanguard A47 Substation Access Review Technical Note (Royal HaskoningDHV, March 2018)
17.12.2018	Meeting	Agenda item to discuss technical requirements for A47 Accesses.
04.01.2019	Briefing Note 04 – Technical review of design standards produced by Aecom.	DMRB ¹ technical review of A47 Substation Access B drawing TP-PB4476-DR014-D.03.
15.01.2019	SOCG, Highways England.	Acknowledgement of Norfolk Vanguard Ltd's commitment to producing a SACTN in the first quarter of 2019.
16.01.2019	Briefing Note 06 – DMRB Technical review of design standards 2 produced by Aecom.	DMRB technical review of A47 National Grid Substation Access A drawing TP-PB4476-DR012-D.03 and National Grid Overhead Line Modifications Works Access D1 drawing TP-PB4476-DR015-D0.1.

3 Scope of this SACTN

The scope of this SACTN is as follows:

- 1) Present the Project traffic demand (extrapolated from the Environmental Statement Chapter 24 Traffic and Transport) for the relevant project infrastructure sites;
- 2) Set out the preferred access strategy for each of the relevant project infrastructure sites;
- 3) Clarify the traffic movements and the traffic management approach associated with the preferred access strategy; and
- 4) Provide preferred access design drawings for technical approval.

4 Updated Norfolk Vanguard Traffic Demand

During the construction phase of the Project, Heavy Goods Vehicles (HGVs) and workforce traffic will require access to project infrastructure sites south of the A47, namely the:

- Onshore project substation
- Mobilisation area 1a
 - MA1a – West (traffic serving the 400kv cable installation between the onshore project substation and the NGSE);
 - MA1a – East (traffic serving the onshore cable route to the east of the onshore project substation);
 - and
- National Grid substation extension (NGSE).

A subset of National Grid's construction traffic will need to access the field to the north of the A47 to complete the Overhead Line Modification (OHLM) works.

¹ Design Manual Roads and Bridges incorporating TD 42/95 Geometric Design of Major/Minor junctions (DMRB Volume 6 Section 2 Part 6, January 1995) and TD 41/95 Vehicular Access to All-Purpose Trunk roads, (DMRB Volume 6 Section 2 Part 7, March 1995)

Forecast vehicle trips have been extrapolated from Environmental Statement Chapter 24 Traffic and Transport (Document 6.1) (and are reproduced within **Table 4.1.**)

Table 4.1 Norfolk Vanguard Traffic Demand

Norfolk Vanguard Work Activity	Daily Movements		Peak Hour Movements	
	LCVs	HGVs	LCVs	HGVs
Onshore Project Substation	100	54	50	6
National Grid Substation Extension	100	68	50	7
MA1a-West	40	48	20	5
MA1a-East	40	48	20	5
OHLM works*	4	20	2	2
Totals	284	218	142	23
Total Vehicle Movements	502		165	
LCV = Light commercial Vehicle				
<p>A total of 200 HGVs and 40 LCV movements will be required to access north off the A47 to complete the Overhead Line Modifications work. These movements would be conducted over two separate construction peaks lasting a week each and * separated by a gap of four to six months. It should be noted that these numbers have been assessed and are presented in the ES for the NGSE and are not in addition to the numbers used therein. The numbers presented in Table 4.1 represent daily and peak hour movements.</p>				

Table 4.2 details the peak daily HGV movements and the programmed length of duration. For comparison purposes, the average daily HGV movements (outside of the peak duration) have also been detailed within **Table 4.2.**

Table 4.2 Norfolk Vanguard Daily Peak and Average HGV Movements and Durations

Infrastructure	Peak Daily HGV Movements	Peak Duration	Average Daily HGV movements	Average Duration
Onshore Project Substation	54	<ul style="list-style-type: none"> 12 weeks for mobilisation 12 weeks for demobilisation 	14	76 weeks
National Grid Substation Extension	68	<ul style="list-style-type: none"> 8 weeks for mobilisation 8 weeks for demobilisation 	10	70 weeks
MA1a-W	48	12 weeks	20	4 weeks
MA1a-E	48	40 weeks	12	30 weeks
OHLM works	20	2 weeks	n/a	n/a
Totals	218	n/a	56	n/a

5 Preferred Access Strategy

Table 5.1 details the preferred access strategy for each of the relevant project infrastructure sites, the locations of the accesses are presented in **Appendix C**.

Table 5.1: Preferred Access Strategy

Access ID (DCO Schedule ref.)	Access Description	Access to Infrastructure Sites	Eastings	Northings
A (AC 181)	An upgraded DMRB compliant rural simple junction with a 'no right turn' temporary traffic management strategy at the existing Necton National Grid Electricity Substation access	NGSE	588435	310734
B (AC 183)	A new DMRB compliant right turn ghost island junction – all movements permitted (Spicer's Corner).	NV onshore project substation MA1a-West MA1a-East	589285	311409
D1 (AC 182)	An upgraded DMRB compliant rural simple junction with a 'no right turn' temporary traffic management strategy at existing field access.	NG OHLM	588668	310932

6 Traffic Management Strategy

A traffic management strategy has been developed for each access which is proportional to the forecast traffic demand and the duration of that impact.

Access A and D1 (National Grid works)

Both Accesses A and D1 will be DMRB compliant rural simple junctions with a 'no right turn' temporary traffic management strategy. The temporary traffic management strategy proposed for Access A and Access D1 is to utilise a left turn in / left turn out only. This would entail any potential right turning construction vehicles to divert and perform the following 'u-turn' manoeuvres:

1. Westbound traffic to utilise the 'McDonalds Roundabout' located on the A47 / Norwich Road roundabout junction approximately 2.8 miles west of Access A near Swaffham. **Figure 1** graphically depicts the construction vehicle diversion route.
2. Eastbound traffic to utilise the eastbound offramp off the A47 and turning right onto Tavern Lane. At the traffic signal-controlled junction with the A1075 (Yaxham Road) at Dereham, construction vehicles would turn right and proceed south east under the A47 taking the westbound onramp back onto the A47. **Figure 2** graphically depicts the construction vehicle diversion route.

It is not possible to provide two-way HGV entry/exit at Access D1 due to land constraints and therefore further traffic management measures are required to ensure two HGVs do not meet in the 'bell mouth' and obstruct the flow of traffic on the A47. All site bound HGVs destined for Access D1 will temporarily park at a segregated layby approximately two miles west of the site. From here, the drivers will communicate with a designated contact at the site to ascertain that no HGVs are leaving the site. Once, confirmed the driver will continue their journey and enter access D1 unopposed. The location of the layby is detailed in **Figure 1**. It is considered the traffic management strategy is appropriate in this instance due to the temporary nature of the access and the low daily numbers of HGV's (10 incoming and 10 outgoing).

Access B (NV onshore project substation, MA1a-West and MA1a-East)

A DMRB compliant right turn ghost island junction – all movements permitted. No temporary traffic management (including diversion manoeuvres) is required to support the access strategy for this location.

Traffic Distribution and Assignment

This sub-section quantifies the traffic that will be required to undertake the diversion manoeuvres for Access A and D1.

As detailed within the Chapter 24 of the ES (Royal HaskoningDHV, July 2018) materials would likely be imported from ports local to the project. Kings Lynn Port to the west and Lowestoft/Great Yarmouth to the east are considered the most likely source for all materials. As further identified in Paragraph 178 of Chapter 24, it was assumed that up to a maximum of 70% of traffic could be generated from either port location. Thus, **Table 6.1** details the two traffic distribution scenarios which inform the potential traffic demand at each diversion junction.

Table 6.1 Traffic Distribution Scenarios

Scenario	Kings Lynn (west)	Great Yarmouth / Lowestoft (east)
Scenario 1	70%	30%
Scenario 2	30%	70%

Appendix D details the peak daily traffic demand generated from each access and the corresponding turning movements including the required u-turn movements for each traffic distribution scenario.

Appendix E graphically depicts the turning movements via a series of network flow diagrams detailing the am, pm and daily peak construction flows for both HGVs and employees for both traffic distribution scenarios. **Table 6.2** and **Table 6.3** detail a summary of the am and pm peak worst case u-turn movements at each identified junction for both traffic distribution scenarios.

Table 6.2: Traffic Distribution Scenario 1 Summary

	AM		PM	
	U-turn at McDonalds Roundabout	U-turn at Dereham	U-turn at McDonalds Roundabout	U-turn at Dereham
HGVs	1	3	1	3
Employees	1	17	33	1
Totals	2	20	34	4

Table 6.3 Traffic Distribution Scenario 2 Summary

	AM		PM	
	U-turn at McDonalds Roundabout	U-turn at Dereham	U-turn at McDonalds Roundabout	U-turn at Dereham
HGVs	3	1	3	1
Employees	1	17	33	1
Totals	35	19	36	2

It can be noted from **Table 6.2** and **Table 6.3** that the worst case scenario for u-turning traffic movements at the McDonalds roundabout would be during Traffic Distribution Scenario 2 with 36 construction vehicles (3 HGVs) utilising this route during the PM peak. Dereham would experience a worst case scenario of 20 construction vehicles (3 HGVs) during Traffic Distribution Scenario 1 am peak.

The respective peak movements through both u-turn junctions would be indiscernible from day to day traffic fluctuations and therefore represents a negligible impact on junction capacity and driver delay.

7 Proposed Access Designs

As detailed in **Table 2.1**, AECOM on behalf of Highways England, produced two DMRB Technical Reviews (BN04 and BN06) of Access A, B and D1 draft design drawings. AECOM provided two categories of recommendations:

- 1) Critical to Highways England's acceptability of the application; or
- 2) Not critical but still regarded as important.

Table 7.1 details the AECOM recommendations and the Norfolk Vanguard design response.

Table 7.1: DMRB Technical Review and Responses

Access	Doc.	Highways England Recommendation	Critical / Important	Norfolk Vanguard Design Response
Access A (AC 181)	BN06	A fully compliant DMRB arrangement comprising a ghost-island right turn would represent the preferable junction arrangement at this location (para. 4.8)	Important	<p>A ghost-island junction would be a disproportional solution in context of the traffic demand set out in Table 4.2.</p> <p>A commitment will be included within the Outline Traffic Management Plan (OTMP) for an upgraded DMRB compliant simple rural junction with a 'no right turn' traffic management access strategy. To be enforced via the mechanisms presented within the OTMP.</p>
		Traffic signs and markings in accordance with national standards should be demonstrated fully at the detailed design stage (para. 4.9)	Important	A commitment within the OAMP for all traffic signs and road markings will be provided in accordance with national guidance and fully demonstrated at the detailed design stage.
		The potential to close off the southern access to the service road serving the dwelling known as the 'The Grove' should be investigated (para. 4.13)	Important	The potential for closing off the southern access of 'The Grove' will be explored. Landownership of this location is currently being investigated. This will be confirmed through the submission of the final AMP post-consent.
		Visibility splays of 4.5m x 215m from Access A in accordance with the requirements of TD 42 should be demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage (para. 4.14)	Important	<p>Horizontal visibility splay shown as achievable in drawing TP-PB4476-DR012-F1.0.</p> <p>A commitment will be provided within an update to the OAMP for a vertical visibility splay to be demonstrated during the detailed design stage when access designs will be presented on topographical surveys base layers.</p>
		A revised access layout should be proposed that would allow vehicles to enter and exit at the same time on a fully paved surface. Vehicular swept path plots should be provided in support of the revised A47 Substation Access A junction layout to demonstrate the ability of an articulated vehicle and large tipper (the design vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb of A47 centre lines (Para. 4.11)	Critical	<p>A revised drawing TP-PB4476-DR012-F1.0 has been produced detailing the two-way movements of HGVs on a fully paved surface.</p> <p>Drawings TP-PB4476-DR017-F1.0 and TP-PB4476-DR018-F1.0 demonstrate the swept paths of the Design vehicles do not overrun the kerb or centre lines of the access road or the A47.</p>

Access	Doc.	Highways England Recommendation	Critical / Important	Norfolk Vanguard Design Response
		The proposed corner radii and exit tapers at Access A should be reviewed in the context of the guidance set out in TD 42 and the grasscrete over-run area extended if necessary to provide the appropriate corner radii and tapers (para. 4.15)	Critical	Drawing TP-PB4476-DR012-F1.0 details the junction revised to incorporate a DMRB compliant rural simple junction including 15m radii with tapers of 1:10 over a distance of 25m.
Access D1 (AC 182)	BN06	A fully compliant DMRB arrangement comprising a ghost-island right turn would represent the preferable junction arrangement at this location (para. 5.2)	Important	<p>A ghost-island junction would be a disproportional solution in context of the traffic demand set out in Table 4.2.</p> <p>A commitment will be included within an update to the OTMP for an upgraded DMRB compliant simple rural junction with a 'no right turn' traffic management access strategy. To be enforced via the measures presented within the OTMP.</p>
		Traffic signs and markings in accordance with national standards should be demonstrated fully at the detailed design stage (para. 4.9)	Important	A commitment within the OAMP for all traffic signs and road markings will be provided in accordance with national guidance and fully demonstrated at the detailed design stage.
		Visibility splays from Access D1 in accordance with the requirements of TD 42 should be demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage (para. 4.14)	Important	<p>Horizontal visibility splay shown as achievable in drawing TP-PB4476-DR012-F1.0.</p> <p>Vertical visibility requirements of 215m (60mph) cannot be achieved at this location due to the nearby crest in the carriageway. An alternative solution is to provide a reduced visibility requirement of 90m via a temporary 30mph speed limit and additional traffic management measures.</p> <p>A commitment will be included within an updated OAMP to provide a reduced speed limit and vertical visibility to be demonstrated during the detailed design stage when access designs will be presented on topographical survey base layers.</p>
		The service road access should be closed and alternative provision be made to access the dwelling known as 'The Grove'. If this is not possible, Aecom recommend that appropriate corner radii are provided and swept paths and	Important	The potential for closing off the southern access of 'The Grove' will be explored. Landownership of this location is currently being investigated. This will be confirmed through the submission of the final AMP post-consent.

Access	Doc.	Highways England Recommendation	Critical / Important	Norfolk Vanguard Design Response
		visibility splays illustrated on a further revision of Drawing TP-PB4476-DR015 Rev D0.3 to demonstrate that its legitimate use by vehicles will not be compromised by the proposed new junction (Para. 5.15)		
		Vehicular swept path plots should be provided in support of the revised A47 Substation Access D1 junction layout to demonstrate the ability of an articulated vehicle (the Design vehicle) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines. The swept paths presented should also demonstrate that an articulated vehicle entering the site is able to stand clear of the carriageway whilst an articulated vehicle is exiting the field area within the limits of the order boundary shown (para. 5.9)	Critical	The traffic management access strategy for Access D1 will remove any potential conflict between incoming and outgoing HGVs at Access D1. Drawings TP-PB4476-DR023-F1.0 and TP-PB4476-DR024-F1.0 demonstrate that the swept paths of the Design vehicles do not overrun the kerb or centre lines of the access road or the A47.
		The proposed corner radii should be reviewed in the context of the guidance set out in TD 42 with respect to nearside tapers on the major and minor road exits from the junction (para. 5.14)	Critical	Drawing TP-PB4476-DR012-F1.0 details the junction revised to incorporate a DMRB compliant ghost island junction including a 15m radii with tapers of 1:6 over a distance of 30m for the minor and major road entries.
Access B (AC 183)	BN04	Vehicular swept path plots should be provided in support of the proposed A47 Substation Access B junction layout to demonstrate the ability of an articulated vehicle and large tipper (the Design vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines and extended to include the passage of the design vehicle on the access road where it bends immediately south of the junction (para 4.9)	Critical	A revised drawing TP-PB4476-DR014-F1.0 has been produced detailing the two-way movements of HGVs on a fully paved surface. Drawings TP-PB4476-DR017-F1.0 and TP-PB4476-DR018-F1.0 demonstrate the swept paths of the Design vehicles do not overrun the kerb or centre lines of the access road or the A47. The drawing demonstrates that two-way HGV movement is possible where the access road bends immediately south of the junction.
		Vehicle swept paths should be provided for an articulated vehicle and large tipper (the Design vehicles) to demonstrate that large vehicles which enter the site are able to turn within the site and exit the site onto the A47 in a forward facing direction (para. 4.10)	Critical	Drawing TP-PB4476-DR014-F1.0 includes a note detailing the movement of HGVs and a commitment for a turning area will be included within the OTMP/OAMP.

Access	Doc.	Highways England Recommendation	Critical / Important	Norfolk Vanguard Design Response
		The proposed visibility splay should be reviewed with respect to the need to achieve an 'x' distance of 4.5m on the minor arm in all but exceptionally difficult circumstances, in accordance with TD 42 (Para. 7.5) and demonstrated to be deliverable within land in the control of either in the control of either the applicant or the highway authority (para. 4.15)	Critical	<p>Increasing the 'x' distance to 4.5m will require the removal of a large proportion of established hedgerows, vegetation and trees. This will have ecological impact and would remove much of the native mature screening required to mitigate the landscape impact.</p> <p>The existing 'x' distance of 2.4m as shown in drawing TP-PB4476-DR014-F1.0 is deliverable within land controlled by Norfolk Vanguard Ltd and is deemed suitable in a 'regulated' environment.</p>
		The existing farm access track should be closed and alternative provision be made to access the land via the minor arm of Access B. If this is not possible, swept paths and visibility splays should be illustrated on a further revision of drawing TP-PB4476-DR014 Rev D0.3 to demonstrate the legitimate use by agricultural vehicles of the proposed new layout. If the farm track access is to be retained then a Relaxation to design standards is likely to be required due to the spacing of the junctions. Suitable justification for this would need to be demonstrated to obtain approval from the Overseeing Organisation. In addition, due to the apparent presence of the crest curve located to the west of the farm access junction, it should be demonstrated that the required visibility can also be achieved in the vertical plane (para. 4.17).	Critical	<p>Alternative access arrangements are being explored between Norfolk Vanguard Ltd and the landowner, whereby a single point of access may be provided at Access B for construction and farm traffic.</p> <p>Details to be finalised during the detailed design stage and a commitment will be included within the final TMP and AMP.</p> <p>A commitment will be provided within an update to the OAMP for a vertical visibility splay to be demonstrated during the detailed design stage when access designs will be presented on topographical surveys base layers.</p>
		Traffic signs and markings in accordance with national guidance should be demonstrated fully at the detailed design stage (para. 4.9)	Important	A commitment within the OAMP for all traffic signs and road markings will be provided in accordance with national guidance and fully demonstrated at the detailed design stage.

The revised access designs can be found in **Appendix F** and corresponding swept path analysis are provided in **Appendix G**.

Highways England require a Stage 1 Road Safety Audit to be carried out on each access before any agreement in principle is reached. The audits will be completed and any recommendations will be completed by Deadline 6 of the DCO Examination.

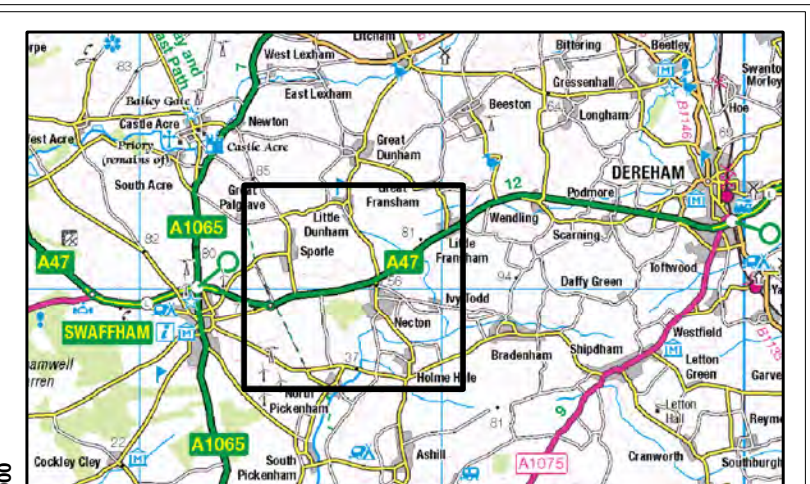
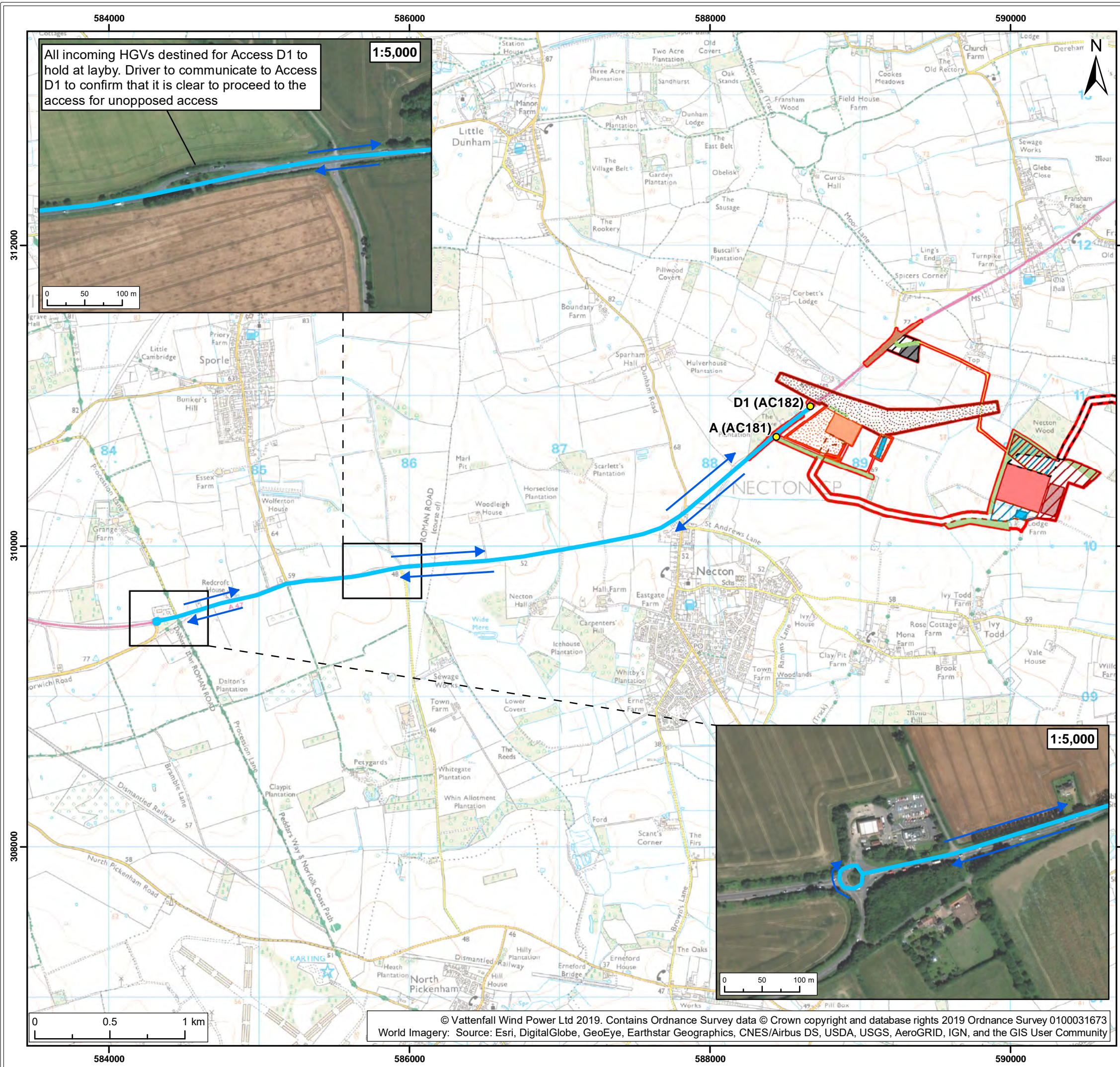
8 References

