Sizewell C, Route D2 and B1122 Study

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Executive Summary

Executive Summary

General

This report is written in response to a brief entitled ‘Sizewell C Route D2 B1122 Study’ issued by Suffolk County Council in December 2013. EDF Energy, the developer for the new Sizewell C Power Station, has identified the B1122 as the main access route to the site. The B1122 extends from the A12, north of Yoxford, to Leiston passing through the rural villages of Middleton Moor and Theberton.

AECOM have been advised that communities on the B1122 have previously experienced the impact of traffic associated with the construction of the existing Sizewell B nuclear power station. At that time Suffolk County Council and the CEGB commissioned other consultants to assess options for mitigating the impact on communities on the B1122. This work included the assessment of various options including improvements to the B1122 and other routes that would remove the need to use the B1122.

AECOM have developed the original route proposals, the B1122 local bypass option (Middleton Moor and Theberton bypasses) and the D2 new route proposal. AECOM have also prepared option plans for a solution to provide improvements at the A12/B1122 intersection consisting of a new roundabout at Yoxford.

This report provides a high level assessment on options for providing relief to communities along the B1122 and with a view to identifying any “showstoppers” for the delivery of improvements in addition to; the cost for constructing the improvement, benefits to journey times for the development traffic and the environmental impact of the improvements.

Route Options

For the bypass options AECOM have considered, in accordance with the brief, the following routes, all of which are shown in principle on the accompanying (outline) plan number 60315689-SHT-00-FVSW-C-0004, of the proposed schemes.

- The Sizewell B1122 western bypass of Middleton Moor is a single carriageway that measures approximately 1.6km in length;
- The B1122 bypass of Theberton West is a single carriageway that measures just over 3.1km in length;
- The B1122 bypass of Theberton East is a single carriageway that measures just over 2.6km in length;

- Route D2 is a single carriageway that measures just over 7km. It has been identified as the most direct route to the site of the proposed Sizewell C power station, located between the A12 in the west to the north of Leiston in the east. The route has been designed as an alternative to the existing road, the B1119 which cuts through the town of Saxmundham;
- The Yoxford roundabout located to the east of Yoxford replacing the junction between the B1122 and the A12.

  Refer to accompanying drawing for further details of the routes.

Scheme Development and Construction Programme

A construction programme estimate has been put together to show the approximate years in which the design and construction could take place. The construction and time Table 1 shows a summary of indicative construction programme for each scheme.

Table 1: Summary of construction programmes

Activity	D2	Theberton East	Theberton West	Middleton Moor
Carry out Preliminary Design and consultation	2014	2014	2014	2014
Announce Preferred Route	2015	2015	2015	2015
Carry out Detailed Design	2015/2016	2016	2016	2016
Public Inquiry	2016	2016	2016	2016
Order Publication Period and CPO	2017	2017	2017	2017
Award of Tender	2018	2018	2018	2018
Construction Period	2018-2020	2018/2019	2018 - 2020	2018/2019
Open to Traffic	2020	2020	2020	2020

Construction Cost Estimates

The following costs taken from the reporting are represented in Table 2 as follows;

Table 2: Summary of costs

Route (Road Area)	Net Total (inc Opt Bias, Contingency, Inflation etc.)
Middleton Moor 13,785m2	£ 6,081,473
Theberton East 21,262m2	£ 9,109,718
Theberton West 27,044m2	£ 13,343,242
Route D2 69,541m2	£ 54,851,385
Yoxford Roundabout	£ 5,270,648

Traffic Assessment (Journey Times, Accident Benefits and CO2 Benefits)

A traffic and economic assessment has been undertaken for the B1122 between the A12 between Yoxford and Lover's Lane near Leiston and a proposed D2 route between the A12 south of Saxmundham and Lover's Lane bypassing the B1121 and B1119 roads.

The traffic volumes input to TUBA are for the three forecast years including the Sizewell C development trips which are assumed to occur in 2020 and 2024 but not in 2031 as it is assumed that construction will be complete by this year. Table 3 and table 4 give the total traffic volumes by section of route for the Do Minimum scenario. This traffic is formed of three vehicle types: car, LGV and HGV.

Table 3: B1122 Do Minimum (without scheme) traffic volumes

Existing Route (DM Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – Middleton Moor	1690	1.612	3550	4777	3283
Section 2 – Theberton East	2630	2.563	5637	6980	5793
Section 3 – Theberton West	3110	2.971	3550	4777	3283

Table 4: B1121-B1119 Do Minimum (without scheme) traffic volumes

Existing Route (DM Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 - B1121 (A12 to B1121)	1,000	1.11	3,293	4,442	3,575
Section 2 - B1121 (B1121 to D2 tie-in)	500	0.56	5,628	6,907	6,384
Section 3 - B1121 (D2 to B1119)	600	0.67	5,628	6,907	6,384
Section 4 - B1119 (B1121 to Abbey Lane)	4,600	5.11	3,725	5,203	4,059
Section 5 - Abbey Lane (B1119 to B1122)	2,200	2.44	947	2,270	717
	8,900	**9.89**			

Traffic volumes are also required for the Do Something (With Scheme) scenario for the proposed schemes (B1122 and D2 route) and the existing route. These volumes are provided in Table 5 and 6. It is assumed that most traffic accessing both Middleton and Theberton will be local residential and all other existing traffic will use the new bypasses. The travel times shown are for light vehicles. Although the D2 route commences at its junction with the A12, for assessment purposes the starting point is considered to be where traffic is likely to re-route which is considered to be the A12/B1121 junction. Therefore Section 1 of the D2 bypass route option is the A12.

Table 5: B1122 Do Something (with scheme) traffic volumes

Bypass (DS Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – Middleton Moor	1635	1.110	3550	4777	3283
Section 2 – Theberton East	2750	1.890	5637	6980	5793
Section 3 – Theberton West	3200	2.173	3550	4777	3283

Table 6: B1121-B1119 Do Something (with scheme) traffic volumes

D2 Bypass (DS Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – A12 (B1121 to D2 tie-in)	1100	0.79	3,625	5,345	3,373
Section 2 - A12 to B1121	850	0.80	3,625	5,345	3,373
Section 3 - B1121 to B1119	1,900	1.78	3,625	5,345	3,373
Section 4 - B1119 to Abbey Lane	2,300	2.16	4,186	5,937	4,048
Section 5 - B1119 to B1122	2,100	1.97	1,382	2,976	675
Total	**8,250**	**7.50**			
Existing Route (DS Option)					
Section 1 - B1121 (A12 to B1121)	1,000	1.11	168	177	201
Section 2 - B1121 (B1121 to D2)	500	0.57	2,503	2,642	3,011
Section 3 - B1121 (D2 to B1119)	600	0.67	6,324	6,676	7,607
Section 4 - B1119 (B1121 to D2)*	2,200	2.44	570	602	686
Section 5 - Abbey Lane (B1119 to B1122)	2,200	2.44	35	37	42
Total	**6,500**	**7.23**			

*Section 4 is the existing B1119 between Saxmundham and the D2 tie-in.

The existing roads bypassed by the B1122 bypass options and D2 bypass are essentially rural type roads, with 30mph limits on parts of these sections and a short section in Saxmundham that would be classed as ‘urban’ on which posted speeds are 40mph or lower. Sixty year discounted accident benefits in 2010 prices are calculated to be £4.836 million for the B1122 East bypass, £3.857 for the B1122 West bypass and £5.1 million for the D2 bypass. The number of accidents

saved over the sixty year period ranges calculated to be 127 for B1122 East bypass, 98 for B1122 West bypass and 138 for the D2 bypass. Table 7 details the assessment of the accident cost and benefits for route D2, shown below.**Table 7: Accident costs and benefits**

	B1122 East	B1122 West	D2
Benefit Summary (£000s)			
Total Without-Scheme Accident Costs	12,432	9,670	18,498
Total With-Scheme Accident Costs	7,594	5,813	13,404
Total Accident Benefits Saved by Scheme	**4,836**	**3,857**	**5,094**
Accident Summary			
Total Without-Scheme Accidents	182.1	140.8	270.8
Total With-Scheme Accidents	87.5	66.5	167.9
Total Accidents Saved by Scheme	**94.6**	**74.2**	**102.9**
Casualty Summary			
Total Without-Scheme Casualties (Fatal)	4.1	3.2	6.1
(Serious)	34.8	26.9	51.8
(Slight)	245.5	189.8	365.1
Total With-Scheme Casualties (Fatal)	3.4	2.6	5.4
(Serious)	19.4	14.8	35.2
(Slight)	118.3	90.0	226.7
Total Casualties Saved by Scheme (Fatal)	**0.7**	**0.6**	**0.7**

	B1122 East	B1122 West	D2
(Serious)	**15.4**	**12.2**	**16.6**
(Slight)	**127.2**	**99.8**	**138.4**

Environmental Assessment

Air Quality

B1122 Local Bypasses (Middleton Moor and Theberton)

The main findings of the local air quality assessment are that no exceedence of NO_2 or PM_{10} air quality objective / EU Limit Value were predicted in the Base (2013), Do-Minimum and Do-Something scenario including Sizewell C traffic. All the proposed local bypass options are predicted to lead to an overall improvement in air quality as the assessment scores are negative (including traffic from Sizewell C). The largest change in air quality is predicted to be an improvement in NO_2 concentrations as a result of the proposed B1122 bypass of Theberton East. All the proposed bypass options are predicted to result in an increase in NO_x and carbon emissions in 2024 and 2035 relative to Do-Minimum in the same year.

D2 Route

The main findings of the local air quality assessment are that no exceedence of NO_2 or PM_{10} air quality objective / EU Limit Value were predicted in the Base, Do-Minimum and Do-Something scenario including Sizewell C traffic. The proposed D2 Route is predicted to lead to an overall improvement in air quality as the assessment scores are negative (including traffic from Sizewell C). The largest change in air quality is predicted to be an improvement in NO_2 concentrations of large magnitude as a result of the proposed D2 Route. The proposed D2 route is predicted to result in an increase in NO_x and carbon emissions in 2024 relative to Do-Minimum in the same year. Results also show a decrease in NO_x and carbon emissions in 2035. The positive Total Net Present Value for the D2 route indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes. Table 8 summarises the results from the air quality assessment, shown below.

Table 8: Overall Evaluation of local air quality significance

Key Criteria Questions	Yes / No			
	B1122 western bypass of Middleton Moor	**B1122 bypass of Theberton West**	**B1122 bypass of Theberton East**	**D2 Route**

Is there a risk that environmental standards will be breached?	No	No	No	No
Will there be a large change in environmental conditions?	No	No	Yes	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A
Will many people be affected?	No	No	No	No
Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A

Strong benefits have been predicted for the overall air quality for both the D2 route and the local bypass routes. This benefit is a result of reduced levels of particulates and Nitrogen Dioxide and is envisaged to take place during and after construction with a low likelihood of the air quality exceeding the air quality objective /EU Limit Value.

Noise

A Stage 1 noise assessment by following the principles of the DMRB assessment methodology has been carried out in order to establish whether the assessment should proceed to either the Simple or Detailed Assessment by considering the increases in noise levels at NSRs associated with the proposed scheme.

The results of the TAG assessments indicate that the B1122 bypass of Theberton West is considered to be the most beneficial option among the proposed schemes. Detailed mitigation measures should be considered in the later stages of the DMRB assessment. Residual effects with appropriate mitigation measures are considered to be insignificant. At this stage only noise impacts relating to the operational use of the proposed development is considered. Temporary impacts relating to the construction of the proposed scheme will be dealt with at the later stages of the assessment. Table 9 details the results of the noise assessment, shown below.

Table 9: Noise Assessment Summary Table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
B1122 Local Bypass Theberton East	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
B1122 Local Bypass Theberton West	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
D2 New Option	This scheme will increase noise levels at NSRs directly facing the proposed option in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier; Reconsidering the route alignment as far as possible from highly populated area in Harts Hall, Saxmundham	Insignificant

Noise levels will be reduced significantly providing that the appropriate mitigation measures are put in place. These mitigations will mainly be required in locations where woodland is removed and embankments are positioned.

Biodiversity

The area surrounding the route options of B1122 bypasses and D2 options are largely arable land with occasional improved and semi-improved grassland. A number of small tributaries are present, flowing into the Minsmere Levels and the Old Minsmere River. The area is also home to a large number of small plantation woodlands and perhaps most notable the Ancient Woodland of Buckles Wood.

The Biodiversity study carried out by AECOM set out to assess and evaluate the potential effects of the proposed route options. By identifying a study area, notable habitats and species could be identified as being adversely effected by a particular route. This study area could then identify which route would be the least damaging to the natural environment capital within the area.

There were several survey limitations when the ecological walkover scoping survey was conducted by AECOM.. These included that the survey was only carried out on publically accessible land. Once a preferred route has been decided on a full access survey will be carried out. Another limitation that should be highlighted is that dedicated species surveys have not been carried out in this assessment, this would be carried out in subsequent protected species survey.
For all the proposed routes Slight Adverse effects would be caused due to hydrologically linked drainage systems to internationally designated sites. This is deemed to only have a Slight Adverse effect because of the various sites relatively large distance from the proposed routes. Due to the bisecting of the largely arable land to construct the different routes, habitat fragmentation will occur in close proximity to the road. In many of the cases the road bisects multiple tributaries which support a number of species and groups including water voles, otters and Great Crested Newts (GCN). Valued fauna is also likely to be effected. All the proposed routes cut through notable hedgerows and field margins which support species rich flora and nesting habitats for birds and foraging communities. The agricultural landscape of the proposed bypass is dotted with small pockets of plantation woodlands and the Ancient Woodland of Buckles Wood. The proposed D2 route passes within close proximity of the western side of this route and construction of this route will cause fragmentation as it would be bordered by roads on all sides.

Many of the routes go through woodland that has non-native invasive species. The construction of the new road could lead to enhancement of these areas with specific woodland management. Similarly, the watercourses present along the proposed routes offer poor passage for fish and other species. By extending existing culverts, a sympathetic design to reduce fragmentation could be introduced.

Mitigation measures to limit damage to the environmental capital within the various route options has been explored in the full report. A table summarising the environmental effects of the proposed routes and proposed mitigation measures can be seen in Table 10.

Capabilities on project:
Transportation

Table 10: Biodiversity Summary

Route	Summary Assessment Score	Comments	Mitigation	Residual Effects with Mitigation
Middleton Moor	Slight Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works, New Plantation of deciduous woodland.	Design of alignment of road to avoid habitat loss. Screening from the road via habitat replacement. Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, watervole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Natural England Conservation Licence would be required.	Slight Adverse
Theberton East	Slight to Moderate Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works, Plantation complex. Bisecting of two main tributaries and hedgerows.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Culvert designs to be suitable for safe passage for otter, watervole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Natural England Conservation Licence would be required.	Slight Adverse

Route	Summary Assessment Score	Comments	Mitigation	Residual Effects with Mitigation
Theberton West	Moderate Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works, Plantation complex loss. Bisecting of two main tributaries and hedgerows.	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Additional woodland planted. Culvert designs to be suitable for safe passage for otter, watervole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Natural England Conservation Licence would be required.	Slight Adverse
D2	Moderate Adverse to Large Adverse	Presence of GCN to be considered. Possible loss of habitats and fragmentation of woodland. Proximity of ponds to construction works, Plantation complex loss. Bisecting of two main rivers, notable hedgerows, and pockets of woodlands including Ancient Woodland	Construction mitigation to prevent run off into connected drainage ditches and rivers. Consideration for bridge crossings to minimise habitat loss and fragmentation. Additional woodland planted. Culvert designs and two new road crossings to be suitable for safe passage for otter, watervole and bats. Pre-construction surveys of the chosen route would be required, revealing the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. Natural England Conservation Licence would be required. Ancient woodland is not replaceable. Impacts upon this habitat,	Large Adverse

Landscape

In terms of visual amenity, the proposals are potentially highly visible from a wide range of receptors due to the direct loss of boundary and enclosure vegetation and the introduction of the road corridor into more immediate views. All of the route corridor options are likely to give rise to adverse effects on landscape character and visual amenity. The Middleton Moor bypass is likely to result in greater adverse effects on landscape character and visual amenity than the other proposed options and associated variants with Large Adverse effects on landscape character and Slight to Large Adverse effects on visual amenity. Overall all routes have an adverse effect as a result of the increase in visual impact. This impact could be reduced providing that the carriageway and structures designed will reduce the visual impact on the landscape.

Heritage

This archaeological and cultural heritage section has collated baseline data within a study area of approximately 300 m from the proposed bypass, as required by guidance in DMRB.

Data was collected from Suffolk Historic Environment Record, the English Heritage Archives Services and historic maps. Twenty-six archaeological sites were identified within the study area of D2 and twenty-eight in the study area of the B1122 Bypasses. Two assets will be physically affected and one asset will have its setting affected. All impacts are considered to be Slight Adverse. There will be a Slight Beneficial impact upon sites within the Conservation Areas of Saxmundham and Leiston. Table 11 below summarises the extent to which the new proposed D2 scheme will affect heritage sites.

Table 11 Heritage Assessment Summary Table

Asset	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
Scatter of red tile (12) (Route D2)	Part or complete removal due to bypass.	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
Cropmark (16) (Route D2)	Part or complete removal due to bypass	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
Hurts Hall (5) (Route D2)	Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse

Asset	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
Saxmundham (Route D2)	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial
Leiston (Route D2)	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial

It is concluded that multiple assets would be affected by the proposed D2 route, with two directly positioned at the location of the carriageway; the scatter of red tile (12) and the cropmark (16). The impact of this can be significantly reduced by the introduction of screening.

Water Environment

An assessment of the potential significance of impacts associated with each of the proposed B1122 and D2 sub-options has been undertaken. The assessment acknowledged the importance of watercourses in the vicinity and downstream of the works and the magnitude of potential impacts associated with each scheme (accounting for likely best practice mitigation). It was concluded that the proposed improvements are likely to affect the water perspective of the analysis due to the high amount of water crossing situated along all routes. The result of this revealed that all routes were affected from Negligible Impact to Major Impact. With appropriate mitigation measures, this would reduce the impact to negligible to minor.

Mitigation measures: Noise Barriers

It has been put forward by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue. Following this raised concern; noise barrier proposals with the inclusions of costing have been explored.

The proposed routes of the B1122 bypasses and D2 sub-options will affect the noise levels experienced at properties in the vicinity of the routes. The large quantity of vehicles on the routes will generate a continuous stream of noise from the engine and tyres of the vehicles. Adverse or beneficial effects on present noise levels are dependent on the proximity of the property location to the proposed route. AECOM are proposing to mitigate these effects by the construction of three metre high timber fencing, commonly known as noise or acoustic barriers. A preliminary calculation on where noise barriers may need to be constructed and the extent of the noise

barriers is detailed below. The calculations have followed guidance set out by guidance from the DMRB titled: *'Environmental Barriers: Technical Requirements'.*

It is important to note that after 300m, the noise attenuation experienced with respect to the noise barrier is negligible in the rural location that the proposed routes are in. This is because soft ground such as countryside absorbs sound waves, attenuating the noise quickly over a distance.

Table 12, below, details the evaluation of the data from the NSR's from the survey detailed in section 4.2 of the main report.

Table 12: Summary table of length of noise barriers

Route	No. of noise barriers
Middleton Moor	0
Theberton Bypass East (Option B)	1 x 400m
Theberton Bypass West (Option C)	1 x 400m
D2	0

Community Impacts

This chapter of the report details the impacts of the bypass options upon the communities they pass by comparing the sections of; segregation, pedestrian amenity, cyclist amenity, driver delay and community visual impacts. From assessing the various options, it was concluded that it terms of community impacts, the Middleton Moor & Theberton West option creates the least. Although the two Theberton options had the same amount of beneficial impacts, the eastern option also had more negative effects therefore making it less suitable. The section also outlines potential mitigation measures that if implemented, would reduce the impact upon the community further.

Table 13: Summary of Community Impacts and Mitigations

Community Impacts	Middleton Moor & Theberton East	Middleton Moor & Theberton West	D2
Segregation	Bypass cuts through farmland- 13 fields affected	Bypass cuts through farmland-16 fields affected	Bypass cuts through farmland- 33 fields affected
	Enclosing properties by road corridors of old B1122 and new bypass		Access two properties affected
Mitigation	Access to any severed farmland will be provided	Access to any severed farmland will be provided	Access to any severed farmland will be provided
			Alternative access to properties provided via new connecting roads.
Pedestrian Amenity	1 pedestrian footpath affected	3 pedestrian footpaths affected	11 pedestrian footpaths affected
Mitigation	Stiles provided to connect footpaths at carriageway crossings	Stiles provided to connect footpaths at carriageway crossings	Stiles provided to connect footpaths at carriageway crossings or provide alternative routes
Cyclist Amenity			1 cycleway affected
			Cyclists required to use 3 new roundabout along the mainline
Mitigation			Gate provided to connect cycleways at carriageway crossing
Driver Delay	Access to properties will be slightly diverted potentially causing delays	Access to properties will be slightly diverted potentially causing delays	Access to properties will be slightly diverted potentially causing delays
			Short delays due to queuing at roundabouts
Mitigation	Providing new junctions along the mainline to decrease potential delays to the driver	Providing new junctions along the mainline to decrease potential delays to the driver	Providing new junctions along the mainline to decrease potential delays to the driver
Community Visual Impact	Properties on the south west side of Middleton Moor and east of Theberton will be affected	Properties on the south west side of Middleton Moor and west of Theberton will be affected	Properties in the towns of Saxmundham and Leiston will be affected

Table 14: Net Benefits- Middleton Moor & Theberton East Advantages

Route Option	Advantages	Evidence
Middleton Moor & Theberton East	Air quality improvement for the village of Middleton Moor	Air Quality: Net Value Change of £114,982 along the B1122 - a reduction of 519 T/y in NO_2 and 59 T/y in PM_{10} 3 receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Least effects on biodiversity	With slight to moderate adverse effects, this route option has the least effects upon the biodiversity
	Least effects on Heritage assets within the villages of Middleton Moor and Theberton	Positive effect on 5 listed buildings within Middleton Moor and 8 listed buildings within Theberton by reducing the volume of traffic flow Enhances the historic environment of the two villages due to reduction in vehicle emissions, noise and pollution
	Positive impacts on the community	Creates the least impact upon pedestrian amenity Creates the least impact upon cyclist amenity Causes the least delay to drivers
	Lowest construction costs	£15,191,190.98 for the bypass
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)
	Reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £123,000

Table 15: Net Benefits- Middleton Moor & Theberton East Disadvantages

Route Option	Disadvantages	Evidence
Middleton Moor & Theberton East	Air quality deterioration for parts of the village of Theberton	1 receptor will experience a deterioration of more than 5% due to the new route alignment
	Noise Levels	9 properties have been identified as having a significant impact upon their noise level
	Potential damage to the biodiversity	Slight to Moderate Adverse effects: Crosses tributary of the Old Minsmere River would require a new culvert and an extention to existing Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Loss of amenity land	Larger adverse effects on landscape character than any other option Loss of sections of Yox Valley Special Landscape Area
	Visual Amenity	Enclosing settlements by road corridors Close proximity to properties to the northern of Theberton Large adverse effects to some properties within Middleton Moor Moderate adverse effects to users of the Sandlings Walk Long Distance Path Considerable disruption to immediate views for many public rights of way Larger impacts to visual amenity than any other option
	Potential impact to water environment	More impact upon water environment due to closer proximity to the Minsmere-Walberswick Heath and Marshes SSSI (800m downstream of the proposed crossing)
	Negative Impacts on the community	Creates the most visual impact within the community due to close proximity of the road Creates the most segregation due to separating properties from the rest of the community via a road corridor

Table 16: Net Benefits -Middleton Moor & Theberton West Advantages

Route Option	Advantages	Evidence
Middleton Moor & Theberton West	Air quality improvement for the villages of Middleton Moor & Theberton	Air Quality: Net Value Change of £109,970 along the B1122 - a reduction of 538 T/y in NO_2 and 61 T/y in PM_{10} Three receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Noise Levels	6 properties have been identified as having a significant impact upon their noise level.
	Positive impacts on the heritage within Middleton Moor and Theberton	Positive effect on 5 listed buildings within Middleton Moor and 8 listed buildings within Theberton by reducing the volume of traffic flow Enhances the historic environment of the two villages due to reduction in vehicle emissions, noise and pollution
	Least impact to water environment	Post-Mitigation impacts- insignificant; silt-laden runoff, chemical contamination, water pollution from runoff, morphological effects and loss of ponds
	Least impact on the community	Creates minor segregation amongst the community Creates minor impact upon cyclist amenity Causes minor delays to drivers
	Construction costs	£19,424,714.86 for the bypass
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)
	Largest reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £136,000

Capabilities on project:
Transportation

Table 17: Net Benefits - Middleton Moor & Theberton West Disadvantages

Route Option	Disadvantages	Evidence
Middleton Moor & Theberton West	Potential damage to the biodiversity	Moderate Adverse effects: Crosses two tributaries of the Old Minsmere River would require new culverts for each Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Visual Amenity	Large adverse effects to the visual amenity of some properties within Middleton Moor
	Negative impact on Theberton Hall	Grade 2 listed building would experience visual and aural intrusion due to the location of the proposed bypass
	Smaller reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £103,000

Table 18: Net Benefits- D2 Advantages

Route Option	Advantages	Evidence
D2	Air quality improvement for the villages of Middleton Moor & Theberton	Air Quality: Net Value Change of £62,949 along the B1122 - a reduction of 307 T/y in NO_2 and 54 T/y in PM_{10} Two receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Noise Levels	3 properties have been identified as having a significant impact upon their noise level
	Positive impacts within the towns of Saxmundham and Leiston	Conservation Areas in Saxmundham and Leiston will experience reductions in the volume of traffic passing through the towns leading to a decrease in vehicle emissions, noise and pollution
	Least visual impact for the community	Of the three options, visually effects the community the least
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)

Capabilities on project:
Transportation

Table 19: Net Benefits- D2 Disadvantages

Route Option	Disadvantages	Evidence
D2	Air quality deterioration for parts of Saxmundham	2 receptors will experience deterioration of between 1% and 2.5%
	Potential damage to the biodiversity	Moderate to Large Adverse effects: Crosses rivers Fromus and Hundred would require two new culverts Direct impact to ancient woodland of Buckles Wood causing direct habitat loss Potential impacts downstream upon the Alde and Ore Estuaries Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of numerous hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Loss of amenity land	Moderate adverse effects on landscape character Large adverse effects within the first year: loss of boundary vegetation and small pockets of trees
	Visual Amenity	Moderate to large adverse effects on visual amenity Large adverse impacts to some properties to the south of Saxmundham and north east of Leiston Large adverse impacts to the users of many public rights of way
	Negative impacts on Heritage assets along the route	Potential loss of remains of red tile previously discovered in the area Partial loss of cropmark due to location of bypass route Visual and aura006C intrusion upon the property of Hurts Hall -a grade 2 listed building
	Potential impact to water environment	Potential impacts on the Sizewell Marshes SSSI Impact upon the movement of protected species (eel) in River Fromus
	Largest impact on the community	Disrupts 11 footpaths Disrupts 1 cycleway Requires cyclists to use 3 roundabouts Causes the biggest delay of drivers due to potential queuing at proposed roundabouts Affects access to two properties Cuts through farmland Impacts on the visual amenity of properties situated within Saxmundham and Leiston
	Largest construction costs	£54,851,384.55 total for the bypass

Capabilities on project:
Transportation

Table 20: Restrictions within Middleton Moor and Theberton

B1122 Route Comparisons			
Restrictions	**Middleton Moor**	**Theberton East**	**Theberton West**
HGVs Transferred to new bypass per 24 hours: 2024 (Sizewell Construction Year)	786	877	877
HGVs Transferred to new bypass per 24 hours: 2035 (After Sizewell Construction)	220	327	327
Pinch Points removed (m) -lengths of existing road below 6m wide	428	1392	1392
Number of speed limits replaced by scheme	2	1	1
Speed Limits (mph)	30/40	30	30

Properties were identified in band widths from the existing road in order to identify potential relief from noise, vibration, air quality, dust and other effects. The tables' 21-23 contain the numbers of properties potentially affected from the existing route and bypasses.

Table 21: Band Width benefits with Middleton Moor bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Middleton Moor				
Properties in existing road band	24	38	42	42
Properties in new road band	7	11	12	23
Net Benefits Indicated - properties (no)	17	27	30	19

Table 22: Band Width benefits with Theberton East bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Theberton East				
Properties in existing road band	46 (+C)	59 (+C)	79 (+C)	83 (+C)
Properties in new road band	0	6	38	85 (+C)
Net Benefits Indicated - properties (no)	46 (+C)	53 (+C)	41 (+C)	-2

Table 23: Band Width benefits with Theberton West bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Theberton West				
Properties in existing road band	46 (+C)	59 (+C)	79 (+C)	83 (+C)
Properties in new road band	0	0	22	50
Net Benefits Indicated - properties (no)	46 (+C)	59 (+C)	57 (+C)	33 (+C)

The (+C) indicates that Theberton Church is included within the count of properties which would experience benefits from either of the Theberton bypass routes.

The noise level values associated with the banding widths in Table 10.6 are shown above. The values are set as a guide only and it is still the case that further work will be needed to provide absolute noise values in due course.

Traffic flow : 5,000 vehicles over the 18-hour period 06:00 to midnight
Mean Traffic Speed = 70 km/h
%Heavy vehicles = 10%

Propagation: Rural setting predominantly flat open ground typically grassland.
Receiver height: 4m above ground – typically 1st floor level.

Calculated differences in Noise Levels

From the extreme front of the bands at 50m from road centreline at 1m from the facades of dwellings to the back of the bands at 300m from the road centreline it is calculated that there will be a difference in receptor noise levels of around 12.0 dB(A) $L_{A10,18h}$.

Route D2

In order to accurately model the effects of Route D2 construction on B1122 and the construction of band levels in this situation, there would have to be considerable additional traffic modelling work, beyond the scope of this document.

However estimated daily construction related trips on the B1122 (with the D2 route in place) are currently estimated to be 1036 one-way car trips (i.e. 518 in each direction) and 116 one-way LGV trips.

Conclusion

From the foregoing tabulated and reported information there will clearly need to be further work towards the assessment and design of a suitable bypass scheme in appropriate stages for a highway route to the proposed Sizewell C development. To address the need for a route to the proposed site, bypass options around the villages of Middleton Moor and Theberton were considered. A further route was also considered to the south west of the Sizewell site in the form of route D2.

On a cost basis, the Middleton Moor and Theberton routes would be significantly less to construct than the route of D2.

The accident benefits for the D2 route have been estimated as £5.1 million with 103 accidents saved over a sixty year period. Strong benefits have been predicted for the overall air quality for both the D2 route and local bypass routes. This benefit is a result of reduced levels of particulates and Nitrogen Dioxide and is envisaged to take place during and after construction with a low likelihood of the air quality exceeding the air quality objective /EU Limit Value. Noise levels will be reduced significantly by the proposed routes providing that the appropriate mitigation measures are put in place. These mitigations will mainly be required in locations where woodland is removed and embankments are positioned.

Landscape results have shown adverse effects for all routes as a result in the increase of visual impact. This impact could be reduced providing that the carriageway and structures designed will reduce the visual impact on the landscape.

Biodiversity effects from all sites will be minimal although slightly more adverse for the D2 route given its position on Greenfield sites and across multiple water crossings. Through further investigation and more sensitivity in design, this effect could be reduced further.

It was concluded that the proposed carriageway is likely to affect the water perspective of the analysis due to the high amount of water crossing situated along all routes. Appropriate mitigation measures can reduce the impact to negligible to minor.

The heritage review concluded that multiple assets would be affected by the proposed D2 route, with two directly positioned at the location of the carriageway. The impact of this can be significantly reduced by the introduction of screening.

As a mitigation measure, preliminary design of noise barriers has been carried out at the request of SCC. It can be seen that Theberton East Option B and Theberton West Option C both would need an installation of a noise barrier to protect properties affected by the proposed route. The D2 option would not need noise barriers within this preliminary study. This would need developing at the preferred route stage of the project.

The assessment work undertaken within this report has helped to provide reliable scheme estimates. For the village bypass routes, effects would be minimal with most avoidable by the introduction of mitigation measures outlined throughout the report. For many environmental

sectors, the option Theberton West brings reduced air levels, a lower impact on noise and water. This bypass option would also relieve the most properties in terms of noise, vibration and air quality, which is proven by the band width method in section 10.6. From the extreme front of the bands at 50m from road centreline at 1m from the facades of dwellings to the back of the bands at 300m from the road centreline it is calculated that there will be a difference in receptor noise levels of around 12.0 dB(A) $L_{A10,18h.}$ In order to accurately model the effects of Route D2 construction on B1122 and the construction of band levels in this situation, there would have to be considerable additional modelling work on traffic modelling, beyond the scope of this document.

The results of the community impacts assessment also prefer the route Middleton Moor & Theberton West due to the least impact upon the wider community as well as the environmental benefits of this option. The Yoxford Roundabout would be an essential addition to the village bypasses as it will allow the proposed construction vehicles access to the site avoiding tight restrictions of the existing A12/B1122 junction.

The D2 scheme is proposed to be positioned on what is currently agricultural land, the route causing negative effects to sectors such as landscape and biodiversity. Mitigation measures have the potential to reduce the impact significantly. The significant high comparative cost of the D2 route would need to be tested further to establish cost/ benefit ratios over a specified period in order to make further decisions on its development.

With reference to table 20 above, it is indicated that if the bypasses were not built the restrictions within the villages would impact greatly on the journey times of vehicles travelling to and from Sizewell C as well as the residents within Theberton and Middleton Moor. The villages would suffer due to the amount of HGVs passing through their centres on a daily basis during and after Sizewell C's construction.

Environmental and Cost Estimate Comparison

Route Option	**Summary**	**Cost Estimate (£millions)**
Yoxford Roundabout	The Yoxford roundabout is an essential element of the proposed improvements. Environmental work has not been carried out at this stage.	5.271
with		
Middleton Moor & Theberton West	This grouping of bypass proposals is the most beneficial in the categories of; air quality, noise, landscape, water and community impacts. In terms of air quality, this option has the largest reduction in NO_2 and PM_{10} of 538 and 61 tonnes per year which has a net value of £109,970. The NPV for noise for this bypass is much	19.425

	higher at just under £93,000 than any option. In the long term this route reduces the amount of properties affected to 5% and also reduces the annoyance evaluation from residents. It was deemed that due to the location of the proposed bypass, it would have the least impact upon the landscape character and overall visual amenity of the area. This route is positioned furthest away from any SSSI and therefore compared to the alternatives, reduces the likelihood of contamination via spills making it the best option for maintaining water quality. The last category is that of community impacts. Although the preferred option had the same amount of benefits as the Middleton Moor & Theberton East; it did not score as the worst option for any of the subcategories within community impacts unlike the latter.	
Middleton Moor & Theberton East	This grouping of bypass proposals also has many environmental benefits in the categories of; biodiversity, heritage, community impacts and construction costs. In terms of biodiversity, the route has the least effect on the environment with impacts of slight to moderately adverse. 13 listed buildings from within the villages of Theberton and Middleton Moor would encounter a positive impact due to the reduction in the flow of traffic through the villages. In terms of community impacts, this route creates the least impacts upon the following: pedestrian amenity, delay to drivers and cyclist amenity. The other major benefit of this option is that is has the smallest construction costs of all the routes. However, the potential negative impacts of this route combination include the deterioration of a receptor by more than 5%. 9 properties within Theberton and Middleton Moor have been identified as this route having significant impacts upon them.	15.191
D2	The main advantages of this route include improving the air quality and noise levels within Middleton Moor and Theberton by reducing traffic in the two villages. Of the three proposed routes and route combinations it creates the least community visual impacts due to the location of	54.851

	the bypass not severing any villages. However the route also has many disadvantages over the other two proposed options namely: large effects on biodiversity, moderate effects on landscape character, adverse effects on visual amenity, negative impacts upon heritage in the area, impacts upon the water environment, large community impacts and high construction costs.	

It is suggested that for selected schemes, comprehensive work on design refinement, costings and appropriate traffic work including cost/benefit ratio analysis are carried out in order to decide on a proposed scheme approach.

Once a preferred route has been decided, it is proposed that the following further investigations need to take place – detailed in section 9 below. The results of these may change the design and construction period specified in section 3.

- Liaison with Environment Agency;
- Further Investigation with Statutory Undertakers to C3 stage;
- A cost benefit analysis of the chosen route and
- Scheme delivery through Detailed Design and Construction stages.

1 Introduction

1 Introduction

1.1 General

AECOM have been commissioned by Suffolk County Council to undertake an investigation into options to improve the local highways network to mitigate the Sizewell C development. AECOM understand that EDF Energy has identified the B1122 as the main access route to deliver the Sizewell C development. This route will need to accommodate HGV vehicles for the delivery of materials, coach traffic for transporting workers to the site, abnormal loads and car trips by individual workers/ visitors. The Council has significant concerns about the impact of traffic associated with the development on the communities along the B1122 which will continue over a construction period of approximately nine years. The B1122 links from Yoxford on the A12, to Leiston.

Other access routes include the minor road B1119 and a disused railway line that terminates at Leiston. Key access to the village of Middleton is provided by the B1122 positioned north of the road. The single carriageway also passes through the village of Theberton, located 3km from the town of Leiston.

Sizewell C will be positioned along the Suffolk Coast, just east of Leiston. The construction for Sizewell C is currently anticipated to commence in 2021. The road improvement options which form the subject of this report are assumed to be open to traffic by this time.

1.2 Local Road Network

The A12 leading to B1122 is a key route connecting Ipswich to Lowestoft and Great Yarmouth. Improvements to the A12 are important for the future growth of this part of Suffolk. There is a long standing proposal to improve the section between Wickham Market bypass and the Saxmundham bypass. In addition to improving the route as a strategic link, this improvement would bring traffic relief to the villages of Marlesford, Little Glemham, Stratford St Andrew and Farnham. The county councils view is that the traffic impacts from the proposed Sizewell C development will be of such severity that there is a compelling case for the provision of a bypass to these villages as part of the development. A separate study of these improvements is therefore being undertaken by AECOM on behalf of the County Council, titled Four Villages

1.3 This document

This document follows an initial report completed in 2006 by Trevor Crocker & Partners. This document follows on from the previous report and investigates the potential for four different routes:

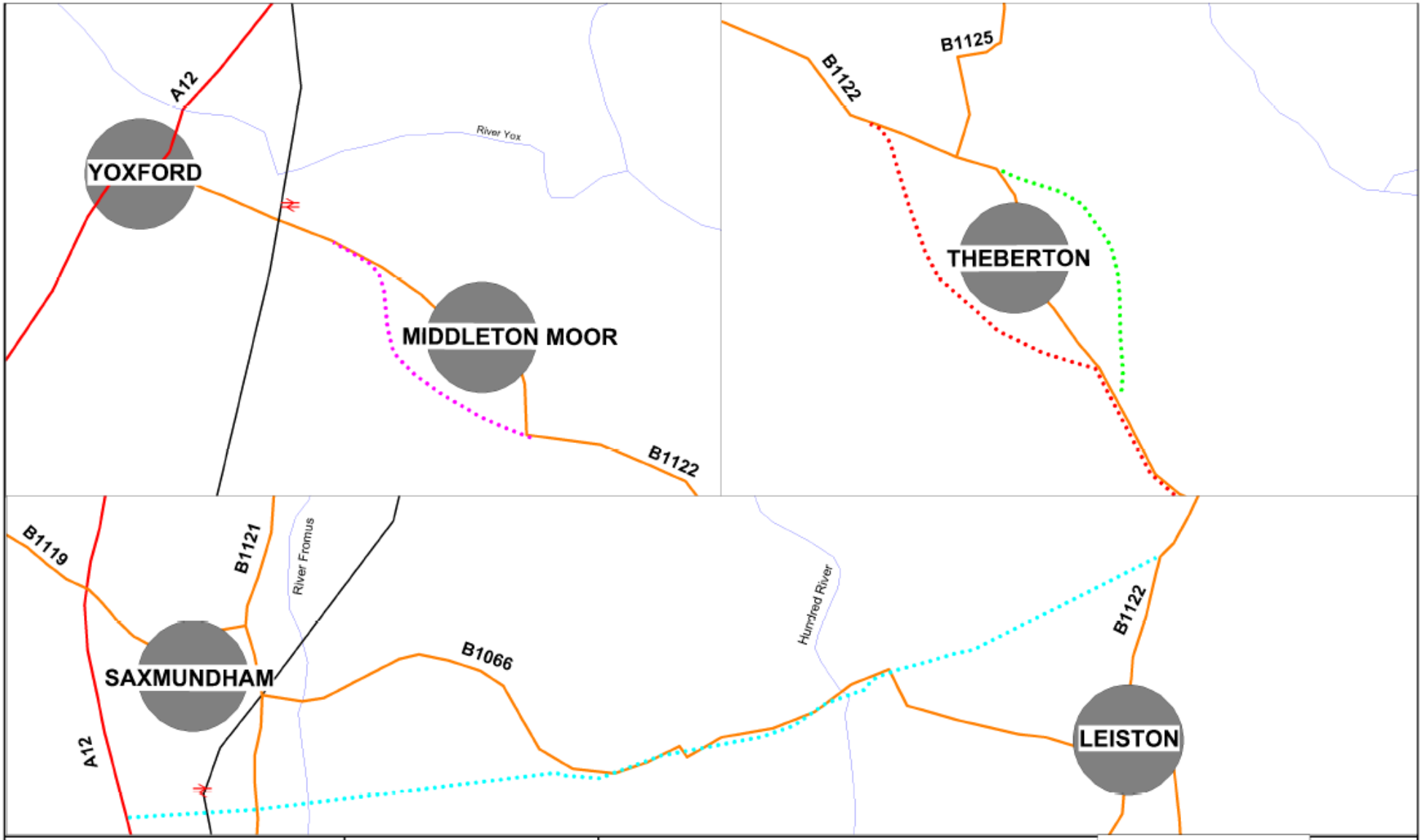
- Three of these are located North West of Leiston and are now referred to as the ‘B1122 Local Bypass Option’. These consist of Middleton Moor Bypass and Theberton East and West Bypasses.
- ‘D2 a new route proposal’ is located south west of Leiston.

This document will investigate the contributing factors that the new routes will cause including environmental factors, costs and benefits to drivers and identify any “showstoppers” to their delivery. Following this, mitigation measures for the B1122 and D2 will be investigated and assessed to a high level.

Subsequent to this initial introduction chapter, the report is structured as five further chapters describing the study work:

- Chapter 2 outlines the route options proposed for the study;
- Chapter 3 outlines the Scheme Development and Construction Programme;
- Chapter 4 reviews the Environmental Assessment;
- Chapter 5 describes the Noise Barrier proposals for the study;
- Chapter 6 evaluates the effect on Journey Times, Accidents and CO2;
- Chapter 7 summarises the Construction Cost Estimates for the Route options;
- Chapter 8 presents AECOM’s Summary and Conclusions;
- Chapter 9 presents the Next Steps required to progress the project;
- Chapter 10 describes the Further Investigative Study.

2 Route Options



Suffolk County Council

Economy, Skills & Environment.
Endeavour House, 8 Russell Road, Ipswich, Suffolk. IP1 2BX.

A12 FOUR VILLAGES AND SIZEWELL

Legend

- B1122 Middleton Moor
- B1122 Theberton East
- B1122 Theberton West
- D2

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2 Route Options

2.1 Introduction

In accordance with the brief, AECOM have prepared a study scope and programme which evaluates the following schemes:

- D2 (from the A12 at Saxmundham to Leiston);
- B1122 Local Bypasses (Middleton Moor, Theberton East and Theberton West);
- Yoxford Roundabout.

The investigation undertaken is based on:

- A thorough review of the past information, Sizewell C Study –to take advantage of the previous experience and identification of problems, but also to place the new insights in the past context;
- A multi-disciplinary approach to technical analyses, covering Environmental, Traffic and wider economic and social issues;
- Summary of the findings and recommendations for the way forward.

It should be noted that in this document the original schemes Options A, B, C and D have been replaced in the text by the following nomenclature;

B1122 Local Bypass option: A – **Middleton Moor Bypass**
B1122 Local Bypass option: B – **Theberton Bypass East**
B1122 Local Bypass option: C- **Theberton Bypass West**
B1122 Local Bypass option: D – **B1122 Road Improvement- part of both the Theberton Bypass options**
D2 Route option as originally described in the Trevor Crocker report.

2.2 Route D2

2.2.1 Location

Route D2 is a single carriageway that measures just over 7km. It has been identified as the most direct route to the site of the proposed Sizewell C, travelling from the A12 in the west to Leiston in the east. The route has been chosen as an alternative to the existing road, the B1119 which cuts through the town of Saxmundham. The B1119 also has many meanders situated along the length of it making it difficult for larger construction vehicles to manoeuvre.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. The site walkover started at the A12 junction at the start of the scheme to Leiston at the end. Observations from this site visit were as follows:

- The site of the proposed route is relatively flat with little variation in levels;
- The railway line at the proposed site of Saxmundham Rail Bridge is on a slight embankment;
- A large pit is located at the south corner adjacent to Leiston Rail Bridge;
- A property is located on the route of D2, at the junction between Abbey Lane and Saxmundham Road (B1119), near the proposed Leiston Rail Bridge;
- The Leiston Railway line appeared to be seldom used;
- Evidence of a gas line was apparent along the B1119;
- Two culverts were located along the B1119 connecting water courses.

2.2.2 Soil Conditions

For the Route D2 option, there is a flood risk at the east part of the proposed route and in the centre. The risk of flooding along this route is higher than the risk of flooding along the proposed B1122 local bypass routes.

According to Figure 6 in AECOMs 'Sizewell – Geotechnical Report' (Appendix 1.1), there is a 1 in 100 chance of flooding each year at the location east of Saxmundham roundabout and at the proposed culvert crossing.

The superficial deposits encountered on both sites consist of the Lowestoft Formation (Diamicton or Sand and Gravels), with local areas of Alluvium. The superficial deposits are underlain by the Crag Group Formation.

From AECOMs previous experience with Lowestoft formation, slopes of 1V:2.5H should be adequate, subject to further ground investigation and laboratory testing. Materials excavated from cuttings are likely to be reused as Class 1A/B and Class 2A/2B. This will need to be confirmed with further ground investigations and classification tests.

The geotechnical desk study report is available in Appendix 1.1 of this report.

2.2.3 Carriageway Layout

The carriageway has been designed following guidance from the Design Manual of Roads and Bridges[1]. It has been proposed that the carriageway width for D2 will be 7.3m. The verge widths on either side of the carriageway will measure 3.5m where possible. For side roads, widths have been designed as 6.1m. At locations where a structure is present, the verge widths are reduced to 2m either side. The route leaves the A12 before Saxmundham by means of a roundabout. It is then proposed to pass several Greenfield sites and reconnect with the B1119. Before connecting with the B1119, it is intended that a rail bridge will be positioned over the railway line connecting Saxmundham to Ipswich. Route D2 will then be lowered back to ground level to form a roundabout at the crossing between the proposed road and the existing B1122.

[1] DMRB, 2013

The route continues in an east bound direction until it meets the B1119. The current side roads of Workhouse Lane and Fristonmoor Lane that join the road at this point will remain, but will use staggered junctions to connect to the new road. Staggered junctions will also be positioned at the junctions to side roads The Green, Saxmundham Road and Buckles Road. The route continues along a similar line as the current B1119 with levelling of the existing line and some alignment improvements where necessary. The route will depart from the current line to form Leiston Rail Bridge, a bridge positioned over the railway line to Leiston. Currently at this chainage, a house is positioned. It is possible that this house will require demolition to allow for the construction of Leiston Rail Bridge. The route will then cross agricultural fields until it reaches the junction between Abbey Road (B1122) and Lovers Lane. At this point, a new roundabout will be positioned.

The proposed route varies from that specified in the brief in several ways. Firstly, the proposed priority junction positioned on the B1121 has been replaced by a roundabout. This decision was made based on safety as the roundabout will reduce traffic speeds on the approach to the existing B1121 as well as reducing the speeds on the approach to the rail bridge. Furthermore, it was originally suggested that the road will tie into the B1122, north of the junction to Lovers Lane with a priority junction. This idea was also replaced with a roundabout to allow slower moving traffic easier access onto the proposed route and to allow existing roads to be linked at this point.

Staggered junctions have been deployed throughout the design of Route D2. These allow vehicles to exit one junction and re-enter the other in the safest manner possible. At points where side roads have been discontinued, diversion roads have been positioned so access is not restricted.

The existing levels of the site vary from the levels proposed. Initially, the route leaves at similar levels to the A12, rising over farmland then peaking. This peak of 32.7m is at a point just before the Saxmundham Rail Bridge to allow enough length for the gradient to reduce to existing levels at the point of the roundabout on the B1121. Route D2 decreases in level to reach a trough of 11.6m where a drainage retention area has been provided. Following this, the levels continue at similar levels to the current with a further peak and trough at 2850m and 4700m where drainage retention areas are positioned. The levels of these troughs are 15.0m and 13.9m respectively. A final drainage retention area is positioned at the end of the scheme by Leiston Roundabout. This is positioned to suit relatively level ground that gradually drops to adjoin the B1122 level at a level of 8.1m. From the adjustments of levels, there will be a deficit of 232,290m^3 of material from construction.

A total of twelve footpaths and bridleways have been affected by the proposed route of D2. To keep these public routes accessible where the proposed carriageways have affected the routes, it has been proposed that gates and stiles will be positioned. Where this has not been possible, footpath diversions would be required.

2.2.4 Statutory Undertakers

A statutory undertaker's investigation was conducted on the 12th February 2014. The authorities that responded as they are affected by the scheme are as follows:

- BT Openreach over ground and underground plant
- Essex and Suffolk Water Trunk Main and Distribution Main
- National Grid Low and Medium Pressure
- Virgin Media

2.2.5 Structures

A total of two rail bridges are proposed along the route of D2, Saxmundham Rail Bridge and Leiston Rail Bridge. It is proposed that these bridges will have spans of 17.5m and 15.9m respectively. Following guidance from Network Rail, the bridges have been designed to allow for 7m clearance[2].

A single river bridge will be situated along the route; Sizewell River Bridge, with a span of 9.5m.

It has also been proposed that two culverts will be required along the proposed route. The design of these would follow guidance from the Environment Agency (EA).

2.3 B1122 Local Bypass: Theberton East

2.3.1 Location

The Sizewell B1122 route of Theberton East is a single carriageway that measures just over 2.6km and has been proposed as a bypass from the village of Theberton situated south of the site. The existing road, B1122 passes centrally through the village with residential areas located at both sides of the carriageway. The proposed design will divert traffic away from Theberton.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff. Observations from this site visit were as follows:

- Predominantly, the route passes agricultural land with few houses affected;
- The site of the proposed route was relatively flat but with the occasional steep dip n the terrain;
- The route passes a densely wooded area.

2.3.2 Soil Conditions

According to Figure 5 in 'Sizewell – Geotechnical Report', there is a 1 in 100 chance of flooding each year in the central part of the scheme.

[2] Network Rail 2014

The superficial deposits encountered on both sites consist of the Lowestoft Formation (Diamicton or Sand and Gravels), with local areas of Alluvium. The superficial deposits are underlain by the Crag Group Formation

From AECOMs previous experience with Lowestoft formation, slopes of 1V:2.5H should be adequate, subject to further ground investigation and laboratory testing. Materials excavated from cuttings are likely to be reused as Class 1A/B and Class 2A/2B. This will need to be confirmed with further ground investigations and classification tests.

A full study of geotechnical information is available in Appendix 1.1 of this report.

2.3.3 Carriageway Layout

The carriageway details are based on guidance from the Design Manual of Roads and Bridges[3]. It has been proposed that the carriageway width for the Theberton East Route will be 7.3m. The verge widths on either side of the carriageway will measure 3.5m where possible. For side roads, widths have been designed as 6.1m. It is proposed that the carriageway will leave the existing B1122 after the B1125 and continue South East until Onners lane where it will rejoin the existing carriageway. The route continues along a similar line as the current B1122 with levelling of the existing line and some alignment improvements where necessary. This final section of the scheme is common in both Theberton West and Theberton East and will be referred to as the B1122 Road improvement.

At certain curvature proposed along the new route, the fence line has been adjusted to allow for increased visibility by dense woodland. This woodland, known as ‘Brown’s Plantation’, may require clearance of wooded areas to achieve adequate visibility.

Staggered junctions have been designed to reconnect Church Road and the existing to the proposed road. Where entrances to side roads have been terminated at their current positions, new entrances have been realigned to fit with the designed route. It is proposed that access routes to the village will now be made via Church Road to the East and a side road to the South.

The existing levels of the site vary from the levels proposed. The proposed Theberton East route reaches a peak height towards the end of the scheme. This level at this point is 19.3m. Troughs are located at the location of a watercourse and 2150m. The levels at these points are 7.2m and 6.8m respectively. As a result of these dips, drainage retention areas have been proposed south east of the road. From the adjustments of levels, there will be an excess of 17649m³ of material from construction.

One footpath has been affected by the proposed route of Theberton East. To keep the public route accessible where the proposed carriageway has affected the route, it has been proposed that a stile will be positioned.

[3] DMRB 2013

2.3.4 Statutory Undertakers

A statutory undertaker's investigation was conducted on the 12th February 2014. The authorities that responded as affected by the scheme are as follows:

- Virgin Media
- BT Openreach Underground and Over ground plant
- Essex and Suffolk Distribution Main

2.3.5 Structures

Three culverts have been proposed along the route of Theberton East. These culverts will carry existing water courses with piping used having an inner diameter of 1.5m. The design of these would follow guidance of the Environment Agency[4].

2.4 B1122 Local Bypass: Theberton West

2.4.1 Locations

The Sizewell B1122 route of Theberton West is a single carriageway that measures just over 3.1km and has been proposed as a bypass from the village of Theberton situated North East of the site. The existing road, B1122 passes centrally through the village with residential areas located at both sides of the carriageway. The proposed design will divert traffic away from this area and re-join the B1122 in the direction of Leiston.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff Observations from this site visit were as follows:

- Predominantly, the route passes agriculture land with few houses affected.
- The site of the proposed route was relatively flat with minor undulations along the route.

2.4.2 Soil Conditions

According to Figure 5 in 'Sizewell – Geotechnical Report', there is a 1 in 100 chance of flooding each year in the central part of the scheme.

The superficial deposits encountered on both sites consist of the Lowestoft Formation (Diamicton or Sand and Gravels), with local areas of Alluvium. The superficial deposits are underlain by the Crag Group Formation

From AECOMs previous experience with Lowestoft formation, slopes of 1V:2.5H should be adequate, subject to further ground investigation and laboratory testing. Materials excavated from cuttings are likely to be reused as Class 1A/B and Class 2A/2B. This will need to be confirmed with further ground investigations and classification tests.

A full study of geotechnical information is available in Appendix 1.1 of this report.

[4] Environment Agency, 2014

2.4.3 Carriageway Layout

The carriageway details are based on guidance from the Design Manual of Roads and Bridges[5]. It has been proposed that the carriageway width for the Theberton West Route will be 7.3m. The verge widths on either side of the carriageway will measure 3.5m. For side roads, widths have been designed as 6.1m to allow for a stopping distance of vehicles travelling at 60mph, the verge is widened as the area is in cutting and changing direction. This allows for the required visibility. It is proposed that the carriageway will leave the existing road, B1122 just after Hawthorn Road and continue in a South direction. The route passes Greenfield sites and re-joins the B1122. The route continues along a similar line as the current B1122 with levelling of the existing line and some alignment improvements where necessary. This final section of the scheme is common in both Theberton West and Theberton East and will be referred to as the B1122 Road improvement.

Staggered junctions are proposed where Pretty Road joins the Theberton West Route. Standard junctions have been positioned to join the current road with the proposed. Where entrances to side roads have been terminated at their current positions, new entrances have been realigned to fit with the designed route.

The existing levels vary from the levels proposed. Currently, the route levels are uneven with the start of the route being positioned on a gradient. The new vertical profile for the Theberton West scheme requires troughs. The troughs are at levels 10.4m and 6.4m respectively. As a result of these troughs, two drainage retention areas have been located at these locations. As the scheme starts at a relatively low level, a smaller drainage retention area has been proposed. The outfall for this small drainage retention area is to be taken into local watercourses. The scheme peaks at the end of the scheme where the route reconnects with the B1122. The level at this point is 19.3m. As a result of the scheme earthworks there will be an excess of material summing 38,275m^3.

A total of three footpaths have been affected by the proposed route of Theberton West. To keep these public routes accessible where the proposed carriageways have affected the routes, it has been proposed that stiles will be positioned.

2.4.4 Statutory Undertakers

A statutory undertaker's investigation was conducted on the 12th February 2014. The authorities that responded as affected by the scheme are as follows:

- Virgin Media
- BT Openreach Underground Plant
- Essex and Suffolk Distribution Main

[5] DMRB, 2013

2.4.5 Structures

Three culverts have been proposed along the route of Theberton West. These culverts will carry current water courses with piping used of an inner diameter of 1.5m. The design of these would follow guidance of the Environment Agency (Environment Agency).

2.5 B1122 Local Bypass: Middleton Moor

2.5.1 Locations

The Sizewell B1122 route of Middleton Moor is a single carriageway that measures just over 1.6km and has been proposed as a bypass from the village of Middleton Moor situated east of the site. The existing road, B1122 passes centrally through the village with residential areas located at both sides of the carriageway. The proposed design will divert traffic away from this area and re-join the B1122 after this.

A site walkover of the proposed route took place on the 12th March 2014 by AECOM staff Observations from this site visit were as follows:

- Predominantly, the route passes agricultural land.
- The site of the proposed route was relatively flat with only minor variance in topography.
- A building located at the junction between Fordley Road and Yoxford Road may conflict with the proposed scheme.

2.5.2 Soil Conditions

Middleton Moor shows the highest chance of flooding of all the B1122 local bypass routes. According to Figure 5 in ‘Sizewell – Geotechnical Report’, there is a 1 in 100 chance of flooding each year in the south east of the scheme.

The superficial deposits encountered on both sites consist of the Lowestoft Formation (Diamicton or Sand and Gravels), with local areas of Alluvium. The superficial deposits are underlain by the Crag Group Formation

From AECOMs previous experience with Lowestoft formation, slopes of 1V:2.5H should be adequate, subject to further ground investigation and laboratory testing. Materials excavated from cuttings are likely to be reused as Class 1A/B and Class 2A/2B. This will need to be confirmed with further ground investigations and classification tests.

A full study of geotechnical information is available in Appendix 1.1 of this report.

2.5.3 Carriageway Layout

The carriageway details are based on guidance from the Design Manual of Roads and Bridges[6]. It has been proposed that the carriageway width for Middleton Moor will be 7.3m. The verge

[6] DMRB, 2013

widths on either side of the carriageway will measure 3.5m where possible. For side roads, widths have been designed as 6.1m.

It is proposed that the carriageway will leave the existing road, B1122 and continue south. The route passes Greenfield sites currently used for agricultural purposes. The route then rejoins the B1122.

Staggered junctions have been used to connect Littlemoor Road and Fordley Road to the proposed route. Other roads have been terminated at their current positions and realigned to fit with the designated route.

The existing levels of the site vary very little from the proposed. Currently, the start level is at 13.2m and the finish level 9.5m. The route troughs towards the end of the proposed route at the connection to the current B1122. The proposed level at this point is 9.5m. The peak of this route is at the centre. The proposed level at this point is 27.5m. It is proposed that the levels will be smoothened with drainage retention areas positioned at the start and end of the scheme. As a result of the requirement to smoothen the levels, there is an overall deficit of fill material of 3,450m^3.

No footpaths have been affected by the proposed route of Middleton Moor.

2.5.4 Statutory Undertakers

A statutory undertaker's investigation was conducted on the 12th February 2014. The authorities that responded as affected by the scheme are as follows:

- BT Openreach Underground Plant
- Essex and Suffolk Distribution Main

2.5.5 Structures

It has been proposed that two culverts will be required along the route. The design of the culvert is reinforced concrete box units measuring 1500x2500x1550mm. The design of these would follow guidance of the Environment Agency (EA).

2.6 Yoxford Roundabout

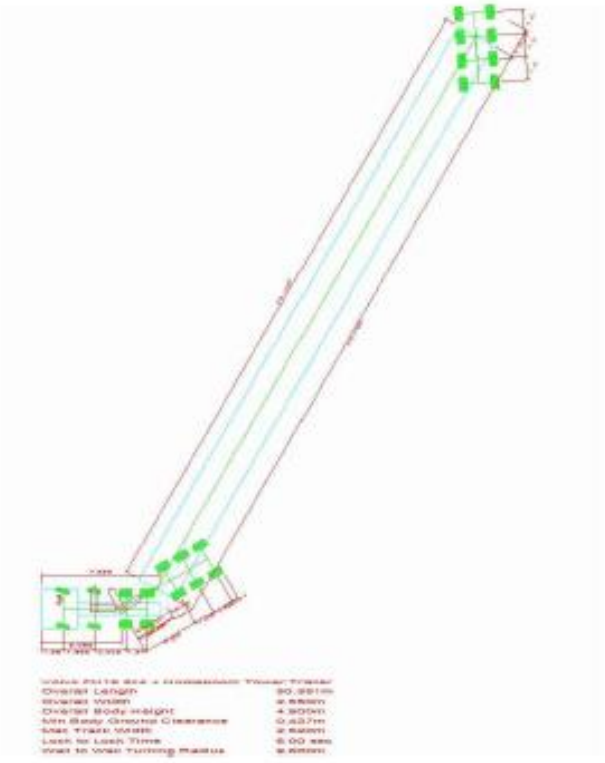
The A12 for investigation is a single carriageway in the village of Yoxford. As in certain other unimproved parts of the A12, substandard curves are situated along its route causing potential issues for construction vehicles such as Abnormal Indivisible Loads (AILs). As a result of this, AECOM have been commissioned the task of investigating the potential for a roundabout at the junction between the B1122 and A12.

This task has been additionally agreed by Suffolk County Council as necessary towards the investigations in this report.

2.6.1 Abnormal Indivisible Loads

Abnormal Indivisible Loads (AIL's) are loads that cannot be divided into smaller sections when carried by road. SCC determined the AIL's as being just over 50m in length. The vehicle is steerable by both the front and back wheels. This information was taken into consideration when modelling the vehicle for the design of the roundabout. The vehicle used for this design shown in the diagram.

Figure 2.5. Drawing of vehicle designed for Yoxford Roundabout plan



2.6.2 Investigation

Currently the site is situated on a sharp radius curve on the A12. The B1122 joins at approximately ninety degrees to the outgoing A12 in the Lowestoft direction. As most of the heavy construction traffic from Lowestoft will access the Sizewell site through this point the new roundabout will need to have adequate overrun areas for the passage of AIL vehicles. The proposed roundabout site is occupied by the current junction, a hotel to the west and Greenfield sites to the east. Housing exists to the south of the current junction and will require access to the roundabout in the final design. Drainage of the roundabout will be to a new retention area and thence to the Minsmere River. It is suspected that major statutory undertaker's plant is sited in the A12 and B1122 verges and an allowance for diversion of this is included in the scheme cost estimates.

3 Scheme Development and Construction Programme

3 Scheme Development and Construction Programme

3.1 Sizewell C bypasses Construction Programme

An indicative programme of works, from design to construction, has been defined for the proposed route options based on previous AECOM design and construction work. The programme shows the approximate years in which the design and construction will take place but the durations of these may alter depending on extent of the further work. The following Tables illustrate the programme for each route option.

Table 3.1 D2 Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

Table 3.2 Theberton East Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

Table 3.3 Theberton West Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

Table 3.4 Middleton Moor Construction Programme

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022
Carry out Preliminary Design and consultation									
Announce Preferred Route									
Carry out Detailed Design									
Public Inquiry									
Order Publication Period and CPO									
Award of Tender									
Construction Period									
Open to Traffic									

4 Environmental Assessments

4 Environmental Assessments

4.1 Air Quality

4.1.1 Introduction

The proposed “B1122 local bypass” route options considered in this assessment are detailed below:

- Middleton Moor Bypass;
- Theberton Bypass East; and
- Theberton Bypass West.

The proposed bypass routes are combined and two options have been defined and assessed. Details of these options are reported in the methodology section.

The route D2, which starts at the junction on the Saxmundham bypass and ends to the south of Abbey Lane into the B1122, has also been assessed.

This air quality option appraisal considers the potential effects on local air quality of the proposed bypass schemes, considering the additional road traffic movements likely to be generated by the proposed Sizewell C.

A WebTag assessment has also been carried out, to assess the impact of transport options on local air quality by quantifying the change in exposure at properties alongside the roads affected by the proposed bypass routes; a regional assessment and an economic valuation of air pollution.

In addition, a high level qualitative dust assessment has been carried in order to consider possible air quality effects during the construction phase of the proposed bypass.

4.1.2 Regulatory / Planning Policy Framework

4.1.2.1 European Air Quality Directives

The Air Quality Framework Directive (96/62/EC)[7] on ambient air quality assessment and management defines the European Union policy framework for twelve air pollutants known to have a harmful effect on human health and the environment. The mandatory limit values for the pollutants were set through a series of Daughter Directives.

- Directive 1999/30/EC (the 1st Daughter Directive)[8] sets limit values (values not to be exceeded) for sulphur dioxide, nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x), particulate matter (PM_{10}) and lead in ambient air.

[7] Air Quality Framework Directive (96/62/EC)
[8] Council Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.

- Directive 2000/69/EC (the 2nd Daughter Directive)[9] establishes limit values for concentrations of benzene and carbon monoxide in ambient air.
- Directive 2002/3/EC (the 3rd Daughter Directive)[10] establishes long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.
- Directive 2004/107/EC (the 4th Daughter Directive)[11] establishes a target value for the concentration of arsenic, cadmium, nickel and benzo(a)pyrene in ambient air so as to avoid, prevent or reduce harmful effects of arsenic, cadmium, nickel and polycyclic aromatic hydrocarbons on human health and the environment as a whole.
- Directive 2008/50/EC consolidates existing air quality legislation apart from the 4th Daughter Directive and provides a new regulatory framework for $PM_{2.5}$. It makes provision under Article 22 for Member States to postpone attainment deadlines and allow an exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission.

4.1.2.2 UK Air Quality Strategy

The UK Air Quality Strategy (AQS) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality problems, with the exception of ozone, which is instead considered to be a regional problem. The Air Quality (England) Regulations set objectives for the seven pollutants that are associated with local air quality. These objectives aim to reduce the health impacts of the pollutants to negligible levels. Unlike the EU limit values, the objectives outlined in the UK AQS are not mandatory.

The Air Quality Standards Regulations 2010 came into force on 11th June 2010[12], replacing the previous Air Quality Standards Regulations 2007. The 2010 regulations transposed into national legislation the requirements of Directive 2008/50/EC[13] and Directive 2004/107/EC.

4.1.2.3 Local Air Quality Management

The provisions of Part IV of the Environment Act 1995[14] establish a national framework for air quality management, which requires all local authorities in England, Scotland and Wales to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy and the Air Quality (England) Regulations[15],[16], will not be met, the local authority is required to designate

[9] Council Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air
[10] Directive 2002/3/ EC of the European Parliament and of the Council of 12 February 2002 relating to ozone in ambient air
[11] Council Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.
[12] The Air Quality Standards Regulations (2010). SI 2010 No. 1001.
[13] Council Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.
[14] UK Government, Environment Act 1995, http://www.legislation.gov.uk/ukpga/1995/25/contents.
[15] Defra (2000). The Air Quality (England) Regulations, 2000 (SI 2000/928).

an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves. This process is known as 'local air quality management'.

4.1.2.4 National Planning Policy

The recently published National Planning Policy framework[17] states the following with regard to air quality:

Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative effects on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan.

4.1.2.5 Local Planning Policy

In December 2011 Suffolk County Council adopted its Supplementary Guidance (SG) for Air Quality Management and New Development[18]. The principal aims of this SG on air quality are to:

- Maintain and where possible improve air quality;
- Ensure a consistent approach to local air quality management and new development across the county by:
  1. Identifying circumstances where an air quality assessment would be required to accompany an application;
  2. Providing guidance on the requirements of the air quality assessment; and
  3. Providing guidance on mitigation and offsetting of impacts.