Royal HaskoningDHV (March 2018) A47 Substation Access Technical Note (SATN)

Royal HaskoningDHV (July 2018) Norfolk Vanguard Offshore Wind Farm Environmental Statement.
Chapter 24 Traffic and Transport

Royal HaskoningDHV (December 2018) A47 Substation Access Briefing Note (SABN)

9 Figures



Legend:

- Norfolk Vanguard onshore red line boundary
- Onshore cable route
- Onshore 400kv cable route
- Mobilisation zone
- Indicative mobilisation area compound
- Onshore project substation
- Onshore project substation temporary construction compound
- Indicative onshore project substation temporary construction compound
- National Grid substation extension
- National Grid temporary works
- Overhead line temporary works
- Mitigation areas
- Attenuation pond zone
- Indicative attenuation pond
- Indicative mitigation planting
- Access
- Permanent access
- Construction access
- Operation access
- Access Point ID
- Construction vehicle u-turn route
- Total 5.6 mile diversion
- Direction of travel

Project:	Norfolk Vanguard	Report:	A47 Substation Access Clarification Technical Note
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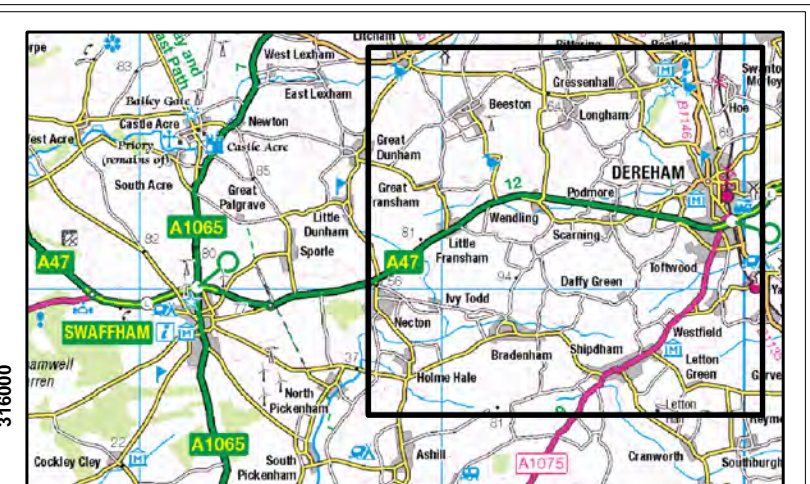
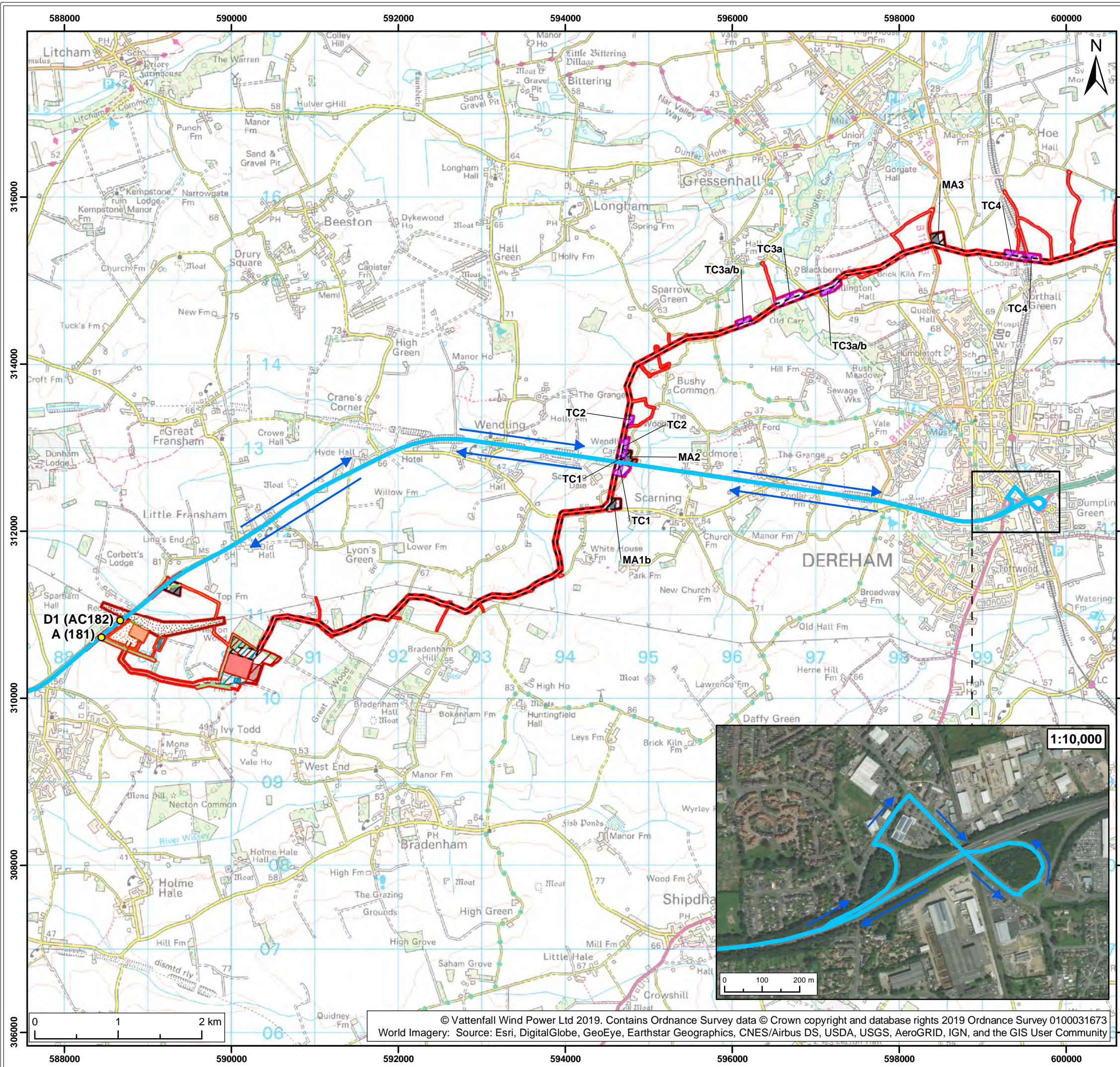
Title:
U-turn via McDonald's Roundabout

Figure:	1	Drawing No:	PB4476-008-006-006			
Revision:	Date:	Drawn:	Checked:	Size:	Scale:	
03	08/03/2019	JT	RE	A3	1:25,000	
02	04/03/2019	LB	RE	A3	1:25,000	

Co-ordinate system: British National Grid EPSG: 27700

VATTENFALL  

Royal HaskoningDHV
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Legend:

- Norfolk Vanguard onshore red line boundary
- Onshore cable route
- Onshore 400kv cable route
- Trenchless crossing zone (e.g. HDD)
- Indicative trenchless crossing compound
- Mobilisation zone
- Indicative mobilisation area compound
- Onshore project substation
- Onshore project substation temporary construction compound
- Indicative onshore project substation temporary construction compound
- National Grid substation extension
- National Grid temporary works
- Overhead line temporary works
- Mitigation areas
- Attenuation pond zone
- Indicative attenuation pond
- Indicative mitigation planting
- Access
- Permanent access
- Construction access
- Operation access
- Access Point ID
- Construction vehicle u-turn route
- Total 15 mile diversion
- Direction of travel

Project: Norfolk Vanguard
 Report: A47 Substation Access Clarification Technical Note

Title: U-turn via Dereham

Figure: 2	Drawing No: PB4476-008-006-007				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
03	08/03/2019	JT	RE	A3	1:45,000
02	04/03/2019	LB	RE	A3	1:45,000

Co-ordinate system: British National Grid EPSG: 27700

Appendix A – A47 Substation Access Technical Note

Note / Memo

**HaskoningDHV UK Ltd.
Transport & Planning**

To: Highways England and Norfolk County Council
 From: Royal HaskoningDHV
 Date: 23 March 2018
 Copy: Norfolk Vanguard Ltd
 Our reference: T&PPB4476N002F2.0
 Classification: Project related

Subject: Norfolk Vanguard Substation – A47 Substation Access Review

1 Introduction

This Technical Note (TN) has been prepared on behalf of Norfolk Vanguard Ltd in relation to the Norfolk Vanguard Offshore Windfarm Project ('the Norfolk Vanguard Project'). The note sets out a review of the Norfolk Vanguard Project onshore access options from the A47.

During the construction phase of the Norfolk Vanguard Project, Heavy Goods Vehicles (HGVs) and workforce traffic will require access to project infrastructure sites south of the A47, namely the:

- Onshore Project Substation;
- Mobilisation Area 1 (MA1); and
- National Grid Substation Extension (NGSE).

A subset of National Grid's construction traffic will need to access the field to the north of the A47 (where an electricity pylon is situated) to complete the Overhead Line Modification (OHLM) works.

Figure 01 details the project infrastructure sites and the associated access study area. The purpose of this note is to evaluate potential access options to inform the Norfolk Vanguard Project design.

1.1 Engagement

To facilitate stakeholder engagement a Transport Expert Topic Group (ETG) was established, consisting of transportation professionals from Norfolk County Council, Highways England and Norfolk Vanguard Ltd. The ETG raised a number of issues with respect to potential access off the A47 all of which have informed this technical note. **Table 1.1** details ETG and other relevant input.

Table 1.1: A47 Consultation Feedback

Consultee	Date	Comment
Highways England	27 February 2017: First Expert Topic Group Meeting	The proposed existing access off the A47 to substation site was presented. It was agreed that a review of the accident record would be undertaken if this facility was to be relied upon. Highways England explained that current policy does

		not prevent a new access from the A47 from being created, however, preference was for an existing access point to be utilised.
Highways England	7 March 2017: EIA Traffic & Transport Method Statement Response (Red:60506522/DN052.0002 BN01)	Impact on A47 at substation site near to Necton raised, requiring detailed analysis of traffic generation and a review of historic collisions.
Highways England and Norfolk county Council	17 July 2017: Second Expert Topic Group Meeting	Queries raised relating to the existing National Grid substation extension site access and potential for a new access north of the site. NCC noted a historic u-turn strategy at Dereham requiring HGV traffic to left turn into Substation Site.
Local Stakeholders	8 September 2017: Site visit with local stakeholders	Stakeholders voiced concerns in utilising a u-turn strategy at Dereham to negate the need for right turns into the substation site.
National Grid	Email correspondence	Liaison with National Grid to determine total quantity of vehicles required to access north of the A47.

2 Access Options

The accesses to be reviewed are detailed within **Table 2.1** together with the associated infrastructure sites served. The access locations are presented in **Figure 02**.

Table 2.1: Potential Accesses

Access ID	Access Description	Access to Infrastructure	Eastings	Northings
A	Existing Necton Electricity Substation access	NV onshore project substation NV MA1 NGSE	588435	310734
B	Existing Farm access	NV onshore project substation NV MA1	589285	311409
C	Existing Field and Residential Access	NG OHLM	588482	310789
D	Existing Field and Residential Access	NG OHLM	588882	311088
D1	Existing Field Access	NG OHLM	588668	310932

2.1 Access A – Existing Necton Electricity Substation Access

Access A was historically used by farmers to access the field south of the A47. In 2014 the access was upgraded to accommodate construction vehicle access for the National Grid and Dudgeon Offshore Windfarm substations collectively known as the Necton Electricity Substation (NES). The upgrade

comprised a simple T junction with grasscrete 'over-run' for abnormal loads. Construction work for the NES was completed by early 2017.

At present the access is currently shared by local farmers accessing farmland and by operational and maintenance vehicles in servicing the NES.

2.2 Access B – Existing Farm Access

Access B is a field and farm access leading south east off the A47. It comprises of a loose gravel track allowing access to various farmland and farm buildings.

2.3 Access C – Existing Field and Residential Access

Access C is a metalled access with a short driveway leading to a gated residential property. At this point the access track turns north east and runs parallel to the A47 through a wooded area for approximately 230m before entering the field with the electricity pylon. This access was proposed by National Grid as their preferred access point.

2.4 Access D – Existing Residential and Field Access

Access D is a field access located on Moor Lane approximately 270m north west of its junction with the A47. The A47/Moor Lane junction is a metalled bellmouth junction leading to a single vehicle track. Moor Lane is used to access farmland, residential properties and a number of farm buildings. This access has been proposed as an alternative to Access C by National Grid.

2.5 Access D1 – Existing Field Access

Access D1 is an existing field access located on the northern verge of the A47 approximately 300 north east of the existing NES access. The access allows immediate access to the field with the electricity pylon. This access has been identified as an alternative to Access C during the course of this study.

3 Baseline Situation

3.1 Highway Environment

The A47 trunk road is identified in the Norfolk County Council (NCC) Local Transport Plan (Norfolk County Council, 2011) as one of Norfolk's key strategic connections and is part of the Strategic Road Network, managed by Highways England.

Within the A47 access study area, the A47 is a relatively straight single carriageway road of typical road width and alignment for a trunk road and is subject to the national speed limit with no street lights present. There is a slight hill with a gradient of approximately 3%. The crest of the hill is located approximately 200m to the northeast of the existing NES access.

The A47 is bounded to the north by established hedgerows, woodland and agricultural land. The existing NES and further agricultural land is located to the south of the A47 with a number of hedgerows that border along the extent of the southern A47 verge.

3.2 Background Traffic Data

Traffic flow data obtained from the Department of Transport confirms a 24 hour Annual Average Daily Flows (AADF) of 15,380 total vehicles including 1,546 HGV component.

Speed surveys were undertaken within the access study area during August and September 2017. The location of the surveys can be observed in **Figure 03**, the results of the speed surveys are detailed **Table 3.1**.

Table 3.1: Speed Survey Results

Speed Survey ID	Date	85 th Percentile (mph) Northbound	85 th Percentile (mph) Southbound
SS1	16.09.17 to 22.09.17	55.5	54.4
SS2	22.08.17 to 28.08.17	54.1	53.5

The results of the speed surveys indicate that vehicle speeds passing the proposed site access are below the posted 60mph speed limit with, a maximum 85th percentile of 55.5 mph recorded.

3.3 Personal Injury Collision (PIC) Data

To assess whether there are any inherent road safety issues within the access study area, detailed STATS19¹ data have been obtained from NCC for the five year period, 01.05.12 to 30.04.17. **Figure 03** details the location of the PICs within the access study area and **Appendix A** provides the STATS19 data.

A review of the STATS19 data has identified two collisions occurring on the A47 within the access study area. The first collision (PIC1) occurred north east of access A and C and involved a driver travelling eastbound who fell asleep at the wheel and veered into an oncoming car. The second collision (PIC2) involved a rear end shunt which occurred when vehicles travelling eastbound braked heavily in the vicinity of 'Spicers Corner' junction. Both collisions resulted in slight injuries.

From the analysis of PICs it is concluded that there is no inherent pattern of collisions identified. Furthermore, neither of the collisions involved HGV traffic and only one (PIC2) was located within 100m of a proposed access.

It should be noted the STATS19 data sourced covers the construction period for the Necton Electricity Substation.

¹ Accidents on the public highway that are reported to the police and which involve injury or death are recorded by the police on a STATS19 form. The form collects a wide variety of information about the accident (such as time, date, location, road conditions).

4 Norfolk Vanguard Traffic Demand

4.1 Vehicle Types

The vehicle types expected to access the Norfolk Vanguard infrastructure sites during construction will include:

- concrete trucks;
- tipper trucks;
- articulated low loader vehicles;
- cranes;
- Light Commercial Vehicles (LCVs);
- site plant; and
- Abnormal Indivisible Loads. (AILs).

Forecast vehicle trips during the project construction period have been extrapolated from the recently submitted Norfolk Vanguard Preliminary Environmental Information Report and are reproduced within **Table 4.1**.

Table 4.1 Norfolk Vanguard Traffic Demand

Norfolk Vanguard Work Activity	Daily Movements		Peak Hour Movements	
	LCVs	HGVs	LCVs	HGVs
Onshore Project Substation	40	58	20	6
National Grid Substation Extension*	40	26	20	3
MA 1 (Cable Route)	40	74	20	8
Totals	120	158	60	17
Total Vehicle Movements	278		77	

* A total of 200 HGVs and 40 LCV movements will be required to access north off the A47 (Access C/D) to complete the Overhead Line Modifications work. These movements would be conducted over two separate construction peaks lasting a week each and separated by a gap of four to six months.

5 Access Standards

The required standard for each access location has been evaluated against the criteria set out in the Design Manual for Roads and Bridges (Department for Transport, 1995). **Table 5.1** summarises.

Table 5.1 DMRB Access Requirements

Access ID	Background AADT Flows		Forecast Daily Construction Flows		Existing Available Visibility (Compliant speed)			DMRB 'Right turn' Traffic Flow Criteria Met ¹	Does Existing Access meet DMRB standards?
	Tot Veh	HGV	Tot Veh	HGV	Left	Right	Vertical		
A	15,380	1,546	278	158	215m (60mph applicable)	215m (60mph applicable)	Yes	Yes – Right turn required	No
B					215m (60mph applicable)	150m (60mph applicable)	Yes		
C			24	20	215m (60mph applicable)	215m (60mph applicable)	Yes	Yes – Right turn required	No
D					113m (60mph applicable)	215m (60mph applicable)	Yes		
D1					215m (60mph applicable)	215m (60mph applicable)	No		

¹DMRB states that upgrading at existing simple junctions to provide a right turn should always be considered where the minor road flows exceed 500 vehicles 2-way AADT, a right turning accident problem is evident or where vehicles waiting on the major road to turn right inhibit the through flow and create a hazard. The key criteria stated in DMRB to provide a Ghost Island junction with a right turn facility includes the major road traffic flows exceeding 13,000 vehicles per day.

Table 5.1 shows that all five accesses currently do not conform to the standards set out in the DMRB for right-turning traffic to be accommodated and each would require engineering to be fully compliant with standards.

6 Access Reviews and Proposals.

A review of each access has been undertaken with reference to the information set out in **Sections 2, 3, 4 and 5**. An assessment of each option has been undertaken using the following parameters:

- Highway Safety;
- Environment; and
- Infrastructure requirement.

6.1 Access A Review

It is noted that the existing access arrangement is below the standard of what would be required for a modern trunk road access serving traffic of significant volumes of (side-road) traffic. To counteract this, a traffic management strategy was employed during the construction of the NES which precluded vehicles from making a right turn in, or right turn out of the site. Recognising these issues, Highways England has directed the following criteria must be met for the existing access to be considered with minimal modifications:

- 1) A review of PICs to evidence no patterns (clusters) attributable to the access design. The PIC review must cover the duration of the construction of the existing Necton Substation.
- 2) A forecast traffic demand no higher for the NES construction phase than that of the existing Necton sub-station.
- 3) A commitment from Norfolk Vanguard Limited to employ a 'no right turn traffic management strategy'.

To assist with the review, Royal HaskoningDHV has obtained anecdotal evidence from the NES substation construction contractors, Wilding Construction Ltd (WCL). WCL were responsible for site management of all partners involved in the construction of the NES (Siemens, Statoil, Laing O'Rourke and National Grid).

Criterion 1

Construction for the NES commenced in 2014 and was completed by early 2017. Construction activity peaked during summer 2016. **Section 3.3** of this report contains a review of PIC data covering these periods and concludes there was no-inherent highway safety issue.

Criterion 2

Section 4 confirms a forecast traffic demand for the construction of Norfolk Vanguard of 278 daily movements, consisting of 158 HGV movements and 120 light vehicle movements.

WCL feedback indicates at the height of the Construction works for the NES a total of 400 operatives and approximately 230 cars were accessing the site every day along with an average of 25-30 deliveries of various vehicle sizes from concrete lorries to tipper trucks.

The total NES daily peak construction traffic movements equates to approximately 520 movements per day (noting the HGV component is 60 movements).

This anecdotal evidence indicates that the forecast traffic flows for the Norfolk Vanguard Project could comfortably meet Criterion 2 albeit a higher HGV demand is predicted [to that of the NES].

Should the forecast higher HGV component be of concern to Highways England, daily movements could be controlled to NES levels by a Construction Traffic Management Plan but this would potentially impact on construction duration.

Criterion 3

The NES traffic management strategy consisted of an enforced restriction on right turns in and out of the site. This required HGV arrivals from the east to travel eastbound on the A47 turning off at the A1075 junction at Dereham and then returning westbound back to the Substation access. This journey would entail a diversion route totalling 15.5 miles.

HGV departures to the east would travel westbound to the 'McDonalds' Norwich Road Roundabout before 'u' turning and returning eastbound. This journey would entail a diversion route totalling 5.5 miles.

Light vehicles were also subject to the enforced restriction but had the option of a shorter eastbound diversion by utilising the layby at Spicers Corner to make a right turn to return westbound.

Feedback from WCL indicates the strategy (backed up with reporting and enforcement) was adhered to by all contractors (sub-station, cabling and National Grid).

If the NES traffic management strategy was applied to the Norfolk Vanguard Project, based on current forecasts this would lead to 79 HGVs per day making the 15.5 mile diversion via Dereham - a total increase of 1224.5 miles per day. This is likely to manifest in increased tender prices due to larger fleet sizes and fuel costs.

A further consideration is traffic growth subsequent to the NES consent (2012). It is conceivable that the characteristic of the highway network has changed as the economy has rallied in the region.

Specific to the diversion route, it is notable from site visits that Dereham has significant traffic congestion which particular impacts on two signalised junctions located at Tavern Lane/ Yaxham Road and Yaxham Road/ Greens Road. If NES traffic management strategy was to be implemented in the modern era it is recommended that a full assessment of capacity, delay, noise and air quality is undertaken for the Dereham diversion route.

To alleviate the restrictions associated with utilising the existing junction arrangement a standard DMRB² compliant design has been considered at this location (notated as Access A1).

The following subsections review Access A and A1 in context with the adopted study parameters.

Highway Safety

From a highway safety perspective, Access A currently provides the requisite highway visibility of 215m for a 60mph road in both directions. Within the visibility envelope the highway has a straight horizontal alignment with a slight gradient which rises to the eastbound. DMRB Compliant vertical visibility is achievable for Access A.

Access A1 would also achieve all the highway safety parameters as detailed for Access A.

Environmental Impact (Access A)

No significant vegetation clearance is required to obtain visibility splays. As previously noted, there are indirect environmental impact concerns with respect to the diversion route through Dereham.

Environmental Impact (Access A1)

From an ecology perspective, approximately 772m² of vegetation would need to be removed to allow for widening of the A47 and additional visibility splay envelopes. The timescales would be dictated by seasonal constraints.