Suffolk Coastal District Council is preparing a new District Local Plan which sets out the planning policies, proposal and actions for the future development to 2027. The adopted Supplementary Planning Guidance (SPG) will be replaced by the Supplementary Planning Documents under the Suffolk Coastal District Local Plan. The "Section 106 guidance for developers" provides information on air quality:

"The Local Authorities will seek to mitigate impacts from new developments that are detrimental to air quality and are in or adjacent to an AQMA or have a quantifiable impact on air quality in an AQMA by seeking contributions for measures to offset pollution effects."

4.1.2.6 Greenhouse Gases

The UK Government is committed to reducing emissions of greenhouse gases responsible for climate change. Under the Kyoto Protocol, the Government has set a legally binding target to reduce emissions of greenhouse gases to on average 12.5% below 1990 levels between 2008 and 2012. The European Union has set targets and policies that extend beyond the original

[16] Defra (2002). The Air Quality (England) (Amendment) Regulations, 2002 (SI 2002/3043).
[17] Department for Communities and Local Government (2012), National Planning Policy Framework. March 2012. Page 29.
[18] Air Quality Management and New Development, 2011. Available http://www.suffolk.gov.uk/business/planning-and-design-advice/supplementary-guidance-air-quality-management-and-new-development-2011

ambition of the Kyoto Protocol. The European Climate Change Programme (ECCP)[19] outlines a climate change strategy to help prevent temperatures from increasing to more than 2°C above pre-industrial levels. The ECCP's strategy which was agreed by the Council of Ministers in spring 2007 sets three targets to be reached by 2020:

- Greenhouse gas emissions: Cut by 20% from 1990 levels (or by 30% in the event of an adequate international agreement).
- Energy from renewable sources: Increase to 20% of all energy.

Energy efficiency: Improve by 20%.

To achieve these targets, different policy measures have been adopted, in particular the EU Emissions Trading Scheme and various regulations and standards such as the Renewables Directive and Energy Performance in Buildings Directive.

The UK adopted the Climate Change Act[20] in November 2008, which sets a target for the UK to reduce carbon emissions to 80% below 1990 levels by 2050 and established the concept of carbon budgets. To drive progress towards this target, the Act introduces five year "carbon budgets", which define the emissions pathway to the 2050 target by limiting the total greenhouse gas emissions allowed in each five year period, beginning in 2008. The first three carbon budgets were announced in April 2009, covering the periods 2008-12, 2013-17 and 2018-22. It requires emissions reductions of just over 22%, 28% and 34% respectively below 1990 levels, and is in line with the recommendations of the Committee on Climate Change. Each sector must play its part in taking action to achieve these budgets.

It is therefore important that the impacts of proposed transport interventions on greenhouse gas emissions are incorporated within the cost benefit analysis.

4.1.2.7 Standard and Key Policies

The following guidance documents have been used in this chapter in order to assess the effects of the proposed development and to determine the significance of any impacts on local sensitive receptors:

- Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 1: Air Quality, HA 207/07 and associated Interim Advice Notes (IAN 170/12, 174/13);
- Highways Agency, Approach to Evaluating Significant Air Quality Effects[21];
- Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 3: Disruption due to construction
- The policy and technical guidance notes, LAQM.PG(09)[22] and LAQM.TG(09)[23], issued by the Government to assist local authorities in their Local Air Quality Management responsibilities;

[19] European Commission, European Climate Change Programme. Available from http://ec.europa.eu/clima/policies/eccp/index_en.htm
[20] The Climate Change Act 2008 (c27).
[21] Highways Agency, Design Manual for Roads and Bridges, Volume 11 Section 3, Part 1: Air Quality

- The UK Air Quality Strategy;
- Department for Communities and Local Government (2012), National Planning Policy Framework;
- Building Research Establishment (BRE) publications, 'Control of Dust from Construction and Demolition Activities' and 'Controlling Particles, Vapour and Noise Pollution from Construction Sites';
- Suffolk Coastal District Council's Local Air Quality Review and Assessment Reports.

4.1.3 Baseline Conditions

4.1.3.1 Pollutant of Concern

Nitrogen dioxide

The Government and Devolved Administrations adopted two Air Quality Objectives for NO_2 to be achieved by the end of 2005. These are:

- An annual mean concentration of 40 µg/m^3; and
- A one-hour mean concentration of 200 µg/m^3, this is not to be exceeded more than eighteen times per year.

In practice, meeting the annual mean objective was anticipated to be considerably more challenging than attaining the one-hour objective. The EU First Daughter Directive also sets limit values for NO_2 to be achieved by 1st January 2010, which have been incorporated into UK legislation. The Directive includes a one-hour limit value of 200 µg/m^3, not to be exceeded more than eighteen times per year and an annual mean limit value of 40 µg/m^3.

NO_2 and nitric oxide (NO) are collectively known as oxides of nitrogen, or NO_x. All combustion processes produce NO_x emissions, predominantly in the form of NO, which then undergoes conversion in the atmosphere to NO_2, mainly as a result of its reaction with ozone (O_3). It is NO_2 that has been most strongly associated with adverse effects upon human health. NO_2 can irritate the lungs and lower resistance to respiratory infections such as influenza. Continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air which may cause increased incidence of acute respiratory illness in children.

Updated total NO_x emissions estimates for 2011 showed that road transport accounted for the largest proportion (33%) of total UK NO_x emissions. Energy industries remained the second largest contributor. Road transport emissions have declined significantly since peaking in 1990 as a consequence of various policy measures, with total emissions reducing by 64% between 1990 and 2011. Further reductions are expected in future years.

Emissions from industrial sources have also declined significantly, due to the fitting of low NO_x burners, and the increased use of natural gas plant. Industrial sources generally make a small

[22] Defra, (2009) Local Air Quality Management, Policy Guidance. LAQM.PG(09).
[23] Defra, (2009) Local Air Quality Management, Technical Guidance. LAQM.TG(09).

contribution to ground level NO_2 levels, although breaches of the hourly NO_2 objective may occur under rare meteorological conditions due to emissions from these sources.

The annual mean objective of 40 µg/m^3 is currently widely exceeded at roadside sites throughout the UK, with exceedences also reported at urban background locations in major conurbations. The number of exceedences of the one-hour objective show considerable year-to-year variation, driven by meteorological conditions, which give rise to winter episodes of poor dispersion and summer oxidant episodes.

4.1.3.2 Particulate Matter

The Government and the Devolved Administrations adopted two Air Quality Objectives for PM_{10} to be achieved by the end of 2004:

- An annual mean concentration of 40 µg/m^3 (gravimetric); and
- A 24-hour mean concentration of 50 µg/m^3 (gravimetric) to be exceeded no more than thirty-five times per year.

Particulate matter is composed of a wide range of materials arising from a variety of sources, and is typically assessed as total suspended particulates, or as a mass size fraction. The European air quality standards have adopted the PM_{10} standard for the assessment of fine particulate matter. This expresses particulate levels as the total mass size fraction at or below an aerodynamic diameter of 10 µm. Particles of this size are able to penetrate beyond the nose and throat deep into the respiratory system reaching the bronchi and lungs.

Extensive scientific research has provided evidence of associations between exposure to fine particulate matter (PM) and increased morbidity and mortality. Numerous studies have associated particulate pollution with acute changes in lung function and respiratory illness, resulting in increased hospital admissions for respiratory disease and heart disease and the aggravation of chronic conditions such as bronchitis and asthma.

Adverse effects on the cardiovascular and respiratory systems have been causally linked with both short-term and long-term exposures to PM. Two collaborative projects undertaken in ninety cities in the United States and 29 European cities reported links between daily mortality and PM concentration on the same day or several preceding days. Increases in total mortality of 0.27% per 10 µg/m^3 increase in PM_{10} and 0.6% per 10 µg/m^3 increase in PM_{10} were determined for the US and European city studies, respectively[24],[25]. Long-term exposure to PM has been implicated in observed increases in all-cause, cardiopulmonary and lung cancer mortality[26],[27].

There is some concern that fine particles from diesel exhaust may have a carcinogenic effect. This may be due to air-stream entrained particles carrying adsorbed carcinogens into the

[24] Dominici F, Burnett R (2003). Risk models for particulate air pollution. J Toxicol Env Health Part A. 66: 1883–1889.
[25] Katsouyanni K., Touloumi G., Samoli E., et al (2001). Confounding and effect modification in the short-term effects of ambient particles on total mortality: results from 29 European cities within the APHEA-II project. Epidemiology 12: 521–531.
[26] Krewski D, Burnett RT, Goldberg MS, Hoover K, Siemiatiycki J, Jerrett M, Abrahamowicz M, White WH (2000). Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality. Cambridge, MA: Health Effects Institute.
[27] Hoek G, Brunekreef B, Goldbohm S, Fischer P, van den Brandt PA. (2002). Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. Lancet 360:1203–1209.

respiratory system. The effects of particulate matter exposure on human health are complex and masked by other factors such as weather and lifestyle. Importantly, however, there is broad agreement in the scientific community that there is no threshold exposure level below which the adverse effects of PM exposure are no longer discernible[28].

In the UK, commercial, residential, agriculture and fishing, stationary and mobile combustion are the major sources of particulate emissions in 2011 (24%). Total UK PM_{10} emissions have fallen by more than 60% between 1980 and 2011 to around 113 kilotonnes. Revised figures indicate that after commercial, residential, agriculture and fishing, stationary and mobile combustion sources, road transport (21%) and industrial processes emissions (14%) remain the principal sources of PM_{10} in 2011.

Emissions of PM_{10} have decreased considerably in the past thirty years. PM_{10} emissions from road transport peaked during the early 1990s and have since fallen by around 46% (1993 to 2011). The energy and industry sectors have seen a decrease of 86%, for the same period. The reduction is mainly due to the decline in coal use and also the result of legislative and technical control of emissions from both road traffic and industrial sources. Energy Industries accounted for 7% of total PM_{10} emissions in 2011, compared with 27% in 1990.

4.1.3.3 Construction Dust

Dust is defined as all particulate matter up to 75 µm in diameter and comprising both suspended and deposited dust, whereas PM_{10} is a mass fraction of airborne particles of diameter of 10 µm or less. The health impacts associated with dust include: eye, nose and throat irritation in addition to the nuisance caused by deposition on cars, windows and property. Dust and PM_{10} emissions arise from a number of sources, so both construction activities and emissions from vehicles associated with the construction site need to be considered.

Literature suggests that the most sensitive vegetation species appear to be affected by dust deposition at levels above 1000 $mg/m^2/day$ that is five times greater than the level (200 $mg/m^2/day$) at which most dust deposition may start to cause a perceptible nuisance to humans so vegetation is much less sensitive to dust than human activities. Most species appear to be unaffected by dust until deposition rates are at levels considerably higher than 1000 $mg/m^2/day$. Without mitigation, some construction activities can generate considerable levels of fugitive dust, although this is highly dependent on the nature of the ground and geology, time of year construction occurs in, length of time specific construction activity (e.g. boring) occurs for and prevailing meteorology during this activity.

4.1.4 Summary of Local Air Quality Management in Suffolk Coastal District Council

In 2006, the Suffolk Coast District Council declared an AQMA for NO_2 due to monitored exceedences of the annual mean NO_2 objective at a number of properties near Woodbridge Junction (Lime Kiln Quay Road, Thoroughfare and St. John's Street in Woodbridge). A second AQMA has since been declared in 2009 for a single property in the Port of Felixstowe.

[28] WHO (2003). Health Aspects of Air Pollution with Particulate Matter, Ozone and Nitrogen Dioxide.

The first round of review and assessment was completed in 2001 and no AQMA were declared.

The 2005 Air Quality Action Plan and Progress Report confirmed the potential risk that Suffolk Coastal District Council may exceed the air quality objectives for NO_2, SO_2 and PM_{10}. Further investigation in the form of a Detailed Assessment found that an AQMA was required due to exceedences of the annual mean NO_2 objective at Lime Kiln Quay Road/The Thoroughfare/St John's Street junction, Woodbridge. The area was subsequently declared an AQMA in 2006.

The Fourth round of the Updating and Screening Assessment confirmed that concentrations continued to exceed the annual mean objective at Woodbridge, and that Ferry Lane, Felixstowe required a Detailed Assessment due to NO_2 exceedences. The Detailed Assessment showed that the container handling and HGV activity from the port was the cause of the high NO_2 concentrations. An Action Plan was produced for the Felixstowe AQMA. Thirteen measures have been recommended to reduce NO_2 concentrations and 2011 diffusion tube monitoring showed that concentrations have dropped below the 40 µg/m^3 objective.

An Action Plan Progress Report for the Woodbridge Junction AQMA was included in the 2012 Updating and Screening Assessment. This report shows that measures to reduce traffic congestion has been successful at the junction with some reductions in concentrations. However, the area remains above the objective value and further work is required to reduce concentrations.

Monitoring results in 2012 by the automatic NO_X analyser and diffusion tubes situated within the AQMA at Woodbridge confirm that the annual mean NO_2 objective continues to be exceeded. Diffusion tube concentrations within the AQMA at Felixstowe showed a further reduction in 2012. A Detailed Assessment was also undertaken for Stratford St. Andrew area which confirmed the requirement for declaration of an AQMA at this location due to exceedence of the NO_2 concentrations. The Detailed Assessment report has been taken to Suffolk Coastal's Cabinet who have recommended declaration of an AQMA to cover the 4 houses situated at Long Row, Main Road, Stratford St Andrew.

The proposed bypass routes are outside the AQMA's. Further information on local air quality management and Review and Assessment undertaken by Suffolk Coastal District Council can be found on the Council's website[29].

4.1.4.1 Air Quality Monitoring in Suffolk Coastal District Council

A number of air quality monitoring sites are operated by Suffolk Coastal District Council using both automatic (i.e. continuous monitoring) and non-automatic (i.e. diffusion tubes) measurement methods

Monitoring results in recent years recorded at the continuous monitoring site in Suffolk Coastal District Council is summarised in Table 4.1.1. The Woodbridge monitoring station is located just over 17 km south to the proposed D2 route. Due to the distance and the monitor's location in an AQMA, concentrations monitored at this location are unlikely to represent conditions at the

[29] Air Pollution in Suffolk Coastal District Council available from http://www.suffolkcoastal.gov.uk/yourdistrict/envprotection/airquality/reports/ Accessed 19/02/2014.

proposed site. Currently, Suffolk Coastal Council has thirty-nine diffusion tube monitoring sites and one automatic monitoring which are shown in Table 4.1.2. In 2012 and 2013 additional diffusion tubes were put in place along the A12 to inform the planning application for the Sizewell C power station. These tubes are located at Little Glemham, Farnham and Stratford St. Andrew.

Table 4.1.1: Air quality continuous monitoring station results

Site ID	Grid Reference		Site Type	In AQMA	Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$), Number Hourly Exceedences in Parenthesis		
	X	Y			2011	2012	2013
Woodbridge Junction	627590	249260	Kerbside	Yes	**42** (0)	**44** (1)	**42** (0)

Notes: Exceedences of air quality objectives / EU limit values are shown in bold

Table 4.1.2: Annual Mean Results of Diffusion Tubes Monitoring

Site ID	Grid Reference		Site Type	In AQMA	Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$)		
	X	Y			2011	2012	2013[b]
Little Glemham 1	634200	225880	Roadside	No	17	14	14
Farnham 1	636270	260130	Roadside	No	29	26	29
Farnham 2	636270	260110	Roadside	No	33	31	31
Stratford St. Andrew 1	635740	259990	Roadside	No	**43**	**42**	**40**
Stratford St. Andrew 2	635740	260010	Roadside	No	N/A	26	26
Stratford St. Andrew 4	635870	260110	Roadside	No	N/A	24	16

Stratford St. Andrew 5	635720	259990	Roadside	No	N/A	18	N/A
Stratford St. Andrew 6	635790	260040	Roadside	No	N/A	N/A	23
Stratford St. Andrew 7	635720	259970	Roadside	No	N/A	N/A	34

Notes: Exceedences of air quality objectives / EU limit values are shown in bold; b) Bias adjusted using the National Bias Adjustment Factor (0.8).

The results in Table 4.1.2 indicate that the annual mean air quality objective / EU limit value (40 µg/m^3) was not exceeded at eight of the nine roadside diffusion tubes close to the proposed bypass schemes but did exceed the objective at Stratford St. Andrew 1 between 2011 and 2013.

4.1.4.2 Background Concentrations

A large number of small sources of air pollutants exist, which individually may not be significant, but collectively, over a large area, need to be considered in the modelling process. The emissions from these sources form part of the background air quality in the vicinity of the proposed bypass scheme. Defra have produced mapped background concentrations covering the whole of the UK for use by local authorities in the completion of their Review & Assessment (R&A) reports in the absence of local background monitoring or where insufficient background monitoring data is available. The maps provide background pollutant concentrations for each 1 km by 1 km grid square within the UK.

Table 4.1.3 shows the comparison of the closest urban background tube, number 21, which is located in Felixstowe with the grid square closest to that tube (629500, 234500). Diffusion tube 21 at Felixstowe is located more than 22 km to the south of the bypass routes, therefore, this monitoring location is not considered to be representative of the background concentration in the study area however it does allow the mapped Defra concentrations to be compared with monitored NO_2 concentrations. The urban background diffusion tube shows similar concentrations when compared to the mapped background concentrations.

Roadside diffusion tubes located at Little Glemham, Farnham and Stratford St. Andrew are not suitable as source of background concentrations in the study area, due to their close proximity to the A12. The use of the results from roadside sites as background concentration in the air quality assessment, would lead to a double count of the road contributions.

Table 4.1.4 shows the average mapped background concentrations for grid squares located along side the bypass routes. Background NO_2 concentrations have been calculated without the influence of local road sources in accordance with Defra guidance[30] and using the updated Defra

[30] Defra 2012. Local Air Quality Management Note on Projecting NO2 Concentrations. April 2012.

source apportionment adjustment calculator. Concentrations for both NO_2 and PM_{10} are significantly below annual mean objectives.

Table 4.1.3: Annual mean diffusion tube results versus mapped background concentrations

Diffusion Tube	Grid Reference		Monitored Annual NO_2 Mean Concentration ($\mu g/m^3$)		DEFRA NO_2 Mapped Background Concentration ($\mu g/m^3$)	
	X	Y	2012	2013	2012	2013
Felixstowe 21	629250	234430	22.0	21.0	21.6	21.2

Table 4.1.4: Mapped background concentrations

Road Section	2013		2024		2035	
	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)
B1122 Bypasses	9.7	15.3	7.2	14.2	7.1	14.1
D2 Route	9.7	15.7	7.3	14.6	7.2	14.5

4.1.5 Assessment Methodology

The bypass has the potential to impact on air quality during its operational and construction phases. The main impacts during the construction phase will be airborne dust generated during demolition and construction activities. These impacts have been assessed qualitatively.

The main impacts during the operational phase are likely to be associated with road traffic. The effect on local air quality due to change in road traffic associated with the proposed bypass options have been predicted in accordance with the Design Manual for Roads and Bridges (DMRB)[31] , which provides a methodology to be followed when assessing the effects of a road scheme/s on local and regional air quality.

[31] Highways Agency (2007). Design Manual for Roads and Bridges, Volume 11 Section 3 Part I: Air Quality. HA 207/07.

A Transport Analysis Guidance (WebTAG) assessment has also been undertaken to estimate the overall change in human exposure to pollution and emissions of regional air pollutants (including carbon) as a result of the scheme.

In assessing the potential impact of road traffic emissions the following scenarios have been assessed:

- Baseline scenario, 2013, which describes the current local road network in 2013;
- Do-Minimum scenario (DM) including Sizewell C, which describes the local road network including the Sizewell C traffic in place in 2024 (Sizewell peak construction year) and 2035;
- Do-Something scenario (DS) including Sizewell C with the proposed bypass schemes, which describes the proposed bypass/D2 route schemes including the Sizewell C traffic in 2024 (Sizewell peak construction year) and 2035.

Scenarios without Sizewell C traffic were not assessed as the bypass would be built for the Sizewell traffic.

The following bypass options have been considered in this air quality assessment:

- Option 1: Middleton Moor and Theberton East;
- Option 2: Middleton Moor and Theberton West; and
- Route D2.

4.1.5.1 Construction Phase

A qualitative assessment has been undertaken to assess the potential impacts of airborne dust and emissions generated during the construction phases of the scheme. The assessment has been conducted in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 3 Part 3, Disruption due to Construction[32].

According to the DMRB guidance, the impacts that may arise due to construction activities may affect people in residential properties or place of work, people visiting shopping centre or community facilities, pedestrian and travellers. When materials are transported from the highway construction site, the construction access routes should also be assessed.

Possible impacts can be:

- Dust deposition resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM_{10} concentrations as a result of dust-generating activities on site; and
- An increase in the concentrations of airborne particles and nitrogen dioxide resulting from exhaust emissions of diesel-powered vehicles and equipment used on site.

[32] DMRB, http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3.htm

4.1.5.2 Operational Phase

DMRB 'Scoping' Level Assessment

The assessment of the operational phase of the development has been undertaken following the approach outlined in DMRB Volume 11 Environmental Assessment Section 3 Part 1 Air Quality (HA 207/07), Chapter 3[33]. As such, the following tasks have been undertaken:

4.1.5.3 Local Air Quality

Initially, traffic datasets for the Do-Minimum and Do-Something scenarios for each proposed link were compiled and the 'affected' road links identified. Paragraph 3.12 of the DMRB defines affected roads, with regard to local air quality, as those meeting one or more of the following criteria:

- Changes in Annual Average Daily Traffic (AADT) of 1,000 vehicles or more;
- Changes in Heavy Duty Vehicle flows of more than 200 AADT;
- Daily average speed changes of 10 kph or more; or
- Peak hour speed changes of 20 kph or more.

For those road links which meet one or more of the above criteria the DMRB assessment methodology requires that:

- Existing sensitive receptors within 200 metres of the affected road links be identified.
- Selection of receptor locations where the impacts of the proposed scheme are expected to be greatest. Consideration was given to the proximity of properties to the proposed schemes.
- Calculation of pollutant concentrations associated with road traffic emissions at each receptor location using the DMRB Screening Method for future Do-Minimum and Do-Something scenarios to assess the potential impact of the road scheme on local air quality.

Additional scenarios have been modelled for the pollutant NO_2 in accordance with the Highways Agency's Interim Advice Note (IAN 170/12)[34], which provides supplementary advice to users of DMRB, using the spreadsheet tool provided[35]. This additional scenario takes into account the slower decline in vehicle NO_x emissions than was originally forecast in the DMRB model. These additional scenarios are:

[33] Highways Agency, Design Manual for Roads and Bridges. Volume 11 Section 3, Part 1: Air Quality, HA 207/07. May 2007.
[34] Highways Agency, Interim Advice Note 170/12 Rev 1, Updated Air Quality Advice on the assessment of Future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality', June 2013. Available from http://www.dft.gov.uk/ha/standards/ians/index.htm
[35] Highways Agency, Long Term Gap Analysis Calculator, 2012 (version 1.0). Available from http://www.dft.gov.uk/ha/standards/ians/index.htm

- Projected base year 2024, which assesses the local road network in 2013 using 2024 vehicle emission factors and 2024 background concentrations; and
- Projected base year 2035, which assesses the local road network in 2013 using 2035 vehicle emission factors and 2035 background concentrations. Due to limitations of the Highway's Agency DMRB Screening Method worksheet, the assessment has been applied to the nearest possible year, i.e. year 2025.

These are then used to calculate a gap factor, as described in IAN 170/12, which is then applied to the results from the DMRB screening method.

4.1.5.4 Regional Air Quality

Again, traffic datasets for the Do-Minimum and Do-Something scenarios were compiled and the 'affected' road links identified. Paragraph 3.20 of the DMRB defines affected roads, with regard to regional air quality, as those meeting one or more of the following criteria:

- A change of more than 10% in AADT;
- A change of more than 10% to the number of heavy duty vehicles; or
- A change in daily average speed of more than 20 kph.

As traffic data was available for affected roads, calculations have been made of the change in total emissions that will result from the project using the regional tab of the DMRB Screening Method.

4.1.5.5 WebTAG Assessment

The WebTAG assessment at plan level, as prescribed in TAG Unit 3.3.3 'The Local Air Quality Sub-objective 2013 ', provides guidance on assessing the impact of transport options on local air quality by quantifying the change in exposure at properties alongside the roads affected by the proposed scheme. This quantification includes all significant changes in exposure on existing routes, new routes or on the local network at relevant properties as defined in LAQM.TG(03), including residential flats and houses, hospitals, schools and churches.

The steps used to carry out the assessment are detailed below:

- NO_2 and PM_{10} concentrations are determined for the assessment years for all routes affected, for the DM and DS scenarios using the DMRB screening methodology at 20 m, 70 m, 115 m and 175 m from the road centre.
- The number of properties in the study area are counted and categorised into either of the following bands:

  1) Road centre to 50 m from road centre;
  2) 50 m – 100 m from road centre;
  3) 100 m – 150 m from road centre; or
  4) 150 m – 200 m from road centre.

- The above step is repeated for each affected route for both DM and DS. For each of the four bands, the pollutant concentration is then multiplied by the number of properties in that band and the results summed to give a total score for all routes, for each assessment year. Two separate scores, one for NO_2 and another for PM_{10} are calculated.
- The total score for the DM scenario is deducted from the DS score to give an overall impact score, with a negative score indicating reduced exposure to pollution, hence an improvement in air quality, and a positive score indicating higher exposure to pollutants thus a worsening in air quality.

The WebTAG results are presented quantitatively according to the 'Environment – Local Air Quality – Plan Level' worksheets, and qualitatively in reference to the UK Air Quality Strategy Objectives.

In addition to the assessment of direct impacts on air quality this assessment also includes:

- A Social and Distributional Impact (SDI) analysis which looks at the index of social deprivation in an area and allows the social impacts of the scheme to be assessed, both in absolute terms and how they distribute across different social groups.
- An economic evaluation of air pollution which calculates the impacts of the scheme on air quality in monetary terms considering the economic values associated with the changes. The valuation is calculated based on the change in NO_x emissions and PM_{10} concentrations. Economic valuations for NO_2 concentration are currently not published by the Inter Departmental Group on Costs and Benefits (Air Quality) (IGCB (AQ)) and, therefore, values for NO_x emissions have been used as a proxy. The resultant values reflect the cost of health impacts associated with exposure to air pollution.

4.1.6 Assessment of Local Air Quality

4.1.6.1 Sensitive Receptors

In accordance with guidance set out in the DMRB methodology (Section 5.2), only residential properties and ecologically designated sites within 200 metres of roads affected by a development need to be assessed. No sensitive ecologically sites have been identified within 200 metres of the proposed scheme or those affected by the proposed scheme and, as such, designated ecological sites were not considered in the assessment.

Five receptors were selected across the B1122, at locations considered likely to experience the greatest air quality change as a result of the proposed B1122 bypass schemes. Affected road links within 200 m of the receptors were identified and the shortest distance from the receptor to the centre of the affected road link(s) measured. Receptor 8 is located 200 m further from the proposed Bypass A and it has been selected in order to assess the effect of this bypass on the local air quality of Middleton Moor.

Table 4.1.5: Sensitive receptors

Option	Receptor ID	Grid Reference		Details	Roads within 200m
		X	Y		
B1122 Local Bypass	8	641619	267770	Residential	B1122
	9 B	643896	265708	Residential	B1122 and Theberton East
	9 C	643896	265708	Residential	B1122 and Option C
	10	643935	266223	Residential	Theberton East
	11	643801	265657	Residential	B1122 and Option C
	12	644818	264303	Residential	B1122
D2	13	638300	261691	Residential	Main Road (B1121)
	14	638620	262920	Residential	South Entrance (B1121)
	15	639360	262484	Residential	Route D2
	16	642651	263143	Residential	B1119/Route D2 and Abbey Lane
	17	638999	262983	Residential	Church Hill (B1119)

4.1.6.2 Traffic Data

Conversion NO_x to NO_2

The proportion of NO_2 in NO_x varies greatly with location and time according to a number of factors including the amount of ozone available and the distance from the emission source.

AQEG[36] reported that urban NO_x concentrations had declined since the early 1990s as a result of decreasing road traffic emissions. Decreases in NO_2 were not as distinct, resulting in an increase in the NO_2/NO_x ratio. The magnitude of the increase was inconsistent with the increase expected solely as a consequence of reduced NO_x concentrations. The findings were supported by monitoring data from a number of locations in London and the Automatic Urban Rural Network (AURN) monitoring data from across the UK.

The observations prompted research into the NO_2/NO_x relationship and an updated version of the relationship was published[37]. More recently a spreadsheet[38] has been produced, which provides a revised methodology for converting NO_x to NO_2 for any given year. The most recent version of this methodology, updated in 2012, has been used for the purpose of this assessment

[36] Air Quality Expert Group; Nitrogen Dioxide in the United Kingdom; 2004
[37] Deriving NO_2 from NO_x for Air Quality Assessments of Roads –Updated to 2006, Air Quality Consultants.
[38] NOX from NO_2 Calculator, 2012. Available from http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html

for all scenarios. The 'All UK traffic' mix was used in the calculation as this offers the best representation of local traffic conditions and hence the NO_2/NO_x relationship for Suffolk Coastal.

4.1.7 Significance Criteria

4.1.7.1 Local Air Quality Impact

The Interim Advice Note (IAN 174/13)[39] updated advice for evaluating local air quality effects. The methodology is reported in Appendix 1.2.

The methodology proposed in IAN 174/13 only applies to those receptors exceeding the air quality thresholds; therefore an analysis has been carried out using the Highways Agency method[40] to evaluate the significance of local air quality effects arising from road schemes.

The Highways Agency proposed that local air quality assessments are evaluated based on five indicators:

- Effect on "hot-spots": Change in absolute concentrations of pollutants;
- Change in exposure: Change in number of receptors (human or ecological as appropriate) already exposed to air quality over objectives, i.e. removal and creation of exceedences;
- Change in exposure: Number of properties where air quality is improved/worsened;
- Triggering in statutory duties: Concentrations pushed over national air quality objectives in a new location; and
- Change in timescales to achieve air quality thresholds.

Table A3.1.9 in Appendix 1.2 sets out the methodology proposed by the Highways Agency to evaluate the significance of a scheme against the air quality indicators described above. This approach seeks to describe the significance of air quality impacts taking into consideration of the sensitivity, extent, magnitude and duration of an impact.

4.1.7.2 Regional Assessment

There are no significance criteria for assessing effects of regional emissions. These effects will be put into context based on national and regional emissions. Potential mitigation measures will be described where necessary.

4.1.7.3 Construction Dust Impact

A 'Stage 2' assessment has been undertaken to identify the factors and effects associated with the disruption due to construction activities.

Below are the steps required for the assessment:

- Estimate number of sensitive receptors within 100 m of each option route, in particular residential properties, schools, hospitals, aged persons homes or libraries;

[39] IAN 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07), June 13.
[40] Review of the Highways Agency's Approach to Evaluating Significant Air Quality Effects Version 1.1, Highway Agency, September 2012.

- Identify ecological receptors within 100m of a route option, which might need to be protected from adverse impacts;
- Note any likely significant differences in the magnitude of disruption between routes. For example, large earthwork activities, tunnelling or bridgeworks.

An assessment of the borrow and surplus material requirements must also be carried out, if sufficient data is available.

4.1.8 Assumptions and Degree of Certainty

The assumptions that have been used in this air quality assessment are:

- In the Do-Something scenarios it has been assumed that no local traffic will use the existing B1122; and
- A constant average speed has been used for the B1122, B1122 local bypass routes and D2 route.

4.1.9 Predicted Effects

4.1.9.1 Model Verification

The model results have been verified and adjusted as shown in Appendix 1.2.

In addition to the systematic errors the model is still likely to predict concentrations slightly different to actual ambient values. This is termed random error and must also be considered. It is possible to account for the degree of random error, according to guidance provided by Environmental Protection United Kingdom (EPUK)

'Stock U Values', figures provided by EPUK, allow the standard deviation of the model (SDM) to be calculated. The Stock U Value for NO_2 is between 0.1 and 0.2 for an annual mean (it is higher for shorter averaging periods). The SDM can be calculated according to:

$$SDM = U \times Co$$

Where Co is the air quality objective (40 µg/m^3 for the NO_2 UK annual mean objective).

Therefore:

$$SDM = 0.1 \times 40 = 4\ \mu g/m^3$$

This calculation quantifies the uncertainty in the identification of areas where an exceedence of the air quality objective can be considered possible. This region, therefore, extends between 36 µg/m^3 to 44 µg/m^3 at 1 standard deviation from the objective.

Table 4.1.6: Probability of exceedence of annual mean NO_2 Objective

Probability of Exceedence	Uncertainty	Concentration Range ($\mu g/m^3$)
Very likely	> Mean + 2 SD	>48
Likely	Mean + 1 SD – Mean +2 SD	44 – 48
Probable	Mean - Mean + 1 SD	40 – 44
Possible	Mean - Mean – 1 SD	36 – 40
Unlikely	Mean - 1 SD – Mean - 2 SD	32 – 36
Very Unlikely	< Mean – 2 SD	< 32

The terminology given in Table 4.1.6 is used in conjunction with the modelling uncertainty concentrations and can be directly compared to the results presented in the results sections.