Infrastructure Requirements (Access A1 only)

The following infrastructure improvements would be required:

- Removal of the existing grasscrete.
- Widening of the A47 carriageway to include a right turn lane and ghost island facility.
- Removal of existing vegetation to allow for highway widening and visibility splays.
- Realignment and widening of existing access approach to cater for a 7.3m approach width allowing passing of two HGVs.
- Construction of new a new bellmouth with 15m corner radii (potentially wider for abnormal loads).

In addition, there will be increased costs related to traffic management to allow existing NES and farm traffic to continue to use the access.

² Design speed of 100km/h (60mph) including ghost island right turn facility with turning lane width of 3.5m and queuing storage length of 49.5m.

The widening of the A47 carriageway would occur within land under Norfolk Vanguard control or public highway and would require night time working over several weeks.

The design of the access should allow for infrequent ALLs to be delivered to site without further widening or strengthening work to be completed outside of the upgraded access envelope.

6.2 Access B Review

The current Access B is approximately 16m north of the existing Spicers Corner junction with the A47 to the north. The layout of these junctions creates a left-right stagger which is not compliant with DMRB standards.

Based on the current baseflows and forecast Norfolk Vanguard project construction flows, Access B would require upgrading to a DMRB standard compliant access. A new access point would need to be created approximately 68m to the south west of the existing access to create a DMRB³ compliant right-left stagger with a minimum 50m distance between both junction centrelines.

The following subsections review Access B in context with the adopted study parameters.

Highway Safety

From an existing highway perspective, there has been no collision patterns identified as described in Section 3.3. Access B would be standard compliant and meet all the required visibility splays for a 100kph design speed.

Environmental Impact

From an ecology perspective, the new access would require the removal of existing vegetation and the potential removal of a number of established trees. The vegetation clearance would encompass the whole of the visibility envelope and to the extents of the new access and A47 widening works this would comprise of approximately 750m² of land.

Infrastructure Requirements

The following infrastructure improvements would be required:

- Widening of the A47 carriageway to include a right turn lane and ghost island facility.
- Construction of a new access to incorporate a bellmouth with 15m corner radii and a 7.3m approach width allowing passing of two HGVs (potentially wider for abnormal loads).
- Additional internal track to tie back into the substation access track.

³ Design speed of 100km/h (60mph) including ghost island right turn facility with turning lane width of 3.5m and queuing storage length of 49.5m.

The required visibility of 215m to the east would be achieved following relocation of the access 68m further south and the widening works on the southern verge of the land within Norfolk Vanguard control or public highway land.

The construction works would require night time working with substantial temporary traffic management required over several weeks.

The design of the access should allow for infrequent ALLs to be delivered to site without further widening or strengthening work to be completed outside of the upgraded access envelope.

6.3 Access C and D Review

The following subsections review Accesses C, D and D1 in context with the adopted study parameters.

Highway Safety

From a highway safety perspective Access C could achieve the requisite 215m visibility splays with vegetation cutback in both directions. Access D would require the cutback/remove approximately 100m of established hedgerow to the east to be compliant. Both accesses are situated on relatively straight roads on a hill with approximately a 3% gradient.

Both Access C and Access D would introduce conflicts with either existing farm or residential traffic and neither the access track (Access C) or Moor Lane (Access D) would allow two way HGV traffic movements. At both access locations vehicles exiting the A47 may have to wait for traffic departing the access points onto the A47. This has the potential of causing vehicles to queue back from these pinch points causing an obstruction to the A47 flow of traffic.

Recognising these road safety concerns, a potential alternative access in this vicinity has been identified (notated as D1). Access D1 is an existing field access 334m northeast of Access D with direct access to the field with the electricity pylon. The access could be widened and two-way HGV movements would be possible with no sharing of road space with existing farm traffic or other public vehicles.

Horizontal visibility is good (215m) in both directions. Vertical visibility is compromised approaching the junction from both directions with a minimum vertical height achievable of 0.48m from the west and 0.33m from the east. These heights are based on the height above the carriageway an approaching motorist can view over the hill crest to the access from a stopping sight distance of 215m (100kph design speed). These measurements do not meet the required 0.26m minimum height detailed in the DMRB and therefore Access D1 would require a speed restriction to achieve the desired forward visibility.

Environmental Impact

From an ecology perspective, all the accesses would require the removal of existing vegetation and the potential removal of a number of established trees. The vegetation clearance would encompass the whole of the visibility envelope.

Infrastructure Requirements

There is minimal scope for junction widening at Access C and D to allow the safe two-way movements of construction HGVs. Access C is constrained by an immediate right hand bend, while Access D is constrained by private properties and a drainage ditch to the north of the access route.

Access D1 has greater scope for junction improvements and would require the following infrastructure improvements:

- Removal of existing vegetation to allow for visibility splays.
- Widening of existing access approach to cater for a 6m approach width allowing passing of two HGVs.
- Construction of new a new bellmouth with 10m corner radii.

Proposed Access Management Strategy

A total of 200 HGVs and 40 LCVs would be required to access the Electricity Pylon field to complete the OHLM works. The works would be subject to two construction peaks of between 1-4 weeks with a 4-6 month gap between each peak.

It is therefore considered that constructing a DMRB compliant right-turn access would be disproportional to the traffic demand. As an alternative, it is proposed to implement an Access Management Strategy for the duration of the OHLM works. The Access Management Strategy would eradicate right turn maneuverers on the A47 by enforcing left in, left out manoeuvres to minimise infrastructure provision. and would include options based on which substation access (A or B) is taken forward.

All OHLM traffic would check in at the main NGSE works using Access A or A1. Traffic would then exit left out of Access A or A1 and perform a u-turn manoeuvre at the roundabout junction between the A47 and Norwich Road. A left turn in to either Access C, D or D1 could then be completed. This strategy would require an approximate 4.5mile diversion for a forecast 240 vehicles and could be enforced within the CTMP.

7 Summary and Conclusions

Table 7.1 provides a summary of the Norfolk Vanguard Project access review and applies a simple scoring system to differentiate between option.

Table 7.1. Access Scoring summary

Access Options	Highway Safety	Environmental Impacts	Infrastructure Requirements	Totals	Comments
A	2	2	5	9	<ul style="list-style-type: none"> - Requires u-turn traffic management strategy approval. - Potential capacity, delay, noise and air quality impacts within Dereham associated with diversion route.
A1	5	3	1	9	DMRB compliant access, significant engineering and environmental works required.

B	5	3	1	9	DMRB compliant access, significant engineering and environmental works required.
C	1	2	3	6	<ul style="list-style-type: none"> - Requires u-turn access management strategy approval. - Potential highway safety concern for A47 traffic associated with narrow access/egress.
D	1	2	4	7	<ul style="list-style-type: none"> - Requires u-turn access management strategy approval. - Potential highway safety concern for A47 traffic associated with narrow access/egress.
D1	4	2	3	9	<ul style="list-style-type: none"> - Requires u-turn access management strategy approval. - Requires a temporary speed limit for the duration of the OHLM works.
Highway safety scoring system used 1-5 (1 indicates low safety, 5 indicates high safety).					
Environmental impacts scoring system used 1-5 (1 indicates major impact, 5 indicates minimal impact).					
Infrastructure requirements scoring system used 1-5 (1 indicates greatest total cost, 5 indicates least total cost).					

For the project infrastructure sites south of the A47, Accesses A, A1 and B all score identical.

It is considered that the traffic management stipulations associated with Access A would have a significant impact on the efficient construction of the sub-station which in turn represents an economical risk. Access A1 and B have substantial infrastructure costs associated with implementing a standard compliant design.

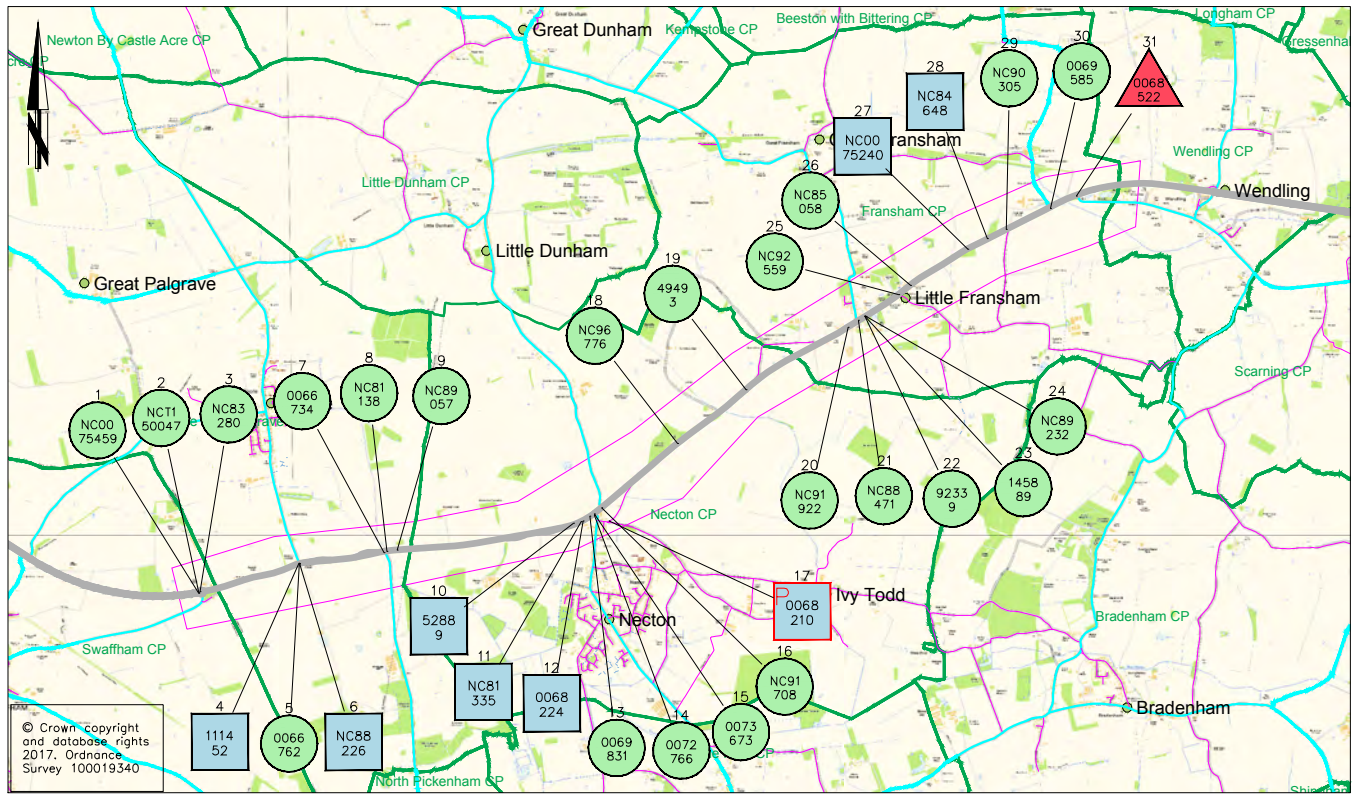
Notwithstanding, based on the road safety and environmental impact assessment, there are no overriding reasons to reject any of these three access options. Furthermore, there are no overriding technical/policy constraints preventing both Access A/A1 and B being utilised, rather, there are potential road safety benefits in removing vehicle conflicts between Substation and NGES/OHLM works.

With regard to the OHLM works, Accesses C and D have constrained access/egress which give rise to safety concerns on the A47. Access D1 is the clear preferred option, but will require an approval of a temporary speed limit for the duration of the works.

APPENDICES

APPENDIX A
STATS 19 Data

Five years to end April 2017



Reference Number	1 NC00 75459	2 NCT1 50047	3 NC83 280	4 1114 52	5 0066 762	5a 0066 762	6 NC88 226	7 0066 734	8 NC81 138	9 NC89 057	10 5288 9	11 NC81 335	12 0068 224	13 0069 831	14 0072 766	15 0073 673
Date / Day	Fr 01	We 11	Mo 25	Fr 30	Fr 10		Th 19	Fr 03	Mo 09	Sa 21	We 09	Mo 23	Th 29	Mo 04	Su 14	Tu 20
Month	Nov	Mar	Aug	Sep	Aug		Feb	Aug	Jun	Aug	Mar	Jun	Nov	Mar	Jul	Aug
Year	2013	2015	2014	2016	2012		2015	2012	2014	2015	2016	2014	2012	2013	2013	2013
Time	1300	0845	1500	1733	0640		1115	1445	0845	1303	0638	2207	0920	1040	1915	1139
Severity	SI	SI	SI	Se	SI		Se	SI	SI	SI	Se	Se	Se	SI	SI	SI
Dark / Lit																
Weather Conditions																
Road Surface																
Special Conditions																
Carriageway Hazards																
Vehicle Manoeuvres																
Vehicle 1	5e															
Vehicle 2	6t															
Vehicle 3	7c															
Vehicle 4	8															
Casualty / age																

Reference Number	16 NC91 708	17 NC068 210	18 NC96 776	19 4949 3	20 NC91 922	21 NC88 471	22 9233 9	23 1458 89	24 NC89 232	25 NC92 559	26 NC85 058	27 NC00 75240	28 NC84 648	29 NC90 305	30 0069 585	31 0068 522	
Date / Day	Fr 03	Tu 04	Tu 08	Su 07	Sa 11	We 04	We 06	Tu 29	Fr 27	We 05	Su 26	Th 24	Tu 14	Mo 11	Th 14	Mo 24	
Month	Jul	Dec	Dec	Feb	Jul	Mar	Jul	Nov	Mar	Aug	Oct	Oct	Oct	Oct	May	Feb	Dec
Year	2015	2012	2015	2016	2015	2015	2016	2016	2015	2015	2014	2013	2014	2015	2013	2012	
Time	1514	1630	0856	1100	1600	1640	0745	0815	0750	1322	1235	2250	0640	1717	1010	1430	
Severity	SI	Se	SI	SI	SI	SI	SI	SI	SI	SI	SI	Se	Se	SI	SI	Fa	
Dark / Lit																	
Weather Conditions																	
Road Surface																	
Special Conditions																	
Carriageway Hazards																	
Vehicle Manoeuvres																	
Vehicle 1	5e																
Vehicle 2	6t																
Vehicle 3	7c																
Vehicle 4	8																
Casualty / age	39 42	16	21	59	62 60 60 60	64	49 47	35	29	62	52 11 17 40	17	31	42	22	77 69	

Full Details Report Summary -

Accidents Found Date Range: 03/08/2012 - 29/11/2016

Grid Coordinate Range: 584290,309490 - 592050,313000

Accident Date BETWEEN '01-May-2012' AND '30-Apr-2017'

Accident Severity

	2012	2013	2014	2015	2016	Total
Fatal	1	0	0	0	0	1
Serious	2	1	2	1	2	8
Slight	2	5	3	9	3	22
Total	5	6	5	10	5	31

Casualty Severity

	2012	2013	2014	2015	2016	Total
Fatal	3	0	0	0	0	3
Serious	2	1	2	1	2	8
Slight	4	6	7	18	4	39
Total	9	7	9	19	6	50

Casualty KSI

	2012	2013	2014	2015	2016	Total
Adult KSI	5	1	2	1	2	11
Slight	4	6	7	18	4	39
Total	9	7	9	19	6	50

Accident Date BETWEEN '01-May-2012' AND '30-Apr-2017'

1.3 Accident Reference: NC96776 Slight NECTON, A47 APPROX 450MTRS SOUTH WEST OF MOOR LANE Accident 18 of 31

1.7 Date & 1.9 Time.....Tuesday 08/12/2015 08:56	1.15 Speed limit.....60 Mph
1.11 Grid co-ordinates.....588525/310812	1.14 Road type.....Single c'way
1.10 Local Authority.....Breckland	1.16 Junction detail.....Not at or within 20m of junction
1.12/1.13 1st road identity..A47	1.17 Junction control.....
1.18/1.19 2nd road identity..	1.24 Special conditions...None
1.22 Weather.....Rain	1.25 Carriageway hazards..None
1.21 Light conditions.....Daylight	1.5 Number of vehicles...2
1.20a Crossing(human).....No Human control within 50m	1.6 Number of casualties..1
1.20b Crossing(physical).....No crossing facility within 50m	1.23 Surface.....Wet

Did a police officer attend?
Yes

Accident Description

V1 ON A47 HEADED TOWARDS NORWICH WHEN DRIVER OF V1 FELL ASLEEP AT WHEEL DRIFTED ACROSS C/WAY AND HIT V2 IN OPPOSITE DIRECTION

2 Vehicles

2.4 Veh ref no.....1	2.16 First impact.....Offside
2.17 Other vehicle.....0	2.12 Hit object in c'way..None
2.5 Vehicle class.....Car	2.14 Hit object off c'way.None
2.10 Junction location...Not at junction	2.18 Parts damaged..... / /
2.9 Restricted location.On main carriageway	2.21 Driver gender.....Male
2.8 Movement from/to....South west North east	2.22 Driver age.....25
2.7 Manoeuvres.....Going ahead other	
2.11 Skidding.....No	2.24 Hit and Run.....No
2.13 Left c'way.....Left c'way Offside	2.23 Breath test.....Negative
2.6 Towing.....No	2.29 Journey purpose.....Commuting to/from work
2.28 Foreign vehicle.....Not foreign	

2.4 Veh ref no.....2	2.16 First impact.....Offside
2.17 Other vehicle.....0	2.12 Hit object in c'way..None
2.5 Vehicle class.....Car	2.14 Hit object off c'way.None
2.10 Junction location...Not at junction	2.18 Parts damaged..... / /
2.9 Restricted location.On main carriageway	2.21 Driver gender.....Male
2.8 Movement from/to....North east South west	2.22 Driver age.....21
2.7 Manoeuvres.....Going ahead other	
2.11 Skidding.....No	2.24 Hit and Run.....No
2.13 Left c'way.....Did not leave c'way	2.23 Breath test.....Negative
2.6 Towing.....No	2.29 Journey purpose.....Commuting to/from work
2.28 Foreign vehicle.....Not foreign	

1 Casualty

3.5 Cas ref no.....1	3.15 Car passenger.....No
3.6 Casualty class.....Driver or Rider	3.16 PSV passenger.....No
3.7 Gender.....Male	3.14 Seat belt usage.....Worn but not independently
3.8 Age.....21	3.13 Medical pupil.....Other (3.19 School
3.9 Severity.....Slight	3.10 Pedestrian location..Not a pedestrian
3.4 Vehicle no.....2	3.11 Pedestrian movement..Not a pedestrian
3.12 Ped Direction.....Not a pedestrian	3.19 Roadworker injured...No

Accident Date BETWEEN '01-May-2012' AND '30-Apr-2017'

1.3 Accident Reference:49493 Slight A47

Accident 19 of 31

1.7 Date & Time.....Sunday 07/02/2016 11:00	1.15 Speed limit.....60 Mph
1.11 Grid co-ordinates.....589129/311289	1.14 Road type.....Single c'way
1.10 Local Authority.....King's Lynn and West Norfolk	1.16 Junction detail.....Not at or within 20m of junction
1.12/1.13 1st road identity..A47	1.17 Junction control.....
1.18/1.19 2nd road identity..	1.24 Special conditions...None
1.22 Weather.....Unknown	1.25 Carriageway hazards..None
1.21 Light conditions.....Daylight	1.5 Number of vehicles...2
1.20a Crossing(human).....No Human control within 50m	1.6 Number of casualties.1
1.20b Crossing(physical).....No crossing facility within 50m	1.23 Surface.....Dry

Did a police officer attend?
No - reported over the counter

Accident Description

VEH2 IN A LINE OF TRAFFIC ON THE A47 TRAVELLING TOWARDS FRANSHAM. THE LINE OF TRAFFIC BRAKED HEAVILY AS DID VEH2, BUT VEH1 COLLIDED WITH THE REAR OF VEH2 CAUSING WHIPLASH INJURIES TO THE PASSANGER IN THE FRONT OF VEH2.