4.1.9.2 Local Air Quality Assessment Results

2024 Including Sizewell C Traffic

Concentrations of NO_2 and PM_{10} at sensitive receptors, where the impacts of the proposed bypass schemes including the Sizewell C traffic are deemed likely to be greatest, are given in Table 4.1.7 to Table4.1.9 below. As required by the Highways Agency, two sets of results are reported for the pollutant NO_2 to show the adjustments made to project future concentrations. Modelled results and changes in concentrations between the Do-Something and Do-Minimum scenarios are reported to one decimal place, as stated in the Interim Advice Note 174/13[41]

[41] Interim Advice Note 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07), June 13

Table 4.1.7: Predicted annual mean NO_2 Concentrations at sensitive receptors – 2024 including Sizewell C Traffic

Receptor	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$) Defra's Technical Guidance				RATIO A LAQM.TG(09) Projected Base Year / Modelled 2013 Base Year	RATIO B Alternative Projection Between 2013 and 2024	GAP FACTOR Ratio B /Ratio A	2024 DM x Gap Factor	2024 DS x Gap Factor
	2013 Base Year	Projected Base Year 2024	2024 DM	2024 DS					
B1122 Receptors									
8	12.6	9.5	9.5	7.2	0.76	0.92	1.22	11.6	8.8
9 B	14.5	11.1	11.1	7.8	0.76	0.92	1.21	13.4	9.5
9 C	14.5	11.1	11.1	7.6	0.76	0.92	1.21	13.4	9.1
10	9.7	7.2	7.2	9.9	0.74	0.92	1.24	8.9	12.3
11	10.6	7.9	7.9	7.9	0.75	0.92	1.23	9.8	9.8
12	16.3	11.2	15.9	15.9	0.69	0.92	1.34	21.3	21.3
D2 Receptors									
13	12.4	9.6	10.8	7.6	0.77	0.92	1.20	12.9	9.1
14	14.2	11.1	12.6	13.4	0.78	0.92	1.18	14.9	15.8
15	9.7	7.4	7.4	8.0	0.75	0.92	1.22	9.0	9.8
16	12.4	9.5	11.5	12.7	0.77	0.92	1.20	13.8	15.3
17	13.3	10.2	11.7	8.3	0.77	0.92	1.20	14.1	9.9

Table 4.1.8: Predicted improvement/deterioration in air quality – 2024 including Sizewell C Traffic

Receptor	Defra's Technical Guidance Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)			Highways Agency Long Term NO_2 Trend Projections ($\mu g/m^3$)		
	Impact			Impact		
	DS-DM	Improvement / Deterioration in Air Quality	Magnitude	DS-DM	Improvement / Deterioration in Air Quality	Magnitude
B1122 Receptors						
8	-2.3	Improvement	Medium	-2.8	Improvement	Medium
9 B	-3.3	Improvement	Medium	-3.9	Improvement	Medium
9 C	-3.5	Improvement	Medium	-4.3	Improvement	Large
10	2.7	Deterioration	Medium	3.4	Deterioration	Medium
11	0.0	No change	N/A	0.0	No change	N/A
12	0.0	No change	N/A	0.0	No change	N/A
D2 Receptors						
13	-3.2	Improvement	Medium	-3.8	Improvement	Medium
14	0.8	Deterioration	Small	0.9	Deterioration	Small
15	0.6	Deterioration	Small	0.8	Deterioration	Small
16	1.2	Deterioration	Small	1.5	Deterioration	Small
17	-3.4	Improvement	Medium	-4.2	Improvement	Large

4.1.9.3 B1122 Receptors

The results in Table 4.1.7 indicate that the UK annual mean NO_2 objective of 40 µg/m^3 is likely to be achieved at all receptors along the B1122 in the base year 2013 and future year 2024 with or without the proposed bypass options.

The maximum NO_2 concentration is predicted to occur at Receptor 12 in the Do-Minimum and Do-Something scenarios, with a NO_2 annual mean concentration of 21.3 µg/m^3 based on the Highway Agency's. Receptor 12 is predicted to experience no change in terms of local air quality in accordance with IAN(174/13).

Receptor 9 is predicted to experience the largest beneficial change in air quality as a result of the proposed bypass Route C, with a decrease in annual mean NO_2 concentrations of 4.3 µg/m^3 based on the Highway Agency's calculation methodology or 3.5 µg/m^3 based on Defra's Technical Guidance methodology. The modelling predicts that all receptors located along the B1122, in Middleton Moor and Theberton, except those located near the proposed bypass schemes, are predicted to experience an improvement in air quality. Receptor 10 is predicted to experience the largest adverse impact as a result of the proposed bypass Route B, with an increase in annual mean NO_2 concentration of 3.4 µg/m^3 based on Highway Agency methodology and 2.7 µg/m^3 based on Defra's Technical Guidance methodology.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 8 and 9B and 9C will experience an improvement of more than 5% (2 µg/m^3) of the NO_2 annual mean objective as result of proposed bypass schemes;
- Receptor 10 will experience a deterioration of more than 5% (2 µg/m^3) of the NO_2 annual mean objective;
- No receptor is expected to experience an improvement or deterioration of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience an improvements and deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience changes (both improvements and deteriorations) of less than 1% (0.4 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 11 and 12 will experience no change in NO_2 annual mean.

The adverse impacts predicted for the proposed bypass routes are of a medium magnitude, however, they can be considered to be insignificant given that the proposed routes are unlikely to create any exceedences of the UK annual mean NO_2 objective. All the proposed schemes are predicted to have a beneficial effect on receptors located along the B1122 and an adverse effect on receptors located close to the proposed route of the respective bypass.

4.1.9.4 D2 Receptors

The results in Table 4.1.7 indicate that the UK annual mean NO_2 objective of 40 µg/m^3 is likely to be achieved at all receptors in the base year 2013 and future year 2024 with or without the proposed bypass .

The maximum NO_2 concentration is predicted to occur at Receptor 14 in the Do-Something scenarios, with a NO_2 annual mean concentration of 15.8 µg/m^3 based on the Highway Agency's. Receptor 14 is predicted to experience a deterioration of small magnitude in terms of local air quality in accordance with IAN(174/13).

Receptor 17 is predicted to experience the largest beneficial change in air quality as a result of the proposed D2 route, with a decrease in annual mean NO_2 concentrations of 4.2 µg/m^3 based on the Highway Agency's calculation methodology or 3.4 µg/m^3 based on Defra's Technical Guidance methodology. Receptor 16 is predicted to experience the largest adverse impact as a result of the proposed D2 route, with an increase in annual mean NO_2 concentration of 1.5 µg/m^3 based on Highway Agency methodology and 1.2 µg/m^3 based on Defra's Technical Guidance methodology.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- Receptor 13 and 17 will experience an improvement of more than 5% (2 µg/m^3) of the NO_2 annual mean objective as result of proposed bypass schemes;
- No receptor will experience a deterioration of more than 5% (2 µg/m^3) of the NO_2 annual mean objective;
- Receptor 16 is expected to experience deterioration of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience improvements of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean NO_2 objective;
- Receptor 14 and 15 will experience deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience improvements of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean NO_2 objective;
- No receptor will experience any changes of less than 1% (0.4 µg/m^3) of the UK annual mean NO_2 objective;

The adverse impacts predicted for the proposed bypass routes are of a medium magnitude, however, they can be considered to be insignificant given that the proposed schemes are unlikely to create any exceedences of the UK annual mean NO_2 objective. The proposed bypass scheme is predicted to have a beneficial effect on receptors located along the B1121 (between the A12 and Church Hill B1121) and on the B1119 and an adverse effect on receptors located closest to the proposed bypass scheme and on South Entrance -B1121(Link 9 in Table A3.1.4).

Table 4.1.9: Predicted annual mean PM_{10} Concentrations at sensitive receptors – 2024 Including Sizewell C Traffic

Receptor	Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)			Impact		
	2013	2024 DM	2024 DS	DS-DM	Improvement / Deterioration in Air Quality	Magnitude
B1122 Receptors						
8	15.8 (0)	15.4 (0)	14.2 (0)	-1.2	Improvement	Small
9 B	16.2 (0)	15.8 (0)	14.3 (0)	-1.5	Improvement	Small
9 C	16.2 (0)	15.8 (0)	14.2 (0)	-1.6	Improvement	Small
10	15.3 (0)	14.2 (0)	14.6 (0)	0.4	Deterioration	Small
11	15.4 (0)	14.4 (0)	14.3 (0)	-0.1	Improvement	Imperceptible
12	16.3 (0)	15.7 (0)	15.7 (0)	0.0	No change	N/A
D2 Receptors						
13	16.2 (0)	15.3 (0)	14.6 (0)	-0.7	Improvement	Small
14	16.5 (0)	15.7 (0)	15.8 (0)	0.1	Deterioration	Imperceptible
15	15.7 (0)	14.6 (0)	14.6 (0)	0.0	No change	N/A
16	15.7 (0)	14.6 (0)	15.4 (0)	0.8	Deterioration	Small
17	16.1 (0)	15.4 (0)	14.7 (0)	-0.7	Improvement	Small

4.1.9.5 B1122 Receptors

The results in Table 4.1.9 indicate that the UK annual mean PM_{10} objective of 40 µg/m^3 is likely to be achieved at all receptors along the B1122 in the base year 2013 and future year 2024 with or without the proposed bypass .

The maximum PM_{10} concentration is predicted to occur at Receptor 12 in the Do-Minimum and Do-Something scenarios, with a PM_{10} annual mean concentration of 15.7 µg/m^3 based on the Highway Agency's. Receptor 12 is predicted to experience no change in terms of local air quality in accordance with IAN (174/13).

Receptor 9 is predicted to experience the largest beneficial change in air quality as a result of the proposed bypass Route Theberton West, with a decrease in annual mean PM_{10} concentrations of 1.6 µg/m^3. The modelling predicts that all receptors located along the B1122, in Middleton Moor and Theberton, except those located near the proposed bypass schemes, are predicted to experience an improvement in air quality. Receptor 10 is predicted to experience the largest adverse impact as a result of the proposed bypass Theberton East, with an increase in annual mean PM_{10} concentration of 0.4 µg/m^3.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- No receptor will experience an improvement or deterioration of more than 5% (2 µg/m^3) of the PM_{10} annual mean objective as result of proposed bypass schemes;
- Receptor 8 and 9 (Theberton East and Theberton West) are expected to experience an improvement of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean PM_{10} objective;
- No receptors are expected to experience deterioration of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 10 will experience deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean PM_{10} objective;
- No receptor will experience an improvement of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 11 will experience a deterioration of less than 1% (0.4 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 12 will experience no change in PM_{10} annual mean.

The adverse impacts predicted for the proposed bypass routes are of a small magnitude, however, they can be considered to be insignificant given that the proposed schemes are unlikely to create any exceedences of the UK annual mean NO_2 objective. All the proposed routes are predicted to have a beneficial effect on receptors located along the B1122 and an adverse effect on receptors located close to the proposed route of the respective bypass.

4.1.9.6 D2 Receptors

The results in Table 4.1.9 indicate that the UK annual mean PM_{10} objective of 40 µg/m^3 is likely to be achieved at all receptors in the base year 2013 and future year 2024 with or without the proposed bypass .

The maximum PM_{10} concentration is predicted to occur at Receptor 14 in the Do-Something scenarios, with a PM_{10} annual mean concentration of 15.8 µg/m^3. Receptor 14 is predicted to experience a deterioration of imperceptible magnitude in terms of local air quality in accordance with IAN (174/13).

Receptor 13 and 17 are predicted to experience the largest beneficial change in air quality as a result of the proposed D2 route, with a decrease in annual mean PM_{10} concentrations of 0.7 µg/m^3. Receptor 16 is predicted to experience the largest adverse impact as a result of the proposed D2 route, with an increase in annual mean PM_{10} concentration of 0.8 µg/m^3.

The following conclusions can be made in accordance to the Highways Agency's air quality indicator:

- No receptor will experience an improvement or deterioration of more than 5% (2 µg/m^3) of the PM_{10} annual mean objective as result of proposed bypass scheme;
- No receptors are expected to experience an improvement or deterioration of between 2.5% and 5% (1-2 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 16 will experience deteriorations of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 13 and 17 will experience improvements of between 1% and 2.5% (0.4 – 1 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 14 will experience a deterioration of less than 1% (0.4 µg/m^3) of the UK annual mean PM_{10} objective;
- Receptor 15 will experience no change in annual mean $PM_{10.}$

The adverse impact predicted for the proposed bypass scheme is of a small magnitude, however, it can be considered to be insignificant given that the proposed routes are unlikely to create any exceedences of the UK annual mean PM_{10} objective. The proposed bypass is predicted to have a beneficial effect on receptors located along the B1121 (between the A12 and Church Hill B1121) and on the B1119 and an adverse effect on receptors located close to the route of the bypass and on South Entrance (B1121).

4.1.10 WebTAG

4.1.10.1 Local Air Quality Assessment Results

A local air quality assessment was carried out to determine the overall assessment score which indicates firstly whether the schemes will create an increase or a decrease in exposure to air quality and secondly the number of properties that will experience a deterioration or an

improvement in their exposure to air quality as a result of the proposed schemes. The NO_2 and PM_{10} results for the B1122 local bypass options and D2 route are presented in Table 4.1.10, which include Sizewell C traffic. Example of the WebTAG distance bands are presented in the Appendix 1.2, Figure A3.1.6 and A3.1.7.

4.1.10.2 B1122 Local Bypass Option

All the proposed bypass options are predicted to lead to an overall improvement in air quality as the assessment scores are negative. The number of properties which will experience an improvement, no change and deterioration vary with options.

The option, which leads to the lowest assessment score, is Option Middleton Moor & Theberton West where 104 properties will experience an improvement in air quality, thirty-eight properties will experience deterioration in air quality and thirty-five properties will experience no change in air quality. It should be noted however, that whilst a relatively large number of properties are likely to be affected by the proposed options, the overall assessment scores indicate that the magnitude of potential effects on air quality are likely to be small at these properties.

4.1.10.3 D2 Route

The proposed D2 is predicted to lead to an overall improvement in air quality as the assessment scores are negative. 396 properties will experience an improvement in air quality, 219 properties will experience deterioration in air quality. There are no properties that will experience no change in air quality.

Table 4.1.10: WebTAG Assessment scores – 2024 Including Sizewell C Traffic

Road Section	PM_{10}				NO_2			
	Improvement	No change	Deterioration	Net total assessment for PM10, all routes	Improvement	No change	Deterioration	Net total assessment for NO2, all routes
B1122 Local Bypass Option								
Option Middleton Moor & Theberton East	104	35	50	-59	104	35	50	-519
Option Middleton Moor & Theberton West	104	35	38	-61	104	35	38	-538
D2 Route								
D2 Route	396	0	219	-54	396	0	219	-307

4.1.11 Regional Air Quality Assessment Results

Results for the regional air quality assessment are reported in Table 4.1.11.

Table 4.1.11: Regional pollutant emissions (T/yr) – Including Sizewell C Traffic

Scheme Option	NO_x T/y							PM_{10} T/y							Carbon T/y						
	2013	2024		2035		Change		2013	2024		2035		Change		2013	2024		2035		Change	
		DM	DS	DM	DS	2024	2035		DM	DS	DM	DS	2024	2035		DM	DS	DM	DS	2024	2035
B1122 Local Bypass Option																					
Middleton Moor & Theberton East	3.5	7.6	7.8	4.1	4.3	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.0	0.0	473	960	992	626	651	32	25
Middleton Moor & Theberton West	3.5	7.6	8.2	4.1	4.5	0.6	0.4	0.1	0.2	0.2	0.1	0.1	0.0	0.0	473	960	1050	626	692	90	66
D2 Route																					
D2 Route	2.9	3.9	6.7	3.3	3.3	2.8	-0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.0	380	604	849	496	478	245	-18

4.1.11.1 B1122 Local Bypass Option

The results in Table 4.1.11 indicate that the proposed local bypass scheme options are predicted to result in an increase in NO_x and carbon emissions in 2024 and 2035 relative to Do-Minimum in the same year. Table 4.1.11 shows no change in PM_{10} emissions. The increase in regional emissions is mainly due to the increase in road length.

Middleton Moor & Theberton West routes show a larger increase in regional emissions, due to the slight longer length of route Theberton West compared to route Theberton East.

4.1.11.2 D2 Route

The results in Table 4.1.11 indicate that the proposed D2 route is predicted to result in an increase in NO_x and carbon emissions in 2024 relative to Do-Minimum in the same year. Table 4.1.11 shows no change in PM_{10} emissions. The increase in regional emissions is mainly due to the increase in road length. Results also show a decrease in NO_x and carbon emissions in 2035 relative to Do-Minimum in the same year, likely due to the relative change in HDV/LDV ratios on the network links.

4.1.12 Economic Evaluation of Air Pollution

A monetary valuation of changes in air quality has been carried out for all the bypass options.

Table 4.1.12: Monetary valuation estimation of changes in air quality

Scheme Option	Quantitative Assessment		Summary Assessment		
	"Net Total Route Assessment" (opening year) for PM_{10}	Change in NOx emissions over 60 year appraisal period (tonnes)	Net Present Value of change in PM_{10} concentrations (£)	Net Present Value of change in NOx emissions (£)	Total Net Present Value of Change in Air Quality (£)
B1122 Local Bypass Option					
Middleton Moor & Theberton East	-59	10	120,470	-5,488	114,982

Middleton Moor & Theberton West	-61	27	124,643	-14,672	109,970
D2 Route					
D2 Route	-54	14	73,157	-10,208	62,949

The positive Total Net Present Value presented in Table 4.1.12 for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes, despite the negative Net Present Value of the change in NO_x emissions. Option A&B is the most beneficial and D2 the least beneficial.

4.1.13 Social and Distributional Impacts of Air Quality

4.1.13.1 B1122 Local Bypass Option

In terms of social distributional impacts, the study area covers two Lower Super Output Areas (E01030222 and E01030187). In the latest Index of Multiple Deprivation (IMD), area E0103022 was ranked 20,787 out of 32,482 in England, where 1 was the most deprived and 32,482 the least; and area E01030187 was ranked 14,730 out of 32,482. The overall area affected is therefore less deprived than the average.

4.1.13.2 D2 Route

In terms of social distributional impacts, the study area covers five Lower Super Output Areas (E01030222, E01030187, E01030186, E01030212, and E01030209). In the latest Index of Multiple Deprivation (IMD), area E0103022 was ranked 20,787 out of 32,482 in England, where 1 was the most deprived and 32,482 the least; area E01030187 was ranked 14,730 out of 32,482; area E01030186 was ranked 20,037 out of 32,482; area E01030212 was ranked 18,899 out of 32,482; and area E01030209 was ranked 20,118 out of 32,482. The overall area affected is therefore less deprived than the average.

4.1.14Construction Dust Assessment

The construction phase of the proposed scheme will lead to the generation of dust and PM_{10} within the boundaries of the construction areas. Whilst the majority of this dust will be contained within the boundaries, some will be transported in the air to sites outside the construction areas, possibly giving rise to adverse impacts. The main impact is likely to be nuisance caused by the deposition of dust on properties, vehicles and street furniture.

Dust sensitive receptors have been identified within 100m of the proposed routes in accordance with the methodology outlined in the DMRB guidance. A summary of the receptors and

sensitivity within 100 m from each proposed route is reported in Table 4.1.13. The likely earthworks area is also reported in this table.

Table 4.1.13: Number of sensitive receptors and sensitivity

Route	Sensitive Receptors within 100 m from Route		Approximate Earthworks Area (m^2)	More Details
	Number	Details		
B1122 Local Bypass Option				
Middleton Moor	9	Residential	30,850	N/A
Theberton East	7	Residential	49,400	N/A
Theberton West	4	Residential	43,000	N/A
D2 Route				
D2 Route	1	Residential	116,000	N/A

4.1.15 Opportunity for Mitigation and Enhancement

4.1.15.1 Construction Phase

It is possible to mitigate adverse impacts during the construction period, and it will be necessary to balance the severity of an impact with its duration. Should effective mitigation measures be enforced and implemented within a Dust Management Plan and/or CEMP then the residual impact of the construction phase will be of negligible significance with respect to all the construction activities.

4.1.15.2 Operational Phase

No mitigation measures are proposed during the operational phase.

4.1.16 Residual Impacts

4.1.16.1 Construction Phase

Construction impacts are likely to arise from constructions activities in the form of dust and particulate matter emissions. With appropriate mitigation measures, the significance of these impacts can be reduced to of negligible significance.

4.1.16.2 Operational Phase

4.1.17B1122 Local Bypass

The main findings of this local air quality assessment are:

- The proposed bypass routes are not located within an AQMA;
- No exceedence of NO_2 or PM_{10} air quality objective / EU Limit Value were predicted in the Base, Do-Minimum and Do-Something scenario including Sizewell C traffic;
- The proposed bypass routes are estimated to bring traffic relief to the villages of Middleton Moor and Theberton and they are expected to improve air quality overall;
- The largest change in air quality is predicted to be an improvement in NO_2 concentrations of large magnitude at Receptor 9 as a result of the proposed Route C, while the largest negative impacts are of a medium magnitude at Receptor 10. In both cases concentrations of PM_{10} and NO_2 remain well below the AQS objective levels;
- All the proposed local bypass options are predicted to lead to an overall improvement in air quality as the assessment scores are negative (including traffic from Sizewell C);
- All the proposed bypass options are predicted to result in an increase in NO_x and carbon emissions in 2024 and 2035 relative to Do-Minimum in the same year;
- The positive Total Net Present Value for all the bypass options indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes.
- The significance of the proposed bypass schemes is considered insignificant overall (Table 4.1.14), except for Option C which is considered to be significant due to the large beneficial changes in NO_2 concentrations.

4.1.18 D2 Route

The main findings of this local air quality assessment are:

- The proposed bypass route is not located within an AQMA;
- No exceedence of NO_2 or PM_{10} air quality objective / EU Limit Value were predicted in the Base, Do-Minimum and Do-Something scenario including Sizewell C traffic;
- The proposed bypass route is expected to improve air quality overall;
- The largest change in air quality is predicted to be an improvement in NO_2 concentrations of large magnitude at Receptor 17 as a result of the proposed D2 Route, while the largest negative impacts are of a small magnitude at Receptor 16. In both cases concentrations of PM_{10} and NO_2 remain well below the AQS objective levels;
- The proposed D2 Route is predicted to lead to an overall improvement in air quality as the assessment scores are negative (including traffic from Sizewell C);
- The proposed D2 route is predicted to result in an increase in NO_x and carbon emissions in 2024 relative to Do-Minimum in the same year. Results also show a decrease in NO_x and carbon emissions in 2035.
- The positive Total Net Present Value for the D2 route indicates a net beneficial impact (i.e. air quality improvement) over the lifetime of the schemes.

- The significance of the proposed bypass schemes is considered significant overall (Table 4.1.14) due to the large beneficial changes in NO_2 concentrations.

Table 4.1.14: Overall evaluation of local air quality significance

Key Criteria Questions	Yes / No				
	Middleton Moor	**Theberton East**	**Theberton West**	**B1122 Road Improvement**	**D2 Route**
Is there a risk that environmental standards will be breached?	No	No	No	No	No
Will there be a large change in environmental conditions?	No	No	Yes	No	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A	N/A
Will many people be affected?	No	No	No	No	No
Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A	N/A
On Balance is the Overall Effect Significant?	No	No	Yes	No	Yes

4.1.19 Summary Table

Table 4.1.15: Air quality assessment summary table

Route	Net total assessment, all routes (II-I)		Total Net Present Value of Change in Air Quality (£)	Qualitative Impacts
	NO_2	PM_{10}		
Middleton Moor and Theberton East	-519	-59	114,982	Improved local air quality near B1122 due to reduced traffic flows. Adverse effect on receptors located near the new route. No exceedences of the air quality objectives at sensitive receptors.
Middleton Moor and Theberton West	-538	-61	109,970	
D2 Route	-307	-54	62,949	

4.2 Noise

4.2.1 Introduction

The following chapter considers the potential noise and vibration impacts of the proposed improvement/bypass options to the B1122 in Suffolk. The B1122 extends from the A12, north of Yoxford to Leiston, passing through the rural villages of Middleton and Theberton. Details of these options are described in the prediction methodology section.

The objective of this assessment is:

- To gather sufficient data to establish the likely noise and vibration impact on sensitive receptors in the vicinity associated with the various options being considered and
- To establish whether the assessment should proceed to either the Simple or Detailed Assessment (as defined in the DMRB) by considering the increases in noise levels at selected Noise Sensitive Receptors (NSRs) associated with the proposed scheme.

At this stage only noise and vibration impacts relating to the operational use of the proposed development is considered. Noise and vibration impacts relating to the construction of the proposed road improvements will be dealt with at later stages of the assessment.

4.2.2 Regulatory / Planning Policy Framework

4.2.2.1 National Planning Policy

The National Planning Policy Framework (NPPF) was published on the 27 March 2012 (Department for Communities & Local Government, 2012); coming into immediate effect and replacing the majority of previous Planning Policy Guidance notes (PPGs) and Planning Policy Statements (PPSs). The relevant paragraphs from the NPPF relating to noise are set out below.

The relevant paragraphs from the NPPF relating to noise are:

Paragraph 109: The planning system should contribute to and enhance the natural and local environment by:

- Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.

Paragraph 123: Planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established ; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Paragraph 143: In preparing Local Plans, local planning authorities should:

- Set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion, traffic, tip and quarry-slope stability, differential settlement of quarry backfill, mining subsidence, increased flood risk, impacts on the flow and quantity of surface and groundwater and migration of contamination from the site; and take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality; and
- When developing noise limits, recognise that some noisy short term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction.

Paragraph 144: When determining planning applications, local planning authorities should:

- Ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source, and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

The NPPF replaces the following noise specific documents:

- Planning Policy Guidance 24: Planning and Noise (3 October 1994);
- Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction In England (23 May 2005); and
- Planning Policy Statement 23: Planning and Pollution Control (3 November 2004).

Noise Policy Statement for England (NPSE) March 2010

The Noise Policy Vision is to “promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development”, and its aims are that “Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible, contribute to the improvement of health and quality of life.”

4.2.2.2 Local Planning Policy

Suffolk County Council Local Planning Validation Requirements

The document outlines the validation requirements and information required to assess environmental consequences expected to arise from proposed developments. The requirements for a range of developments are provided, with a Noise Impact Assessment required for most.

> “Noise Impact Assessment
>
> The assessment should identify properties and premises that are likely to be sensitive to noise, and provide information on proposed noise levels through the different stages of the work, the predicted or actual noise emissions from specific plant, the length of time plant will be in use, (i.e. ‘on time’), and the methods to be employed to control noise, where operations are proposed outside of normal operating hours. A sample of noise calculations should be provided for a typical scenario within the site. Special consideration should be given to the impact of background noise on new schools and to acoustic design options where relevant.”

4.2.2.3 Standard and Key policies

- Design Manual for Roads and Bridges (DMRB) HD 213/11 (Revision 1) (The Highways Agency et al., 2011);
- Calculation of Road Traffic Noise (CRTN) (Department of Transport, 1988); and

- Transport Appraisal Guidance Unit 3.3.2 ‘The Noise Sub-objective’ (HMSO, 2012).

4.2.3 Baseline Conditions

An initial site-walk over has been undertaken on 20th March 2014 in order to determine the characteristic of the area in the vicinity of the B1119 and B1122. Noise Sensitive Receptors (NSRs) that would likely to be exposed to noise from the proposed road scheme have been identified.

It is noted that residential properties in the vicinity of the proposed routes are generally two storey buildings. No high density residential tower blocks have been identified.

It is understood that the dominant noise source currently affecting NSRs is noise from traffic on the B1119 and B1122. Occasionally farm traffic associated with nearby farm activities on the local road network was noted, however noise from farm activities is not considered to affect the noise climate significantly.

In addition there is a railway which runs parallel to the A12 from Melton to Saxmundham and then continues north to Lowestoft. Noise from rail traffic to the south of the A12 was not audible at those selected receptors (property ID B1825, B1831 and B1832, refer to Table 4.2.2) at the time of the visit. Railway noise is considered unlikely to affect the noise climate at NSRs near to where the proposed routes are to be located. At a small number of farm houses located in the close vicinity of the existing railway probably it is likely that these will be dominated by noise from railway traffic.

No significant industrial or other noise sources in the area have been identified.

It is therefore considered that road traffic noise from the B1119 and B1122 are predominantly affecting most of the area in the vicinity of the proposed routes. Noise from road traffic on the local road network is considered relatively insignificant.

4.2.4 Study Area

The DMRB requires a corridor 600m either side of a scheme to be considered; due to limited information, this assessment will however consider only known properties within a 200 m corridor. The address point data has been used to determine the uses of buildings within the study area, however only limited building layout information has been made available. Predicted noise levels at some properties may have been over predicted due to the missing buildings (e.g. garages or farm buildings, which can act as a barrier) between noise sources and NSRs.

The current noise climate at the nearby NSRs located in the identified villages in the vicinity of the B1119 and B1122 has been predicted based on available traffic data provided by AECOM. A level of 55 dB $L_{ight,\ outside}$ has been chosen because the DMRB requires that the following should be included in the Scoping Study:

“Whether there is likely to be a change in noise level of 3 dB $L_{night,outside}$ or more in the long term at any sensitive receptor within the study area where an $L_{night,outside}$ greater than 55 dB is predicted.”

Table 4.2.1 Current noise climate in the vicinity of the B1119 and B1122

Day time, $L_{A10, 18h}$ dB	Approximate distance from the B1119 and B1122, m	Night time, $L_{night,outside}$ dB	Approximate distance from the B1119 and B1122, m
55	25	55	10

The results shown in Table 4.2.1 indicate that NSRs within approximately 25m are dominated by noise from traffic on the B1119 and the B1122. It is considered that noise from these roads would be unlikely to be significant at NSRs located at a distance more than approximately 200m. It is also considered likely that noise from other roads at NSRs in excess of 200m from the B1122 and B1119 would be the dominant noise source. The threshold night time noise level of 55 dB has been considered as a guideline to determine the study area for the methodology adopted in this assessment, detailed in following section.

Sample NSRs have been chosen to identify the potential noise impacts at selection of receptors within the study area to be representative of expected to be most affected by the proposed options. For each sample receptor location the noise levels for all assessed scenarios have been predicted at 4m above ground, considered to be representative of first floor window height.

It is anticipated that there are no changes in traffic flows on roads except on those which are directly connected to the proposed route options.

All properties within the study area have been have been categorised as either sensitive receptors (including residential, health and educational) or non-sensitive receptors (including industrial/commercial and amenity/recreation).

4.2.5 Assessment Methodology

The methodology adopted in this report for assessing the noise and vibration impacts from the proposed improvement/bypass scheme follow that prescribed in the Highways Agency Design Manual for Roads and Bridges Volume 11 Section 3 Part 7 HD 213/11-Revision 1 Noise and Vibration (DMRB) published in November 2011. The DMRB describes the three noise assessment stages – Scoping, Simple and Detailed.

This Scoping (Stage 1) assessment follows the DMRB procedures for assessing impacts as required for a scoping assessment in DMRB.

The aim of the scoping assessment is to report the likely impact from a change in either the noise or vibration levels at sensitive receptors within the study area from road traffic after the proposed scheme becomes operational and determine whether noise and vibration needs to be further assessed.

4.2.5.1 Noise

For noise, the assessment threshold levels for establishing whether the assessment should proceed to the Simple or Detailed Stage are as follows:

- Short Term Impact (at opening): whether there is likely to be a change in noise level of 1 dB $L_{A10,18h}$ or more;
- Long Term Impact (within 15 years of opening);
- whether there is likely to be a change of 3 dB $L_{A10,18h}$ or more;
- Whether there is likely to be a change of 3 dB $L_{night,outside}$ or more where a level of 55 dB $L_{night,outside}$ is predicted at any sensitive receptor within the study area.

Where a long term night-time assessment is required, the Transport Research Laboratory (TRL) report 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping' (Abbott & Nelson, 2002) has been used to derive the $L_{night,outside}$ noise levels. Based on the predicted baseline noise levels for the night time period, it is considered that night time noise levels at NSRs that are at a distance of around 200m or greater from the A12 are less than the threshold level of 55 $L_{night,outside}$ dB for the period 23:00 to 07:00 hours.

4.2.5.2 Vibration

For vibration, the DMRB sets an assessment threshold level of whether there is likely to be an increase in the Peak Particle Velocity (PPV) level of groundborne vibration to above 0.3mm^{-1}, or a predicted increase from an existing level of 0.3mm^{-1} at any sensitive receptor within the study area

The generation of ground borne vibration from traffic on the proposed road improvement/bypass is associated with road surface irregularities causing vehicles' tyres to impact the road surface which can cause vibration at buildings in close proximity. At this stage, road surface details are not available. However, it is anticipated that there will be no road surface irregularities on the proposed scheme and therefore ground borne vibration is unlikely to be an issue.

4.2.5.3 Scoping DMRB Assessment

For the purpose of a scoping assessment, the significance of operational noise impacts have been defined as being either insignificant if the increases in noise levels are below the assessment threshold levels stated above or significant if they are met. For an option identified to be significant this indicates it to be less favoured compared to options identified to be insignificant.

In assessing the potential noise impact from road traffic the following scenarios have been considered with the assessment options described in Table 4.2.3:

- Baseline 2013 (i.e. existing situation)

- Do-Minimum scenario (DM) including Sizewell C which describes the local road network including the Sizewell C traffic in place in 2024 (peak construction year) and 2035 (post-construction of Sizewell C development);
- Do-Something scenario (DS) including Sizewell C with the proposed bypass schemes, which describes the proposed bypass/D2 route schemes including the Sizewell C traffic in 2024 (peak construction year) and 2035 (post-construction Sizewell C development).

It is understood that the opening year of the proposed improvement/bypass routes is in 2022, however it is anticipated higher traffic flows in 2024 due to the planned Sizewell C development construction work in 2024 which is considered as a worst case scenario for short term. In this assessment, traffic flows in 2024 including the construction traffic flows associated with Sizewell C development in the total traffic flows are considered as opening year traffic flows.

For the Do-Something scenarios, it has been assumed that 100% of the total traffic flows will be on the by-pass options and 0% of the total traffic will be on the by-passed roads.

Table 4.2.2 Assessed proposed options

Option	Road Sections	Description
B1122 Local Bypass Theberton East	Middleton Moor Bypass + Theberton Bypass East	Improvement (Single carriageway) to Middleton Moor Bypass (section A) and a single carriageway bypass of Theberton Bypass East (section B)
B1122 Local Bypass option C	Middleton Moor Bypass + Theberton Bypass West	Improvement (Single carriageway) to Middleton Moor Bypass (section A) and a single carriageway bypass of Theberton Bypass West (section C)
D2 new option	D2	New D2 route with a single carriageway

4.2.5.4 TAG Assessment

In assessing the change in noise impacts for each of the above comparisons, the current DMRB methodology requires the noise levels to be reported at the facade of each property where the least beneficial change in noise level occurs. This means that whilst the noise assessment is precautionary, potential benefits of a scheme can be underestimated. The previous DMRB methodology dating back to 1994 reported the noise levels at the facade of each property where the maximum noise level occurs i.e. the most exposed facade for each scenario. This approach allows the assessment of noise and vibration nuisance together with the assessment required for the monetary evaluation of road schemes (TAG) to be compatible. Both nuisance and monetary

evaluations are based on the research findings which correlate the facade exposed to the highest noise level with residents' dissatisfaction with the noise experienced in their homes and which form the noise exposure response relationships described in the current DMRB methodology. Therefore the assessment has been based on the change in noise level for the most exposed façade of the property as per the previous DMRB methodology.

4.2.6 Noise modelling

All road traffic noise levels have been calculated using the CadnaA© noise prediction software, which predicts the $L_{A10,18h}$ traffic noise level at dwellings and other NSR locations in accordance with the CRTN (Department of Transport, 1988). CadnaA© models have been built for the following traffic scenarios:

- Do-Minimum including traffic associated with Sizewell C Development in peak construction year 2024;
- Do-Something including traffic associated with Sizewell C Development construction in peak construction year 2024; and
- Do-Something excluding traffic associated with the Sizewell C Development in future year 2035.

All calculations are based on the provided traffic flows (18-hour Annual Average Weekday Traffic, AAWT), percentages of HGV and average speed. Note road traffic noise levels have been modelled for the B1119 and B1122 and the proposed route options only; since noise levels from other roads on the local network such as slip roads are unlikely to result in a significant impact on the assessment.

Additional noise model input data includes:

- Road speed in km/h (existing and single carriageway – 70km/h) based on the road classification published in CRTN paragraph 14.2 for single carriageway roads subject to a speed limit of 50 mph;
- 18-hour Annual Average Weekday Traffic (AAWT) and HGV percentages (provided by AECOM);
- Existing topography (3D Digital terrain model (DTM) LIDAR) for the proposed route corridor;
- Ordnance Survey open data, Land-Form Panorama for a buffer distance on either side);
- Road surface types (standard surface conditions for DM scenarios and low noise surface conditions for DS scenarios);
- Ground type (taken as acoustically absorptive (G=1), except area within 4m buffer from any building assumed as hard ground);

Existing building heights taken as 8m high, a common assumption made in noise mapping for typical two storey buildings.

Due to the lack of available information at this stage, road surface type and ground type have been assumed to be the same across all scenarios, which is considered to be reasonable. Topographical information for the proposed route corridor was not available at the time of the assessment. Consequently, it has been assumed that ground levels will not vary significantly from the existing situation after the proposed scheme is constructed.

4.2.7 Noise Modelling Assumptions

The following assumptions have been made in this assessment.

- Road traffic noise from the B1119 and B1122 are assumed to be the most significant noise source affecting NSRs in the vicinity of the B1119 and B1122 and the proposed routes.
- Noise from traffic on local road network nearby NSRs away from the roads identified above has been assumed to be insignificant in comparison to noise from the B1119 and B1122.
- For Do-Something scenarios all traffic flows on the proposed sections; Theberton Bypass East sections and Theberton Bypass West section, no traffic flows on the existing B1122.
- For Do-Something scenarios all traffic flows on the proposed section, D2 New Option, no traffic flows on the existing B1119. and
- No construction traffic related to Sizewell C construction work in the future year scenarios 2035.

Due to the limited mapping information (including building footprints) available, sensitive receptors within 200m on either side of the proposed route (rather than 600m) has been considered in this assessment. It is considered for the purposes of a Scoping assessment; the key findings will remain valid.

4.2.8 Predicted Impacts

In order to assess the potential noise impacts it is necessary to make comparisons of noise levels in the short term and long term. Note that in accordance with DMRB, the assessment of night noise is not required for the short term assessments. In summary, the assessed scenarios, for each option, are as follows:

- Do-Minimum scenario 2024 including Sizewell construction traffic verses Do-Something scenario 2024 including Sizewell construction traffic; and
- Do-Minimum scenario 2024 including Sizewell construction traffic verses Do-Something scenario 2035 excluding Sizewell construction traffic.

An assessment of noise levels, $L_{A10,\ 18h}$ in the short and long term for the day for B1122 Bypass Theberton East including traffic associated with the Sizewell C Development, indicate the noise impacts during the day are significant in short term, but are insignificant in long term. A reason

for significant impact in short term is due to the traffic diversion and the close proximity to the proposed B1122 Bypass Theberton East to some properties.

An assessment of noise levels, $L_{A10,\ 18h}$ in the short and long term for the for B1122 Bypass Theberton West including traffic associated with the Sizewell C development indicate the noise impacts during the day are significant in short term but are insignificant in long term. A reason for significant impact in short term is due to the traffic diversion and the close proximity to the proposed B1122 Bypass Theberton West to some properties.

An assessment of noise levels, $L_{A10,\ 18h}$ in the short and long term for the day for D2 new option including traffic associated with the Sizewell C development, indicate that noise impacts during the day are insignificant in both short and long term. A reason for significant impact in short term is due to the traffic diversion and the close proximity to the proposed bypass option D2 New Option to some properties.

An assessment of noise levels, $L_{night,outside}$ in the long term for the night for B1122 Bypass Theberton East including traffic associated with the Sizewell C development, indicates that the noise impacts during the night are insignificant. However, changes in noise level in the long term for the night indicate noise impacts are significant for properties close proximity to the B1122 Bypass Theberton East.

An assessment of noise levels, $L_{night,outside}$ in the long term for the night for B1122 Bypass option C including traffic associated with the Sizewell C development, indicate that the noise impacts during the night are insignificant in long term. However, changes in noise level in long term for the night indicate noise impacts are significant; a reason for this significant impact is due to the traffic diversion and the close proximity to the B1122 Bypass Theberton West.

An assessment of noise levels, $L_{night,outside}$ in the long term for the night for D2 new option, indicate that noise impacts during the night in long term are insignificant.

4.2.9 Summary

Indications of the number of properties that may experience significant impact are shown in Table 4.2.4.

Table 4.2.4 Summary of results showing significant impacts for sample properties

Option	Number of Sample Properties Assessed as Significant Impact		
	Day		Night
	SHORT TERM	LONG TERM	LONG TERM
B1122 Local Bypass Theberton East	9	1	1
B1122 Local Bypass Theberton West	8	1	1
D2 New Option	1	0	0

The results from Table 4.2.4 indicate that option D2 New Option is considered to be the most beneficial as it results in fewer properties being assessed as significant.

4.2.10 Summary

The number of properties within the study area assessed to have a significant impact has been used to compare options. Each option is ranked (R) according to the number of significantly impacted dwellings for each assessment; short term and long term (including night time). The noise impact index (NII) is then derived by summation of the ranking for each option which allows a matrix to be populated as illustrated in Table 4.2.5. It should be noted that the option with the lowest NII value is the preferred option with respect to noise.

Table 4.2.5 Summary of results indicating significant impacts

Option	Number of Properties Assessed as Significant Impact, Rank (R)			Noise Impact Index (NII)
	Day		Night	
	SHORT TERM	LONG TERM	LONG TERM	
Theberton East	3	3	3	9
Theberton West	2	2	2	6
D2 New Option	1	1	1	3

In summary, Table 4.2.5 provides an overview for dwellings where the change in noise levels has exceeded the threshold levels i.e. a change in noise level of 1 dB or more for short term and 3 dB for long term assessment. The table indicates that D2 New Option is considered to be the most beneficial option.

It should be noted that the number of dwellings predicted to experience a significant impact should be considered as an indication only for the purpose determining whether a detailed assessment should be required.

4.2.11 Monetary Valuation of Noise Impacts

The Monetary valuation of noise impacts from a road scheme is aimed at complementing the noise assessment and help in the decision process when comparing different transport options by placing a value on noise determined from people's willingness to pay to avoid transport related noise. The process for determining the monetary valuation of noise impacts from road schemes that is described in this section follows the procedure set out in the Department for Transport's "Transport Analysis Guidance" (TAG) Unit 3.3.2 The Noise Sub-Objective, January 2014.

For monetary valuation in TAG, it looks at the comparison between Do-Minimum and Do-Something in the design year, within 15 years after opening. Although the opening year is understood to be 2022, it has been assumed that there is no significant change in traffic growth from 2022 to 2024.

The TAG assessments in monetary and annoyance valuations are graphically presented in Figure 4.2.1 and Figure 4.2.2 respectively.

Figure 4.2.1 TAG Assessment – Monetary Valuation

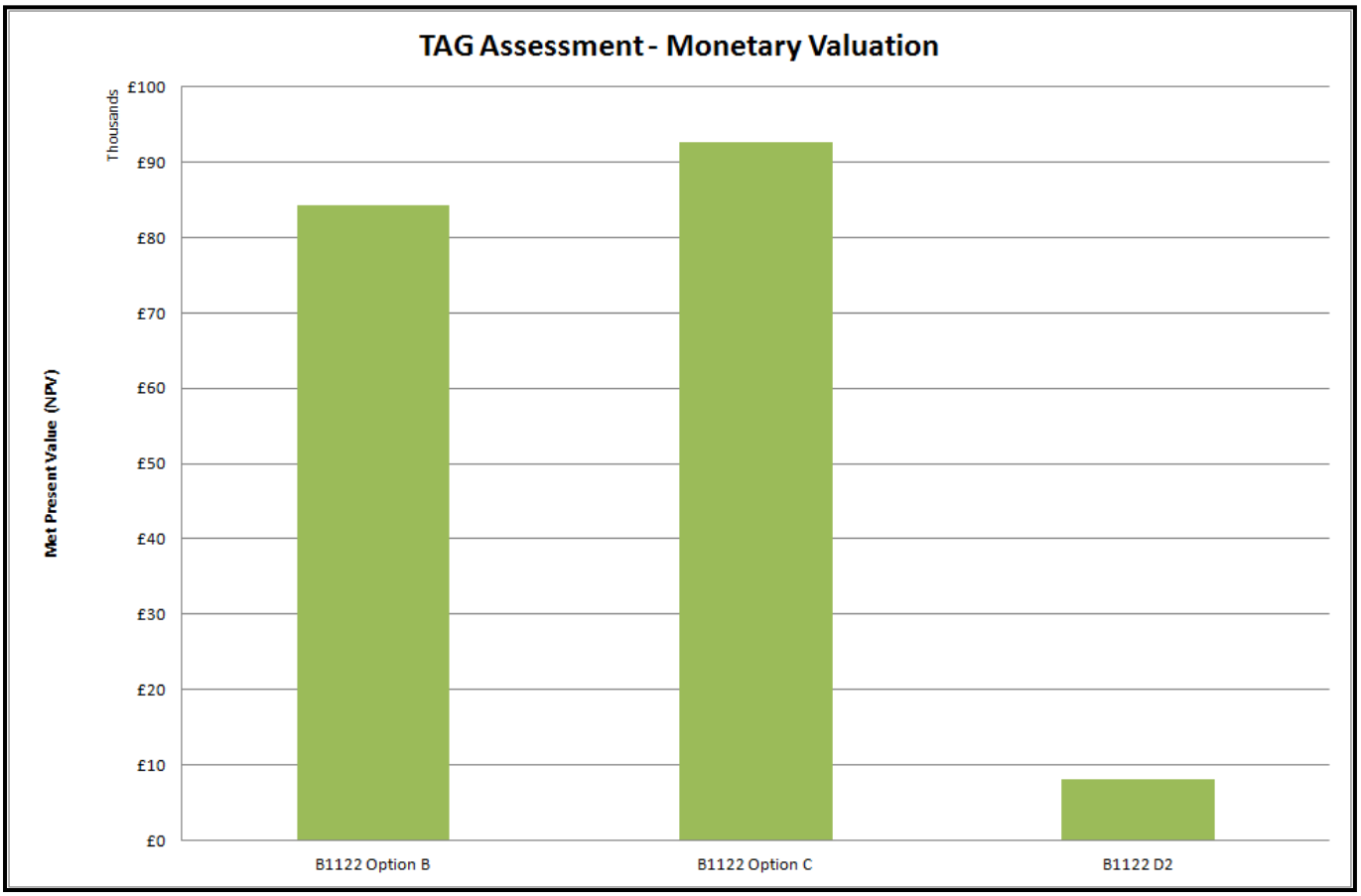


Figure 4.2.1 show the results from the TAG monetary valuation for the proposed options. The Net Present Value (NPV) prices show that for DS2035 (post-construction) verses DM2024 (peak construction) scenarios for all options there are positive values meaning there are net benefits. This trend can be explained because of the changes in traffic flows.

Based on this monetary valuation, Theberton West is considered to be the most beneficial option. The reason for the difference from the best ranked scheme using NII, is that the TAG methodologies consider the magnitude of impact, rather than simply an exceedence of impact.

Figure 4.2.2 TAG Assessment – Annoyance Evaluation

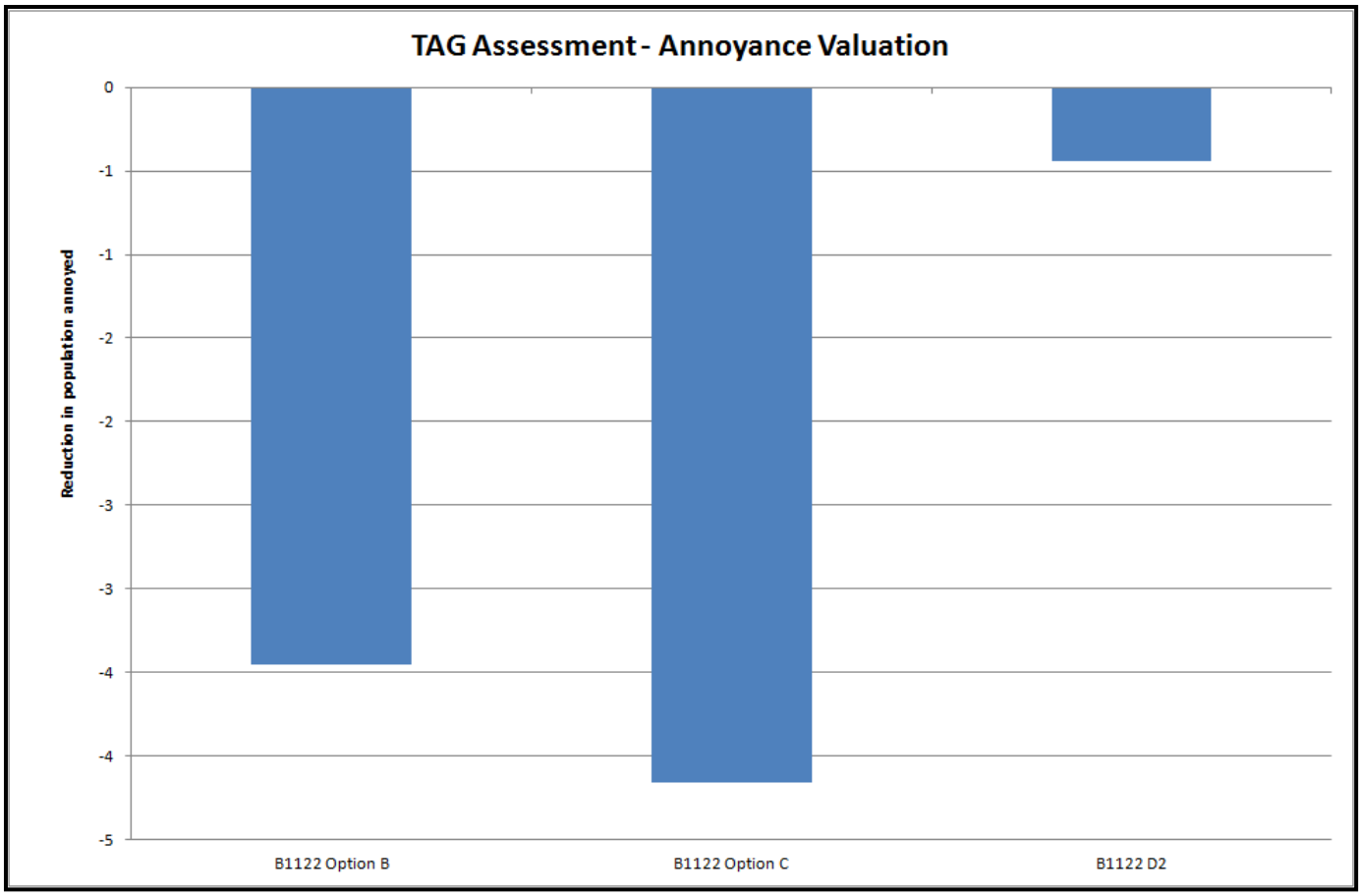


Figure 4.2.2 show the results from the TAG annoyance evaluation for proposed options, positive value shown in the figure reflects an increase in people annoyed by noise.

Theberton West results in the least people annoyed by road traffic noise from its option.

It should be noted that due to the lack of detailed information regarding the study area and existing building footprints the above TAG assessment can only provide indicative monetary and annoyance estimates. However, for the purposes of this comparative study, the methodology is considered sufficiently robust for evaluating the most beneficial option.

To summarise, the results of the TAG assessment in monetary and annoyance valuations indicate that Theberton West will provide the most net benefits and will result in the least people annoyed. As previously mentioned, the reason for the difference from the best ranked scheme using NII, is that the TAG methodologies consider the magnitude of impact, rather than simply an exceedence of impact.

4.2.12 Opportunity for Mitigation and Enhancement

The proposed options (with either Single or Dual carriageway option) will increase noise levels at nearby NSRs and would be likely to exceed the threshold noise levels in both the short and long term. All options would therefore require mitigation measures.

In order to avoid the noise exceedences due to the proposed options, following mitigation measures should be considered:

- Where practicable road aligned to be as far as possible from highly populated areas.
- Carefully consider vertical alignment and use of cuttings etc to maximise the potential for screening.
- Use of acoustic barriers and bunds.
- The use of low noise surfacing to reduce the generation of tyre/road noise.
- Detailed mitigation measurements should be considered in the detailed stages of the DMRB assessment process.

4.2.13 Residual Impacts

It is anticipated that with appropriate mitigation, the predicted noise levels would be unlikely to exceed the threshold levels for short and long term for all proposed routes.

4.2.14 Summary Table

A Stage 1 noise assessment by following the principles of the DMRB assessment methodology has been carried out in order to establish whether the assessment should proceed to either the Simple or Detailed Assessment by considering the increases in noise levels at NSRs associated with the proposed scheme.

The results of the TAG assessments indicate that Theberton West is considered to be the most beneficial option among the proposed schemes.

Detailed mitigation measures should be considered in the later stages of the DMRB assessment. Residual effects with appropriate mitigation measures are considered to be insignificant.

At this stage only noise impacts relating to the operational use of the proposed development is considered. Temporary impacts relating to the construction of the proposed scheme will be dealt with at the later stages of the assessment.

In conclusions, a detailed assessment will be required in order to assess noise and vibration impacts due to the proposed options in accordance with DMRB methodology. At detailed assessment stage, the following information is required:

- Detailed information regarding the scheme proposals;
- Detailed electronic maps (OS Mastermap) showing the site layout and surrounding area in either .dwg or .dxf format;
- Detailed electronic maps for Do-Something scenarios show the road width, edge of roads, top and bottom of earth work in either .dwg or .dxf format;
- These maps should cover not just the proposed routes, but the wider area (including 1km buffer zone either side of the proposed routes);

- Topographical data cover the study area of 1km buffer zone from any proposed route options;
- Traffic data for the baseline (existing) year, opening year and future year (worst affected year within fifteen years after opening year) for all affected road links;
- Traffic data is required in format of 18-hour (06:00 – 24:00) AAWT (Annual Average Weekday Traffic) flows with percentage of HGV (Heavy Good Vehicles are considered as weights greater than 3.5 tonnes);
- Average Speed in km/h;
- Width of roads (both a single and dual carriageway);
- Road surface type;
- Address point data is required regarding the uses of existing buildings in the surrounding area (for example, education / health facilities, residential / commercial units etc);
- Information regarding Building heights of existing and proposed buildings;
- Information regarding any proposed location of barriers or topographic features, such as earth bunds; and
- Information regarding the proposed construction methods, plant and programme.

The required information listed above is essential in order to provide a robust detailed assessment.

A summary of the assessment are tabulated as below.

Table 4.2.6 Noise assessment summary table

Route	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
Theberton East	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
Theberton West	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
D2 New Option	This scheme will increase noise levels at NSRs directly facing the proposed option in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier; Reconsidering the route alignment as far as possible from highly populated area in Harts Hall, Saxmundham	Insignificant

4.3 Biodiversity

4.3.1 Introduction

The Biodiversity section assesses the potential effect of the route options on the natural environmental capital within the area that has the potential to be directly or indirectly affected by the routes, Route Options Appraisal. The aim of the Route Options Appraisal is to identify the potential for the Study Area to support protected or notable habitats and species that have the potential to be adversely affected by the route proposals (key receptors). Highlight the magnitude

of the potential effects at the broad scale on these key receptors and identify which effects can be adequately mitigated for.

4.3.2 Route Options

The route options are broadly described in Table 4.3.1 below.

Table 4.3.1: Route options assessed

Route Option	Overview
Middleton Moor	Deviates south of the B1122 at Middleton Moor, crossing Littlemoor Road and rejoining the B1122 at the junction with Fordley Road.
Theberton East	Deviates east of the B1122 to the north of Theberton, to the south of Leiston Road, passing east of Theberton and rejoining the B1122 at the junction with Onner's Lane. Then the road follows the existing course of the B1122 south of Theberton, from the junction with Onner's Lane and Moat Road, southwards until the point where the road curves to the south-west at Old Abbey.
Theberton West	Deviates west of the B1122 to the north of Theberton, north of Leiston Road, passing west of Theberton, crossing Pretty Road and rejoining the B1122 at Moat Road. Then the road follows the existing course of the B1122 south of Theberton, from the junction with Onner's Lane and Moat Road, southwards until the point where the road curves to the south-west at Old Abbey.
D2	Deviates west of the B1122 at the junction with Abbey Lane, crossing the railway via a new bridge and joining the existing course of the B1119, continuing west and then deviating to the south after passing Fristonmoor Lane. The route continues west, crossing the B1121 and the railway, and then joining the A12 south of Saxmundham.

4.3.3 Quality Assurance

All AECOM Ecologists are members, at the appropriate level, of the Chartered Institute of Ecology and Environmental Management (CIEEM) and follow their code of professional conduct when undertaking ecological work.

AECOM is ISO 9001:2008, ISO 14001:2004 and OHSAS 18001:2007 Health and Safety accredited.

4.3.4 Biodiversity Assessment Guidance

Biodiversity assessment guidance has followed a combination of WebTAG Unit A3 Environmental Impact Appraisal Chapter 9 Impacts on Biodiversity which also signposts DMRB 11.3.4 and 'Guidelines for Ecological Impact Assessment in the UK' (CIEEM,2006), developed by the Chartered Institute of Ecology and Environmental Management to promote good practice in Ecological Impact Assessment in the UK.

The methodology for appraising the impact of a scheme on the environmental topics landscape, townscape, the historic environment, biodiversity and the water environment follows a common general approach. Specific considerations for each environmental topic at each stage are described in subsequent Chapters. The generic steps are as follows:

- **Step 1:** Scoping and identification of study area
- **Step 2:** Identifying key environmental resources and describing their features
- **Step 3:** Appraise environmental capital
- **Step 4:** Appraise the proposal's impact
- **Step 5:** Determine the overall assessment score

4.3.4.1 Step 1: Scoping and Identification of Study Area

A desktop study was undertaken to collate and analyse protected habitat and species information within 500m either side of each route option (hereafter referred to as the Study Area) for locally and nationally designated features and within 5km for nationally or internationally designated sites (Natura 2000) that have the potential to be hydrologically linked to the site.

The following publically available data were examined:

- Multi-Agency Geographic Information for the Countryside (MAGIC) website (2012)[42];
- National Biodiversity Network[43]
- Ordinance Survey Mapping
- Aerial Photography
- Suffolk Biodiversity Action Plan
- Environment Agency "What's In your backyard" Interactive Maps[44]

Data was purchased from the following sources:

- Suffolk biodiversity records centre
- This data was provided in GIS format.

42 [Available Online, Accessed 22/04/2014] http://magic.defra.gov.uk/website/magic/
43 [Available Online, Accessed 22/04/2014] http://www.nbn.org.uk/
44 [Available Online, Accessed 22/04/2014] http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

4.3.4.2 Step 2: Identifying Key Environmental Resources and Describing their Features

'Key environmental resources' is the term used to describe site or location specific elements of the environment that provide qualities and functions which are considered by the community (local, regional, national or international) to be of particular value. In order to identify the key environmental resources within the Study Area, an ecological walkover scoping survey was conducted. The survey was undertaken of the Study Area on 31st March and the 1st of April 2014 by AECOM ecologists Dr Martina Girvan BSc(Hons) MSc CEcol MCIEEM and Dr Heather Oaten BSc(Hons) MSc MCIEEM.

Only features that were potentially directly affected by the roads were directly accessed. The habitats were assessed in terms of their quality and potential to support the protected and notable species.

4.3.4.3 Step 3: Appraise Environmental Capital

The third step uses the concept of environmental capital, to assess what matters and why it is important. Note that it is important to assess what matters, why at present and how that may change over time in the absence of the proposal. This provides the baseline level of environmental capital against which the impact of the proposal can be appraised. The environmental capital methodology builds on information about environmental character by using a set of common indicators and definitions to add cultural and subjective values and assess impacts, in order to produce an overall qualitative summary of baseline environmental capital.

Table **4.3.** presents guidance on describing and valuing features.

Table 4.3.2: Guidance on describing the biodiversity and earth heritage value of features

Value	Criteria	Examples
Very high	High importance and rarity, international scale and limited potential for substitution	Internationally designated sites
High	High importance and rarity, national scale, or regional scale with limited potential for substitution	Nationally designated sites Regionally important sites with limited potential for substitution
Medium	High or medium importance and rarity, local or regional scale,	Regionally important sites with potential for substitution

	and limited potential for substitution	Locally designated sites
Low	Low or medium importance and rarity, local scale	Undesignated sites of some local biodiversity and earth heritage interest
Negligible	Very low importance and rarity, local scale	Other sites with little or no local biodiversity and earth heritage interest

Trend data was gathered using the following sources:

- Suffolk Biodiversity Action Plan http://www.suffolkbiodiversity.org/biodiversity-action-plans.aspx
- The State of our Environment Anglia (EA)
- Biodiversity 2020 (DEFRA)
- Natural England Designated Site Citations (NE)
- JNCC Designated Site Information Sheets (JNCC and DEFRA)
- UK BARS (Biodiversity Action Recording System)
- BTO Status Website http://www.bto.org/
- Fifth Otter Survey of England (Environment Agency 2010)
- Wildlife Trust Protected Species Records http://www.wildlifetrust.org.uk/urban/ecorecord/bap/html/gcnewt.htm

4.3.4.4 Step 4: Appraise the proposal's impact

This step in the approach involves describing and scoring the impact of the scheme on the baseline environmental capital established in the preceding step. The descriptions and scores produced in this step will inform judgement about the overall assessment score. Where a scheme affects a number of key environmental resources within a topic, its impact on each resource should be assessed separately.

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Table 4.3.3 presents these criteria for assessing the magnitude of the impact.

Table 4.3.3: Criteria for determining the magnitude of the impact

Magnitude	Criteria
Major negative	The proposal (either on its own or with other proposals) may adversely affect the integrity of the key environmental resource, in terms of the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and / or the population levels of species of interest.
Intermediate negative	The key environmental resource's integrity will not be adversely affected, but the effect on the resource is likely to be significant in terms of its ecological objectives. If, in the light of full information, it cannot be clearly demonstrated that the proposal will not have an adverse effect on integrity, then the impact should be assessed as major negative.
Minor negative	Neither of the above apply, but some minor negative impact is evident. (In the case of Natura 2000 sites a further appropriate assessment may be necessary if detailed plans are not yet available).
Neutral*	Although there may be a slight direct or indirect affect on the habitat no observable SIGNIFICANT impact in either direction.
Positive	Impacts which provide a net gain for wildlife overall.

*Description slightly expanded to incorporate CIEEM Guidelines on significance

4.3.4.5 Step 5: Overall Assessment Score

Step 5 combines the appraisal of biodiversity and earth heritage value of the features, with the appraisal of the magnitude of the impacts, to determine the consequence of those impacts. The assessment score should be determined using

Table **4.3.4** and recorded on the Biodiversity Appraisal Worksheet. Where more than one key environmental resource is involved, an appraisal category is needed for each of these, which are then summarised in an overall summary score on the Appraisal Summary Table for the scheme.

Where a scheme affects more than one key environmental resource, determining the overall summary score is more complex, since the different 'scores' for each key environmental resource considered need to be weighed up in an overall summary score. The guidelines given in Chapter 5 should be followed.

Table 4.3.4: Estimating the overall assessment score

Magnitude of impact	Biodiversity and earth heritage value				
	Very high	**High**	**Medium**	**Lower**	**Negligible**
Major negative	Very Large adverse	Very Large adverse	Moderate adverse	Slight adverse	Neutral
Intermediate negative	Large adverse	Large adverse	Moderate adverse	Slight adverse	Neutral
Minor negative	Slight adverse	Slight adverse	Slight adverse	Slight adverse	Neutral
Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Positive	Large beneficial	Large beneficial	Moderate beneficial	Slight beneficial	Neutral

4.3.5 Document Structure

The results are presented as outlined in

Capabilities on project:
Transportation

Table 4.3.5:

Table 4.3.5: Document structure

Item	Content	Location
WebTAG Biodiversity Impact Worksheet (Steps 1 to 5)	**Step 1**: Scoping and identification of study area **Step 2**: Identifying key environmental resources and describing their features **Step 3**: Appraise environmental capital **Step 4**: Appraise the proposal's impact **Step 5**: Determine the overall assessment score **For all route options**	
Survey Locations and Results	The OS grid reference for each location were a ground truthing survey was undertaken and the description of the habitats and protected species they may support	Text in section below,
Biodiversity Assessment Summary Tables	Summary of potential impacts for each route option	Table 4.3.6, below.
Route overview presenting potential for indirect effects on internationally designated sites	Route Overview with 5km buffer showing Internationally Designated Sites	Figure 4.3.1
Route overview presenting potential for indirect effects on locally and nationally protected sites	Route Overview with 500km buffer (1k m route corridor) showing other designated sites, protected species results and survey locations	Figure 4.3.1
Middleton Moor presenting potential for direct and indirect	Middleton Moor route with 500m buffer (1k m route corridor) with woodlands and	Figures: 3.3.3a; 3.3.3b

Item	Content	Location
effects on valued receptors	hedgerows recorded from site survey with survey locations	
Theberton East presenting potential for direct and indirect effects on valued receptors	Theberton East route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	Figures: 3.3.4a; 3.3.4b
Theberton West presenting potential for direct and indirect effects on valued receptors	Theberton West route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	Figures: 3.3.5a; 3.3.5b
Route D2presenting potential for direct and indirect effects on valued receptors	D2 route with 500m buffer (1k m route corridor) with woodlands and hedgerows recorded from site survey with survey locations and woodland and watercourse names	Figures: 3.3.6.1a; 3.3.6.1b;3.3.6.2a; 3.3.6.2b; 3.3.6.3a; 3.3.6.3b; 3.3.6a 3.3.6b.

4.3.6 Geographical Information System Methodology

Therefore the ecological scoping walkover survey information has been converted to a GIS system that would enable any potential ecological constraints related to potential route option locations to be instantly investigated as well as provide a visual representation of the ecological constraints within the Study Area that can constantly be updated as further information, e.g. the results of species surveys, are gathered.

The OS Mastermap topography shapefile for the Study Area was downloaded to the GIS package ArcMap 10 (grid reference file S026NW at 1:1250 scale). This shapefile did not contain hedgerows, so hedgerows were digitised with the limitations as set out in section 4.3.7 using site notes and a geo-referenced satellite image to determine their locations. Ecological constraints data were added to the shapefile dataset from site notes taken during the ecological scoping walkover survey. For each polygon, the total number of ecological constraints was calculated

and a choropleth map produced to identify the distance of each of the habitats present within the Study Area.

4.3.7 Survey Limitations

The ecological walkover scoping survey and protected species assessment were subject to a number of limitations:

- Access to all areas of the site was not carried out as this was a scoping survey/ only access was available on publically accessible land.
- No buildings or trees were individually assessed for their potential to support bats.
- Only woodlands, waterbodies or hedgerows directly affected by the route were ground truthed.
- Only hedgerows with the potential to be affected by the route have been presented on the map.

An ecological walkover scoping survey only provides a snapshot of the broad habitats and potential species present in an area at the time the survey is undertaken.

Late March/early April is not the optimal season for ecological habitat assessment, however there was sufficient information gathered via desk study and walkover to confidently determine the potential effects at the required level.

Species are mobile and can move in to and out of an area quickly. The survey relies on evidence such as tracks and droppings to provide evidence that a species is present.

The locations of all features and target notes are indicative and approximate only.

AECOM takes no responsibility for the accuracy of data provided by third parties.

With relation to data from the local biological records centre, the information/data received was sourced from both listed recorders and members of the public. The information/data received was sourced from both published and unpublished material. The quality of the ecological data from the different sources is highly variable. The absence of records does not prove the absence of a species.

Incidental results for protected species has been reported, however these do not represent dedicated species surveys and confirmation of the potential suitability’s of habitat to support protected species stated in this report will be confirmed by subsequent protected species surveys.

4.3.8 Overview

The area surrounding the route options is largely arable (mostly oil seed rape) with occasional improved and semi-improved grassland. A large number of ponds and wooded copses are present within the landscape. There are a number of small tributaries which are likely to flow into the Minsmere Levels (designated as an Special Protection Area (SPA), Special Area of Conservation (SAC), Site of Special Scientific Interest (SSSI), County Wildlife Site and Ramsar)

to the north west of the area and the Old Minsmere River. Sizewell Marshes SSSI, lies east of the eastern end of the Route option D scheme. A watercourse links the eastern end of the scheme to the SSSI, which lies downstream. Sizewell Marshes are important for their large area of lowland, unimproved wet meadows. There are a large number of small plantation woodlands in the area and small semi-natural woodlands some of which are designated as County Wildlife Sites such as Theberton Woods and England Covert. There is one CWS woodland that is also on the Ancient Woodland Inventory that is Buckles Wood.