2 Vehicles

2.4 Veh ref no.....1	2.16 First impact.....Front
2.17 Other vehicle.....0	2.12 Hit object in c'way..None
2.5 Vehicle class.....Car	2.14 Hit object off c'way.None
2.10 Junction location...Not at junction	2.18 Parts damaged..... / /
2.9 Restricted location.On main carriageway	2.21 Driver gender.....Male
2.8 Movement from/to....East West	2.22 Driver age.....-1
2.7 Manoeuvres.....Going ahead other	2.24 Hit and Run.....No
2.11 Skidding.....No	2.23 Breath test.....Not contacted
2.13 Left c'way.....Did not leave c'way	2.29 Journey purpose.....Unknown
2.6 Towing.....No	
2.28 Foreign vehicle.....Not foreign	

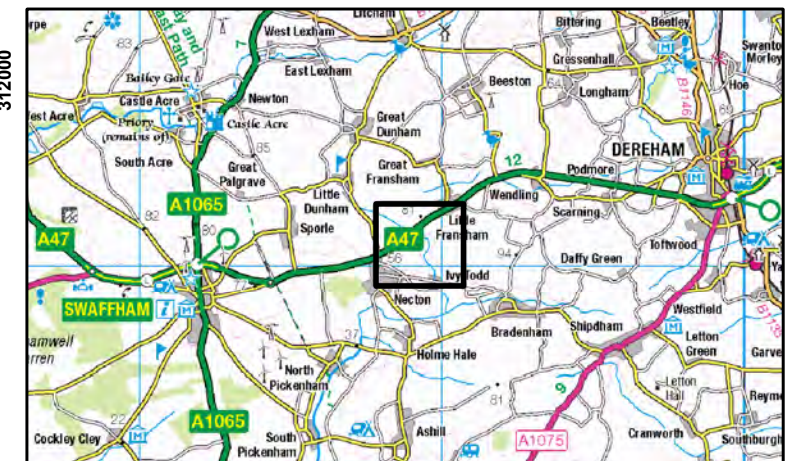
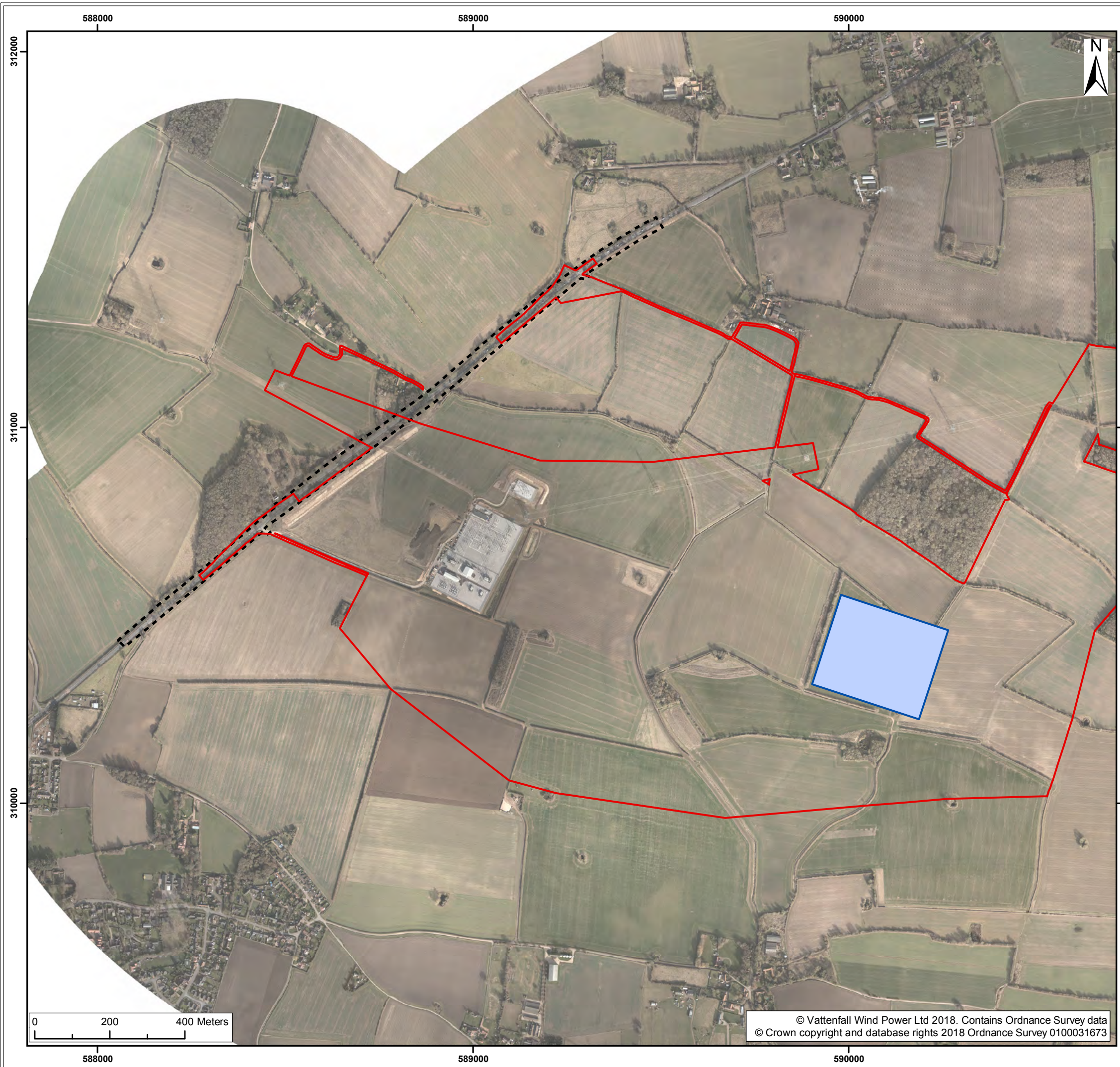
2.4 Veh ref no.....2	2.16 First impact.....Back
2.17 Other vehicle.....0	2.12 Hit object in c'way..None
2.5 Vehicle class.....Car	2.14 Hit object off c'way.None
2.10 Junction location...Not at junction	2.18 Parts damaged..... / /
2.9 Restricted location.On main carriageway	2.21 Driver gender.....Not known
2.8 Movement from/to....East West	2.22 Driver age.....60
2.7 Manoeuvres.....Going ahead other	2.24 Hit and Run.....No
2.11 Skidding.....No	2.23 Breath test.....Not contacted
2.13 Left c'way.....Did not leave c'way	2.29 Journey purpose.....Unknown
2.6 Towing.....No	
2.28 Foreign vehicle.....Not foreign	

1 Casualty

3.5 Cas ref no.....1	3.15 Car passenger.....Front
3.6 Casualty class.....Passenger	3.16 PSV passenger.....No
3.7 Gender.....Female	3.14 Seat belt usage.....Unknown
3.8 Age.....59	3.13 School pupil.....Other (3.19 School
3.9 Severity.....Slight	3.10 Pedestrian location..Not a pedestrian
3.4 Vehicle no.....2	3.11 Pedestrian movement..Not a pedestrian
3.12 Ped Direction.....Not a pedestrian	3.19 Roadworker injured...No

FIGURES

FIGURE 1
Site Location



- Legend:
- Proposed Norfolk Vanguard onshore project substation
 - Red Line Boundary
 - A47 Access Study Area

Note:
 PMAI to be located within Red Line Boundary
 at a location to be determined

Project:	Report:
Norfolk Vanguard	A47 Access Review

Title:
 Site Location Plan

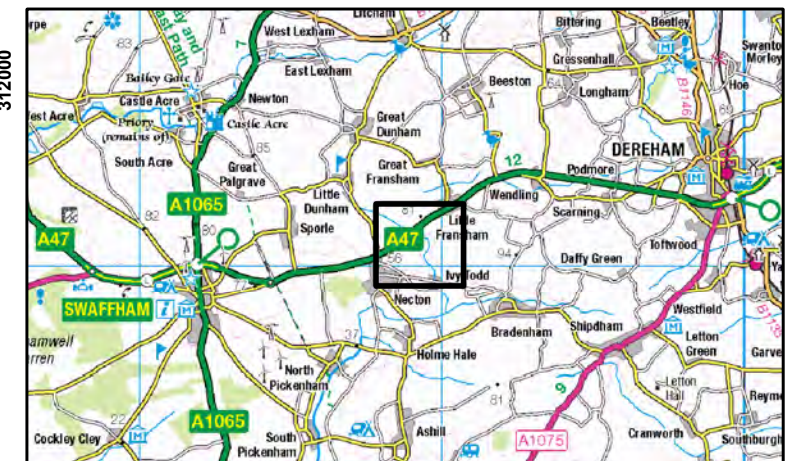
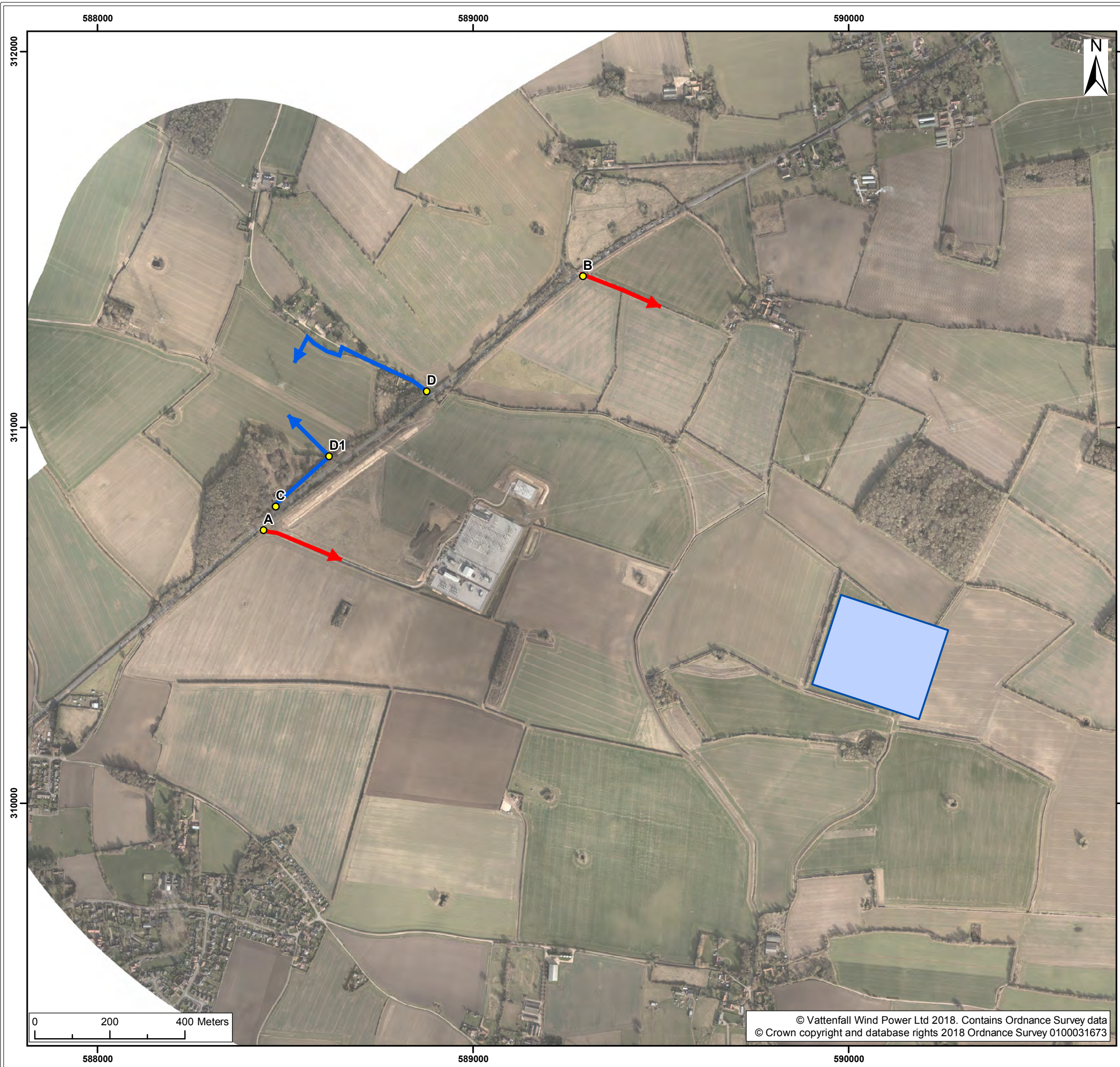
Figure: 1	Drawing No: PB4476-003-00X-001				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	12/01/2018	GC	RE	A3	1:10,000

Co-ordinate system: British National Grid EPSG: 27700



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FIGURE 2
Access Options



- Legend:
- Proposed Norfolk Vanguard onshore project substation
 - Access Point ID
 - Access Options for National Grid Overhead Line Modification Works
 - Access Options for Norfolk Vanguard Onshore Project Substation and National Grids Substation Extension

Project:	Report:
Norfolk Vanguard	A47 Access Review

Title:

Access Options

Figure: 2	Drawing No: PB4476-003-00X-002				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	12/01/2018	GC	RE	A3	1:10,000

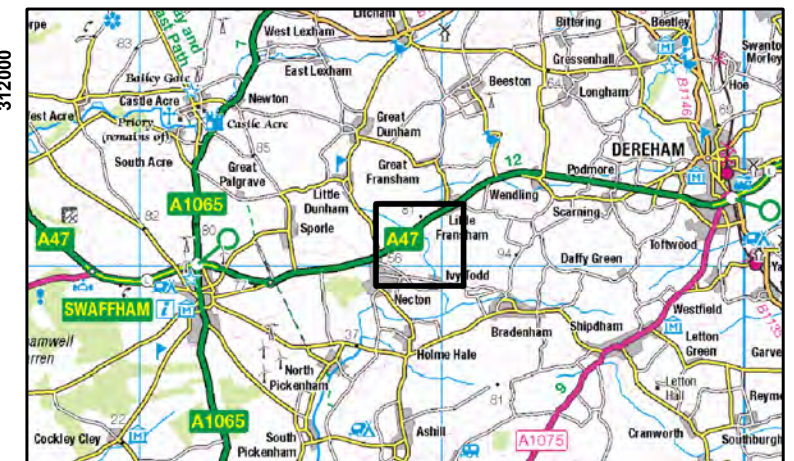
Co-ordinate system: British National Grid EPSG: 27700



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FIGURE 3

Speed Survey and Personal Injury Collision Locations



- Legend:
- Proposed Norfolk Vanguard onshore project substation
 - A47 Access Study
 - Access Point ID
 - Injury Collision Location
 - Speed Survey Locations

Project:	Report:
Norfolk Vanguard	A47 Access Review

Title:
Speed Survey and Personal Injury Collision Locations

Figure: 3	Drawing No: PB4476-003-00X-003				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	12/01/2018	GC	RE	A3	1:10,000

Co-ordinate system: British National Grid EPSG: 27700



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Appendix B – Aecom Briefing Notes

Project:	Highways England Spatial Planning Arrangement 2016-2020	Job No:	60506522 / DN052.002
Subject:	Norfolk Vanguard Wind Farm – A47 Substation Access Technical Note Review		
Prepared by:	Kelly Davis	Date:	11th May 2018
Checked by:	Andrew Cuthbert	Date:	16th May 2018
Verified by:	Liz Judson	Date:	17th May 2018
Approved by:	Andrew Cuthbert	Date:	17th May 2018

Introduction

1. This Briefing Note provides a response to the Norfolk Vanguard Substation – A47 Substation Access Review Technical Note, ‘the A47 Access TN’, produced by Royal Haskoning DHV (RHDHV) on behalf of Vattenfall Wind Power Ltd, dated 23 March 2018 which relates to the Norfolk Vanguard Offshore Windfarm project.
2. This Briefing Note follows AECOM’s previous reviews of the Traffic and Transport Method Statement and Preliminary Environmental Information Report (PEIR) which are documented in Briefing Notes 01 (March 2017) and 02 (December 2017) respectively.
3. The Wind Farm itself will be located off the Norfolk Coast. However, electricity generated will access the National Grid at a substation adjacent to the A47 Trunk Road at Necton, to the west of Dereham. As part of the Norfolk Vanguard project, an extension to the existing substation will be required as well as construction of a new onshore substation (at the Necton site) for the Norfolk Vanguard Wind Farm.
4. The A47 Access TN refers to the access to the onshore sub-station and proposed sub-station extension during the construction phase of the Norfolk Vanguard project.
5. A number of access options off the A47 have been presented, which Highways England have been invited to consider and comment on. Each option has been assessed against a set of criteria including highway safety, environmental impact and infrastructure requirements. Speed, volume and historic Personal Injury Accident (PIA) data for this section of the A47 has also been provided.
6. The data provided shows that there are no existing accident patterns or trends and that average speeds recorded are within the range of 50-60mph. Therefore, in terms of visibility splays from the proposed accesses, 215m is required to be compliant with DMRB standards for a 100kph design speed.

Substation Access (Access Options A, A1 and B)

7. During previous consultation discussions for the Norfolk Vanguard project, Highways England explained to RHDHV that the Policy set out in DfT Circular 02/2013 would not prohibit a new substation access point being created on the A47, but that the preference would be to use an existing access.

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8. RHDHV have since explained that two substation accesses, to the south of the A47, are required. The existing access would be used for construction traffic relating to the extension of the existing National Grid substation and another access would be needed for the construction of the offshore substation for the Norfolk Vanguard Wind Farm. Access options A, A1 and B have been considered as presented in drawing no. PB4476-003-00X-002 of the A47 Access TN.
9. AECOM understand from our previous review of the PEIR that the construction period for the substations will be approximately 18 months. During this time, a total of 164 vehicle movements a day are expected (84 HGVs and 80 light vehicles). Of these, 66 vehicle movements a day would be associated with the National Grid substation extension (26 HGVs and 40 light vehicles) and 98 would be associated with the Norfolk Vanguard onshore substation (58 HGVs and 40 light vehicles).
10. The existing National Grid substation near Necton is currently accessed via a priority T-junction off the A47 westbound carriageway, referred to in the A47 Access TN as 'Access A'. As the A47 Access TN explains, this access was upgraded in 2014 to accommodate construction vehicle access for the National Grid and Dudgeon Offshore Wind Farm substations, known as the Necton Electricity Substation (NES). RHDHV have acknowledged that the existing 'Access A' junction is sub-standard.
11. During the construction of the NES a traffic management strategy was employed which included a temporary right turn ban into and out of Access A. Instead construction traffic had to u-turn at either the A1075 junction at Dereham (to the east) or the Norwich Road roundabout at Swaffham (to the west). The A47 Access TN highlights that if a similar traffic management strategy was employed for Norfolk Vanguard, it is forecast to result in 79 HGVs a day making a 15.5 mile diversion via Dereham and suggests that a full assessment of the impact of the diversion route would be required. **AECOM agree that the junctions to the east and west of the site access would require capacity assessments if this were the case.**
12. As an alternative, 'Access A1' has been considered at this location to upgrade the existing junction to a DMRB compliant layout which would allow right turns into and out of the substation access.
13. Access A1 would require widening of the A47 carriageway to accommodate a right turn lane and ghost island, construction of a new bellmouth and removal of vegetation associated with the carriageway widening to allow for required visibility splays.
14. Although Access A1 would offset some of the concerns regarding the diversion route and resulting impact this would have on the SRN, the construction of the upgraded junction itself would result in some disruption to A47 through traffic near to the substation site.
15. A secondary access to the Norfolk Vanguard substation site is required to the south of the A47. This is proposed to be 'Access B' which is an existing farm track just north of the Spicer's Corner junction. RHDHV recognise that Access B would need to be upgraded to make it DMRB compliant. This would involve creating a new access point to the south of the existing farm track to ensure adequate spacing between the Spicer's Corner junction (to the north of the A47) and the new Access B junction.
16. Access B would require widening of the A47 carriageway to accommodate a right turn lane and ghost island and construction of a new bellmouth.
17. Section 7 of the A47 Access TN scores the proposed access options against the set of criteria mentioned above (para 4) and concludes that Access A, A1 and B score identically. AECOM agree that either the proposal for Access A (with a traffic management strategy for banned turns employed) or an upgraded Access A1 (with right turn lane) appear suitable.

-
18. **Highways England will require scale plans of the proposed Access A/A1 and Access B junction layouts (with dimensions and visibility splays shown) before agreeing to the proposals in principle. Any agreement would also be subject to acceptance by NCC and a Stage 1 Road Safety Audit.**
 19. **If Access A is progressed, Highways England would require the temporary traffic management strategy or construction management plan for review and an assessment of the impact of u-turning traffic on the A47/ A1075 junction at Dereham.**

Access to the north of A47 (Access Options C, D and D1)

20. As part of the proposed National Grid substation extension, RHDHV have advised that access to a field containing an electricity pylon to the north of the A47 (off the eastbound carriageway) will be required for overhead line modification works. The A47 Access TN explains that these works will comprise two construction peaks, each lasting one week with a gap of 4-6 months between each peak. During the construction peaks a total of 48 vehicle movements a day (40 HGVs and 8 light vehicles) have been forecast. Access options C, D and D1 have been considered as presented in drawing no. PB4476-003-00X-002 of the A47 Access TN.
 21. Some minor works would be required to allow HGV's to use any of the proposed accesses to the north of the A47. Due to the relatively short construction periods, RHDHV assert that fully compliant DMRB upgrades to the existing access options (with right turn lanes and ghost islands) would be disproportionate to the impact of the construction activity. AECOM agree with this as the works and traffic management required to implement the junction upgrade works would be likely to take longer than the construction periods for the overhead line modification works themselves.
 22. After assessing the various access options against the set of criteria mentioned above (para 4), the A47 Access TN concludes that Access Option D1 is the preferred option. Although Option D1 would require a temporary speed restriction in order to achieve sufficient visibility splays in the vertical plane, AECOM agree that this option appears to be the most suitable as Options C and D are too narrow to accommodate HGVs exiting and entering the access simultaneously and hence carry a risk of vehicles queuing back and causing an obstruction to A47 through traffic.
 23. The works required to facilitate access via Option D1 would include removal of existing vegetation to allow for sufficient visibility splays and widening of the existing access to allow the passing of two HGVs.
 24. **AECOM recommend that Highways England state their preference for Option D1 as the most suitable access to the north of the A47 for the overhead line modification works.**
 25. **If this option is progressed, Highways England will require scale plans of the proposed Access D1 junction layout (with dimensions and visibility splays shown) before agreeing to the proposal in principle. Any agreement would also be subject to acceptance by NCC and a Stage 1 Road Safety Audit.**
 26. **Highways England would also require the temporary traffic management strategy or construction management plan for scrutiny.**
-

Project:	Highways England Spatial Planning Arrangement 2016-2020	Job No:	60572359/DN052.003
Subject:	Norfolk Vanguard Wind Farm - DMRB Technical Review		
Prepared by:	Andrew Beard	Date:	20 December 2018
Checked by:	Andrew Cuthbert	Date:	24 December 2018
Verified by:	John Alderman	Date:	4 January 2019
Approved by:	Andrew Cuthbert	Date:	4 January 2019

Executive Summary

Following a DMRB technical review of drawing TP-PB4476-DR014 Rev D0.3, which supersedes drawing PB4476-002 Rev D0.2 submitted alongside the Environmental Statement and supporting documents prepared by Royal Haskoning DHV (RHDHV), in support of the Norfolk Vanguard Wind Farm proposals, AECOM make the following recommendations.

Recommendations regarded as critical to the acceptability of this planning application:

1. Vehicular swept path plots should be provided in support of the proposed A47 Substation Access B junction layout to demonstrate the ability of an articulated vehicle and large tipper (the Design Vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines and extended to include the passage of the design vehicle on the access road where it bends to the east immediately south of the junction (para 4.9);
2. Vehicular swept path plots should be provided for an articulated vehicle and large tipper (the Design Vehicles) to demonstrate that large vehicles which enter the site are able to turn within the site and exit the site onto the A47 in a forward facing direction (para. 4.10);
3. The proposed visibility splay should be reviewed with respect to the need to achieve an 'x' distance of 4.5m on the minor arm in all but exceptionally difficult circumstances, in accordance with TD 42 (para. 7.8) and demonstrated to be deliverable within land in the control of either the applicant or the highway authority (para 4.15);
4. The existing farm track access should be closed and alternative provision be made to access the land via the minor arm of Access B. If this is not possible, swept paths and visibility splays should be illustrated on a further revision of Drawing TP-PB4476-DR014 Rev D0.3 to demonstrate the legitimate use by agricultural vehicles of the proposed new layout. If the farm track access is to be retained then a Relaxation to design standards is likely to be required due to the spacing of the junctions. Suitable justification for this would need to be demonstrated to obtain approval from the Overseeing Organisation. In addition, due to the apparent presence of the crest curve located to the west of the farm access junction, it should be demonstrated that the required visibility can also be achieved in the vertical plane (para. 4.17); and
5. The proposed corner radii should be reviewed in the context of the guidance set out in TD 42 (para. 7.17) with respect to nearside tapers on the major and minor road exits from the junction (para 4.18).

Recommendations regarded as important but not critical to the acceptability of this planning application:

6. Traffic signs and markings in accordance with TD 42, TSM and TSRGD should be demonstrated fully at the detailed design stage (para 4.8).

AECOM recommend that the consultation response from Highways England asserts that the recommendations listed above should be addressed.

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1. Introduction

- 1.1. AECOM, on behalf of Highways England, have undertaken a technical review of drawing TP-PB4476-DR014 Rev D0.3, which supersedes drawing PB4476-002 Rev D0.2 submitted alongside the Environmental Statement (ES) and supporting documents prepared by Royal Haskoning DHV (RHDHV), in support of the Norfolk Vanguard Wind Farm proposals. The drawing illustrates the layout proposed for an additional direct access (Access B) off the A47 to serve the proposed Norfolk Vanguard substation at Necton, to the west of Dereham.
- 1.2. AECOM have previously reviewed the Environmental Impact Assessment Traffic & Transport Method Statement (TTMS), Preliminary Environmental Information Report (PEIR) and Norfolk Vanguard Substation – A47 Substation Access Review Technical Note (A47 Access TN), each produced by RHDHV. The results of the previous reviews are reported in AECOM BN01 (March 2017), BN02 (December 2017) and BN03 (May 2018).
- 1.3. This Briefing Note (BN04) will review the layout proposed at the A47 Substation Access B priority junction with a view to determining whether or not the proposed layout is compliant with the requirements of the Design Manual for Roads and Bridges (DMRB).
- 1.4. For ease of reference, AECOM's main comments and recommendations are presented in bold and underlined text throughout the note. Recommendations regarded as critical to the acceptability of this layout are coloured **red**. Recommendations regarded as important but not critical to the acceptability in principle of this planning application are highlighted in **amber**.