All information has been recorded on an ArcMapping platform and can be manipulated as required for subsequent detailed site studies.

4.3.9 Regulatory / Planning Policy Framework

The most relevant planning-related documents are presented in Appendix 1.3 along with a list of the most relevant Local Biodiversity Action Plan (LBAP) species and include the following:

- The Conservation of Habitats and Species Regulations 2010 (as amended);
- The Wildlife and Countryside Act 1981 (as amended);
- Natural Environment and Rural Communities Act 2006;
- National Planning Policy Framework (2012);
- Suffolk Coastal District Local Plan - Core Strategy and Development Management Policies (2013)
- Suffolk Biodiversity Action Plan (2014)

4.3.10 Designated Sites

Designated sites are presented within the WebTAG tables Appendix 1.4 and the definition of these designations is presented within Appendix 1.5 and their legislative protection in Appendix 1.6. They have been presented within 5km for nationally and internationally designated sites and a 1km route corridor around the options for locally designated sites. The Minsmere Levels Complex (designated as an SPA, SAC, SSSI, County Wildlife Site and Ramsar) is the key designated site (on the east coast) that is connected to the study area via a network of rivers and small tributaries and relate to route Middleton Moor, Theberton East and Theberton West. There is a SAC, Dew's Pond SAC designated for Great Crested Newts (GCN) which is over 3km away from these route options and not connected to the study area.

Sizewell marshes SSSI lies towards the eastern end of route D2 and tributaries of the Hundred River could link the scheme indirectly to this SSSI.

There are a large number of plantation woodlands in the area and semi-natural woodlands some of which are designated as County Wildlife Sites such as Theberton Woods and England Covert within. There is one CWS woodland that is also on the Ancient Woodland Inventory, Buckles Wood.

4.3.11 Habitats

Named woodlands and watercourses and there distance from the route options are recorded within the WebTAG tables Appendix 1.4

Species rich hedgerows that were noted during site survey are also marked on the map (although see survey limitations). Woodlands, ponds and semi-improved grasslands have also been presented. Their conservation status relating to conservation objectives has been considered using the WebTAG methodology outlined in Section 2 above.

4.3.12Hedgerows and Field Margins

Largely arable fields with small or no field margins (which are an LBAP habitat), some improved and semi-improved pasture. The hedgerows are species rich with common elm, hawthorn, blackthorn, elder, ash, dog rose, hornbeam, oak and crab apple amongst the most dominant species. The ground flora of these hedgerows support typical woodland/ shade tolerant species such as primrose, lords and ladies, lesser celandine, ground ivy, red dead nettle cow parsley and alexanders. There are frequent mature standard trees within the hedgerows. These provide excellent nesting habitat for birds and foraging commuting and potentially roosting habitat for bats, they would also provide habitat for reptiles although mostly sub-optimal.

4.3.13Semi-improved grassland

There were small areas of more species rich grassland within the floodplain of the water courses which come under the category of coastal and floodplain grazing marsh (LBAP Habitat). They were semi-improved neutral grassland with soft rush.

4.3.14Woodlands

The agricultural landscape is dotted with small pockets of mature semi-natural broadleaved and mixed woodland, copses and old plantation shelter belts – not named (LBAP Habitat). These have well formed canopies including common elm , oak and ash with occassional scots pine and larch and understories of hawthorn and elder with ground layers of violet, primrose, nettle, lords and ladies, dog’s mercury, lesser celandine, alexanders, wood avens, false oat grass and false brome amongest others. There are some areas where cherry laurel and rhododendron may become invasive. Many of these woodlands are linked to each other via hedgerows and ditches and many support small waterbodies within. In addition to roosting foraging and commuting bats they are likely to support breeding great crested newts and setting badger.

4.3.15Watercourses

There are four major tributaries to the Leiston Beck and Minsmere Old River in the area of routes Middleton Moor, Theberton East and Theberton West. Mostly low flow at the time of survey. Obviously rapid flow through during heavy rain though as erosion was noted. Larger rivers have tree lined banks ofmature willow and alder and have the potential to support otter and water vole and roosting, foraging and commuting bats. The riparian zone would also support reptiles. Occasional water vegetation such as water cress and flag iris was noted. Around Route D2 the River Fromus and the Hundred River are the largest watercourses and other tributaries.

4.3.16 Ponds

There are a large number of ponds within the agricultural landscape, many within wooded copses. Many of these are connected to the wider area via hedgerows and the drainage network and have the potential to support Great Crested Newts (GCN).

4.3.17 Protected Species

Protected species records are provided in Appendix 1.7. Their legislative protection is outlined in Appendix 1.6 and their conservation status relating to conservation objectives has been considered using the WebTAG methodology outlined in Section 4.3.5, above.

The following receptors were scoped out as either not present or not likely to be affected significantly by any of the route options:

- White clawed crayfish – no records and no suitable habitats;
- Dormouse – no records and sub optimal habitats;
- Wintering birds – unlikely to be significantly affected by any of the route options.

Buildings were not assessed for their potential to support roosting bats or barn owl as in addition to lack of access for these areas it is assumed that no buildings will be demolished for the road construction.

4.3.17.1 Water vole and Otter

The River Fromus, the Old Minsmere River and the Hundred River have records of both water vole and otter and the banks of these rivers are suitable for otter holts and water vole burrows.

4.3.17.2 Great Crested Newts (GCN)

There are a large number of ponds with the agricultural setting to potentially support GCN and many are connected by hedgerows to other ponds and wooded copses. There are records of GCN in the area and Dew’s Pond SAC is within 3km. This pond is specifically designated for GCN indicating that GCN are prevalent in the area.

4.3.17.3 Badger

The agricultural fields provide excellent foraging habitat and they are connected to multiple wooded copses that could support setting badgers. There are records of badgers in the area.

4.3.17.4 Nesting Birds

The hedgerows, woodlands and mature trees offer excellent nesting and foraging habitats for breeding birds. There were records of common birds in the area which is likely to support LBAP species such as dunnock, starling, song thrush, lapwing, tree sparrow, linnet, skylark, grey partridge and lesser spotted woodpecker.

4.3.17.5 Bats

The hedgerows, mature trees and woodlands combined with the waterbodies make excellent commuting and foraging habitat for bats which may roost within mature trees. There are records of common and soprano pipistrelle and brown long eared bat (BLE) in the area (LBAP species) including BLE roosts in Theberton and Saxmundham.

4.3.17.6 Reptiles

Although much of the habitat was sub-optimal, field margins, hedgerows and riparian corridors would support reptiles, there are records of grass snake within the study area and it is likely that the habitat would also support common lizard and slow worm also (LBAP species).

4.3.17.7 Fish and Aquatic invertebrates

These have not been assessed in detail and please see the Water Resource Section for greater detail but the majority of the watercourses would support stickleback and common invertebrates. The larger rivers would support eels (also an LBAP species), brook lamprey and sea trout and there are records from the River Ore and Old Minsmere River of these species.

4.3.17.8 Other notable species

It is likely that the landscape would support UK and LBAP species such as brown hare, hedgehog, other amphibians and a range of terrestrial invertebrates.

4.3.18 Potential Impacts

Following identification of the key receptors the potential effects from the route options were assessed;

4.3.18.1 Construction Impacts

- Habitat Loss from the working corridor
- Fragmentation from the working corridor
- Direct Mortality from vegetation clearance and construction
- Disturbance from vegetation clearance and construction
- Pollution/Deposition from construction vehicles
- Pollution/Runoff from construction vehicles and sedimentation to water courses
- Lighting for late evening early morning working during winter

4.3.18.2 Operational Impacts

- Permanent Habitat Loss from the road
- Direct mortality/Road Traffic Accidents (RTAs)
- Noise from the traffic
- Severance permanently due to the road

- Disturbance from the traffic
- Pollution/Deposition from aerial particulates
- Pollution/Runoff from the road
- Recreational increased use of areas
- Littering/Vandalism
- Lighting

4.3.19 Summary Potential Effects

4.3.19.1 Overview

Please review Table 4.3.6 for the summary of the key potential effects and required mitigation for the route options that are of moderate adverse or above. The potential effects for all established potential effects are as detailed and summarised in the WebTAG Table in Appendix 1.4 Tables A1 to A4 for each receptor.

All of the route options would have slight adverse effects following mitigation with the exception of the effects (from D2) on Buckles Wood which is on the Ancient Woodland Inventory (AWI) which cannot effectively be mitigated and should be avoided causing habitat loss of small amounts of woodland and hedgerows and small amounts of agricultural land. Some ponds may be lost and would be fragmented and culverting of rivers and ditches may be required with potential for pollution to watercourses and watercourses that drain to the Minsmere Levels and Sizewell Marshes designated sites. There will be permanent fragmentation of these habitats prior to mitigation. There is also potential for direct mortality, habitat loss and fragmentation of habitat and disturbance to faunal receptors.

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodland plantations are likely to support badgers and nesting birds, and common reptiles are likely to be present within any field or woodland edge habitats as are commuting and foraging bats, there may also be tree roosts present. The river floodplains may support water vole populations of which are in national decline although, similarly for otter. Most significantly there are a large number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, especially as there are records of GCN presence in the area. The works have the potential to cause a loss of GCN terrestrial habitat, fragmentation of meta populations and therefore a reduction of fitness in the overall GCN population which could compromise its favourable conservation status in the area.

In this summary only effects of moderate or above, that are likely to differentiate the route options are presented, full assessment is presented in the aforementioned appendices. Some species for example such as nesting birds will be slightly adversely affected on every route.

The mitigation for these works is likely to be significant and the success of which is uncertain, for example bridging certain areas may be required rather than culverting, under road tunnels for connectivity and offset mitigation in addition to the extensive surveying and protected species

surveys, licensing, and potential translocation/ exclusion that will also be required, for example with regards to water vole, otter, bats, GCN and badger. Therefore the cost of mitigating impacts should be considered for each option during decision making.

Prior to mitigation the overall predicted significance of the impacts on each route is as follows:

- Middleton Moor Route A Slight Adverse
- Theberton Bypass East Slight to Moderate Adverse
- Theberton Bypass West Moderate Adverse
- Route D2 Summary assessment score: Moderate to Large Adverse (Fragmentation of a large number of woodlands and the AWI Buckles Wood)

4.3.19.2 Middleton Moor Route A

Summary assessment score: SLIGHT ADVERSE

The majority of assessed impacts upon valued receptors resulting from Middleton Moor Bypass (Route A) were Slightly Adverse. A few impacts, fragmentation and habitat loss upon predominantly hedgerows, woodlands ponds and ravine features were assessed as being moderate adverse. Overall the scheme was assessed as being slight adverse.

Qualitative comments:

The illustrative alignment for Route A does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these within 2km and 2 SSSIs are within 2km Sizewell Marshes Minsmere-Walberswick Heaths and Marshes and they are hydrologically linked to the drainage systems in the areas therefore although it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Middleton Moor as proposed, Minsmere Levels CWS could also be indirectly affected via drainage systems.

Habitat loss and fragmentation of hedgerows and woodlands and fragmentation of ponds are the key effects. With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodlands in the vicinity of the routing are likely to support badgers, nesting birds foraging and roosting bats and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, and any pond fragmentation effects addressed. Great Crested Newt populations are present in the area, Dew's Ponds site is designated for this species.

4.3.19.3 Theberton Bypass East

Summary assessment score: SLIGHT TO MODERATE ADVERSE

The majority of assessed impacts upon valued receptors resulting from Theberton Bypass East were slight to moderate adverse. A few impacts, upon predominantly hedgerows and woodlands were assessed as being Moderate Adverse.

Qualitative comments:

The illustrative alignment for Theberton East does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is within 2km and 2 SSSIs are within 1km Sizewell Marshes Minsmere-Walberswick Heaths and Marshes and they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Theberton East as proposed, Minsmere Levels CWS could also be indirectly affected via drainage systems.

The illustrative alignment for Theberton East has the potential to affect a number of habitats. One tributary of the Old Minsmere River would require extended culverting and one a new culvert. There will be loss and fragmentation of woodland habitats Rattla corner and the Greenhouse/Fox Grove/Browns plantation complex and fragmentation of hedgerows and ponds. With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodlands in the vicinity of the routing are likely to support badgers and nesting birds, foraging and roosting bats and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, and any pond fragmentation effects addressed.

4.3.19.4 Theberton Bypass West

Summary assessment score: MODERATE ADVERSE

The majority of assessed impacts upon valued receptors resulting from Theberton Bypass West were Moderate Adverse due to impacts upon watercourses habitat loss and fragmentation of hedgerows, woodlands and numerous ponds were assessed as being Moderate Adverse.

Qualitative comments:

The illustrative alignment for Theberton West does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing, although the closest of these is within 2km from the proposed works and two SSSIs are within 1km Sizewell Marshes Minsmere-Walberswick Heaths and Marshes and they are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Theberton East as proposed, Minsmere Levels CWS could also be indirectly affected via drainage systems.

The illustrative alignment for Theberton West has the potential to affect a number of habitats. Two tributaries of the Old Minsmere River would require new culverts. There will be loss and fragmentation of woodland habitats particularly Yew Tree corner and Plumtreehills Covert and the Greenhouse/Fox Grove/Browns plantation complex and fragmentation of hedgerows and ponds. With regards to valued fauna, the routing is likely to affect a number of species and

groups. The woodlands in the vicinity of the routing are likely to support badgers and nesting birds, foraging and roosting bats and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, and any pond fragmentation effects addressed.

4.3.19.5 Route D2

Summary assessment score: MODERATE TO LARGE ADVERSE

This route passes through extensive areas of Greenfield land and fragments numerous woodlands from each other including Buckles Wood Ancient Woodland.

Qualitative comments:

The illustrative alignment for Route D2 does not bisect internationally designated sites. Internationally designated sites are present within 5km of the routing; however the closest of these is within 2km from the proposed road and Sizewell Marshes SSSI is within 1km of the eastern end of the route. They are hydrologically linked to the drainage systems in the areas therefore all though it is considered unlikely there is a small chance that these designated sites would be adversely impacted by Route D2.

The illustrative alignment for Route D2 has the potential to affect a number of habitats. Two new culverts would be required of the River Fromus and the River Hundred, numerous woodlands, ponds and hedgerows would be fragmented from each other. One large advisers impact is predicted on Buckles Wood an ancient woodland as the road would cause direct habitat loss, fragmentation and likely to reduce the quality of the habitat. There is also the potential for there to be impacts downstream upon the Alde and Ore Estuaries designated sites (i.e. from pollution effects).

With regards to valued fauna, the routing is likely to affect a number of species and groups. The woodlands in the vicinity of the routing are likely to support badgers and nesting birds, foraging and roosting bats and common reptiles are likely to be present within any field or woodland edge habitats. A number of ponds are present in the vicinity of the routing, therefore the potential presence of GCN must be considered, and any pond fragmentation effects addressed.

4.3.20 Mitigation

Temporary construction effects will be mitigated by the construction mitigation presented in Appendix 1.8. For example indirect pollution to hydrologically linked designated sites would be prevented by adherence to Pollution Prevention Guidelines resulting in no residual effects. Direct mortality of protected faunal species would be prevented via pre-construction surveys of the chosen route combined with the mitigation presented in Appendix 1.8 if required. Habitat not within the working corridor will be protected. Pre-construction surveys for key receptors would be required as outlined in Appendix 1.8 within the route corridor of the chosen route option to confirm the requirement of these mitigations. Seasonal survey timings are presented in Appendix

1.6. In terms of residual temporary construction impacts only disturbance at a site level is predicted and this disturbance is not likely to be significant.

Operational effects will be mitigated through design (Appendix 1.8) any habitat lost would be replaced and fragmentation minimised, for example new culverts would be designed to be suitable for safe passage for otter, water vole and bats. Population assessment of great crested newts would determine whether the fragmentation of ponds would adversely affect the favourable conservation status of that species and appropriate underpasses and replacement habitat would be created as required. Where online mitigation cannot be undertaken offset mitigation may be required.

Summary route option effects of those potential impacts greater than slight adverse and specific mitigation required is presented in Table 4.3.6, below.

N.B. Only impacts upon receptors assessed as ‘moderate adverse’ or larger are included within this table (with the exception of designated sites). All impacts are listed in Web-tag table Appendix 1.4

Table 4.3.6: Biodiversity assessment summary table – B1122 and Route D2

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
Middleton Moor	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	New Plantation deciduous woodland Areas of this woodland will be directly affected by the routing resulting in habitat loss and fragmentation.	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. Offset mitigation planting additional woodland elsewhere combined with the replacement of bird nesting and bat roosting potential	None
	Hedgerows At least six hedgerows will be bisected and / or directly affected by the routing.	**Moderate Adverse**	Full hedgerow surveys will be undertaken. Habitat will be replaced. Culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Ponds Four ponds lie adjacent to the routing and may be directly impacted. In total twenty six ponds are in the vicinity of the routing and would be fragmented. Potential for moderate adverse impact upon **GCN.** Ponds will be directly and indirectly impacted by the work and substantial areas of potential connecting GCN terrestrial habitat will be lost.	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
Theberton Bypass East	Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Rattala Wood Would suffer habitat loss and fragmentation, this is a mature missed woodland surrounding one of the tributaries to the Old Minsmere River	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. Offset mitigation planting additional woodland elsewhere combined with the replacement of bird nesting and bat roosting potential	Slight Adverse
	The Browns/Greenhouse/Fox Grove Plantation complex This would require habitat to be lost along the eastern side of the existing road	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the western side of the existing road where there is less valuable habitat	None

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Tributaries Two major tributaries (connected to the Minsmere complex) will be crossed one requiring an extended culvert the other a new culvert. This would result in habitat loss and increased fragmentation of the water courses with potential for downstream effects.	**Moderate Adverse**	Riparian habitat will be replaced. Culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Hedgerows At least six hedgerows will be bisected and / or directly affected by the routing. Mitigation to ensure the routing does not affect the connective properties of these features may be required (i.e. underpasses and / or bat crossings).	**Moderate Adverse**	Full hedgerow surveys will be undertaken. Habitat will be replaced. Culvert designs to be suitable for safe passage for otter, watervole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Ponds One pond lies adjacent to the routing and may be directly impacted. In total nineteen ponds are in the vicinity of the routing, measures to ensure connectivity between them is maintained will be required. **Potential for moderate adverse impact upon GCN** Ponds will be directly and indirectly impacted by the work and substantial areas of potential connecting GCN terrestrial habitat will be lost.	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
Theberton Bypass West	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None
	Yewtree Corner and Plumtreehills Covert Would suffer habitat loss and fragmentation	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. Offset mitigation planting additional woodland elsewhere combined with the replacement of bird nesting and bat roosting potential	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	The Browns/Greenhouse/Fox Grove Plantation complex This would require habitat to be lost along the eastern side of the existing road	**Moderate Adverse**	This habitat loss could be avoided if dualling was weighted towards the western side of the existing road where there is less valuable habitat	None
	Tributaries Two major tributaries (connected to the Minsmere complex) will be crossed both requiring new culverts. This would result in habitat loss and increased fragmentation of the water courses with potential for downstream effects.	**Moderate Adverse**	Riparian habitat will be replaced. Culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Hedgerows At least six notable hedgerows will be bisected and / or directly affected by the routing. Mitigation to ensure the routing does not affect the connective properties of these features may be required (i.e. underpasses and / or bat crossings).	**Moderate Adverse**	Full hedgerow surveys will be undertaken. Habitat will be replaced. Culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Ponds Thirty two ponds are in the vicinity of the routing. Although no ponds are likely to be directly affected connectivity between these ponds is likely to be greatly reduced. **Potential for moderate adverse impact upon GCN** Although no ponds will be directly impacted by the works, substantial areas of potential GCN terrestrial habitat will be lost and connectivity between ponds will be fragmented. Mitigation and licensing may be required.	**Slight/ Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation
D2	**Designated Sites** Small potential for indirect effects to hydrologically linked designated sites.	**Slight Adverse**	Construction mitigation to prevent run off or sedimentation into connected drainage ditches and rivers	None

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Buckles Wood Ancient Woodland Inventory The road passes very close to the south-western end of Buckles Wood. It would likely cause habitat loss and a reduction in quality of this habitat from operational noise, disturbance and would permanently fragment it from the surrounding other woodlands and hedgerows. It would be bordered by roads on all sides.	**Large Adverse**	Ancient woodland is not replaceable. Impacts upon this habitat, including indirect impacts should be avoided.	Large Adverse
	Bloomfield's Covert adjoined to Leekhall Plantation In addition to direct habitat loss this woodland complex would be fragmented from the wider habitat including other woodlands.	**Moderate Adverse**	A well designed underpass in this location to allow movement of badger, bats, and amphibians. Planting to encourage bats to fly safely over the road at this point would also be	Slight Adverse
	Woodlands General There are numerous woodlands along the route, at least 20 and these are connected through networks of hedgerows, in the western and eastern portion of the route it would be passing through greenfield areas and permanently fragmenting these woodlands from each other.	**Moderate Adverse**	When taken cumulatively it is unlikely that the mitigation would reduce the effect of fragmentation to an acceptable level	Moderate Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Tributaries Two rivers would require new crossings. The River Fromus and the Hundred River. This would result in habitat loss and increased fragmentation of the water courses with potential for downstream effects.	**Moderate Adverse**	Riparian habitat will be replaced. Consideration should be given to a bridge crossing. If a culvert is chosen culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse
	Hedgerows At least four notable hedgerows will be bisected and / or directly affected by the routing. Mitigation to ensure the routing does not affect the connective properties of these features may be required (i.e. underpasses and / or bat crossings).	**Moderate Adverse**	Full hedgerow surveys of those to be affected. Habitat will be replaced. Culvert designs to be suitable for safe passage for otter, water vole and bats. Over road passage points will also be created via roadside planting to encourage bats and birds up and over the road.	Slight Adverse

Route	Qualitative Impacts	Assessment	Mitigation N.B. Please See Mitigation Table in Appendix 1.8 for full details.	Residual Effects With Mitigation
	Ponds Six ponds lie adjacent to the routing and may be directly impacted. In total forty -two ponds are in the vicinity of the routing, measures to ensure connectivity between them is maintained will be required. **Potential for moderate adverse impact upon GCN.** Ponds will be directly and indirectly impacted by the work and substantial areas of potential connecting GCN terrestrial habitat will be lost.	**Moderate Adverse**	Pre-construction surveys of the chosen route would be required. These surveys would reveal the connections between GCN meta populations and enable the design of suitable underpasses and replacement breeding and terrestrial habitat. NE protected species licensing and associated mitigation is likely to be required.	Slight Adverse depending on the success of the mitigation

4.3.21 Enhancement

Many of the woodlands have patches of Schedule 9 (WCA, 1981 as amended) non-native invasive plant species such as cotoneaster and rhododendron within (also cherry laurel while not on schedule 9 is invasive). Enhancement of these woodlands could be achieved by management of these species and specific woodland management to increase biodiversity.

Many of the watercourses have been culverted with poor passage for fish and other species and un-natural banks. When extending existing culverts these areas could be more sympathetically designed to encourage passage and reduce fragmentation.

4.3.22 Residual Effects

No residual effects on internationally designated sites are predicted. Similarly no residual effects are predicted on the SSSI's in the area. There may be temporary construction disturbance to faunal at the site level but this is not expected to be significant. There may be increased operational mortality to birds, bats, badger and otter although these are unlikely to be significant. Route D2 is the only route that is unlikely to be adequately mitigated for due to the fragmentation of large stretches of connected Greenfield habitat and the isolation of Buckles Wood which is on the AWI.

4.4 Landscape

4.4.1 Introduction

The objective of DMRB Stage 1 Landscape Effects assessment is to "*undertake sufficient assessment to identify the landscape constraints associated with particular broadly defined routes or corridors*" (Design Manual for Roads and Bridges, Volume 11, Section 3, Part 5).

This section of the report identifies the potential landscape and visual constraints and broad effects associated with the three bypass route options facilitating the provision of access for construction traffic to Sizewell nuclear plant. A desktop study has been undertaken to broadly determine the landscape and visual constraints associated with the study area and the potential for effects to the character of the landscape and the visual amenity, and to inform the option appraisal process.

The three proposed bypass route options are described within Chapter 2 of this report and in summary comprise the following:

- Sizewell Route D2;
- Sizewell B1122 (There are two options both of which share the northern and southern sections of the proposed route but differ in the central compartment); and
- A 'Do minimum' option.

4.4.2 Scope of Study

The study area looks at the landscape and visual resource within 2km of the route options corridor as it is considered, that this distance is the limit within which the significant effects may arise.

4.4.3 Regulatory / Planning Policy Framework

4.4.3.1 National Planning Policy

The National Planning Policy Framework 2012 (NPPF) seeks to protect the environment and promote sustainable growth.

The overarching presumption in favour of sustainable development should form the basis of every planning decision. The NPPF aims to conserve and enhance the natural environment in part through the protection of valued landscapes.

4.4.3.2 Local Planning Policy

The study area is covered by The Suffolk Costal District Local Plan-Core Strategies and Development Management Policies (adopted 2013). This is the current local plan which will guide development across the district until 2027 and beyond. Policies relevant to the landscape include the following:

- SP15- Landscape and Townscape- This policy states that the council will seek to protect and enhance the various landscape character areas in addition to the Area of Outstanding Natural Beauty (AONB), the valleys and tributaries of the rivers, Blyth, Deben, Fynn, Hundred, Mill, Minsmere, Ore, Orwell and Yox, and the designated Parks and Gardens of Historic or Landscape Interest are considered to be particularly significant. This policy also seeks to enhance and preserve the attributes that contribute to the historical and architectural value of the towns and villages.
- SP17- Green Space- this policy seeks to ensure that communities have well managed access to green space within settlements, countryside and coastal areas in order to benefit health, community cohesion and greater understanding of the environment, without detriment to wildlife and landscape character.

In addition to the Suffolk Costal District Local Plan-Core Strategies and Development Management Policies, local planning policy also considers the ‘Saved Policies’ from the Suffolk Costal Local Plan (2013). The following ‘Saved Policies’ are relevant to this assessment:

- AP4- Parks and Gardens of Historic or Landscape interest: This policy states ‘The District Council will encourage the preservation and/or enhancement of parks and gardens of historic and landscape interest and their surroundings. Planning permission for any proposed development will not be granted if it would have a materially adverse impact on their character, features or immediate setting.’
- AP13- Special Landscape Areas: This policy states that ‘The valleys and tributaries of the Rivers Alde, Blyth, Deben, Fynn, Hundred, Mill, Minsmere, Ore and Yox, and the Parks

and Gardens of Historic or Landscape Interest are designated as Special Landscape Areas and shown on the Proposals Map. The District Council will ensure that no development will take place which would be to the material detriment of, or materially detract from, the special landscape quality.'

The Suffolk Coast and Heaths AONB Management Plan 2013 – 2018 also covers part of the study area. It seeks to co-ordinate the action of the organisations that make up the AONB and has a role in supporting local authorities, identify issues, aims and objectives that are relevant to the AONB and that can be underpinned by planning policy.

4.4.4 Baseline Conditions

The study area is located in the east of Suffolk, to the north east of Ipswich between the settlements of Saxmundham in the south, Leiston to the East and Yoxford to the north, encompassing various small villages centred on the network of primary and secondary road corridors.

The study area comprises a series of villages/ hamlets and farmsteads located along the B1122 and in close proximity to the B1119 corridor to the east of the A12 and Saxmundham. The central clay plateau comprises a number of rivers draining east and south which have dived the edge of the plateau into a series of 'fingers'.

The landform and character is a predominantly gently rolling heavy clay plateau with ancient woodlands and parklands. The landscape is heavily influenced by glacial till left behind by the great Anglican glaciations. Flatter parts have heavy, poorly drained soils whilst the undulating edges are better drained.

In general the enclosure pattern is ancient and organic in appearance. Where estate influence is stronger and the landscape is heavily managed there are straighter boundaries comprised of a mix of hedges, hedgerows and trees. Many of the pastures were converted to arable land in the late 18th century with the introduction of clay-pipes and underground drainage.

Blocks of woodland some of which are ancient woodland are scattered amongst the arable and grazing land. There are many mature trees including, oak, ash, field maple and hornbeam.

4.4.4.1 Designations

See Appendices 2.4D and 2.4F for Designations

4.4.4.2 Suffolk Coast & Heaths Area of Outstanding Natural Beauty (AONB)

Located on the coast of East Anglia, the Suffolk Coast & Heaths AONB encompasses 155 square miles of wildlife-rich wetlands, ancient heaths, windswept shingle beaches and historic towns and villages. The AONB extends from the Stour Estuary in the south to Kessingland in the north; it is a low lying costal area. The AONB sits across the character areas of: Estate Sandlands, Rolling estate Sandlands, Coastal Levels, Coastal Dunes and shingle ridges and Plateau estate farmlands. The Suffolk Coast & Heaths AONB is a nationally valued landscape and lies within the eastern portion of the study area extending approximately 1km to the south of the southern boundary of the study area.

4.4.4.3 Special Landscape Areas (SLA)

Special Landscape Areas are locally designated landscapes where the inherent attributes of the landscape, which are particularly vulnerable to change, are protected due to their resulting special landscape quality. They include some river valleys which still possess traditional grazing meadows and marshes, with their hedgerows, dykes and associated flora and fauna. There are three SLAs that lie within the study area:

- Upper Deben Valley SLA;
- Aldringham area SLA; and
- Yox Valley SLA.

4.4.4.4 Non-Registered Parks and Gardens

The Suffolk Coastal District Council encourages the preservation and or the enhancement of parks and gardens of historic and landscape interest and their surroundings. Although not on the National Register the following parks and gardens are recognised for their character and appearance and should be safeguarded. The non-registered parks and gardens identified within the study are as follows:

- Rookery Park;
- Grove Park; and
- Cockfield Hall Park.
- Sandlings Walk, Long Distance Path (Sizewell to Dunich)

The fifty-eight mile route encompasses lowland habitats using riverside, forest and heathland paths. It passes through Martlesham Heath, Woodbridge, Rendlesham Forest, Snape and Sizewell. It passes to the south of the study area and runs through the eastern part of the study area to the east of Theberton.

4.4.4.5 Conservation Areas

Conservation areas are defined as 'areas of special architecture or historic interest, the character or appearance of which it is desirable to protect or enhance.' Within the study area there are two conservation areas:

- Yoxford Conservation Area; and
- Saxmundham Conservation Area.

4.4.4.6 Tree Preservation Orders

There are two tree preservation orders within the study area, none of which are directly impacted by the proposed route options.

4.4.4.7 Landscape Character

See Appendices 2.4C and 2.4E for Landscape Character

4.4.4.8 National Character Area

The study area sits within one national landscape character area profile; NCA Profile 82: Suffolk Coast and Heath. The key characteristics include:

- A predominantly low-lying landscape with some areas along the coastal plain below or at sea level;
- Dynamic coast shaped by long sweeping bays, cut by the series of more sheltered estuaries. The shoreline is defined by shingle beaches and structures;
- Rivers flow west-east forming intimate, twisting alluvial valleys;
- Expansive coastal level grazing marshes divided by drainage dykes containing internationally important reedbeds and fens;
- Farm woodlands, plantations and field boundary trees provide a treed character with substantial coniferous forest in the core of this NCA. Ancient broadleaved woodland and parkland wood pasture cloak the southern river valley and estuary slopes.
- Inland valleys contain small-scale historic patterns of irregular drained meadow enclosure, bounded by elm hedgerows;
- Settlement is sparse, with small, isolated villages and farmsteads. The larger urban settlements are confined to the north and south;
- Large developments such as Sizewell nuclear power station contribute to landmark diversity. Major transport infrastructure includes the A14 and A12 and the main East Coast rail line; and
- Public access is extensive both on the land and rivers.

4.4.4.9 Local Landscape Character

Suffolk County Council Landscape Character Assessment (2011): The Suffolk Landscape Character Assessment has been carried out jointly by all the District Councils and The County Council. The landscape character types relevant to the study area include the following:

1. Ancient Estate Claylands LCT

   Key Characteristics:

   - Gently rolling heavy clay plateaux with ancient woodlands and parklands;
   - Dissected Boulder Clay plateau;
   - Organic pattern of field enclosures;
   - Straight boundaries where influence of privately owned estates is strongest;
   - Enclosed former greens and commons;

- Parklands;
- WWII airfields;
- Villages with dispersed hamlets and farmsteads;
- Timber framed buildings;
- Distinctive estate cottages; and
- Ancient semi-natural woodland.

Condition- These landscapes are subject to considerable change which is promoted by their relationship to the A12 trunk road and the creation of airfields in the 1940's. There is considerable intrusion of suburbanisation with horse paddocks, barn conversions and ranch-style fencing. As on other parts of the plateau claylands, industrial agricultural buildings make a significant impact, especially where there is inadequate screening.

2. Coastal Levels

   Key Characteristics: Flat coastal grazing land reclaimed from saltmarsh, behind sea and river walls comprising:

   - Flat marshland adjacent to the coast or estuaries
   - Marine alluvium soils
   - Sinuous and complex mediaeval dyke networks
   - Uniform 19th century dyke networks
   - Cattle-grazed wet grassland
   - Widespread modification for arable production
   - Small plantations and carr woodlands
   - Inland side of rising ground often wooded
   - Important wildlife conservation areas
   - Unsettled landscape with domestic buildings on the fringes
   - Derelict wind pumps

Condition - Although some parts of it are in arable cultivation, the largest remaining tract of coastal levels in grassland is on the Waveney. These coastal levels along the river Waveney give the most extensive impression of how this striking landscape would have looked before conversion to arable. The other grassland units are small and more influenced by the features of the landscape that surrounds them.

3. Estate Sandlands LCT

Key Characteristics: A landscape of large geometric fields, plantation woodlands and remnant heathland comprising:

- Flat or very gently rolling plateaux of free-draining sandy soils, overlying drift deposits of either glacial or fluvial origin
- Chalky in parts of the Brecks, but uniformly acid and sandy in the south-east
- Absence of watercourses
- Extensive areas of heathland or acid grassland
- Strongly geometric structure of fields enclosed in the 18th & 19th century.
- Large continuous blocks of commercial forestry
- Characteristic ‘pine lines’ especially, but not solely, in the Brecks
- Widespread planting of tree belts and rectilinear plantations
- Generally a landscape without ancient woodland, but there are some isolated and very significant exceptions
- High incidence of relatively late, estate type, brick buildings
- North-west slate roofs with white or yellow bricks. Flint is also widely used as a walling material
- On the coast red brick with pan-tiled roofs, often black-glazed

Condition- There is a stronger urban influence. Martlesham has lost much of its rural character and most of the remnant heathland, such as at Rushmere and Foxhall, is in a suburban environment, further ‘tamed’ by being used for golf courses. Even in the central and northern parts of the coastal area there is a steady pressure of suburbanisation and tourism related development.

4. Rolling Estate Claylands LCT

   Key Characteristic: A valley side landscape of clay loams with parklands and fragmented woodland comprising:

   - Rolling valley-side landscape
   - Medium clay and loamy soils
   - Organic pattern of fields
   - Occasional areas of more rational planned fields
   - Numerous landscape parks
   - Substantial villages
   - Fragmented woodland cover, both ancient and plantation

- Winding hedged and occasionally sunken lanes

Condition- The condition of these landscapes is very variable throughout and is often influenced by major transport routes such as the A12 and the presence of larger settlements such as Saxmundham and Wickham Market.

5. Rolling estate Sandlands LCT

   Key Characteristics:

   - Rolling river terraces and coastal slopes
   - Sandy and free draining soils with areas of heathland
   - Late enclosure with a pattern of tree belts and straight hedges
   - Landscape parklands
   - A focus of settlement in the Estate Sandlands landscape
   - 19thC red brick buildings with black glazed pantiles in the east
   - Lark valley buildings are frequently of brick or flint with tiled or slate roofs
   - Tree belts and plantations throughout
   - Occasional and significant semi-natural woodlands and ribbons of wet woodland
   - Complex and intimate landscape on valley sides

Condition- Many of these valley side landscapes are under considerable development pressure because there are concentrations of settlement and land use change. However there are excellent areas of semi-natural landscapes and intact landscapes in many places.

6. Valley Meadowlands

   Key characteristics include:

   - Flat valley floor grasslands on silty and peat soils
   - Flat landscapes of alluvium or peat on valley floors
   - Grassland divided by a network of wet ditches
   - Occasional carr woodland and plantations of poplar
   - Occasional small reedbeds
   - Unsettled
   - Cattle grazed fields
   - Fields converted to arable production

Condition- Some of these landscapes are in excellent condition, however, many are affected by intakes into arable production, by horse grazing and by under-grazing. The sense of tranquillity

and isolation of this landscape can also be intruded upon by the development of the adjacent rolling valley landscapes, which are often a focus for settlement and development.

7. Valley Meadows and Fens

   Key characteristics include:

   - Flat valley floor grasslands on silt and peat soils with small valley fens comprising:
   - Flat, narrow, river valley bottoms
   - Deep peat or mixtures of peat and sandy deposits
   - Ancient meres within the valley bottoms & important fen sites
   - Small grassland fields, bounded by dykes running at right angles to the main river
   - Sparse scattering of small alder carr & plantation woodlands
   - Part of a wider estate type landscape
   - Largely unsettled, except for the occasional farmstead
   - Drier fields turned over to the production of arable crops
   - Cattle grazing now often peripheral to commercial agriculture
   - Loss to scrub encroachment, tree planting and horse paddocks

Condition- Some parts of this landscape are still in fine condition and retain a rural feel. This is mostly due to the retention of the traditional management of cattle grazing, a pattern shown at its best at Blyford. However, there is also a lot of neglect and poor management in these landscapes. The difficult access to small fields results in them often being peripheral to any form of active agriculture and so they are tending to be lost to scrub encroachment, tree planting and horse paddocks.

4.4.4.10 Visual Context

The visual resource within the study area comprises the following key receptors:

- Settlements: within the study area there are a number of small dispersed settlements with larger more dense settlements at the extent of the study area. These include; Yoxford to the north, Leiston to the East and Saxmundham to the west of the study area.
- Public Rights of Way: There are a large number of Public Rights of Way (PRoW) within the study area. The PRoW provide a varied visual experience contrasting from enclosed views through woodland to more expansive views of agricultural land or parkland.
- Road Users – there is a dispersed network of minor roads within the study area many of which cross the proposed route options. Many of these roads are bordered by hedgerows and intermittent trees which often limit visibility of the wider landscape. The nature of the views is transitory for road users passing through the landscape.

- Pedestrians - There is a network of footpaths that exist within the study area, many of which follow vehicular routes and a number of PRoW.
- Railway: there are two railway routes within the study area including the east coast main line running north-south between Norwich and Ipswich. The second splits off the mainline at Saxmundham and runs east towards Leiston. Passengers may have transitory views from where gaps in vegetation allow.

4.4.5 Assessment Methodology

The Stage 1 Landscape and Visual assessment was undertaken with reference to the following guidance:

- The Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 5 Landscape Effects (The Highways Agency et al., 1993);
- Interim Advice Note 135/10 Landscape and Visual Effects Assessment (The Highways Agency et al., 2010);
- TAG Unit A3, Environmental Impact Appraisal (Department for Transport WebTAG, 2014); and
- Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3), Institute of Environmental Management and Assessment (2013).

The DMRB, Stage 1 assessment requires a desk based appraisal to identify the landscape constraints associated with the route options under consideration. Consideration has been given to the wider landscape setting of the study area within the visual appraisal.

In accordance with TAG Unit A3, the character of the route corridor options and surrounding landscape is described in terms of the qualities/characteristics of pattern, tranquillity, cultural landscape, and land cover and these are presented in the Landscape Worksheets (Appendices 2.4A and 2.4B).

Pattern refers to the topography, form, elevation, enclosure and scale; the way that these elements, in relation to each other form the landscape. Tranquillity refers to existence, or lack of, a sense of isolation and remoteness. Cultural features contribute elements of an historic or traditional nature, such as built forms and architectural styles, settlement and field patterns, archaeological sites, noted views and areas with a strong cultural association. Land cover determines land use and the contribution this makes to the character of the landscape. This includes cognisance of semi-natural habitats, whose importance to landscape can be cross referenced with nature conservation interests, particularly biodiversity. Vegetation would also be relevant.

The visual appraisal broadly considers the degree of anticipated change to visual amenity experienced by receptors. Receptors include residential properties, workplaces, recreational facilities, road users, pedestrians and other outdoor sites used by the public which would be

likely to experience a change in existing views as a result of the proposed route options. A desk study was undertaken to inform the appraisal of visual effects.

The approach has involved a review of published documentation including the following:

- Aerial Photography;
- Ordnance Survey and Google Street View;
- Suffolk Coastal District Local Plan-Core Strategies and Development Management Policies (adopted 2013);
- Countryside Character, Volume 7; South East & London (1999); and
- Suffolk County Council Landscape Character Assessment (2011).

4.4.6 Landscape Appraisal Criteria

The landscape appraisal criteria follow the methodology outlined in TAG Unit A3, Impacts on Landscape, Environmental Impact Appraisal (2014). The following table provides a description of the overall impact criteria used in identifying the overall effects on the landscape resource.

Table 4.4.1- Landscape affects criteria

Score	Comment
Very Large Adverse effect	The scheme would result in exceptionally severe adverse impacts on the landscape because it: • At complete variance with the landform, scale and pattern of the landscape; • Is highly visual and extremely intrusive, destroying fine and valued views both into and across the area • Would irrevocably damage a degrade, badly diminish or even destroy the integrity of characteristics and elements and their setting; • Would cause a very high quality or high vulnerable landscape to be irrevocably changed and its quality very considerably diminished; • Could not be integrated: there are no environmental design measures that would protect or replace the loss of a nationally important landscape; • Cannot be reconciled with government policy for the protection of nationally recognised countryside.
Large Adverse effect	The scheme is very damaging to the landscape in that it: • Is at considerable variance with the landform, scale and pattern of the landscape • Is visually intrusive and would disrupt fine and valued views of the area • Is likely to degrade, diminish or even destroy the integrity of a range of characteristics and elements and their setting • Will be substantially damaging to a high quality or highly vulnerable landscape, causing it to change and be considerably diminished in quality • Cannot be adequately integrated • Is in serious conflict with government policy for the protection of nationally recognised countryside

Score	Comment
Moderate Adverse effect	The scheme is: • Out of scale with the landscape, or at odds with the local pattern and landform • Visually intrusive and will adversely impact on the landscape • Not possible to fully integrate, that is, environmental design measures will not prevent the scheme from scarring the landscape in the longer term as some features of interest will be partly destroyed or their setting reduced or removed • Will have an adverse impact on a landscape of recognised quality or on vulnerable and important characteristics or elements • In conflict with local and national policies to protect open land and nationally recognised countryside
Slight Adverse effect	The scheme: • Does not quite fit the landform and scale of the landscape • Although not very visually intrusive, will impact on certain views into and across the area • Cannot be completely integrated because of the nature of the scheme itself or the character of the landscape through which it passes • Affects an area of recognised landscape quality • Conflicts with local authority policies for protecting the local character of the countryside
Neutral effect	The scheme is well designed to: • Complement the scale, landform and pattern of the landscape • Incorporate environmental design measures to ensure that the scheme will blend in well with surrounding landscape characteristics and landscape elements • Avoid being visually intrusive nor have an adverse effect on the current level of tranquillity of the landscape through which the scheme passes • Maintain existing landscape character in an area which is not a designated landscape, that is, neither national or local high quality, nor is it vulnerable to change • Avoid conflict with government policy towards protection of the countryside.

Score	Comment
Slight Beneficial effect	The scheme: • Fits well with the scale, landform and pattern of the landscape • Incorporates environmental design measures to ensure they will blend in well with surrounding landscape • Will enable some sense of place and scale to be restored through well-designed planting and environmental design measures • Maintains or enhances existing landscape character in an area which is not a designated landscape, nor vulnerable to change • Avoids conflict with government policy towards protection of the countryside
Moderate beneficial effect	The scheme provides an opportunity to enhance the landscape because: • It fits very well with the scale, landform and pattern of the landscape • There is potential, through environmental design measures, to enable the restoration of characteristics, partially lost or diminished as the result of changes resulting from intensive farming or inappropriate development • It will enable a sense of place and scale to be restored through well-designed planting and environmental design measures, that is, characteristics are enhanced through the use of local materials and species used to fit the scheme into the landscape • It enables some sense of quality to be restored or enhanced through beneficial landscaping and sensitive design in a landscape which is not of any formally recognised quality • It furthers government objectives to regenerate degraded countryside
Major beneficial effect	The scheme provides an opportunity to greatly enhance the landscape because • It greatly enhances the character (including quality and value) of the landscape • It creates an iconic high quality feature and/or series of elements • It enables a sense of place, scale and quality to be restored in an area formerly of high landscape quality Note that very few, if any, schemes are likely to merit this score.

4.4.7 Visual Appraisal Criteria

The landscape assessment has involved consideration of the extent to which the proposals would affect visual amenity, at a broad, study area wide level. Assessment is based on the information gathered through desk study analysis of the proposed options. A more detailed assessment of effects to specific receptors will be considered in greater detail at the next stage of the assessment process. The following criteria have been used when considering the appraisal of visual effects.

Table 4.4.2- Visual affects criteria

Degree of Effect	Description
Large Adverse /Beneficial effect	• Substantial alteration to elements/features of the baseline (pre-development) conditions. • Where the proposed development would cause a very noticeable alteration in the existing view • This would typically occur where the Development closes an existing view of a landscape of national importance and the proposed development would dominate the future view.
Moderate Adverse /Beneficial effect	• Alteration to one or more elements/features of the baseline conditions such that post development character/attributes of the baseline will be materially changed. • This would typically occur where the Development closes an existing view of a local landscape and the proposed development would be prominent in the future view.
Slight Adverse / beneficial effect	• A minor shift away from baseline conditions. • This would typically occur where change arising from the alternation would be discernible but the underlying character/composition/attributes of the baseline condition will be similar to the pre-development. • It would also occur where the Development newly appears in the view but not as a point of principal focus or where the proposed Development is closely located to the viewpoint but seen at an acute angle and at the extremity of the overall view.
Neutral effect	• Where there is no discernible improvement or deterioration in the existing view.

4.4.8 Assumptions and Degree of Certainty

The landscape and visual appraisal broadly considers the degree of anticipated change to the landscape character and visual amenity experienced by receptors which would potentially occur as a result of the proposed route options.

Assumptions have been made as to the likelihood of effects but are limited to the information available and desk-based mapping and associated techniques as outlined in section 3.4.4 Assessment Methodology.

Temporary construction effects will be associated with all of the route options and will need to be assessed once the preferred options are developed further and detailed information becomes available. At this stage, temporary construction effects have not been considered for any of the options due to the high level nature of the study and insufficient level of information available to make any meaningful evaluation.

4.4.9 Predicted Impacts

Potential effects on the landscape resource may include the following:

- The route options may encroach into existing agricultural land, increasing the urbanisation of the landscape through which it passes;
- The route options may involve the loss or fragmentation of important and distinctive landscape elements (open space, woodland and trees, topographical features);
- The proposals may affect designated landscapes, such as an AONB, Non-registered Parks and Gardens, Special Landscape Areas, either directly (through encroachment/loss of landscape features) or indirectly, by affecting setting and/ or views to the designated landscapes.

Potential effects on visual amenity may include the following:

- The route options may intrude into existing views experienced by users of the study area, including local residents, road users and recreational users in the surrounding countryside;
- The route options may result in the loss of important landscape elements (e.g. hedgerows, roadside tree planting) or changes to cuttings and embankments, which may open up views of the existing road infrastructure which did not previously exist;
- The route options may increase the ‘corridor’ effect of the road, changing the way that people perceive the landscape;
- The route options may introduce lighting to previously unlit areas, intruding into night-time views experienced by local residents.

4.4.10 Opportunities for Mitigation and Enhancement

The route options should be developed to avoid key landscape and visual receptors, including settlements and dwellings, as well as designated landscapes and important landscape features such as woodland and TPOs.

The advice on good practice in landscape design provided in DMRB Volume 10 and Landscape Character documents (Suffolk County Council) should be adhered to. Objectives for possible landscape mitigation measures should include the following:

- Build on distinctive place, quality and character of the landscape
- Use of natural characteristics in design
- Retain existing features and re-use site-won materials
- Protect species, habitats and ecosystems
- Support biodiversity with native planting
- Design for low maintenance and management
- Secure adequate land to allow integrated solutions
- With the following more specific measures:
- Achieving best fit with contours;
- Retaining existing vegetation;
- Optimising protection for nearby houses through use of cuttings or existing features;
- Avoiding loss or damage of landscape features;
- On and offsite planting;
- Mounding and earth shaping; and
- Consideration of the form and finish of structures and appearance of other features e.g. road signs.

Mitigation should seek to integrate the route options and associated structures into the landscape as far as possible. Potential mitigation could consist of screen planting or reinstatement of hedgerows to limit views of the by-pass options from the wider area and to integrate structures (bridges, embankments, cuttings) into the landscape. Consideration should also be given to the siting of road signage and the height and appearance of lighting (where required for example at junctions) and the barriers used as a median closure. Mitigation should also consider sensitive siting of retention ponds and the use of native species of local provenance.

4.4.11 Residual Impacts

The following sets out the findings of the landscape and visual appraisal of the three route options and should be read in conjunction with the Landscape Appraisal Worksheets contained in Appendices 2.4A and 2.4B which provide further detail on the landscape features affected.

4.4.11.1 Option - Do Minimum

The result of the 'Do Minimum' option would result in improvements to the junction of the B1122 and the A12. The junction lies within the Conservation Area of Yoxford and in close proximity to Rookery Park, Grove Park and Cockfield Hall Park which are non-registered Parks and Gardens. The additional movement of construction traffic along the section of the B1122 between the site access and the junction with the A12 is unlikely to result in a noticeable change to the landscape character or visual amenity resulting in a Neutral to Slight Adverse Effect, depending on the extent of change proposed.

4.4.11.2 Option- Sizewell D2

Landscape Character

The Sizewell D2 route would result in a mix of on-line widening and sections of new off-line road alignment. The sections of on-line widening would be less intrusive in terms of effects on landscape character with effects limited to the removal of roadside vegetation and incursion into adjacent agricultural land. The majority of the proposed route however, comprises a new alignment passing across agricultural land and crossing various vegetated field boundaries. Large Adverse effects in year one is considered to result due to the fragmentation of the pattern and land cover and the loss of boundary vegetation and small pockets of trees particularly where junctions and slip roads are proposed. Following the establishment of replacement planting and additional landscape mitigation measures the effect is considered to reduce to Moderate Adverse in year fifteen. There is the potential for localised adverse effects on the Upper Deben Valley SLA (the Aldringham SLA is largely unaffected); however the overall integrity of the SLA is unlikely to be substantially affected by the introduction of this route option.

Visual Amenity

Route D2 passes through largely open farmland and as a result is visible from a number of scattered properties. This route option would result in a variety of visual effects ranging from Slight to Large Adverse depending on the type of receptor (residential properties are more sensitive to this type of development than vehicle users of the local road network), proximity and orientation of the receptor in relation to the route corridor and the presence of intervening elements such as landform or planting which may screen elements of the route option from view.

Where the route passes in close proximity to the outlying properties south of Saxmundham and north-east of Leiston, residents are likely to experience large adverse effects on their visual amenity. Properties between these two settlements will have a range of mid-ground to distant views of the proposed route option although intervening vegetation may partially screen views resulting in Moderate or Slight Adverse effects. Most views will also be seen in combination with large overhead transmission lines that run parallel to the south of this route option.

Road users along the western section of the existing B1119 corridor and travellers on the railway line between Saxmundham and Leiston are both likely to have transitory views where gaps in vegetation allow. The transitory nature of these views is not likely to result in significant effects. However a large number of Public Rights of Way are intersected by this route option which would result in Large Adverse effects on the immediate visual amenity for users along these routes. Mitigation planting would help integrate the road corridor into the wider landscape and into views which combined with screen planting has the potential to reduce some of the visual effects by year fifteen.Option - Sizewell B1122

There are two options both of which share the northern and southern sections of the proposed route but differ in the central compartment. Option A is to the north of the settlement of Theberton and the current B1122 road corridor whilst Theberton East runs south of Theberton and the existing B1122. Both options comprise off-line widening with shorter sections to the north and south of the corridor where on-line widening of the B1122 is proposed.

Landscape Character

The B1122 route option (both variants) would result in Large Adverse effects in year one due to the fragmentation of the pattern of the landscape and the direct loss of arable farm land and woodland. Variant A of this route option will have a more adverse effect on the landscape than Variant B due to the loss of woodland and greater intrusion into the Yox Valley SLA. It is unlikely that mitigation could reduce the potential effect assessed due to the permanent change to both the physical landscape features and immediate landscape character.

There is the potential for localised adverse effects on the Yox Valley SLA with Variant A extending into the SLA, although it is considered that the effects on the SLA will be relatively localised with the overall integrity of the special landscape character of the majority of the SLA remaining unaffected.

Visual Amenity

This route option would result in a variety of visual effects ranging from Slight Adverse to Large Adverse depending on the type and sensitivity of the receptor, for example residential properties are a more sensitive receptor compared with road travellers along the B1122. Also considered is the proximity and orientation of the receptor in relation to the route corridor and the presence of intervening elements such as landform or planting which may screen elements of the route option from view.

Properties to the northern area of Theberton are particularly sensitive and considered to potentially experience Large Adverse effects on their visual amenity as the proposed route corridor (Variant A) comes in close proximity. This results in foreground to mid-ground views although some woodland vegetation my partially screen views.

Sandlings Walk Long Distance Path runs to the east of the route corridor and within the Suffolk Coast AONB. There is the potential for users of the path to experience medium to longer distance views resulting in Moderate Adverse effects although the focus of views form the path is generally orientated towards the coast. This route option also crosses a large number of Public

Rights Of Way and would cause considerably disruption to the immediate views experienced by users of these routes. Many of the views from these recreational routes are orientated towards the YoxValley SLA. The effect on visual amenity is considered to be Large Adverse, all be it for short sections of the overall route.

There are also a number of scattered properties and clusters of properties set within the wider landscapes which have the potential to result in a range of visual effects. Properties around Middleton for example are likely to experience distant views of the road corridor which would have the potential to result in Slight Adverse effects. Conversely scattered properties along the B1122 in the vicinity of Middleton Moor with more foreground views of the proposed road corridor may result in Large Adverse effects.

Similar to the previous route option, mitigation planting would help integrate the road corridor into the wider landscape and into views which combined with screen planting has the potential to reduce some of the visual effects by year fifteen.

4.4.12 Summary

The following table provides a summary of the landscape and visual effects associated with each route option.

Table 4.4.3- Landscape and visual appraisal summary table

Route	Assessment	Mitigation	Residual Effects With Mitigation
Sizewell – Do Minimum			
Landscape Character	**Neutral – Slight Adverse**	**-**	**Neutral – Slight Adverse**
Visual Amenity	**Neutral – Slight Adverse**	**-**	**Neutral – Slight Adverse**
Sizewell- D2			
Landscape Character	Large Adverse	Reinstatement of boundary planting, structure screen planting	Moderate Adverse
Visual Amenity	Moderate to Large Adverse		Moderate to Large Adverse
Sizewell – B1122			
Landscape Character	Large Adverse	As Above	Large Adverse
Visual Amenity	Slight to Large Adverse	As Above	Slight to Large Adverse

In terms of visual amenity, the proposals are potentially highly visible from a wide range of receptors due to the direct loss of boundary and enclosure vegetation and the introduction of the road corridor into more immediate views.

All of the route corridor options are likely to give rise to adverse effects on landscape character and visual amenity. Whilst there are a range of landscape and visual effects within the wider area, where receptors are in relatively close proximity to the route corridor, effects are likely to be more intense and significant changes to landscape character and visual amenity are in general considered to be limited to within 2km of the scheme.

Route Sizewell-B1122 (Middleton Moor, which runs north of Theberton) is likely to result in greater adverse effect on landscape character and visual amenity than the other proposed options and associated variants with Large Adverse effects on landscape character and Slight to

Large Adverse effects on visual amenity. This is due to the proposed route causing notable direct loss of land cover, particularly woodland within a landscape in which woodland is limited and which is designated as a Special Landscape Area. In addition this route brings significant road infrastructure to the north of the settlement, which in combination with the existing B112 route would appear to enclose the settlement by road corridors.

All of the proposed options should adopt the use of good practice in landscape design identified in DMRB Volume 10. Landscape mitigation measures may include reinstatement boundary planting as well as structure and screen planting. They should build on the distinctive character and quality of the various landscapes, respecting setting and creating a sense of place experienced through a journey, travelling through the landscape. An important project objective should be to reconnect features, re-establish patterns and ensure continuity of elements in the landscape through good design.

4.5 Heritage

4.5.1 Introduction

The aim of this Scoping Assessment is to identify potential archaeological constraints associated with the B1122 and D2 Sizewell Road Scheme. This section provides an assessment of the proposed bypasses on the previously recorded archaeological remains, historic buildings and historic landscapes.

The B1122 is a rural B-road that runs from the A12 in Yoxford south east to Aldeburgh. There are three proposed bypasses, one at Middleton Moor, and a further two options running east and west of Theberton. The B1119 is a rural road that runs east from Saxmundham to Leiston. The D2 route option will run south of Saxmundham east to north of Leiston. Details of this route can be found in Chapter 2.

The DMRB Volume 11 Environmental Assessment Section 3 Part 2 Cultural Heritage (HA 208/07) forms the basis for this assessment. The assessment of impacts on the known archaeological remains and built heritage was undertaken through the analysis of data obtained during the cultural heritage assessment to determine the potential impacts of the proposed road bypass of the B1122. Cultural heritage in this context means the above and below ground archaeological resource, the built heritage, and historic landscapes.

This original data was collected from:

- English Heritage Archives Services; and
- Suffolk Heritage Environment Records (HER).

Some of the date acquired from the HER is collected from the Portable Antiquities Scheme. As such, this data is confidential and has not been reproduced on the figure. However, it is included in the assessment as evidence for archaeology in the study area.

As part of this study the English Heritage online database 'National Heritage List for England' was also consulted.

4.5.2 Regulatory / Planning Policy Framework

National legislation and guidance which is relevant to archaeology and cultural heritage comprises:

- Ancient Monuments and Archaeological Areas Act 1979;
- Planning (Listed Buildings and Conservation Areas) Act 1990; and
- National Planning Policy Framework (NPPF) (March 2012);

The local policy which is relevant to archaeology and cultural heritage are addressed in the Suffolk Coastal Local Plan (Adopted 2001). The relevant policies are:

- AP4 - Parks and Gardens of Historic or Landscape Interest
- AP6 - Preservation of Listed Buildings
- AP7 - Development of Archaeological Sites

Key pieces of guidance include the following:

- DMRB Volume 11 Environmental Assessment Section 3 Part 2 Cultural Heritage (HA 208/07);
- Institute for Archaeologists (IfA) (2012) Standard and Guidance for Historic Environment Desk-Based Assessments.

4.5.3 Baseline Conditions

4.5.3.1 Middleton Moor Bypass

There are five assets within 300 m study area of Middleton Moor Bypass identified on online sources. This includes four listed buildings. There are no recorded Scheduled Monuments, Conservation Areas, Registered Parks and Gardens or Registered Battlefields.

The proposed road scheme bypasses Middleton Moor which is located on high ground to the west of the settlement of Middleton. The name Middleton means 'middle farm or estate' and is Old English (Mills 2003, 327).

There is one Grade II listed building, Moor Farmhouse (29), which dates to the early 16th century. The other three listed buildings are Grade II. The two earliest houses are Beveriche Manor Farmhouse (31) and a thatched house (34) which date to the late 16th to early 17th centuries. The last house is thought to date to the mid to late 17th century although the date 1717 appears on the right hand dormer, suggesting later alterations (32).

There is one undesignated asset which constitutes the deserted medieval village of Hopton (30).

4.5.3.2 Theberton Bypass East

There are five assets within 300 m study area of Theberton East Bypass. This includes five listed buildings. There are no recorded Scheduled Monuments, Conservation Areas, Registered Parks and Gardens or Registered Battlefields.

The proposed road scheme passes to the east of the settlement of Theberton. Theberton is Old English and means 'farmstead or village of a man called Thēodbeorht' (Mills 2003, 456).

The first listed building is the Grade I listed Church of St Peter which dates to the 12th century with 14th, 15th and 19th century additions and restoration (47). The round tower of the church with octagonal belfry stage dates to *c.*1300.

The other four buildings are Grade II listed. They include dwellings such as the 17th century Lilycot (49) and a row of four cottages built in the late 17th to early 19th century (50). Finally, there is the gateway and gate piers at the junction of Leiston Road and Onner's Lane which date to the 19th century (42).

The one undesignated asset in the study area is the remains of a tower mill which was moved from the nearby Little Glemham in around 1730 (25). The mill was in operation until about 1920 and was largely demolished by 1930. The ruinous base of the building remains to the north east of the bypass.

4.5.3.3 Theberton Bypass West

There are twenty-one assets within 300 m study area of Theberton West Bypass identified on online sources. This includes eighteen listed buildings. There are no recorded Scheduled Monuments, Conservation Areas, Registered Parks and Gardens or Registered Battlefields.

The proposed road scheme bypasses the settlement of Theberton to the west of it. Theberton is Old English and means 'farmstead or village of a man called Thēodbeorht' (Mills 2003, 456).

There is one Grade II listed building known as Theberton House (38). It also has five Grade II listed buildings associated with it including stables (41), three gateways (36, 37 & 39) and walls enclosing a garden (40).

To the east of the bypass, there is Grade II listed Theberton Hall (51) with its associated Grade II listed gateway and piers (52). It was built in 1792 for George Doughty, who became the High Sheriff of Leiston in 1793. It had extensive alterations and additions in 1852 in an Italian Renaissance style although these additions were mostly demolished in the 1920s. To the south east of it is the Grade II listed cottage close to Upper Abbey Farmhouse (35).

Within Theberton, there are seven Grade II listed buildings. This includes a barn (45), the Lion Public House (44), which is probably associated with the stable block recorded ten metres away (43), an old rectory (48) and one early 19th century house (33). There is also a manor house and its associated gate piers recorded (46).

The final listed buildings relate to agriculture and include a farmhouse (53) and associated buildings (54) that are to the north west of the bypass.

There are four undesignated assets. These include an early Bronze Age cinerary urn to the east of the bypass (26) and a medieval shrunken village, visible on aerial photography to the north west (27). There are also the remains of a tower mill moved from the nearby village of Little Glemham in around 1730 (25). It is thought to have been in operation until approximately 1920 and was largely demolished by 1930. Finally, there is a dairy and wash house recorded to the north of the bypass (28). It is thought to date to around 1900.

4.5.3.4 D2 Route

There are twenty-four assets within the 300 m study area of D2 route option. This includes six listed buildings. There are no recorded Scheduled Monuments, Conservation Areas, Registered Parks and Gardens or Registered Battlefields.

Two of the listed buildings are Grade II. This includes Buxlow Manor dated to 1678 (1) and the 17th century timber framed Leiston House (5 & 7). The other four Grade II listed buildings include the 17th century Crosswing Farmhouse (2), Wood Farmhouse (6), the 18th century Fisher's Farmhouse (3) and Hurts Hall, built in 1893 (4).

To the south of the route, the Portable Antiquities Scheme records a Bronze Age (2000 BC – 700 BC) sword hilt fragment and a number of Roman (AD 43 – AD 450) pot sherds and coins. This data is confidential and therefore has not been reproduced on the figure.

The only site of prehistoric date is a scatter of flint flakes, found during a field walking survey (10).

There are two assets and two find spots dated to the Roman period (*c.*43 AD to 450 AD). The find spots include two bronze sestertii[45] (14), and a Roman coin (20). There have also been two pottery kilns identified (8 & 18).

One pottery assemblage in the area has possible late Saxon Thetford type ware (AD 850 – 1000) and a medieval (AD 1066 – 1500) pottery sherd (11).

There are a number of find spots from the medieval period which include a medieval silver groat of Heinrich V, Archbishop of Bremen 1463-96 (19), and a scatter of metalwork including a groat, cut halfpenny and `many Nuremberg tokens' (13).

There are eleven assets of post-medieval date (1500 – 1901). The find spot of a coin hoard or purse loss, including coins of Elizabeth I and Charles I, could represent a possible civil war deposit (21). There are also buildings, including two granaries and associated walled garden and shed (9 & 22) thought to be associated with Hurts Hall (4). Two railway lines are recorded in the study area. One is the East Suffolk Railway which opened in 1854 and is an un-electrified secondary railway line running between Ipswich and Lowestoft (24). The traffic along the route consists of passenger services operated by Greater Anglia. The other is the Leiston Branch Railway which opened in 1859 and closed to passengers in 1966 (23). On this line nuclear flask trains for the Sizewell nuclear power stations are operated by Direct Rail Services.

[45] Roman coin (Darvill 2008, 412).

The remaining six assets of post-medieval date comprise the listed buildings described above.

There are four assets of unknown date. There is a scatter of red tile (12) and a number of cropmarks including a large circular enclosure (16). One area of cropmarks could be a mound and trackway, although the record is not certain (17). The date and function of the features are unknown and the records suggest two possible associations, the first as a windmill mound and the second with a former airfield which is situated *c.*300 m to the west. Finally, there is ancient woodland in the area known as Buckles Wood (15).

4.5.4 Assessment Methodology

Following review of heritage assets in the study area of each option, it is recommended that each bypass option which are taken forward are further subjected to a Simple Assessment, as specified by DMRB Volume 11 Section 3 Part 2 Cultural Heritage (HA 208/07). This is to further assess the impacts on the recorded cultural heritage as researched by this assessment, as well as the likelihood for, and potential impacts on, previously unrecorded archaeology, not covered by this Scoping Assessment.

There should be consultation with the relevant County Archaeologist as part of the Simple Assessment to add to our understanding about the heritage culture in the area and to receive advice about the best ways to proceed and mitigate any expected impacts.

The Simple Assessment should also further outline relevant and appropriate mitigation measures. This may include further evaluation such as geophysical surveys in the areas that have archaeological potential that may be partially destroyed by the proposed scheme.

Any archaeological work carried out for the Simple Assessment must be undertaken in line with IfA guidance as well as DMRB and done to the standards deemed appropriate by the Institute for Archaeologists (IfA).

4.5.5 Assumptions and Degree of Certainty

No additional working areas as part of the construction of the bypasses have been considered in this Scoping Assessment, such as for example construction compounds or areas for spoil and bunds. These could result in temporary or permanent construction impacts.
This assessment has only dealt with previously recorded cultural heritage. There is potential for previously non-unrecorded archaeology to be discovered during survive that may be revealed by the construction of the bypass. This potential will need to be assessed in a Simple Assessment.

4.5.6 Predicted Impacts

The potential impacts from the proposed development on cultural heritage comprise impacts to the significance of heritage assets. This may be caused by physical impacts on archaeological features or impacts on the setting of heritage assets. These impacts may be temporary and permanent and can occur during construction and operation of the development.

4.5.6.1 Middleton Moor Bypass

The proposed bypass does not pass through any recorded archaeology detailed in this scoping report.

There is the potential for there to be a positive effect on a number of heritage assets as a result of the reduction in the volume of traffic which is anticipated. There are five listed building situated along the B1122 through the area of Middleton Moor. As a group, they have historical significance associated with their role in the development of the settlement. They are surrounded by an open and agricultural landscape which forms their setting. This agricultural setting is only considered to contribute to their significance to a minor extent. Moor Farmhouse is considered to be of high value whilst the others listed buildings are considered to be of medium value due to their designations. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a Slight Beneficial significance of impact.

4.5.6.2 Theberton Bypass East

The proposed bypass does not pass through any recorded archaeology detailed in this scoping report.

The heritage assets within the settlement of Theberton will receive a positive impact as a result of anticipated reduced amounts of traffic. Theberton contains eight listed building within its centre. As a group, they have historical significance associated with their role in the development of the settlement, as well as architectural significance from the building styles and materials used. Theberton is surrounded by an open agricultural landscape which forms its setting. This agricultural setting is only considered to contribute to its significance to a minor extent. The buildings in Theberton are considered to be of high and medium value due to their designations. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a Slight Beneficial significance of impact.