2. Background

- 2.1. The Norfolk Vanguard Wind Farm itself will be located off the Norfolk Coast. However, electricity generated will access the National Grid at a substation adjacent to the A47 Trunk Road at Necton, to the west of Dereham. As part of the Norfolk Vanguard project, an extension to the existing substation will be required as well as construction of a new onshore substation (at the Necton site) for the Norfolk Vanguard Wind Farm. The substation will be accessed by vehicular traffic via the A47.
- 2.2. Highways England is the highway authority with respect to the SRN, comprising the A47. Highways England's primary interest will be the impact of traffic generated by the site on the safe and free flow of traffic using the A47.
- 2.3. RHDHV have previously advised that a secondary access to the Norfolk Vanguard substation site is required to the south of the A47. This is proposed to be 'Access B' which is an existing farm track just north of the Spicers Corner junction. AECOM previously recommended in BN03 that *"Highways England will require scale plans of the proposed Access A/A1 and Access B junction layouts (with dimensions and visibility splays shown) before agreeing to the proposals in principle. Any agreement would also be subject to acceptance by NCC and a Stage 1 Road Safety Audit."*
- 2.4. Specifically, this DMRB review considers the proposed mitigation presented by RHDHV in drawing no. TP-PB4476-DR014 Rev D0.3 with respect to the proposed A47 Substation Access B Concept Drawing.
- 2.5. The current access to the development area is a farm track located approximately 16m north of the existing Spicers Corner junction with the A47. The existing access location forms a substandard left-right staggered crossroad junction with Spicers Corner. The proposed Access B comprises a priority T-junction with ghost-island right-turn on the A47, located approximately 50m south-west of Spicers Corner and represents the first point of access to the Strategic Road Network (SRN) from the proposed substation.

3. DMRB Technical Review

- 3.1. This BN04 represents a technical review of drawing no. TP-PB4476-DR014 Rev D0.3 'A47 Substation Access B Concept Drawing' dated October 2018. The review does not constitute a detailed design check of all aspects of the proposals, but is intended to identify aspects of the design which are potential 'show stoppers' and/or aspects which if revised could have an impact upon the predicted junction operation. A site visit has not been undertaken.
- 3.2. This section provides a technical review of the proposed layout with reference to the Design Manual for Roads and Bridges (DMRB) guidance set out in:
 - TD 42/95 – Geometric Design of Major/Minor Priority Junctions (DMRB Volume 6 Section 2 Part 6, January 1995); and
 - TD 41/95 – Vehicular Access to All-Purpose Trunk Roads (DMRB Volume 6 Section 2 Part 7, March 1995).
- 3.3. Reference is also made to TD 9/93 (Highway Link Design) where applicable.
- 3.4. No evidence has been submitted to demonstrate whether the proposed layouts have been subject to a Stage 1 Road Safety Audit (RSA). This review does not constitute a Road Safety Audit.
- 3.5. AECOM has not appointed a Principal Designer or considered the associated aspects that would apply within this role. It is recommended that should this scheme proceed a Principal Designer is appointed by the client in accordance with current CDM Regulations.

4. A47 Substation Access B Junction

Introduction

- 4.1. The current access to the development area is a farm track located approximately 16m north of the existing Spicers Corner junction with the A47. The existing access location forms a substandard left-right staggered crossroad junction with Spicers Corner. The A47 is a two-way single carriageway road subject to the derestricted National Speed Limit of 60mph in the vicinity of the proposed junction.
- 4.2. The proposed Access B comprises a priority T-junction with ghost-island right-turn on the A47, located approximately 50m south-west of Spicers Corner and forming a right-left staggered junction arrangement.
- 4.3. This section considers the proposed mitigation measures illustrated on the RHDHV drawing no. TP-PB4476-DR014 Rev D0.3, described by AECOM as follows:
 - A47 Substation Access B – A new priority junction on the A47 located approximately 50m south of and forming a staggered arrangement with the existing priority junction with Spicers Corner. Localised kerb and carriageway realignment to accommodate the provision of a ghost-island right-turn lane, central hatching and associated arrow head carriageway markings on the A47.
- 4.4. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR021 Rev D0.1 and TP-PB4476-DR022 Rev D0.1 each dated August 2018.
- 4.5. This technical review does not consider the question as to whether the proposed mitigation is sufficient to accommodate the predicted increases in traffic flows at the A47 Substation Access B

junction attributed to the Norfolk Vanguard Wind Farm project, but confines itself to the question of whether the layout proposed meets the requirements of the DMRB.

General Principles

- 4.6. Geometric measurements referenced within this technical note have been obtained from an electronic copy of drawing no. TP-PB4476-DR014 Rev D0.3, which was provided to AECOM by RHDHV on 13 December 2018. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR021 Rev D0.1 and TP-PB4476-DR022 Rev D0.1 which were provided to AECOM in .pdf format by RHDHV on 19 December 2019.
- 4.7. It should be noted that the information presented on drawing no. TP-PB4476-DR014 Rev D0.3 is in two-dimensional form only and therefore a review of the vertical aspects of the proposal has not been undertaken. The vertical aspects could have implications in terms of alignment in both vertical and horizontal planes and also the perceived visibility available and should be provided in due course.
- 4.8. TD 42 (para. 7.78) identifies that guidance for the appropriate use of traffic signs and road markings at priority junctions is contained in the Traffic Signs Manual (TSM). Additionally the Traffic Signs Regulations and General Directions (TSRGD) should be consulted. Indicative signing and lining illustrated on drawing no. TP-PB4476-DR014 Rev D0.3 appears to be broadly consistent with the guidance set out in TD42, TSM and TSRGD. **AECOM recommend that traffic signs and markings in accordance with TD 42, TSM and TSRGD are demonstrated fully at the detailed design stage.**
- 4.9. Vehicular swept paths for an 'articulated vehicle' and 'large tipper' are provided in drawing TP-PB4476-DR021 Rev D0.1 and TP-PB4476-DR022 Rev D0.1 respectively. Whilst AECOM note that the swept paths of each of the design vehicles appear to be broadly accommodated within the proposed junction layout, some overrunning of centre lines is shown and the swept paths do not extend along the access road beyond the immediate junction where the carriageway indicatively bends to the east. It is therefore unclear whether the indicated start/end positions for the design vehicle on the minor arm are practicable in consideration of the preceding/onward path of the vehicle on the access road and/or whether any conflicts are likely to occur where two design vehicles seek to access/egress the minor arm of the junction simultaneously. **AECOM recommend that vehicular swept path plots are provided in support of the proposed A47 Substation Access B junction layout to demonstrate the ability of an articulated vehicle and large tipper (the Design Vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines and extended to include the passage of the design vehicle on the access road where it bends to the east immediately south of the junction.**
- 4.10. An internal layout for the site has not been provided. In order to ensure that vehicles are able to safely exit the site in a forward facing direction such that vehicular traffic is not forced to reverse from the site back onto the A47, **AECOM recommend that vehicular swept path plots are provided for an articulated vehicle and large tipper (the Design Vehicles) to demonstrate that large vehicles which enter the site are able to turn within the site and exit the site onto the A47 in a forward facing direction.**

A47 Substation Access – Ghost Island Priority Junction

- 4.11. The current access to the development area is an existing farm track located approximately 16m north of and forming a sub-standard left-right staggered junction on the A47 with Spicers Corner. BN03 (para.15) identifies that "RHDHV recognise that Access B would need to be upgraded to make it DMRB compliant. This would involve creating a new access point to the south of the

existing farm track to ensure adequate spacing between the Spicer's Corner junction (to the north of the A47) and the new Access B junction". BN03 (para. 16) goes on to state that "Access B would require widening of the A47 carriageway to accommodate a right turn lane and ghost island and construction of a new bellmouth".

- 4.12. The proposed access illustrated by drawing no. TP-PB4476-DR014 Rev D0.3 comprises a priority T-junction with ghost-island right-turn on the A47, located approximately 50m south-west of Spicers Corner and forming a right-left staggered junction arrangement.
- 4.13. AECOM are satisfied that a right-left stagger as proposed is preferable to the existing access location left-right stagger and is consistent with the advice set out in TD 42 (para. 2.30). AECOM are also satisfied that the proposed stagger distance of 50m is consistent with the mandatory minimum stagger distance for a right-left stagger ghost island junction as set out in TD 42 (para. 7.64).
- 4.14. Drawing no. TP-PB4476-DR014 Rev D0.3 illustrates the extent of land required to provide visibility splays of 2.4m x 215m in each direction from the centre line on the minor road. AECOM are satisfied that a DMSSD of 215m is appropriate in this location and is consistent, in principle, with the requirements of TD 9 (Table 3) with respect to forward visibility for the major road right-turn and TD 42 (Table 7/1) with respect to 'y' distance from the Minor Road.
- 4.15. Drawing no. TP-PB4476-DR014 Rev D0.3 illustrates an 'x' distance of 2.4m on the minor road. TD 42 (para. 7.8) states that *"In difficult circumstances, the 'x' distance may be taken as a relaxation from 9.0m to 4.5m for lightly trafficked simple junctions, and in exceptionally difficult circumstances, to 2.4m back from the nearer edge of the major road running carriageway"*. RHDHV do not appear to justify the 'exceptionally difficult circumstances' warranting a relaxation of 'x' distance to 2.4m. AECOM also note that the illustrated kerb realignment and visibility splays require the removal of a significant length of mature trees and hedgerow vegetation adjacent to the highway. It is unclear whether the land required is currently within the control of the applicant and/or whether the required permissions have been obtained for removal of the hedgerow and trees. **AECOM recommend that the proposed visibility splay is reviewed with respect to the need to achieve an 'x' distance of 4.5m on the minor arm in all but exceptionally difficult circumstances, in accordance with TD 42 (para. 7.8) and demonstrated to be deliverable within land in the control of either the applicant or the highway authority.**
- 4.16. Whilst not illustrated on drawing no. TP-PB4476-DR014 Rev D0.3, AECOM are satisfied that a Desirable Minimum Stopping Sight Distance (DMSSD) visibility splay of 215m is achievable for right-turning vehicles on the Major Road, subject to the clearance of vegetation from the identified area.
- 4.17. AECOM note that the existing farm track giving access into the land to be served by proposed Access B is shown as remaining open on Drawing TP-PB4476-DR014 Rev D0.3. Whilst it is evident that this access point is little used (Google streetview shows it as being blocked by a piece of agricultural machinery), the drawing indicates the provision of new kerb lines for the junction. This equates to modification of the existing junction, the modified layout is then required to meet the appropriate design standards. AECOM regard it as undesirable to retain an access point within the overall footprint of the new junction and note that emerging vehicles waiting at the farm track access junction will effectively reduce the visibility to the right for vehicles emerging from the proposed access. TD41 (para. 2.12) states that *"...New direct accesses shall only be sited where they do not encroach on the visibility requirements of adjoining direct accesses or junctions in regular use..."*. **AECOM recommend that the existing farm track access should be closed and alternative provision be made to access the land via the minor arm of Access B. If this is not possible, AECOM recommend that swept paths and visibility splays be illustrated on a further revision of Drawing TP-PB4476-DR014 Rev D0.3 to demonstrate**

the legitimate use by agricultural vehicles of the proposed new layout. If the access is to be retained then a Relaxation to design standards is likely to be required due to the spacing of the junctions. Suitable justification for this would need to be demonstrated to obtain approval from the Overseeing Organisation. In addition, due to the apparent presence of the crest curve located to the west of the farm access junction, it is recommended that it is demonstrated that the required visibility can also be achieved in the vertical plane.

- 4.18. Drawing no. TP-PB4476-DR014 Rev D0.3 illustrates entry/exit corner radii of 15m on the minor road, with tapers over a distance of circa 30m at a ratio of approximately 1:15 to the major road kerb. AECOM consider that the proposed corner radii fall short of the provision recommended by TD 42 (para. 7.17) which advises that “*Where provision is to be made for large goods vehicles, the recommended circular corner radius is:- c. 15m at ghost island junctions, with tapers of 1:6 over a distance of 30m*”. The standard requires an exit taper into both the major and minor road arms, however an approach taper from the major road is not required. The layout illustrated on Drawing TP-PB4476-DR014 Rev D0.3, does not provide an exit taper into the minor arm and the exit taper illustrated into the major road, whilst of the correct length, is of too narrow an angle. This may be the reason for the over running of centre lines shown on the swept paths referred to above. **AECOM recommend that the proposed corner radii are reviewed in the context of the guidance set out in TD 42 (para. 7.17) with respect to nearside tapers on the major and minor road exits from the junction.**
- 4.19. AECOM are satisfied that the major road through lane widths proposed are consistent with the guidance set out in TD 42 (para. 7.20) in that they are illustrated to be within the mandatory threshold of between 3.0m and 3.65m wide.
- 4.20. AECOM are satisfied that the central island taper proposed for the development of the ghost island on the major road is broadly consistent with the guidance contained in TD 42 (para. 7.30, Figure 7/8 and Table 7/3), providing a taper over 104m at a ratio of approximately 1:30 consistent with a design speed of 100kph.
- 4.21. AECOM are satisfied that the turning length, inclusive of reservoir queuing length, illustrated by drawing no. TP-PB4476-DR014 Rev D0.3 for the ghost island right-turn at 49.5m exceeds the minimum requirement of 10m set out in TD 42 (para. 7.32 and 7.33). AECOM are also satisfied that the direct taper length of 25m (TD 42 para.7.34 and Table 7/4), deceleration length of 80m (TD 42 para. 7.40 and Table 7/5a) and ghost island turning lane width of 3.5m (TD 42 para. 7.40) illustrated by drawing no. TP-PB4476-DR014 Rev D0.3 are each consistent with the guidance set out in TD 42.
- 4.22. AECOM consider that, in principle, a DMRB compliant junction is likely to be deliverable at this location subject to resolution of the recommendations set out in this BN04.

5. Conclusion

- 5.1. This Briefing Note (BN04) has been prepared by AECOM, on behalf of Highways England, to provide a DMRB technical review of the mitigation proposed at the A47 Substation Access B junction, illustrated by drawing TP-PB4476-DR014 Rev D0.3 submitted by RHDHV in support of the Norfolk Vanguard Wind Farm proposal.
- 5.2. This review has identified several issues relating to DMRB compliance. AECOMs recommendations regarding these concerns are highlighted by the use of bold underlined text throughout this document. Recommendations regarded as critical to the acceptability of this layout are coloured **red**. Recommendations regarded as important but not critical to the acceptability of this planning application in principle are highlighted in **amber**.
- 5.3. AECOM recommend that the consultation response from Highways England asserts that the recommendations listed above should be addressed.

Project:	Highways England Spatial Planning Arrangement 2016-2020	Job No:	60572359/DN052.003
Subject:	Norfolk Vanguard Wind Farm - DMRB Technical Review 2		
Prepared by:	Andrew Beard	Date:	04 January 2019
Checked by:	Andrew Cuthbert	Date:	10 January 2019
Verified by:	John Alderman	Date:	14 January 2019
Approved by:	Andrew Cuthbert	Date:	16 January 2019

Executive Summary

Following a DMRB technical review of drawing TP-PB4476-DR012 Rev D0.3 and drawing TP-PB4476-DR015 Rev D0.1 submitted alongside the Environmental Statement and supporting documents prepared by Royal Haskoning DHV (RHDHV), in support of the Norfolk Vanguard Wind Farm proposals, AECOM make the following recommendations.

Recommendations regarded as critical to the acceptability of this planning application:

A47 Substation Access A

1. A revised access layout should be proposed that would allow vehicles to enter and exit at the same time on a fully paved surface. Vehicular swept path plots should be provided in support of the revised A47 Substation Access A junction layout to demonstrate the ability of an articulated vehicle and large tipper (the Design Vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb or A47 centre lines. (para. 4.11);
2. The proposed corner radii and exit tapers at Access A should be reviewed in the context of the guidance set out in TD 42 and the grasscrete over-run area extended if necessary to provide the appropriate corner radii and tapers (para. 4.15);

A47 Substation Access D1

3. Vehicular swept path plots should be provided in support of the proposed A47 Substation Access D1 junction layout to demonstrate the ability of an articulated vehicle (the Design Vehicle) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines. The swept paths presented should also demonstrate that an articulated vehicle entering the site is able to stand clear of the carriageway whilst an articulated vehicle is exiting the field area within the limits of the order boundary shown (para. 5.9); and
4. The proposed corner radii should be reviewed in the context of the guidance set out in TD 42 with respect to nearside tapers on the major and minor road exits from the junction (para. 5.14).

Recommendations regarded as important but not critical to the acceptability of this planning application:

A47 Substation Access A

5. A fully compliant DMRB arrangement comprising a ghost-island right-turn would represent the preferable junction arrangement at this location (para. 4.8);
6. Traffic signs and markings in accordance with TD 42, TSM and TSRGD should be demonstrated fully at the detailed design stage (para. 4.9);

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7. The potential to close off the southern access to the service road serving the dwelling known as 'The Grove' should be investigated (para. 4.13);
8. Visibility splays of 4.5m x 215m from Access A in accordance with the requirements of TD 42 should be demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage (para. 4.14);

A47 Substation Access D1

9. A fully compliant DMRB arrangement comprising a ghost-island right-turn would represent the preferable junction arrangement at this location (para. 5.2);
10. Traffic signs and markings in accordance with TD 42, TSM and TSRGD should demonstrated fully at the detailed design stage (para. 5.8);
11. Visibility splays from Access D1 in accordance with the requirements of TD 42 should be demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage (para. 5.11); and
12. The service road access should be closed and alternative provision be made to access the dwelling known as 'The Grove'. If this is not possible, AECOM recommend that appropriate corner radii are provided and swept paths and visibility splays illustrated on a further revision of Drawing TP-PB4476-DR015 Rev D0.3 to demonstrate that its legitimate use by vehicles will not be compromised by the proposed new junction (para. 5.15).

AECOM recommend that the consultation response from Highways England asserts that the recommendations listed above should be addressed.

1. Introduction

- 1.1. AECOM, on behalf of Highways England, have undertaken a technical review of drawing TP-PB4476-DR012 Rev D0.3 and drawing TP-PB4476-DR015 Rev D0.1 submitted alongside the Environmental Statement (ES) and supporting documents prepared by Royal Haskoning DHV (RHDHV), in support of the Norfolk Vanguard Wind Farm proposals to the west of Dereham. The drawings illustrate the layouts proposed for a direct access to the southeast of the A47 (Access A) to serve the proposed Norfolk Vanguard substation at Necton and a direct access to the northwest of the A47 (Access D1) to serve National Grid Overhead Line Modification Works (NG OHLMW). The drawings have been reviewed alongside the supporting text contained in document 8.10, the 'Outline Access Management Plan', submitted as an appendix to ES Chapter 24 'Transport & Traffic'.
- 1.2. AECOM have previously reviewed the Environmental Impact Assessment Traffic & Transport Method Statement (TTMS), Preliminary Environmental Information Report (PEIR) and Norfolk Vanguard Substation – A47 Substation Access Review Technical Note (the SATN) and priority junction layout proposed at the A47 Substation Access B (drawing no. TD-PB4476-DR014 Rev D0.3), each produced by RHDHV, and have also undertaken a junction assessment review. The results of the previous reviews are reported in AECOM BN01 (March 2017), BN02 (December 2017), BN03 (May 2018), BN04 (January 2019) and BN05 (January 2019).
- 1.3. This Briefing Note (BN06) will review the layouts proposed at the A47 Access A and Access D1 priority junctions with a view to determining whether or not the proposed layouts are compliant with the requirements of the Design Manual for Roads and Bridges (DMRB).
- 1.4. For ease of reference, AECOM's main comments and recommendations are presented in bold and underlined text throughout the note. Recommendations regarded as critical to the acceptability of this layout are coloured **red**. Recommendations regarded as important but not critical to the acceptability in principle of this planning application are highlighted in **amber**.

2. Background

- 2.1. The Norfolk Vanguard Wind Farm itself will be located off the Norfolk Coast. However, electricity generated will access the National Grid at a substation adjacent to the A47 Trunk Road at Necton, to the west of Dereham. As part of the Norfolk Vanguard project, an extension to the existing substation will be required as well as construction of a new onshore substation (at the Necton site) for the Norfolk Vanguard Wind Farm. The substation will be accessed by vehicular traffic via the A47.
- 2.2. Highways England is the highway authority with respect to the SRN, comprising of the A47 at this location. Highways England's primary interest will be the impact of traffic generated by the site on the safe and free flow of traffic using the A47.
- 2.3. AECOM previously recommended in BN03 with respect to both Access A and Access D1 that Highways England required scale plans of the proposed junction layouts (with dimensions and visibility splays shown) before agreeing to the proposals in principle. Any agreement would also be subject to acceptance by NCC and a Stage 1 Road Safety Audit.
- 2.4. Specifically, this DMRB review considers the proposed layouts presented by RHDHV in drawing TP-PB4476-DR012 Rev D0.3 and TP-PB4476-DR015 Rev D0.1 with respect to the proposed A47 Access A and Access D1 concept drawings respectively.
- 2.5. The location of the proposed accesses relative to each other and to existing junctions and accesses on the A47, is illustrated on Drawing PB4476-003-00X-002, an extract from which is reproduced as Figure 1 below.

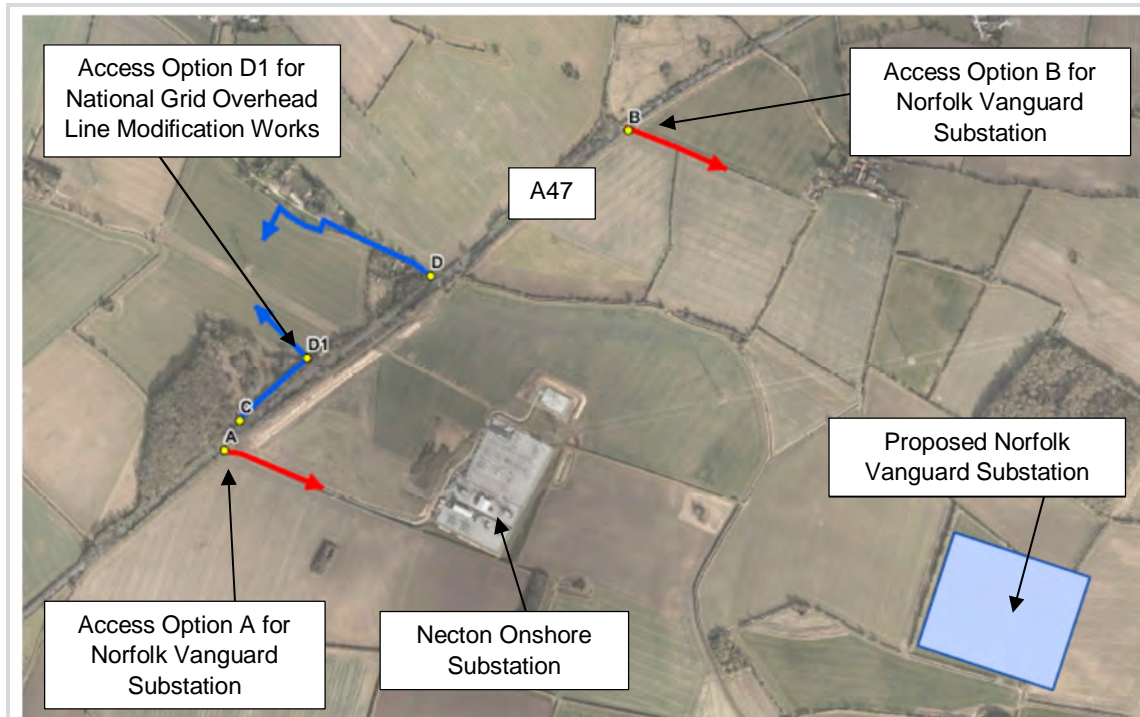


Figure 1. Location of Access A and D1 on the A47 at Necton

3. DMRB Technical Review

- 3.1. This BN06 represents a technical review of drawing TP-PB4476-DR012 Rev D0.3 'A47 Substation Access A Concept Drawing (Left turn in / Left Turn Out)' and drawing TP-PB4476-DR015 Rev D0.1 'A47 Substation National Grid OHLMW Access D1 Concept Drawing (Temporary)', each understood to be dated October 2018. The review does not constitute a detailed design check of all aspects of the proposals, but is intended to identify aspects of the design which are potential 'show stoppers' and/or aspects which if revised could have an impact upon the predicted junction operation. A site visit has not been undertaken.
- 3.2. This section provides a technical review of the proposed layout with reference to the Design Manual for Roads and Bridges (DMRB) guidance set out in:
 - TD 42/95 – Geometric Design of Major/Minor Priority Junctions (DMRB Volume 6 Section 2 Part 6, January 1995); and
 - TD 41/95 Vehicular Access to All-Purpose Trunk Roads' (DMRB Volume 6 Section 2 Part 7, March 1995).
- 3.3. Reference is also made to TD 9/93 (Highway Link Design) where applicable.
- 3.4. No evidence has been submitted to demonstrate whether the proposed layouts have been subject to a Stage 1 Road Safety Audit (RSA). This review does not constitute a Road Safety Audit.
- 3.5. AECOM has not appointed a Principal Designer or considered the associated aspects that would apply within this role. It is recommended that should this scheme proceed a Principal Designer is appointed by the client in accordance with current CDM Regulations.

4. A47 Substation Access A Junction

Introduction

- 4.1. Access A is an existing priority junction with the A47 (illustrated by Figure 2 below), currently serving the existing Necton Electricity Substation (NES) and adjacent farm land. Access A currently comprises a simple T-junction with adjacent 'grasscrete' over-run areas originally provided to accommodate access by 'abnormal loads' during construction of the NES. At present the access is currently shared by local farmers accessing agricultural land south of the A47 and by operational traffic associated with the NES. The A47 is a two-way single carriageway road subject to the derestricted National Speed Limit of 60mph in the vicinity of the junction. Table 4.1 of the SATN shows that, between them, accesses A and B are anticipated to be used by up to an additional 278 vehicles per day during the Substation works, which are anticipated to last for up to six years (Table 24.12 of ES Chapter 24).



Figure 2. Existing access for Necton Onshore Substation (Access A)

- 4.2. Existing accesses serving an unmade service road to the north of the A47 and providing access to a single dwelling known as 'The Grove' are located approximately 27m southwest and 72m northeast of the existing Access A priority junction.
- 4.3. This section considers the proposed Access A layout illustrated on the RHDHV drawing TP-PB4476-DR012 Rev D0.3, which appears to retain the existing simple T-junction arrangement with the A47 with no geometric changes to the existing physical layout. RHDHV propose a left-in / left-out access arrangement at Access A for the duration of the OHLM works, enforced by the implementation of an Access Management Strategy.
- 4.4. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR017 Rev D0.1 and TP-PB4476-DR018 Rev D0.1 each dated August 2018.
- 4.5. This technical review does not consider the question as to whether the proposed layout is sufficient to accommodate the predicted increases in traffic flows at the A47 Substation Access A junction attributed to the Norfolk Vanguard Wind Farm project, but confines itself to the question of whether the layout proposed meets the requirements of the DMRB.

General Principles

- 4.6. Geometric measurements referenced within this technical note have been obtained from an electronic copy of drawing TP-PB4476-DR012 Rev D0.3, which was provided to AECOM by

RHDHV on 3 January 2019. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR017 Rev D0.1 and TP-PB4476-DR018 Rev D0.1 which were also provided to AECOM in electronic format by RHDHV on 3 January 2019.

- 4.7. It should be noted that the information presented on drawing no. TP-PB4476-DR012 Rev D0.3 is in two-dimensional form only and therefore a review of the vertical aspects of the proposal has not been undertaken. The vertical aspects could have implications in terms of alignment in both vertical and horizontal planes and also the perceived visibility available and should be provided in due course.
- 4.8. The proposed access illustrated by drawing no. TP-PB4476-DR012 Rev D0.3 appears to retain the existing priority T-junction with the A47 in situ. Whilst the RHDHV assertion that vehicular right-turn movements will be removed and controlled by an Access Management Strategy is noted, **AECOM consider that, in principle, a fully compliant DMRB arrangement comprising a ghost-island right-turn would represent the preferable junction arrangement at this location.** Any subsequent proposals for a DMRB compliant ghost-island right-turn arrangement would need to consider the implications for the access to 'The Grove' located almost opposite (see paragraph 4.13 below).
- 4.9. TD 42 (para. 7.78) identifies that guidance for the appropriate use of traffic signs and road markings at priority junctions is contained in the Traffic Signs Manual (TSM). Additionally the Traffic Signs Regulations and General Directions (TSRGD) should be consulted. Indicative signing and lining illustrated on drawing no. TP-PB4476-DR012 Rev D0.3 appears to be broadly consistent with the guidance set out in TD42, TSM and TSRGD. **AECOM recommend that traffic signs and markings in accordance with TD 42, TSM and TSRGD are demonstrated fully at the detailed design stage.**
- 4.10. The current access to the development area is an existing service road, circa 4.0m in width, which forms a simple priority T-junction with the A47 and provides access to the existing NES and adjacent agricultural land. Existing kerb radii are circa 6m on the entry to the service road from the A47 and 10m on the exit from the service road to the A47. The existing provision of 'grasscrete' over-run areas adjacent to the service road potentially delivers an effective entry radius of 12m and exit radius of 14.5m for the existing service road should drivers choose to make use of these areas.
- 4.11. Vehicular swept paths for an 'articulated vehicle' and 'large tipper' are provided in drawing TP-PB4476-DR017 Rev D0.1 and TP-PB4476-DR018 Rev D0.1 respectively. Whilst AECOM note that the swept paths of each of the design vehicles appear to be broadly accommodated within the existing junction layout (including over-run areas), some overrunning of A47 centre lines on the left-turn exit manoeuvre is shown and the swept paths overlap on the access road beyond the immediate junction, raising the risk of conflicts occurring where insufficient width is provided for two vehicles to access and egress the development area simultaneously. Potentially a scenario could occur where a vehicle waiting to egress the access blocks the path of a large vehicle wishing to enter the site, forcing that vehicle to stop on the A47 until the junction access area is cleared and potentially increasing the risk of collisions occurring. **AECOM recommend that a revised access layout is proposed that would allow vehicles to enter and exit at the same time on a fully paved surface. Vehicular swept path plots should be provided in support of the revised A47 Substation Access A junction layout to demonstrate the ability of an articulated vehicle and large tipper (the Design Vehicles) to negotiate all legitimate turning movements at the junction without overrunning kerb or A47 centre lines.**

A47 Substation Access A – Simple Priority Junction

- 4.12. The proposed access illustrated by drawing no. TP-PB4476-DR012 Rev D0.3 appears to retain the existing priority T-junction with the A47 in situ. The existing accesses on the northern side of the A47 serving the dwelling known as 'The Grove' also appear to be retained and effectively form a left-right stagger of 27m and right-left stagger of 72m with Access A respectively.
- 4.13. AECOM note that the existing stagger distance of 27m to the southern access serving The Grove falls short of the mandatory minimum stagger distance for a simple left-right stagger as set out in TD 42 (para. 7.65). Whilst acknowledging that the stagger represents an existing situation and vehicular use of the southern access for The Grove is likely to be negligible, **AECOM recommend that the potential to close off the southern access to the service road serving the dwelling known as 'The Grove' should be investigated.**
- 4.14. Drawing TP-PB4476-DR012 Rev D0.3 illustrates the extent of land required to be clear to provide visibility splays of 4.5m x 215m in each direction from the centre line on the minor road. AECOM are satisfied that a Desirable Minimum Stopping Sight Distance (DMSSD) of 215m is appropriate in this location and is consistent, in principle, with the requirements of TD 9 (Table 3) with respect to forward visibility for the major road right-turn (notwithstanding the proposed Access Management Strategy left-in / left-out operation) and TD 42 (Table 7/1) with respect to 'y' distance from the Minor Road. AECOM are also satisfied that an 'x' distance of 4.5m is appropriate and consistent with the acceptable relaxation in difficult circumstances set out by TD 42 (para. 7.8) for lightly trafficked simple junctions. AECOM note the presence of a significant number of mature trees in the hedgerow on the south side of the A47 on both sides of the access point and that these trees also serve the function of screening 'The Grove' from views of the substation. It is unclear from the drawing provided how much of the hedgerow and how many of the trees would have to be removed in order to achieve the visibility splays shown. Notwithstanding this, AECOM are satisfied that a DMSSD visibility splay of 4.5m x 215m is likely to be achievable in both directions from the minor road, in the horizontal plane, subject to the clearance of vegetation from the identified area. Para 3.1 of the OAMP acknowledges the presence of a crest curve located approximately 200m north east of the access point. **AECOM recommend that visibility splays of 4.5m x 215m from Access A in accordance with the requirements of TD 42 are demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage.**
- 4.15. Drawing TP-PB4476-DR012 Rev D0.3 illustrates entry/exit corner radii of 6m and 10m respectively on the minor road at Access A whilst the existing provision of 'grasscrete' over-run areas adjacent to the service road delivers effective entry/exit corner radii of 12m and 14.5m respectively. AECOM consider that the proposed corner radii fall short of the provision recommended by TD 42 (para. 7.17) which advises that "Where provision is to be made for large goods vehicles, the recommended circular corner radius is:- b. 15m at rural simple junctions, with tapers of 1:10 over a distance of 25m". The standard requires an exit taper into both the major and minor road arms, however an approach taper from the major road is not required. The layout illustrated on drawing TP-PB4476-DR012 Rev D0.3, does not provide for an exit taper into the minor arm or into the major road. AECOM consider that this is likely to be contributory in the over running of centre lines on the A47 shown on the swept paths referred to above. **AECOM recommend that the proposed corner radii and exit tapers at Access A are reviewed in the context of the guidance set out in TD 42 (para. 7.17) and the paved area extended if necessary to provide the appropriate corner radii and tapers.**
- 4.16. AECOM consider that the existing and proposed Access A priority junction does not currently constitute a DMRB compliant junction. However, AECOM consider that a DMRB compliant junction is likely to be deliverable at this location, in principle, subject to resolution of the recommendations set out in this BN06.

5. A47 Substation NG OHLMW Access D1 Junction

Introduction

- 5.1. The proposed Access D1 is located on the northern verge of the A47 approximately 300m northeast of the existing NES access (Access A). It is currently an existing field access (illustrated by Figure 3 below), providing immediate access to the field in which the electricity pylon is located, and connecting with the northern section of the unmade service road serving the dwelling known as 'The Grove'. The A47 is a two-way single carriageway road subject to the derestricted National Speed Limit of 60mph in the vicinity of the proposed junction. Table 5.1 of the SATN shows that this access is anticipated to be used by up to 24 vehicles per day during the NG OHLMW works, which are anticipated to last for two one-week periods (footnote to Table 4.1 of the SATN).



Figure 3. Existing field access (Access D1)

- 5.2. RHDHV assert that a fully DMRB compliant ghost island right-turn access to the Electricity Pylon field at Access D1 would be disproportionate to the vehicular demand and construction programme proposed. RHDHV accordingly propose the implementation of an Access Management Strategy to remove right-turn manoeuvres from the A47 by enforcing left-in / left-out movements by construction traffic whereby all OHLM traffic would approach Access D1 from the south and exit to the north. Whilst the RHDHV assertion that vehicular right-turn movements will be removed and controlled by an Access Management Strategy is noted, **AECOM consider that, in principle, a fully compliant DMRB arrangement comprising a ghost-island right-turn would represent the preferable junction arrangement at this location.** However, AECOM accept that the disruption involved in providing a ghost island right turn layout would be disproportionate to the proposed use of the access by construction traffic
- 5.3. This section considers the proposed Access D1 layout illustrated on the RHDHV drawing TP-PB4476-DR015 Rev D0.1, comprising a simple priority T-junction with the A47 located approximately 300m northeast of Access A. The proposed junction with the A47 consists of a minor arm of 7.5m width, serving a gated field access and also providing access to the service road for The Grove, with entry/exit kerb radii with the A47 of circa 14m and 13m respectively. RHDHV also propose a temporary 30mph speed reduction on the A47 for the duration of the OHLM works, over a distance of circa 430m straddling the proposed Access D1 junction.

- 5.4. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR023 Rev D0.1 and TP-PB4476-DR024 Rev D0.1 each dated August 2018.
- 5.5. This technical review does not consider the question as to whether the proposed mitigation is sufficient to accommodate the predicted increases in traffic flows at the A47 Access D1 junction attributed to the Norfolk Vanguard Wind Farm project, but confines itself to the question of whether the layout proposed meets the requirements of the DMRB.

General Principles

- 5.6. Geometric measurements referenced within this technical note have been obtained from an electronic copy of drawing no. TP-PB4476-DR015 Rev D0.3, which was provided to AECOM by RHDHV on 3 January 2019. Additionally, AECOM have cognisance to the RHDHV tracking drawings TP-PB4476-DR023 Rev D0.1 and TP-PB4476-DR024 Rev D0.1 which were also provided to AECOM in electronic format by RHDHV on 3 January 2019.
- 5.7. It should be noted that the information presented on drawing no. TP-PB4476-DR015 Rev D0.3 is in two-dimensional form only and therefore a review of the vertical aspects of the proposal has not been undertaken. The vertical aspects could have implications in terms of alignment in both vertical and horizontal planes and also the perceived visibility available and should be provided in due course.
- 5.8. TD 42 (para. 7.78) identifies that guidance for the appropriate use of traffic signs and road markings at priority junctions is contained in the Traffic Signs Manual (TSM). Additionally the Traffic Signs Regulations and General Directions (TSRGD) should be consulted. Indicative signing and lining illustrated on drawing no. TP-PB4476-DR015 Rev D0.3 appears to be broadly consistent with the guidance set out in TD42, TSM and TSRGD. **AECOM recommend that traffic signs and markings in accordance with TD 42, TSM and TSRGD are demonstrated fully at the detailed design stage.**
- 5.9. Vehicular swept paths for an 'articulated vehicle' and 'large tipper' are provided in drawing TP-PB4476-DR023 Rev D0.1 and TP-PB4476-DR024 Rev D0.1 respectively. Whilst AECOM note that the swept paths of each of the design vehicles appear to be broadly accommodated within the proposed junction layout, some overrunning of centre lines on the articulated vehicle swept paths is shown. AECOM are satisfied in principle that two design vehicles making the left-in / left-out manoeuvre will be able to access/egress the minor arm of the junction simultaneously, however the potential for conflicts between articulated vehicles entering the access from the south and general traffic on the southbound A47 should be reviewed. **AECOM recommend that vehicular swept path plots are provided in support of the proposed A47 Substation Access D1 junction layout to demonstrate the ability of an articulated vehicle (the Design Vehicle) to negotiate all legitimate turning movements at the junction without overrunning kerb or centre lines.** In addition AECOM note that the 'order limits' indicated on the drawing present a challenging alignment within the field area, potentially requiring vehicles to utilise both sides of the access to complete this turn. **The swept paths presented should also demonstrate that an articulated vehicle entering the site is able to stand clear of the carriageway whilst an articulated vehicle is exiting the field area within the limits of the order boundary shown.**

A47 Substation NG OHLMW Access D1 – Simple Priority Junction

- 5.10. Drawing TP-PB4476-DR015 Rev D0.3 illustrates the extent of land required to provide visibility splays of 4.5m x 90m in each direction from the centre line on the minor road, commensurate with the temporary 30mph speed restriction proposed for the A47. AECOM are satisfied that an 'x' distance of 4.5m is appropriate in this location and is consistent with the acceptable relaxation in difficult circumstances set out in TD 42 (para.7.8) for lightly trafficked simple junctions. AECOM

note that the proposed 'y' distance is dependent upon the successful implementation of a Traffic Regulation Order (TRO) introducing a 30mph speed restriction on a circa 430m stretch of the A47.

- 5.11. AECOM also note that the illustrated kerb realignment and visibility splays are likely to require the removal of a significant length of mature trees and hedgerow vegetation adjacent to the highway. It is unclear whether the land required is currently within the control of the applicant and/or whether the required permissions have been obtained for removal of the hedgerow and trees. Given the level of use anticipated for this access point, should the removal of all the vegetation within the visibility splays shown not be feasible, consideration could be given to reducing the 'x' distance to 2.4m as a permitted relaxation at lightly used accesses, as set out at TD41/95 para 2.21. In any case, **AECOM recommend that visibility splays from Access D1 in accordance with the requirements of TD 42 are demonstrated to be deliverable in both the horizontal and vertical plane within land in the control of either the applicant or the highway authority at the detailed design stage.**
- 5.12. AECOM consider that, based on the prevailing derestricted 60mph speed restriction on the A47, a Desirable Minimum Stopping Sight Distance (DMSSD) of 215m is appropriate in this location and consistent with the requirements of TD 9 (Table 3) with respect to forward visibility for the major road right-turn (notwithstanding the proposed Access Management Strategy left-in / left-out operation) and TD 42 (Table 7/1) with respect to 'y' distance from the Minor Road. Whilst not illustrated on drawing TP-PB4476-DR015 Rev D0.3, AECOM understand that, although a DMSSD visibility splay of 215m is likely to be achievable, in principle, in both directions from the minor access in the horizontal plane subject to the clearance of vegetation, vertical visibility is understood to be compromised on the approach to the junction from both directions due to the presence of a crest curve on the A47 carriageway at this location, with the apex of the curve located some 200m northeast of the existing substation access (access A). Accordingly, RHDHV assert that Access D1 would require a speed restriction on the A47 to achieve DMRB compliant forward visibility.
- 5.13. AECOM assume that the proposed Access D1 junction represents a permanent infrastructure provision on the A47 which will remain in situ upon completion of the NG OHLM works. A 90m visibility splay as proposed does not represent a DMRB compliant junction in perpetuity, once the temporary speed restriction on the A47 is lifted and the speed limit reverts to 60mph at this location. However, AECOM accept that the resulting provision will be, in principle, no worse than currently exists at this location and should in principle be satisfactory, provided that the regular, permanent use of this access point reverts to its pre-construction level once the NG OHLM works are complete and no attempt is made to use the resulting improved access for any other purpose.
- 5.14. Drawing TP-PB4476-DR015 Rev D0.3 illustrates entry/exit corner radii of circa 14m and 13m respectively on the minor road, with an exit taper over a distance of 23.5m at a ratio of approximately 1:9 to the major road kerb. AECOM consider that the proposed corner radii fall short of the provision recommended by TD 42 (para. 7.17) which advises that *"Where provision is to be made for large goods vehicles, the recommended circular corner radius is:- b. 15m at rural simple junctions, with tapers of 1:10 over a distance of 25m"*. TD 41 requires similar provision with no further relaxations permitted. The standard requires an exit taper into both the major and minor road arms, however an approach taper from the major road is not required. The layout illustrated on Drawing TP-PB4476-DR015 Rev D0.3, does not provide an exit taper into the minor arm and the exit taper illustrated into the major road is of insufficient length and too narrow an angle. This may be a contributory factor for the over running of centre lines shown on the swept paths referred to above. **AECOM recommend that the proposed corner radii are reviewed in the context of the guidance set out in TD 42 (para. 7.17) with respect to nearside tapers on the major and minor road exits from the junction.**

- 5.15. AECOM note that the existing unmade service road giving access the dwelling known as 'The Grove' served by proposed Access D1 is shown as remaining open on Drawing TP-PB4476-DR015 Rev D0.3. Whilst it is evident that this access point is little used and alternative access points are available further south on the A47, AECOM regard it as undesirable to retain an access point within the overall footprint of the new junction. AECOM also note that the proposed entry/exit radii on the service road minor arm at circa 2m fall short of the minimum corner radii recommended by TD 42 (para. 7.17) of 10m in rural areas where no provision is made for large goods vehicles. Dependent on the level of use anticipated, an alternative layout such as that shown at Layout 8 of TD 41/05 could be considered. **AECOM recommend that the service road access should be closed and alternative provision be made to access the dwelling known as 'The Grove'. If this is not possible, AECOM recommend that appropriate corner radii are provided and swept paths and visibility splays illustrated on a further revision of Drawing TP-PB4476-DR015 Rev D0.3 to demonstrate that its legitimate use by vehicles will not be compromised by the proposed new junction.**
- 5.16. AECOM consider that the proposed Access D1 priority junction does not currently constitute a DMRB compliant junction. However, AECOM consider that a DMRB compliant junction encompassed within a reduced A47 speed limit is likely to be deliverable at this location, in principle, subject to resolution of the recommendations set out in this BN06.

6. Conclusion

- 6.1. This Briefing Note (BN06) has been prepared by AECOM, on behalf of Highways England, to provide a DMRB technical review of the mitigation proposed at the A47 Substation Access A and Access D1 junctions, illustrated by drawing TP-PB4476-DR012 Rev D0.3 and TP-PB4476-DR015 Rev D0.3 submitted by RHDHV in support of the Norfolk Vanguard Wind Farm proposal.
- 6.2. This review has identified several issues relating to DMRB compliance. AECOMs recommendations regarding these concerns are highlighted by the use of bold underlined text throughout this document. Recommendations regarded as critical to the acceptability of this layout are coloured **red**. Recommendations regarded as important but not critical to the acceptability of this planning application in principle are highlighted in **amber**.
- 6.3. AECOM recommend that the consultation response from Highways England asserts that the recommendations listed above should be addressed.

Appendix C – Peak Daily HGV Access Turning Movements

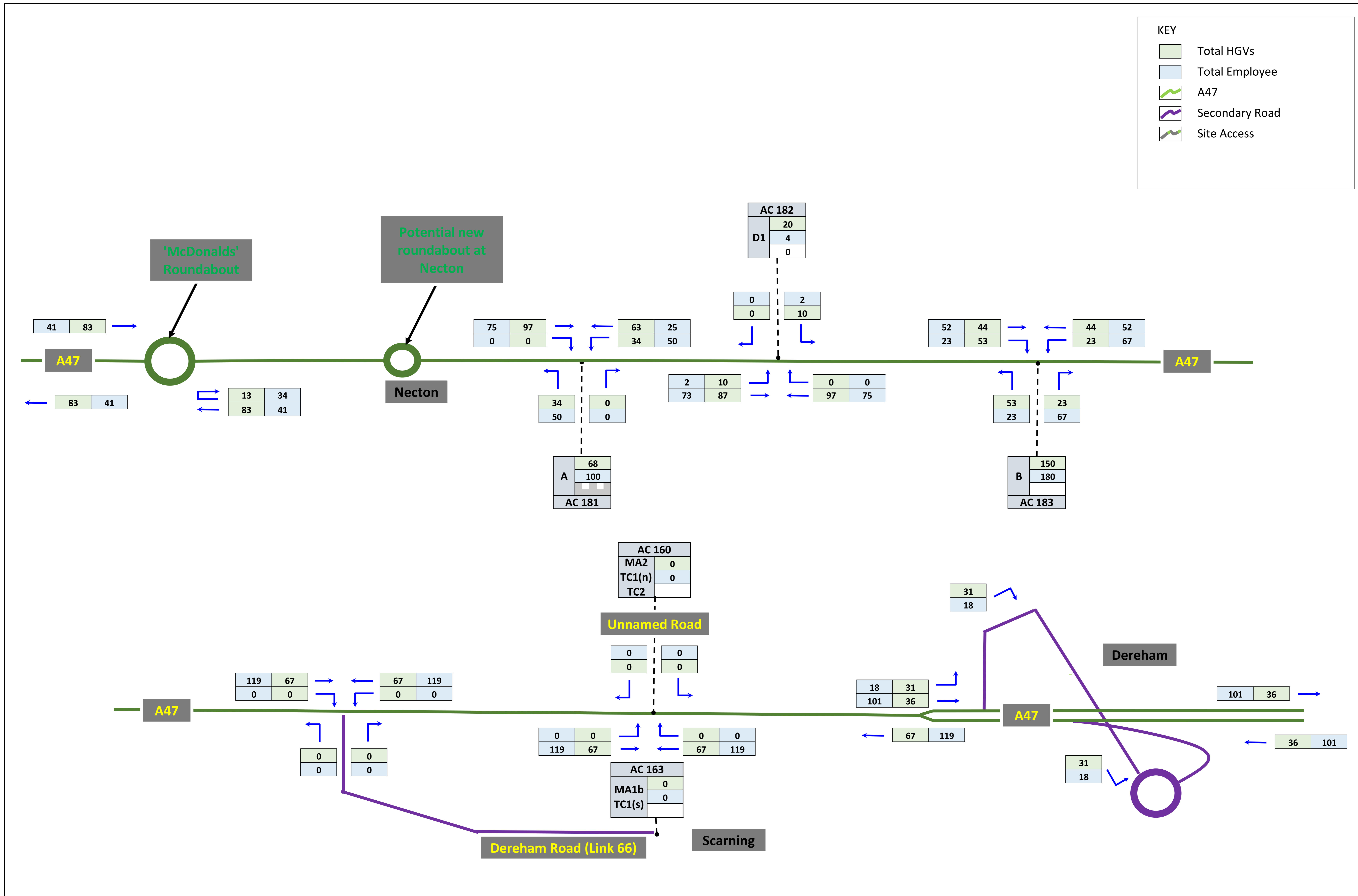
Infrastructure	Daily HGV Movements	Peak Daily HGV Turning Movements							
		If Kings Lynn was Origin Location				If Great Yarmouth / Lowestoft was Origin Location			
		West (70%)		East (30%)		West (30%)		East (70%)	
Access A (AC 181) Turning Movements		E	B	A	F	E	B	A	F
National Grid Extension Works	68	23.8	23.8	10.2	10.2	10.2	10.2	23.8	23.8
Totals	68	23.8	23.8	10.2	10.2	10.2	10.2	23.8	23.8
Access B (AC 183) Turning Movements		C	B	A	D	C	B	A	D
Onshore Project Substation	54	18.9	18.9	8.1	8.1	8.1	8.1	18.9	18.9
MA1a-W	48	16.8	16.8	7.2	7.2	7.2	7.2	16.8	16.8
MA1a-E	48	16.8	16.8	7.2	7.2	7.2	7.2	16.8	16.8
Totals	150	52.5	52.5	22.5	22.5	22.5	22.5	52.5	52.5
Access D1 (AC 182) Turning Movements		A	G	H	B	A	G	H	B
NG OHLM Works	20	7	7	3	3	3	3	7	7
Totals	20	7	7	3	3	3	3	7	7

Turning Movement Key

- A = Left turn in
- B = Left turn out
- C = Right turn in
- D = Right turn out
- E = Left turn in utilising diversion at Dereham
- F = Left turn out utilising diversion at McDonald's Roundabout
- G = Left turn out utilising diversion at Dereham
- H = Left turn in utilising diversion at McDonald's Roundabout

*Only 1 Trenchless Crossing (TC) active at any time. Worst case traffic demand scenario if TC#2 was constructed requiring both launch and receive compounds accessed at AC160.

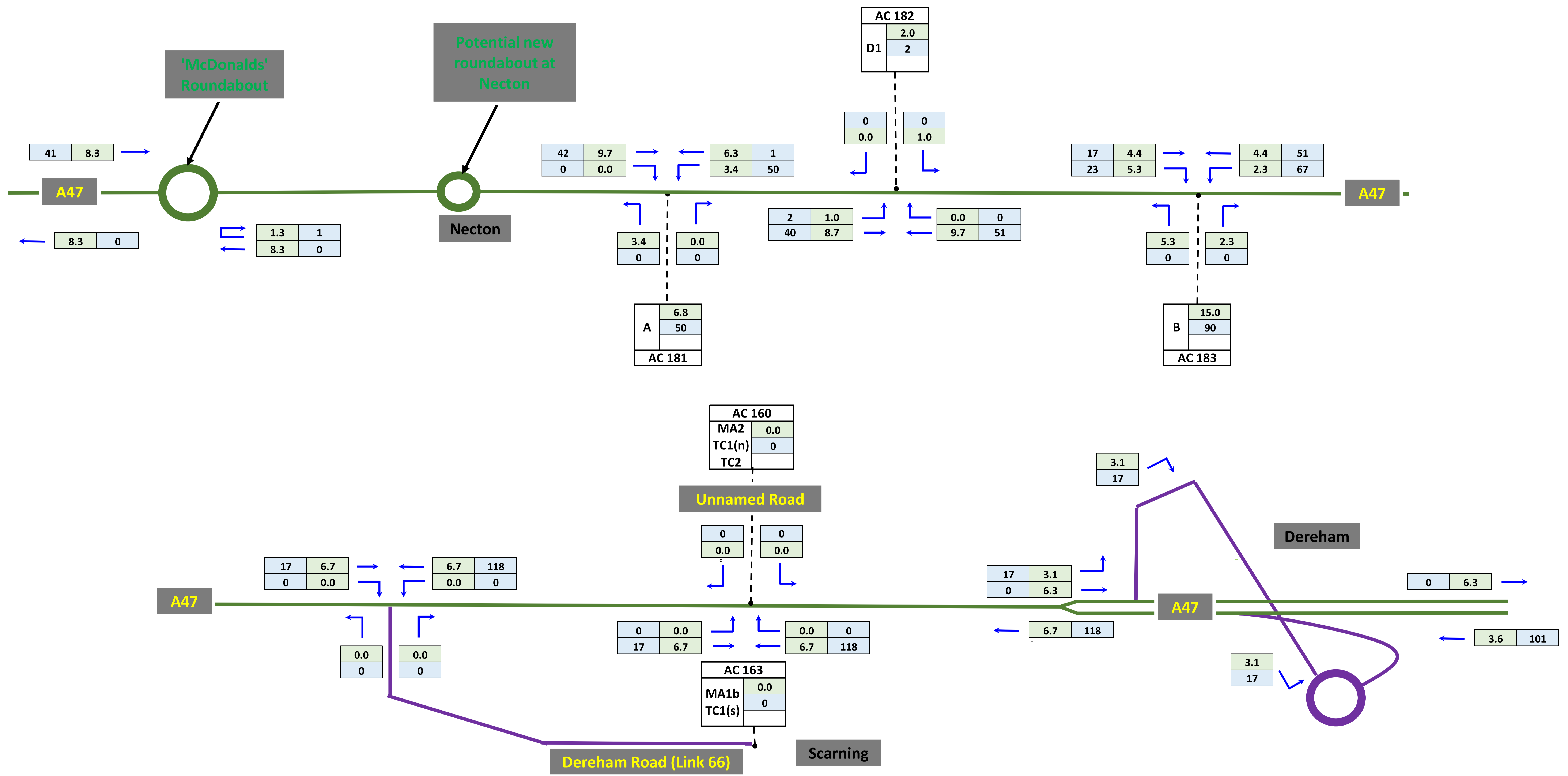
Appendix D – Network Flow Diagrams (AM, PM and Daily)



	Project Title	Appendix Title	Appendix No
	Norfolk Vanguard - A47 Substation Access Clarification Technical Note	Traffic Distribution Scenario 1 - Kings Lynn (70%) Peak Daily Vehicle Turning Movements	
	Job Number	Date	E1
	PB4476	Feb-19	

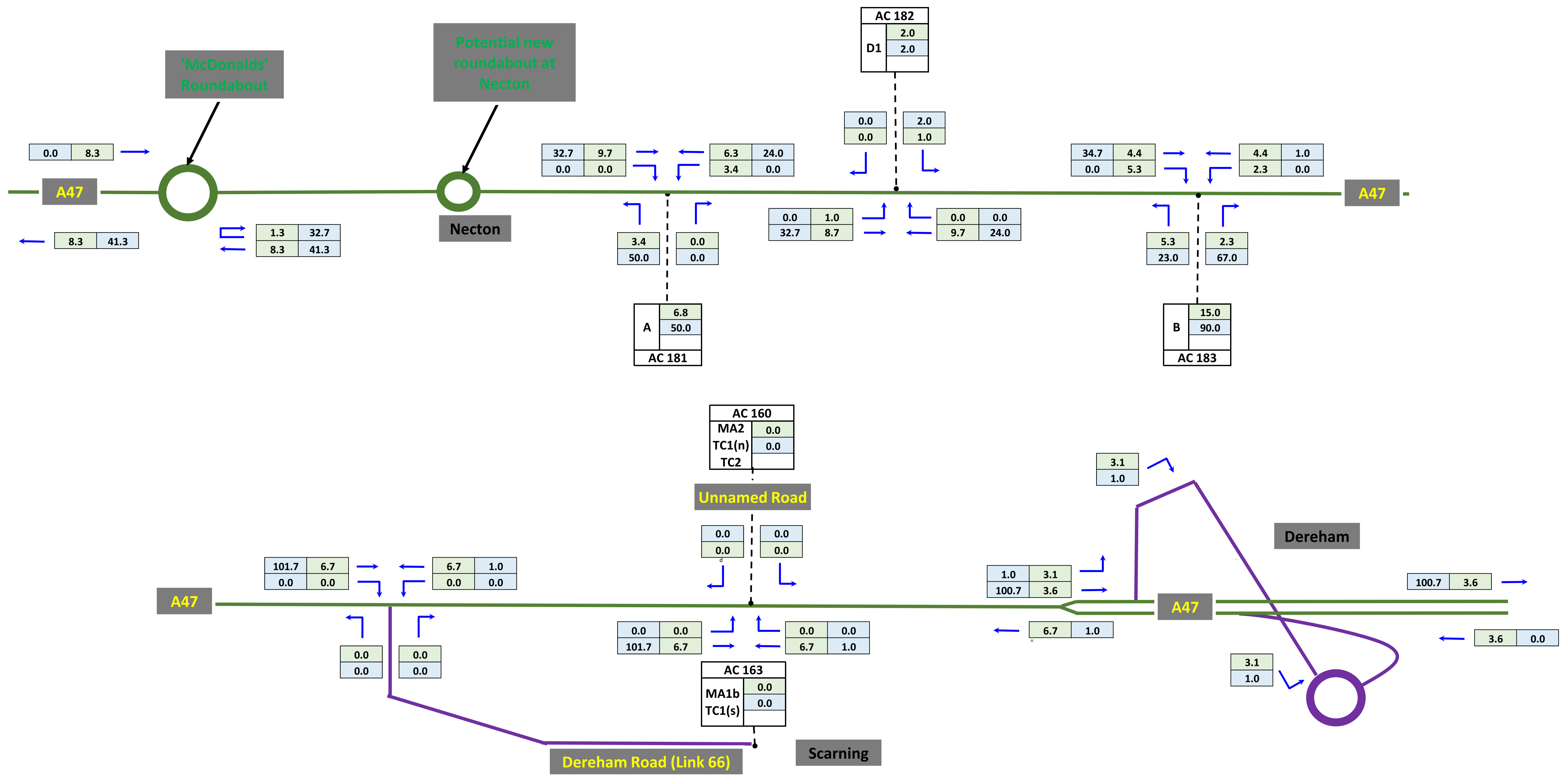
KEY

- Total HGVs
- Total Employee
- A47
- Secondary Road
- Site Access



	Project Title	Appendix Title	Appendix No
	Norfolk Vanguard - A47 Substation Access Clarification Technical Note	Traffic Distribution Scenario 1 - Kings Lynn (70%) AM Peak Vehicle Turning Movements	
	Job Number	Date	E2
	PB4476	Feb-19	

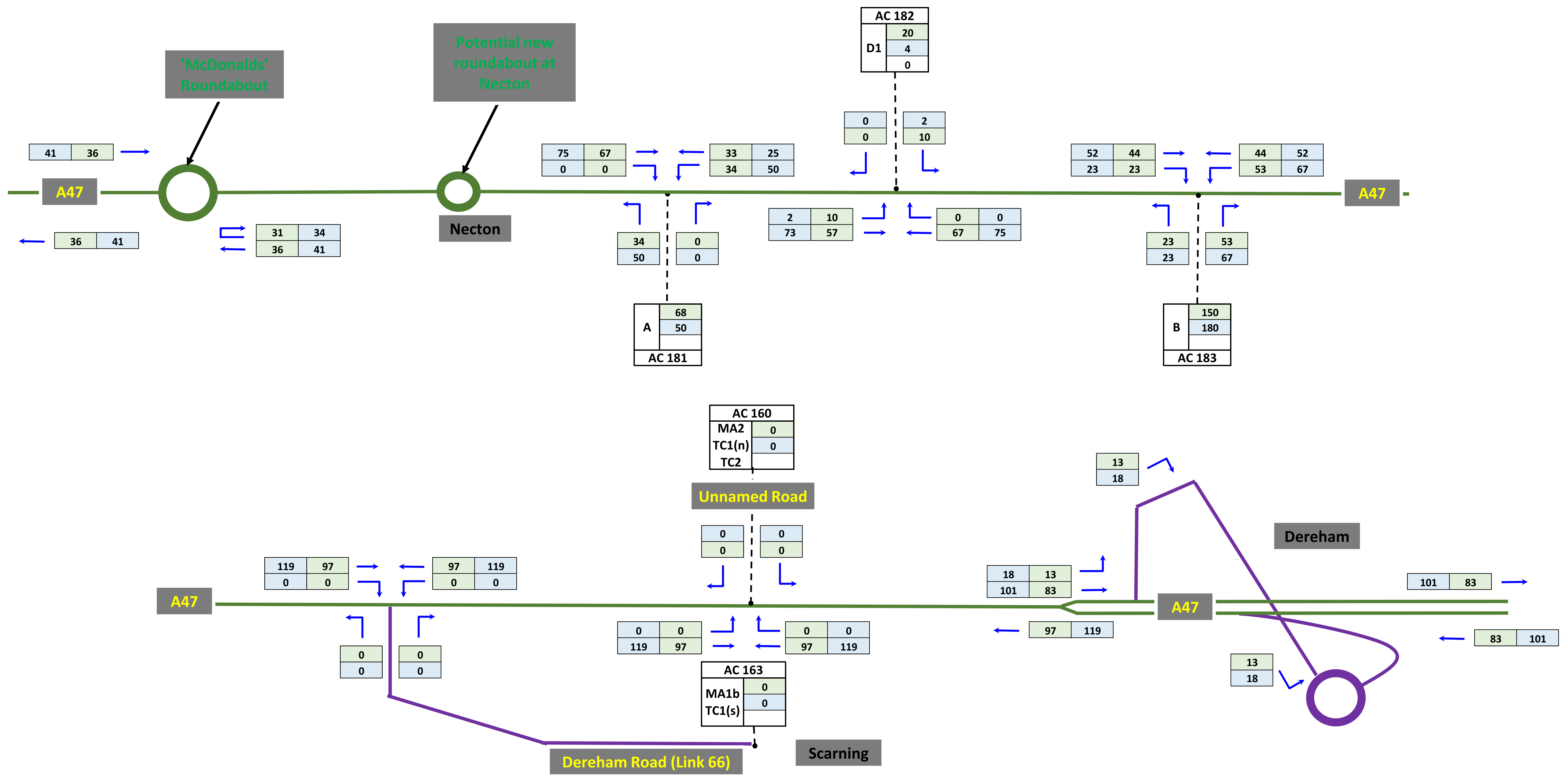
KEY	
	Total HGVs
	Total Employee
	A47
	Secondary Road
	Site Access



	Project Title	Appendix Title	Appendix No
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	Job Number	Date	E3
	PB4476	Feb-19	

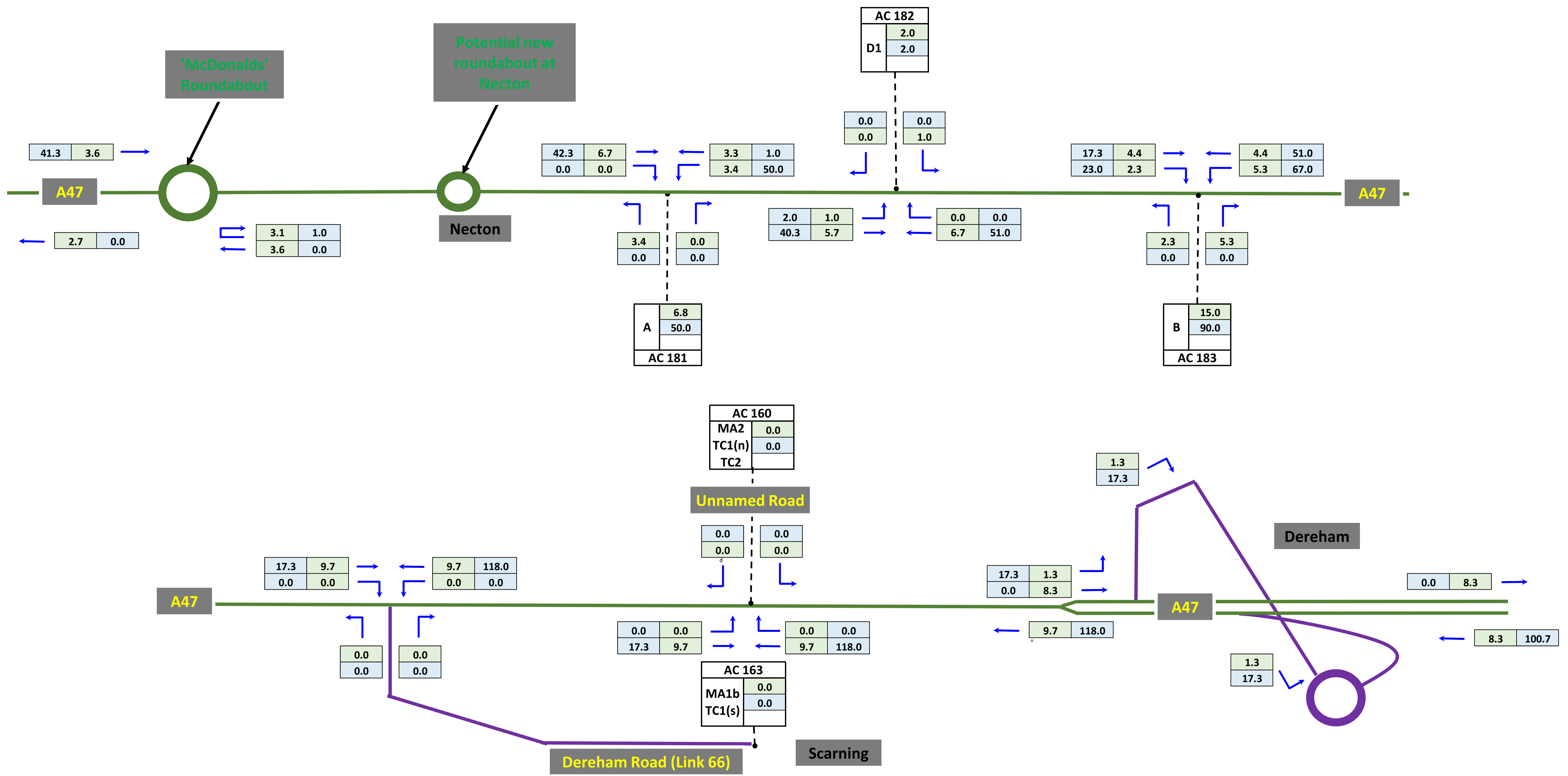
KEY

- Total HGVs
- Total Employee
- A47
- Secondary Road
- Site Access



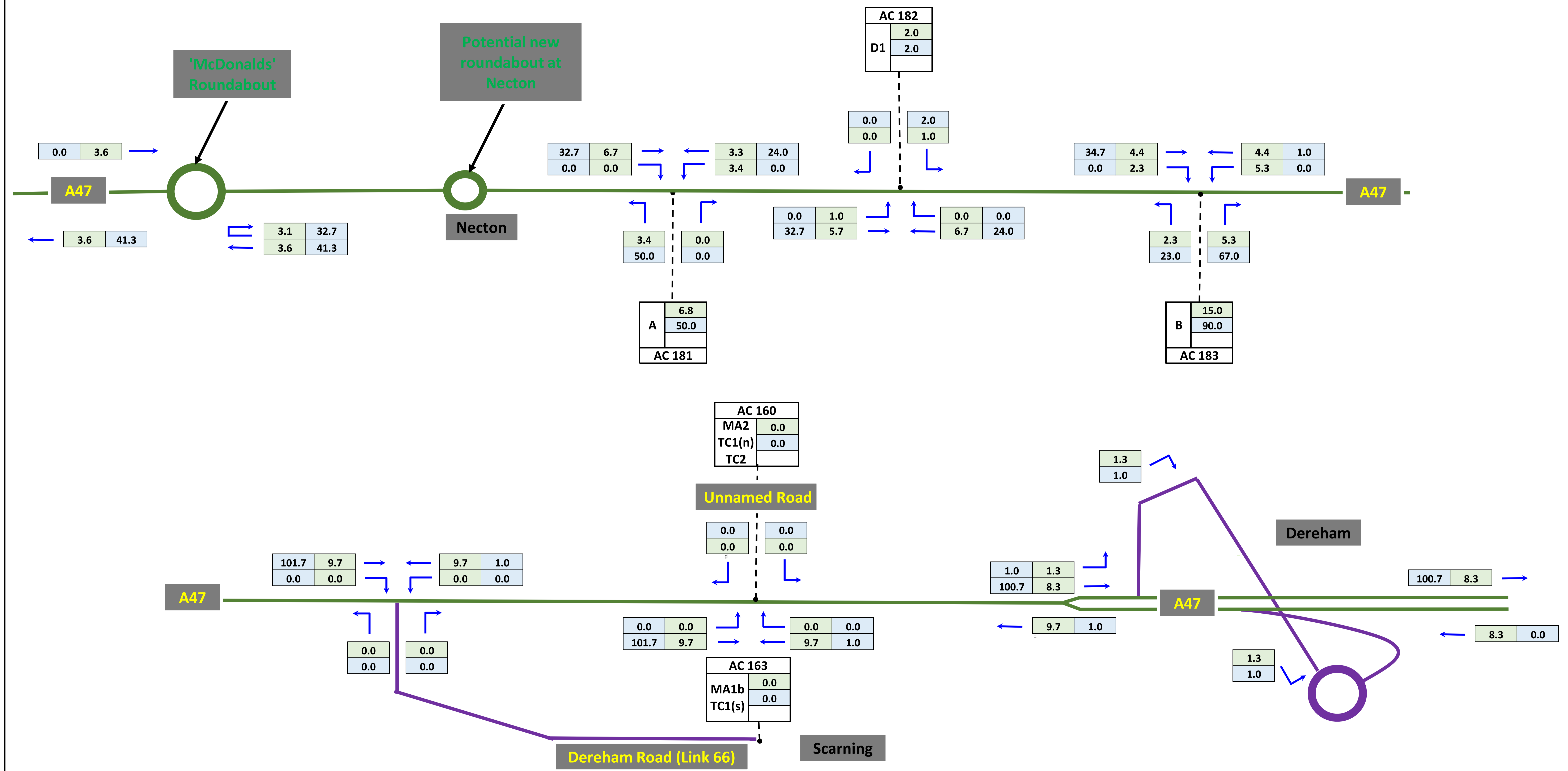
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	Norfolk Vanguard - A47 Substation Access Clarification Technical Note	Traffic Distribution Scenario 2 - Great Yarmouth (70%) Peak Daily Vehicle Turning Movements	
	Job Number	Date	E4
	PB4476	Feb-19	

KEY	
	Total HGVs
	Total Employee
	A47
	Secondary Road
	Site Access



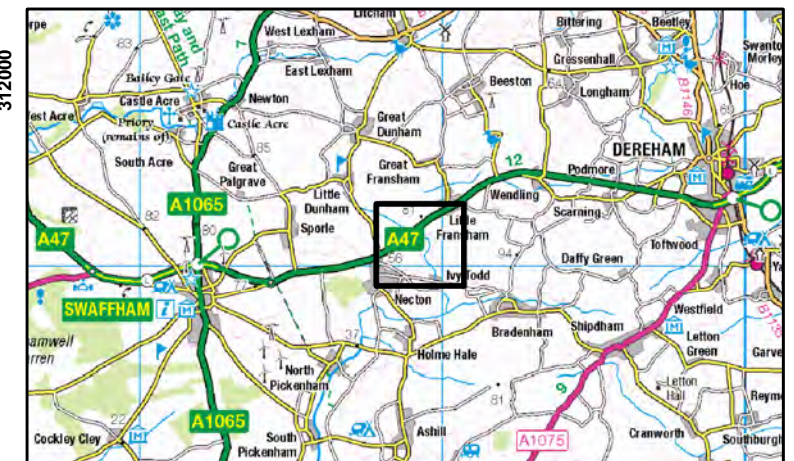
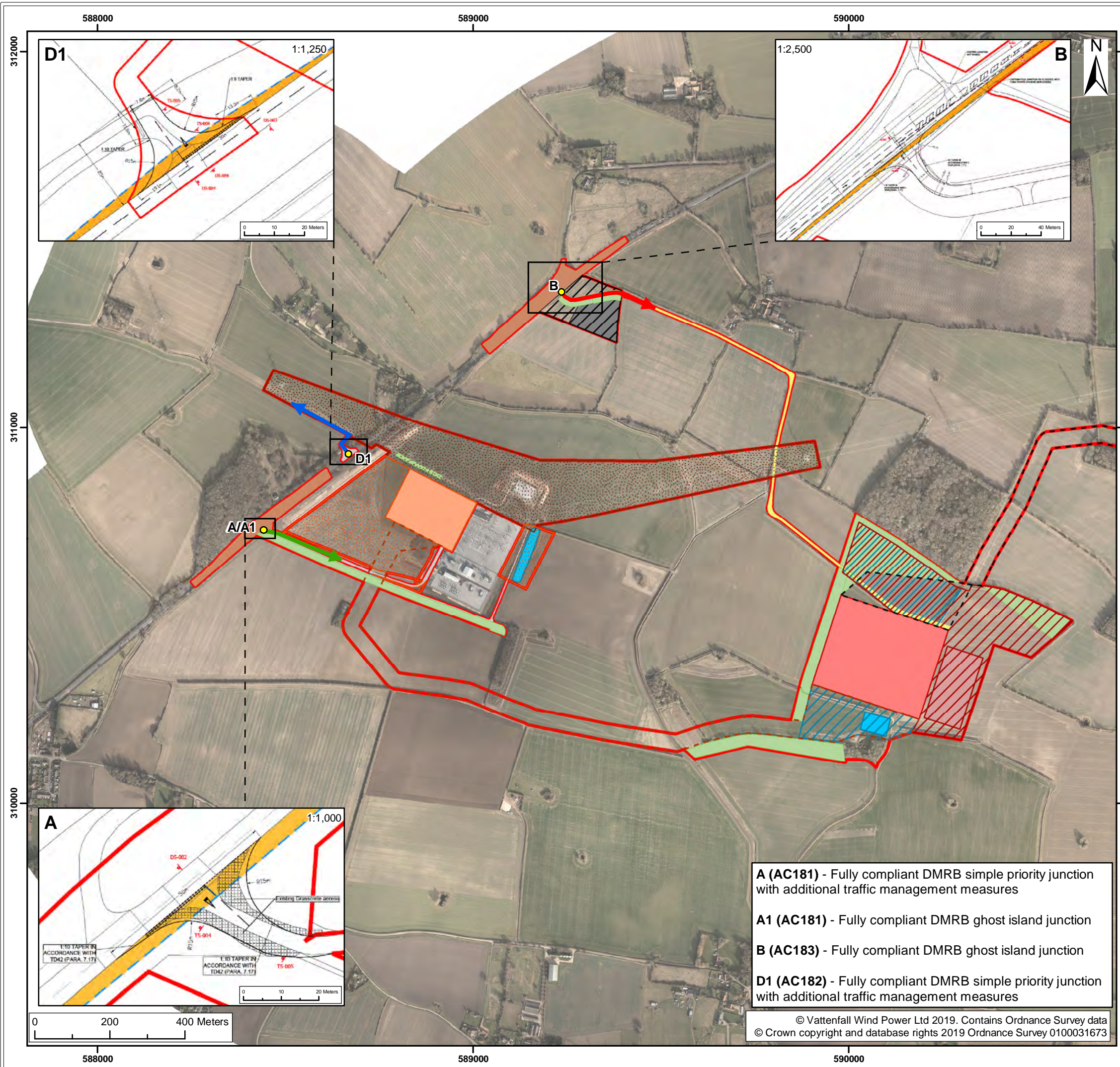
Project Title	Appendix Title	Appendix No
Norfolk Vanguard - A47 Substation Access Clarification Technical Note	Traffic Distribution Scenario 2 - Great Yarmouth (70%) AM Peak Vehicle Turning Movements	
Job Number	Date	
PB4476	Feb-19	

KEY	
	Total HGVs
	Total Employee
	A47
	Secondary Road
	Site Access



Project Title	Appendix Title	Appendix No
Norfolk Vanguard - A47 Substation Access Clarification Technical Note	Traffic Distribution Scenario 2 - Great Yarmouth (70%) PM Peak Vehicle Turning Movements	
Job Number	Date	
PB4476	Feb-19	

Appendix E – Access General Arrangement



- Legend:
- Norfolk Vanguard onshore red line boundary
 - Onshore cable route
 - Onshore 400kv cable route
 - Mobilisation zone
 - Indicative mobilisation area compound
 - Onshore project substation
 - Onshore project substation temporary construction compound zone
 - Indicative onshore project substation temporary construction compound
 - National Grid substation extension
 - National Grid temporary works
 - Overhead line temporary works
 - Mitigation areas
 - Attenuation pond zone
 - Indicative attenuation pond
 - Indicative mitigation planting
 - Access
 - Permanent access
 - Construction access
 - Operation access
 - Access Point ID
 - Access for National Grid Overhead Line Modification Works
 - Access for National Grid Substation Extension
 - Access for Norfolk Vanguard Onshore Project Substation

Project: Norfolk Vanguard
 Report: A47 Substation Access Review

Title: ExA; ISH1; 10.D4.3
 A47 Substation Access Options

Figure:	Drawing No: PB4476-008-006-005				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
04	12/03/2019	LB	RE	A3	1:10,000
03	13/02/2019	JT	RE	A3	1:10,000

Co-ordinate system: British National Grid EPSG: 27700

- A (AC181)** - Fully compliant DMRB simple priority junction with additional traffic management measures
- A1 (AC181)** - Fully compliant DMRB ghost island junction
- B (AC183)** - Fully compliant DMRB ghost island junction
- D1 (AC182)** - Fully compliant DMRB simple priority junction with additional traffic management measures

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Appendix F – Swept Path Analysis Drawings

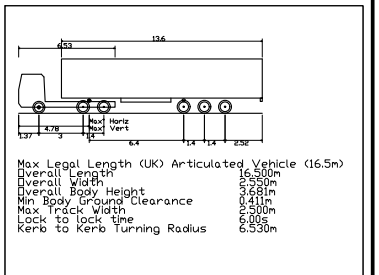
DRAWING No. TP-PB4476-DR017



NOTES
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 2. This drawing has been based upon Ordnance Survey Maps and Royal Haskoning can not guarantee the accuracy of data.

KEY
 ORDER LIMITS

VEHICLE TRACKING



VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

DRAFT - NOT FOR CONSTRUCTION

F1.0	02/19	Updated in accordance with HE comments	JJ	RNE	ADR
D.01		FIRST ISSUE			
REV	DATE	DESCRIPTION	BY	CHK	APP

REVISIONS
 CLIENT



PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

TITLE
 A47 NATIONAL GRID SUBSTATION ACCESS A (AC181)
 ARTICULATED VEHICLE SWEEP PATH ANALYSIS
 (LEFT TURN IN / LEFT TURN OUT)



DRAWN	JJ	CHECKED	RNE	APPROVED	ADR
DATE	31.08.18	SCALE AT A3	1:250	CLIENTS REF.	
DRAWING No.	TP-PB4476-DR017			REVISION	F1.0
CLIENT DWG No.					

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A47 - SUBSTATION ACCESS A (AC181)
 SCALE - 1:250

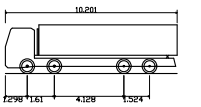
DRAWING No. TP-PB4476-DR018



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KEY
 ORDER LIMITS

VEHICLE TRACKING



Large Tipper
 Overall Length 10.201m
 Overall Width 2.435m
 Overall Body Height 2.890m
 Min Body Ground Clearance 0.341m
 Track Width 2.471m
 Lock to lock time 6.00s
 Kerb to Kerb Turning Radius 11.550m

VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

DRAFT - NOT FOR CONSTRUCTION

F1.0	02/19	Updated in accordance with HE comments	JJ	RNE	ADR
D.01		FIRST ISSUE			
REV	DATE	DESCRIPTION	BY	CHK	APP

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PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

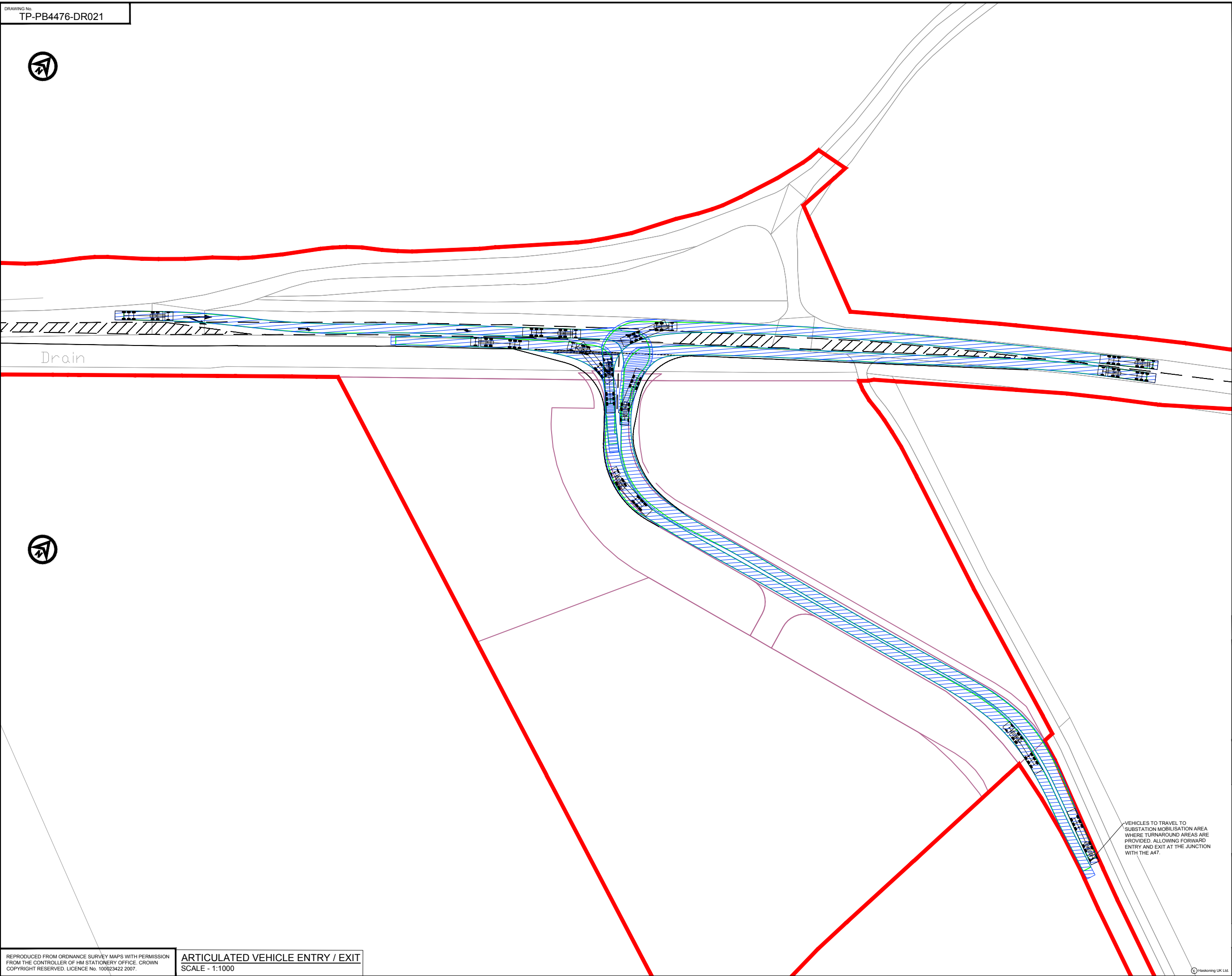
TITLE
 A47 NATIONAL GRID SUBSTATION ACCESS A (AC181)
 LARGE TIPPER
 SWEEP PATH ANALYSIS
 (LEFT TURN IN / LEFT TURN OUT)



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DATE	31.08.18	SCALE AT A3	1:250	CLIENTS REF.	
DRAWING No.	TP-PB4476-DR018			REVISION	F1.0
CLIENT DWG No.					

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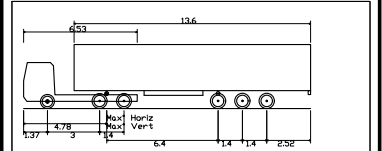
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 SCALE - 1:250



- NOTES**
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KEY
 — ORDER LIMITS

VEHICLE TRACKING



Max Legal Length (UK) Articulated Vehicle	16.50m
Overall Length	16.50m
Overall Width	3.25m
Overall Body Height	3.65m
Min Body Ground Clearance	0.41m
Max Track Width	2.50m
Lock to lock time	6.00s
Kerb to Kerb Turning Radius	6.530m

VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

DRAFT - NOT FOR CONSTRUCTION

F1.0	J1	Updated in accordance with HE comments	J1	RNE	ADR
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REV	DATE	DESCRIPTION	BY	CHK	APP

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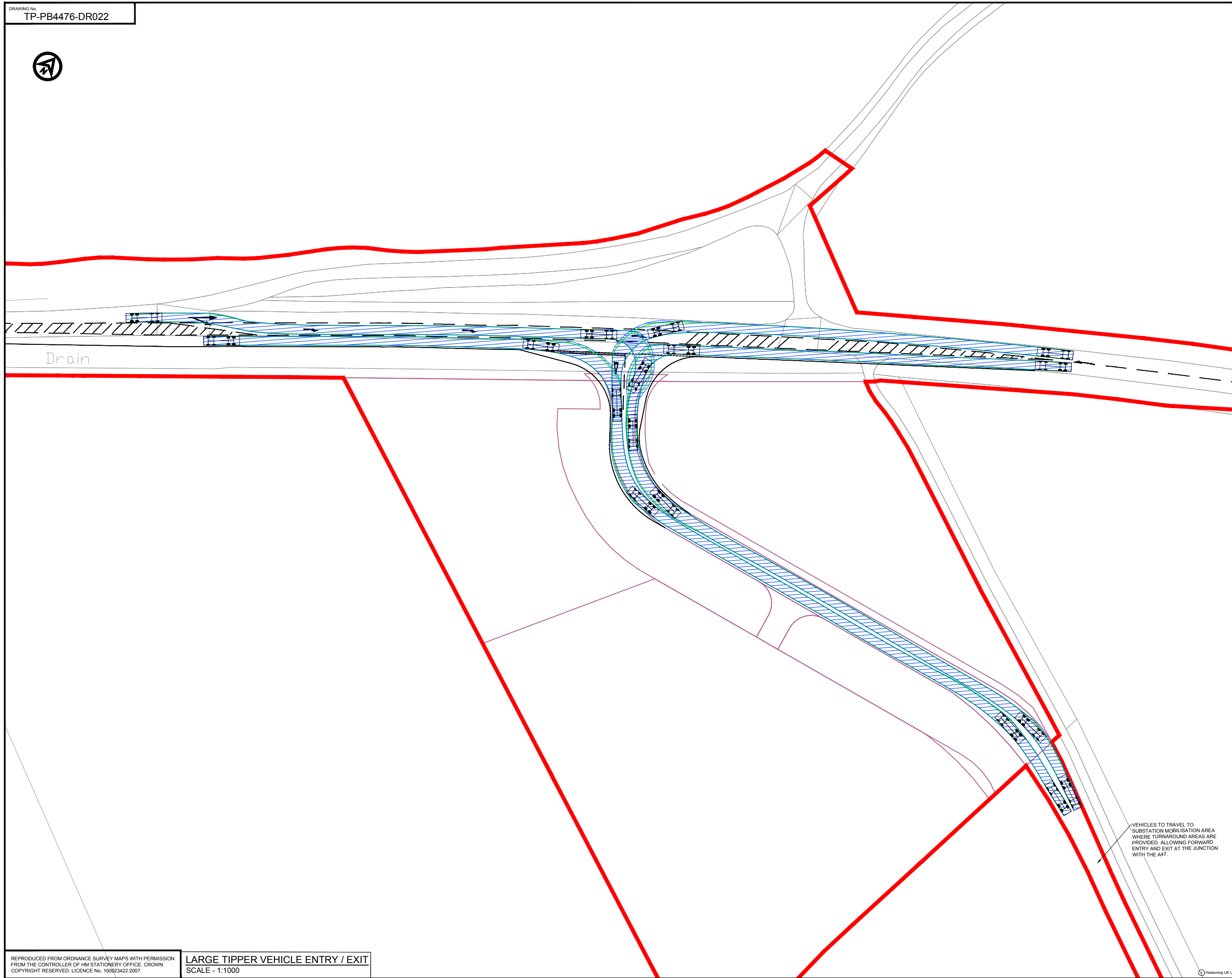


PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

TITLE
 A47 SUBSTATION
 ACCESS B CONCEPT
 ARTICULATED VEHICLE SPA

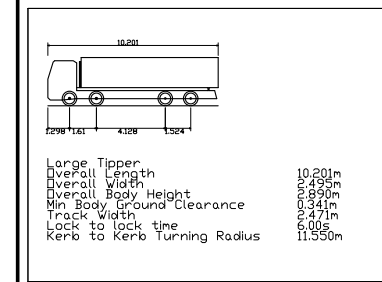


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DATE	31.08.18	SCALE AT A3	1:1000	CLIENTS REF.	
DRAWING No.	TP-PB4476-DR021			REVISION	F1.0
CLIENT DWG No.					



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KEY
 ORDER LIMITS
VEHICLE TRACKING



VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

DRAFT - NOT FOR CONSTRUCTION

F.1.0	J1	Updated in accordance with HE comments	J1	RNE	ADR
D.01		FIRST ISSUE			
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PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

TITLE
 A47 SUBSTATION ACCESS B CONCEPT
 LARGE TIPPER SPA



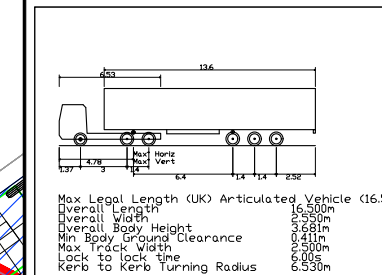
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DRAWING No.	TP-PB4476-DR022			REVISION	F1.0
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KEY
 ORDER LIMITS

VEHICLE TRACKING



VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

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REV	DATE	DESCRIPTION	BY	CHK	APP

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PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

TITLE
 A47 NATIONAL GRID OHLMW ACCESS D1 (AC 182)
 ARTICULATED VEHICLE SWEEP PATH ANALYSIS



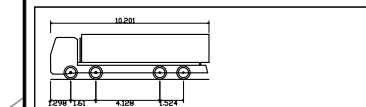
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CLIENT DWG No.					



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KEY
 ORDER LIMITS

VEHICLE TRACKING



Large Tipper
 Overall Length 10.201m
 Overall Width 2.450m
 Overall Body Height 2.950m
 Min Body Ground Clearance 0.341m
 Track Width 2.471m
 Lock to lock time 6.08s
 Kerb to Kerb Turning Radius 11.550m

VEHICLE BODY SWEEP PATH (FORWARD GEAR)
 VEHICLE CHASSIS SWEEP PATH

DRAFT - NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	BY	CHK	APP
F1.0	02/19	Updated in accordance with HE comments	JJ	RNE	ADR
D.01		FIRST ISSUE			

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PROJECT
 NORFOLK VANGUARD OFFSHORE WIND FARM

TITLE
 A47 NATIONAL GRID OHLMW ACCESS D1 (AC182)
 LARGE TIPPER SWEEP PATH ANALYSIS



DRAWN	JJ	CHECKED	RNE	APPROVED	ADR
DATE	31.08.18	SCALE AT A3	1:250	CLIENTS REF.	
DRAWING No.	TP-PB4476-DR024			REVISION	F1.0
CLIENT DWG No.					