4.5.6.3 Theberton Bypass West

The proposed bypass does not pass through any recorded archaeology detailed in this scoping report.

There will be a possible impact on the setting of the Grade II listed Theberton Hall, built in 1792 (51). It has historic historical significance for the information it provides about the development of the post-medieval landscape and the history of settlement in the area. The setting of the asset

comprises the agricultural land which surrounds it. The manor to the east, north and west is surrounded by woodland and the house is best understood within an agricultural landscape. The setting of the asset therefore contributes to its significance. Due to its designation, it is considered to be of medium value. The frontage of the house faces south, towards the proposed route. The route will cut through the agricultural land to the south of the asset. This may cause visual and aural intrusion on an asset that was built in a rural landscape. Therefore, the magnitude of change to the significance of the asset is considered to be Minor Negative. This is because the setting of the asset will have noticeably changed. On an asset of medium value, this will result in a Slight Adverse significance of impact.

There is a possibility that there will be a positive effect on a number of heritage assets within the settlement of Theberton as a result of a reduction in the volume of traffic which is anticipated. Theberton contains eight listed buildings within its centre. As a group, they have historical significance associated with their role in the development of the settlement, as well as architectural significance from the building styles and materials used. The settlement and buildings are surrounded by an open agricultural landscape which forms their wider setting. This agricultural setting is only considered to contribute to their significance to a minor extent. The buildings in Theberton are considered to be of high and medium value due to their designations. The bypass has the potential to enhance the historic environment through a reduction in the volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the assets. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On assets assessed as high and medium value, this results in a slight beneficial significance of impact.

4.5.6.4 D2 Route

There could be two construction impacts on assets within the study area. The first area is where an assemblage of red tile was found (12). While surface finds have been recovered, the scatter could indicate that additional remains may survive below the surface. As such, the site has archaeological significance as the scatter could provide further information about the date of the assemblage. Its location could suggest some kind of habitation site. Due to its potential to contribute to local research objectives it is considered to be of low value. The route passes through the scatter. This could mean the loss of any remains that may be left unrecorded. This would therefore result in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of this asset, resulting in a slight adverse significance of impact.

The second asset is a large circular or sub-square enclosure, visible as a cropmark (16). The asset has archaeological significance as investigation could reveal its function, date and how it was constructed. It may hold some historic significance in relation to settlement and agricultural development of the area. Due to its potential to contribute to local research objectives, it is considered to be of low value. It is likely that the proposed route will pass very close, if not partly through, the asset. This could mean the permanent, partial loss of any remains and would result

in the partial loss of the significance of the asset. This would have a Moderate Negative magnitude of change upon the significance of the asset, as the asset would be clearly modified. On an asset of low value, this would result in a Slight Adverse significance of impact.

There will be a possible impact to the setting of Hurts Hall (5), which is a Grade II listed country house built in 1893. It has architectural significance as an example of a neo-Elizabethan design and it is of historical significance for the information it provides about the development of the post-medieval landscape and the history of settlement in the area. The setting of the asset comprises the agricultural land which surrounds it. The land around the manor is bordered by woodland. The house is best understood within an agricultural landscape where the manor house traditionally held farming land. The setting of the asset therefore contributes to its significance. Due to its designation, it is considered to be of medium value. The main entrance is to the north and the two reception rooms overlook the south and south east, towards the proposed route. The route will cut through the agricultural land to the south of the asset. This may cause visual and aural intrusion on an asset that was built in a rural landscape. Therefore, the magnitude of change to the significance of the asset is considered to be Minor Negative. This is because the setting of the asset will have noticeably changed. On an asset of medium value, this will result in a Slight Adverse significance of impact.

The Conservation Area of Saxmundham makes up the eastern edge of the town. It is an old market town and is characterised by medieval buildings with Georgian and Victorian frontages. The town has historical significance as it adds information to the development of the area during the post-medieval period. Due to its designation, the area is considered to be of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the Conservation Area. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On an asset of medium value, this results in a Slight Beneficial significance of impact.

The character of Leiston Conservation Area is mainly derived from the development of the town during the Victorian era. The Conservation Area has historical and architectural significance due to the quality of the buildings, the interesting shape, form and layout of the area, and the contribution made by landscape features such as private and public gardens, vegetation, walls and metal railings. The area has potential to provide information in relation to its past and development. The Conservation Area is a small part of the larger town of Leiston. Surrounding the town is agricultural land. The setting of Leiston is for the most part, the urban development of the town, which contributes to its significance. Due to its designation, the area is considered to be of medium value. The bypass will enhance the historic environment through reduction in volume of traffic which will lead to a drop in vehicle emissions, noise and pollution. This would have a magnitude of change of Minor Positive on the significance of the asset. This is because there will be a noticeable change to the setting of the settlement and a greater appreciation of the listed buildings. On an asset of medium value, this results in a Slight Beneficial significance of impact.

4.5.7 Opportunity for Mitigation and Enhancement

A programme of further evaluation work is recommended once the design of the final option is progressed. This could include targeted geophysical and/or field walking surveys. Depending upon the results of this evaluation, mitigation during construction may include archaeological excavation, strip, map and record or archaeological watching briefs. Where identified features cannot be avoided they must be fully excavated and recorded in advance of the road construction to allow preservation by record.

All further work will be undertaken in consultation with the County Archaeologist and will follow guidance from the Institute for Archaeologists (IfA).

Mitigation measures to minimise the setting impact of the proposed bypasses are limited. Screen planting along the roadside may assist in mitigating effects. In addition it is recommended that photographic recording of the existing setting of sites should be undertaken prior to the start of construction.

4.5.8 Residual Impacts

With appropriate mitigation in place the magnitude of change on a number of sites will be reduced. Details are contained within Table 4.5.1.

Table 4.5.1: Residual impacts summary table

Route	Asset	Value	Magnitude of change	Significance of effect	Residual magnitude of change	Residual significance of effect
Middleton Moor Bypass	Listed buildings in Middleton Moor	Medium and High	Minor positive	Slight beneficial	Minor positive	Slight beneficial
Theberton Bypass East	Listed buildings in Theberton	Medium and High	Minor positive	Slight beneficial	Minor positive	Slight beneficial
Theberton Bypass West	Theberton Hall	Medium	Minor negative	Slight adverse	Minor negative	Slight adverse
	Listed buildings in Theberton	Medium and High	Minor positive	Slight beneficial	Minor positive	Slight beneficial

Route	Asset	Value	Magnitude of change	Significance of effect	Residual magnitude of change	Residual significance of effect
D2	Scatter of red tile (12)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Cropmark (16)	Low	Moderate negative	Slight adverse	Minor negative	Slight adverse
	Hurts Hall (5)	Medium	Minor negative	Slight adverse	Minor negative	Slight adverse
	Saxmundham	Medium	Minor positive	Slight beneficial	Minor positive	Slight beneficial
	Leiston	Medium	Minor positive	Slight beneficial	Minor positive	Slight beneficial

4.5.9 Summary Table

This archaeological and cultural heritage chapter has collated baseline data within a study area of approximately 300 m from the proposed bypass, as required by guidance in DMRB.

Data was collected from Suffolk Historic Environment Record, The English Heritage Archives Services and historic maps. Fifty-four archaeological sites were identified within the study area. The different route options will have various effects to heritage assets. These are summarised in Table 4.5.2.

Given the number of sites within the study area, it is recommended that a Simple Assessment is undertaken of options taken forward. This should follow guidelines from the DMRB and the IfA and be undertaken in conjunction with consultation with the County Archaeologist.

There may be a requirement for further archaeological evaluation but this cannot be determined until the Simple Assessment has been completed.

While none of the options will have a significant effect on cultural heritage, Theberton Bypass East has the least number of negative effects.

Table 4.5.2: Heritage assessment summary table

Route	Asset	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
Middleton Moor Bypass	Listed buildings in Middleton Moor	Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
Theberton Bypass East	Listed buildings in Theberton	Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
Theberton Bypass West	Theberton Hall (51)	Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Listed buildings in Theberton	Reduction of traffic	Slight Beneficial	N/A	Slight Beneficial
D2	Scatter of red tile (12)	Part or complete removal due to bypass.	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Cropmark (16)	Part or complete removal due to bypass	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
	Hurts Hall (5)	Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
	Saxmundham	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial

Route	Asset	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
	Leiston	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial

4.6 Water Environment

4.6.1 Introduction

A high-level optioneering assessment has been carried out in respect to the water environment for the B1122 and D2 Sizewell with due regard to Transport Analysis Guidance (TAG) Unit A4 Environmental Impact Appraisal (Department of Transport, 2014). The proposed new highway sections have the potential to effect the water environment during both construction and operation. As a high level optioneering assessment has been undertaken, the use of TAG to assess construction, as well as operational impacts, is considered appropriate even though TAG was originally intended to determine operational effects. Following acknowledgement of relevant regulatory and planning policy background and establishment of the existing baseline, potential effects have been identified and assessed. Where there could be significant adverse effects, options for mitigation measures have been considered, any opportunities for enhancement (i.e. positive effects) have also been acknowledged. Any remaining, or residual, effects are then presented. Appropriate options recommendations are made in addition to, where relevant, recommendations for further survey and assessment.

This assessment will evaluate a series of highway options. The B1122 Local Bypass option is located between Yoxford and north of Leiston on the existing B1122. It includes a number of sub-options (Middleton Moor to Theberton West to C and B1122 Road Improvement). As specified in previous text, B1122 Road Improvement is the common ground between B and C. Route D2 commences from south of Saxmundham and ties to the existing B1122 north of Leiston. Both highways and associated sub-options are described further in Table 4.6.1, section 2.

Table 4.6.1 Assessed routes

Route / Sub-Option	New or Modified	Length of highway (km)	Widening (Yes / No or NA)
Middleton Moor	New	1.3	NA
Theberton East	New	1.7	NA
Theberton West	New	2.0	NA
B1122 Road Improvement	Modified	1.0	Yes
D2 Route option	New	6.0	NA

4.6.2 Regulatory / Planning Policy Framework

This section establishes the legislative and planning context for the proposed B1122 and D2 Sizewell options in relation to the water environment. Any proposed development will have to comply with the following European and national legislation, and planning policy.

4.6.2.1 Regulatory Framework

European Legislation

- EC Directive 2000/60/EC The 'Water Framework Directive' (WFD);
- EC Directive 2008/105/EC The 'Priority Substances Directive';
- EC Directive 2004/35/EC The 'Environmental Liability Directive';
- EC Directive 92/43/EEC The 'Habitats Directive'
- EC Directive 79/409/EEC The 'Birds Directive'
- EC Directive 91/676/EEC The 'Nitrates Directive'; and
- EC Regulation 1100/2007 the 'Eels Regulation'.

National Legislation:

- The Flood and Water Management Act 2010;
- The Water Act 2003;
- The Water Resources Act 1991 (as amended);
- The Conservation of Habitats and Species Regulations 2010;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003;
- The Land Drainage Act 1991 (as amended);

- The Environmental (England and Wales) Permitting Regulations 2010 (as amended 2012);
- The Environmental Damage (Prevention and Remediation) (Amendment) Regulations 2010; and
- The Control of Pollution (Oil Storage) (England) Regulations 2001.

4.6.2.2 Planning Policy

The National Planning Policy Framework (NPPF) (March 2012) replaced existing national planning policy that had been in place since 2004 (e.g. PPS23). In particular, Section 11 of the NPPF 'Conserving and Enhancing the Natural Environment' (paragraph 109) states that development should be prevented from contributing to; putting at unacceptable risk from; or being adversely affected by unacceptable levels of water pollution. Section 10 of the NPPF 'Meeting the Challenge of Climate Change, Flooding and Coastal Change' (paragraphs 94 and 99) emphasise the need to adopt proactive strategies to mitigate and adapt to climate change over the long term, taking into account flood risk and water supply and demand considerations.

In addition, 'Future Water', the Government's 'Water Strategy for England was published in February 2008. This strategy sets out the Government's long-term vision for water and the framework for water management in England. This includes ensuring that the water environment is protected from pollution and physical damage.

Principally, local planning policy is determined by the Suffolk Coastal District Local Plan. Policy DM27 Biodiversity and Geodiversity within the Core Strategy is relevant for the water environment. In addition the Suffolk manual (Suffolk Council, 2000) provided highway design advice.

4.6.3 Baseline Conditions

4.6.3.1 Study Area

As identified in Section 1 (Introduction) and 3.6.1 this desk based study considers two options; the 'B1122 Local Bypass Option' and the 'D2 New Route Proposal'. The B1122 local bypass option is located on or adjacent to a stretch of the existing B1122 between Yoxford and Leiston Abbey (north of Leiston) and consists of sub-options Middleton Moor, Theberton East, Theberton West and B1122 Road Improvement as identified in Table 4.6.1. Middleton Moor is a bypass around Middleton Moor; Theberton East and Theberton West are bypass routes around Theberton; and sub-option B1122 Road improvement consists of existing B1122 carriageway widening north of Leiston. The D2 new route proposal is a new highway proposal running east to west from north of Leiston and connecting to the Saxmundham bypass south of Saxmundham. See drawing 60315689-SHT-00-FVSW-C-0004.

A 1 km study area has been considered around each of the proposed route options in order to identify the water features and their attributes that could be affected by any of the options. Isolated ponds that fall within this primary study area that are more than 100 m from a specific option have been scoped out of this assessment as they are considered unlikely to be impacted

by the proposed highways due to lack of hydrological connectivity and the likely extent of construction works from the centre line of the route option. Once the final route has been confirmed, ponds that could be potentially be impacted through construction or operations should be identified (noting that the routes provided so far are indicative and that construction working areas have not been identified).

It is noted that watercourses are dynamic features and it is possible that pollutants can be propagated downstream. Therefore, should a watercourse be crossed by a proposed option where direct effects may occur, indirect effects may result downstream. Therefore effects propagated beyond the primary study area downstream are considered within the secondary study area of up to 5 km downstream from the watercourse crossing point (noting that the risk will likely have diminished by this point unless a major pollution event has occurred).

The primary and secondary study areas for both options are contained in the Environment Agency's (EA) East Suffolk management catchment. The topography of the area is generally flat and low lying (elevations in the study area generally ranging from 5 m AOD to 25 m AOD on the B1122 Local Bypass Option and 10 m AOD to 25 m AOD on the D2 New Route Option), resulting in coastal wetlands and lower channel velocities than elsewhere in the wider East Suffolk Catchment

The topography of the area is generally flat resulting in coastal wetlands and lower channel velocities than elsewhere in the wider East Suffolk Catchment (Environment Agency, 2013). The common underlying geology in the study area is marine derived sands and gravels overlain by glacial till.

The primary study area for both options is rural and contains a number of small towns / villages, each with populations of less than 10,000, including Saxmundham, Leiston, Yoxford, Middleton and Theberton.

4.6.3.2 Surface Water Features

B1122 Local Bypass Option

North east of the B1122 and proposed new routes are the Minsmere River, a Main River and WFD designated watercourse (see below). Minsmere River flows east and discharges to the North Sea at Minsmere via a sluice gate.

The existing B1122 crosses two Main Rivers, Middleton Watercourse and Theberton Watercourse. Both are small watercourses that drain a rural agricultural environment.

There are also other smaller watercourses, fenland field drains and dykes in primary study area. Each of these ultimately drains into the Minsmere River.

D2 New Route Option

The proposed new route crosses over the Hundred River, approximately 3 km from the eastern end of the proposed new route. West of Leiston the Hundred River flows in a southerly-south-westerly direction (it is through this section that the proposed new route would cross the river).

South of Leiston it then flows through fenland to the North Sea. The watercourse is designated as a WFD watercourse from south of Theberton Woods (downstream of the proposed crossing). The Hundred River and one minor tributary are designated as Main Rivers.

The proposed new route also crosses over the River Fromus, approximately 1 km from the western end of the proposed new route. The River Fromus flows south through Saxmundham and is also designated as a Main River and WFD designated watercourse (including where the proposed new route crosses). The River Fromus ultimately joins the River Alde approximately 5 km south of the D2 crossing. The Alde subsequently enters the North Sea.

Ordnance Survey maps also indicate that there are a number of ponds lie within the study area.

4.6.3.3 WFD

Existing WFD classifications for the rivers, described above, are detailed in Table 4.6.2 below (noting that WFD classifications are restricted to larger rivers)

Table 4.6.2 WFD Classifications

Watercourse (WFD ID)	Hydro-morphological Status	2012 Ecological Status or Potential	Objective	Protected Areas
B1122 Local Bypass Option Study Area				
Leiston Beck and Minsmere Old River (GB105035046270)	Heavily Modified (due to land drainage)	Poor Potential	Good Ecological Potential by 2027	Freshwater Fish Directive Nitrates Directive Natura 2000 Habitats and / or Birds Directive
D2 New Route Option Study Area				
Hundred River (GB105035046260)	Heavily Modified (due to flood protection)	Poor Potential	Good Ecological Potential by 2027	Nitrates Directive
Fromus (GB105035045980)	Not designated	Poor Status	Good Ecological Status by 2027	Nitrates Directive

Source: Anglian RBMP (Environment Agency 2009) and Environment Agency consultation (2014)

Minsmere River is included within the designation referred to in Table 4.6.2 as '*Leiston Beck and Minsmere Old River*'. It is currently failing for fish. Not all of the mitigation measures identified to be relevant to this waterbody are currently in place as it is considered to be technically infeasible to implement. Given that the river is not being crossed by the proposed highways works, and is more than 1km from the development, the development is unlikely to impact on delivery of the mitigation measures. Similarly direct opportunities to support the mitigation measures are not considered likely.

The Hundred River failure is driven by Poor fish status. All mitigation measures identified to be relevant to the Hundred River are in place aside from one that targets the implementation of appropriate channel maintenance strategies and techniques (minimise disturbance to channel bed and margins). If it is decided that the development will cross the river, the river crossing should be designed as not to detrimentally impact the ability for the waterbody's mitigation measures to be achieved. Opportunities to help achieve the mitigation measures should be sought during detailed design.

The River Fromus's failure is driven by a Poor diatom status. Moderate fish status is attributed to barriers to migration and some historic pollution. Invertebrate status is currently at Good. Dissolved Oxygen, follows natural seasonal trend reducing dilution of effluent in the hotter months. Phosphorus levels are raised predominantly through point source sewage discharges with some diffuse input from land use practices. If it is decided that the development will cross the river, the river crossing should be designed as not to detrimentally impact the ability for the waterbody's mitigation measures to be achieved. Opportunities to help achieve the mitigation measures should be sought during detailed design.

4.6.3.4 Water Resources & Pollution Incidents

B1122 Local Bypass Option

Within the primary study area, there are ten discharge consents. Eight of these are associated with private individuals and are likely to be small. Anglian Water have two consented discharges.

There have been no reported pollution incidents to controlled waters within the primary study area during the past five years.

Six groundwater and three surface water abstraction licences are located within the primary study area.

D2 New Route Option

Within the primary study area, there are sixteen discharge consents. Twelve of these are associated with private individuals and are likely to be small. Anglian Water have four consented discharges.

There have been four reported pollution incidents to controlled waters within the primary study area during the past five years. These were associated with one sewerage overflow, one unauthorised discharge, one fuel spill incident and one firefighting runoff incident. Each was categorised as having a minor impact to the receiving watercourse.

Five groundwater and two surface water abstraction licences are located within the primary study area (five of which lie to the north of Leiston at the eastern end of the primary study area).

4.6.3.5 Protected Sites / Species

Both of the proposed options are not likely to have any effect on the compliance of the watercourses that are designated under the Nitrates Directive and thus are not considered any further in this assessment. This is because the proposed options would not result in any application of nitrates to groundwater.

The Multi-Agency Geographic Information for the Countryside (MAGIC) interactive map was reviewed to assess for the presence of protected areas within the study area. Consideration was given to Sites of Special Scientific Interest (SSSIs), Ramsars, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) as well as any Local Nature Reserves (LNRs). This section should be read alongside the Biodiversity section (section 3.3).

B1122 Local Bypass Option protected areas

There are no protected areas within the primary study area. However a number of sites are downstream of proposed river crossings and as they are riverine they could potentially be impacted.

Northeast of Theberton lies Minsmere-Walberswick Heaths and Marshes SSSI (in the primary study area of sub-option Theberton East and in the secondary study area of sub-option C). The SSSI lies downstream of sub-option Theberton East and West and the drains that these sub-options cross make their way to the SSSI. This SSSI is designated as containing a complex series of habitats, notably mudflats, shingle beach, reedbeds, heathland and grazing marsh. An adverse water environment impact by the scheme could in turn propagate downstream and impact on the SSSI by affecting the habitat and water quality. Within the secondary study area of sub- options A, B and C lies Minsmere to Walberswick Heaths & Marshes SAC, Minsmere-Walberswick SPA, Minsmere-Walberswick Ramsar and Minsmere Nature Reserve. Minsmere River flows through the SSSI and to the south of the boundary of the SAC, SPA and Ramsar sites. More detailed descriptions of these sites are provided in Section 3.3.

D2 New Route Option protected areas

There is one protected area within the primary study area, Sizewell Marshes SSSI, which lies east of the eastern end of the scheme. A watercourse links the eastern end of the scheme to the SSSI, which lies downstream. Sizewell Marshes are important for their large area of lowland, unimproved wet meadows which support outstanding assemblages of invertebrates and breeding birds. Several nationally scarce plants are also present. An adverse water environment impact by the scheme could in turn propagate downstream and impact on the SSSI by affecting the habitat and water quality. There are a number of other protected sites downstream of proposed river crossing but beyond the secondary study area, and thus it is not considered that they could be impacted. Consultation with the Environment Agency has indicated that eels (*Anguilla anguilla*) are present in the Fromus River (upstream and downstream of the crossing).

4.6.4 Assessment Methodology

Optioneering has been undertaking utilising the methodology outlined in the Transport Analysis Guidance Unit 3.3.11[46].

This assessment is based on professional judgement and informed by best practice guidance, including the ‘The Water Environment Sub-Objective TAG Unit 3.3.11’ (Department for Transport, 2003). The Highways Agency’s Volume 11, Section 3, Part 10 of the ‘Design Manual for Roads and Bridges (DMRB)’ has also been reviewed to aid the adaption of this method to this assessment.

In assessing the significance of potential effects of the Proposed Development, the following were taken into account.

- The importance of the receiving environment; and,

[46] Department for Transport, 2003.

- The potential magnitude of the effect.

The terms receptor ‘importance’ and receptor ‘sensitivity’ are used interchangeably within impact assessments. However, in the context of assessing the effects on the water environment it is commonplace to refer to receptor ‘importance’ only. This is because larger watercourses have a greater potential to dilute and disperse pollutants (i.e. a greater buffering capacity) and are thus less sensitive, although they are often the water bodies that support more diverse aquatic fauna and flora, more likely to be designated as a nature conservation site, and have more important socio-economic and aesthetic attributes. Therefore, to ensure that these water bodies are given an appropriate consideration by the assessment, this impact assessment refers to ‘importance’ only and may differ from other topics as a result.

The importance of an attribute is defined using Table 4.6.3 as presented below:

Table 4.6.3 Guidance for estimating the importance of environmental attributes

Importance	Criteria	Examples
Very High	Attribute with a high quality and / or rarity, regional or national scale and limited potential for substitution	Site protected under EU or UK wildlife legislation (SAC, SPA, SSSI, Ramsar site); and / or Critical social or economic uses (e.g. water supply and navigation).
High	Attribute with a high quality and / or rarity, local scale and limited potential for substitution Attribute with a medium quality and rarity, regional or national scale and limited potential for substitution	WFD High status waterbody (surface water); Aquatic species protected under EU or UK wildlife legislation (e.g. Great Crested Newt); and / or Important social or economic uses such as water supply, navigation or mineral extraction.
Medium	Attribute with a medium quality and / or rarity, local scale and limited potential for substitution Attribute with a low quality and rarity, regional or national scale and potential for substitution	WFD Good status waterbody (surface water); May be designated as a local wildlife site; May support a small / limited population of protected species; and / or Limited social or economic uses.

Importance	Criteria	Examples
Low	Attribute with a low quality and rarity, local scale and potential for substitution	WFD less than Good status waterbody (surface water); No nature conservation designations; Low aquatic fauna and flora biodiversity and no protected species; and / or Minimal economic or social uses.

Adapted from TAG Unit A4[47]

The magnitude of impact considers the scale of the predicted change to baseline conditions resulting from a given impact and takes into account its duration (i.e. temporary or permanent). Definitions are described in Table 4.6.4:

[47] Department for Transport, 2014

Table 4.6.4 Guidance for determining magnitude of impact

Magnitude[48]	Criteria	Examples
Major Adverse	Results in a loss of attribute	Loss of Protected Area; Pollution of potable sources of water abstraction; and / or Deterioration of a waterbody leading to a failure to meet Good Ecological Status (GES) under the WFD and reduction in Class (or prevents the successful implementation of mitigation measures for heavily modified or artificial water bodies).
Moderate Adverse	Results in impact on integrity or loss of part of attribute	Discharge of a polluting substance to a watercourse but insufficient to change its water quality status (WFD class) in the long term; and / or No reduction in WFD class, but effect may prevent improvement (if not already at GES) or the successful implementation of mitigation measures for heavily modified or artificial water bodies.
Minor Adverse	Results in minor impact on attribute	Temporary noticeable effect on designated site features, or key attributes of features; Temporary measurable changes in attribute but of limited size and / or proportion, which does not lead to a reduction in WFD status or failure to improve.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect the use / integrity	No effect on designated site features, or key attributes of features; Discharges to watercourse but no significant loss in quality, fishery productivity or biodiversity; and / or No effect on WFD classification or water body target.

[48] Noting that options and sub-options may provide benefits too.

Adapted from TAG Unit A4[49]

The significance of a potential impact is estimated by its magnitude (determined using Table 4.6.3) and the importance of the affected attribute (determined using Table 4.6.4). Table 4.6.5 provides a guiding matrix to determine the significance of a potential effect.

Table 4.6.5 Criteria for estimating the significance of potential impacts

	Importance of Environmental Attribute			
Magnitude of potential impact	**Very High**	**High**	**Medium**	**Low**
Major	Very Significant	Highly Significant	Significant	Low Significance
Moderate	Highly Significant	Significant	Low Significance	Insignificant
Minor	Significant	Low Significance	Insignificant	Insignificant
Negligible	Low Significance	Insignificant	Insignificant	Insignificant

Source: TAG Unit A4[50]

4.6.5 Assumptions and Degree of Certainty

There is inherent uncertainty associated with this high level assessment, thus the approach seeks to outline risks to the environment and the typical measures that may be selected to address those risks. In doing so, the study has assumed a worst case approach. For example, at the time of assessment no design information relating to the highway drainage or the nature of proposed crossings, so we have assumed runoff will be discharged to the nearest watercourse and where river crossings are required we have assumed that this would be via a box culvert rather than an open-span design.

At the time of assessment no design information relating to the highway drainage was available.

4.6.6 Predicted Impacts

The following potential impacts are presented for both of the options. The magnitude of impacts, and ultimately the significance of any impact, has been downgraded for receptors in the secondary study area as increased distance from the site is likely to reduce the magnitude of any impact.

[49] Department for Transport, 2014
[50] Department for Transport, 2014

4.6.6.1 B1122 Local Bypass Option

As outlined in Section 1 (Introduction) this option has four sub-options (Middleton Moor, Theberton East, Theberton West and the B1122 Road Improvement). Potential impacts are considered individually for each of these.

Middleton Moor crosses Middleton Watercourse. This is designated as a Main River and drains to Minsmere River. There is also a pond adjacent Yankee Lodge.

Theberton East crosses Theberton Watercourse, also designated as a Main River and draining to Minsmere River northeast of Theberton. The crossing point of Theberton Watercourse is approximately 800m upstream of the Minsmere-Walberswick Heaths and Marshes SSSI.

Theberton West also crosses Theberton Watercourse however to the west of Theberton and further upstream. In addition, Theberton West crosses another small watercourse, northwest of Theberton, which also ultimately drains to Minsmere River. Theberton West is also adjacent to three small ponds.

The only surface water feature considered to potentially be impacted by B1122 Road Improvement is a small pond that lies east of the B1122, adjacent to the proposed widened carriageway.

With reference to Table 4.6.3, each of these water crossings and ponds are considered to be of Low importance. This is because none of them are designated sites and they are of minimal economic or social use. . It is not known if the non-main watercourses and ponds could potentially support Great Crested Newts. For the purposes of this high level optioneering assessment it is assumed that they do not.

Construction

Silt-laden runoff (minor magnitude in the primary study area/ negligible magnitude in the secondary study area):

Construction work will generate silt-laden runoff which could cause short term, temporary, but potentially acute pollution of the surface waters if it is allowed to drain to a receiving watercourse without appropriate treatment. Once it reaches the river, the reduced water quality could have secondary effects on the aquatic ecosystem (e.g. fish, macroinvertebrates). In the case of sub-option's Middleton Moor, Theberton East and Theberton West this risk would be present around the proposed river crossing locations. In the case of the ponds in sub-options Middleton Moor, Theberton West and B1122 Road improvement, this risk would be of pollution would be isolated to adjacent ponds (and not downstream of them). In addition, material deposited on the existing carriageway by existing construction vehicles may be mobilised in runoff and reach nearby watercourses depending on the drainage arrangement.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be of Insignificant Impact. This is relevant for each of the sub-options.

The significance of this impact for features considered to be of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be of Low Significance. Note this is only relevant for sub-options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed sub-option Theberton East route) is considered to be of Significant Impact. This assessment is considered to be very conservative given that the SSSI is approximately 800m downstream of the crossing (so that any impact may have diminished by the point the watercourse reaches the SSSI). In addition, as the SSSI is tidal a range of turbidity levels would likely be experienced and flora and fauna would have adapted to such conditions (and so a pulse of sediments may not have a significant impact). Furthermore any impact would be short term and temporary and may in fact have diminished by the point at which any sediment is released. Note this is only relevant for sub-option Theberton East.

- Chemical / fuel contamination and spillages or leaks (moderate magnitude in the primary study area/ minor magnitude in the secondary study area):

Construction processes could result in runoff contaminated with fuels and other pollutant substances (e.g. cement, paints, sealant, lime, etc.) which are either used or stored on site. In addition, there is also the potential risk of chemical and / or fuel spillages and leaks from plant and machinery. This could cause short term, temporary but acute pollution of the surface water environment if allowed to reach receiving watercourses in particular. Furthermore, secondary effects on the aquatic ecosystem could also occur as a result of the pollution incident. The risk to the water environment will be highest at crossing points and adjacent to ponds, although unknown land drains and surface water sewers could act as potential pathways to watercourses elsewhere.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be of Insignificant Impact. This is relevant for each of the sub-options.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be Significant. Note this is only relevant for sub-options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed sub-option Theberton East route) is considered to be Highly Significan**t**. Note this is only relevant for sub-option Theberton East.

- Localised erosion of bed and banks (moderate magnitude in the primary study area/ minor magnitude in the secondary study area):

In the case of the options with watercourse crossings (sub-options Middleton Moor, Theberton East and Theberton West) localised erosion of the watercourse banks and bed may result during the construction period. In addition, should new outfalls associated to highway drainage be required there may be additional localised erosion.

The significance of this impact for features considered to be of low importance (rivers being crossed) is considered to be of Insignificant Impact. This is relevant for sub-options Middleton Moor, Theberton East and Theberton West only.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be Significant. Note this is only relevant for options Middleton Moor, B and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed sub-option Theberton East route) is considered to be Highly Significant. This assessment is considered to be very conservative given that the SSSI is approximately 800m downstream of the crossing (so that any impact would likely have diminished by the point the watercourse reaches the SSSI). Note this is only relevant for Theberton East.

- Inappropriate disposal of waste on site (negligible magnitude):

Welfare services will be provided at the designated construction compound, and it is also expected and assumed that a limited number of portable toilets would be provided across the development working area. If it is not possible to connect these facilities to existing public foul sewers, waste water from these facilities will be regularly emptied by an appropriate specialist Contractor and disposed of off-site. Foul waste water from toilet and welfare facilities will not be discharged into a watercourse under any circumstances.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be Insignificant. This is relevant for sub-options Middleton Moor, Theberton East and Theberton West only.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be of Insignificant Impact. This is only relevant for sub-options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered to be of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed Theberton East route) is considered to be of Low Significance. Note this is only relevant for sub-option Theberton East.

Operation

- Water pollution from highway runoff (negligible magnitude):

The proposed options could result in changed discharges of highway runoff into receiving watercourses from highway drainage. Surface water runoff from roads can contain pollutants such as hydrocarbons, heavy metals, inert particulates, litter and organic matter which can cause chronic pollution of the water environment if allowed to enter watercourses without the appropriate treatment / dilution. Although the proposed sub-options would increase the surface area of impermeable road and thus the volume of highway runoff into local watercourses, only relatively low traffic flows (i.e. all less than 8,000 24 hour Annual Average Daily Traffic (AADT)) are predicted. These flows are significantly below the threshold of 10,000 AADT that is widely accepted as the point where highway runoff can start to impact on receiving watercourses and thus a quantitative assessment would not be necessary during an impact assessment stage. It is considered that appropriate levels of treatment will be applied during detailed drainage design in consultation with water quality specialists.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be Insignificant. This is relevant for options Middleton Moor, Theberton East and Theberton West only.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be of Insignificant Impact (due to distance from the crossings). This is only relevant for sub-options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed sub-option Theberton East route) is considered to be of Low Significance. Note this is only relevant for sub-option Theberton East.

- Spillage risk from polluting substances (negligible magnitude):

Preliminary traffic figures indicate an increase in vehicles using the proposed options (including HGVs). Given the location, near to the East Anglian coast and in a reasonably rural area, it is assumed that most HGVs using this route will be transporting goods that will be or have been carried by ocean going craft (rather than being used locally) via the port of Lowestoft. Goods carried by ocean going craft are typically not hazardous since carrying them on ocean going craft is considered to be a high risk activity. Hence goods on the HGVs using the proposed highways would similarly not be carrying hazardous materials.

In the case of sub-options Middleton Moor, Theberton East and Theberton West there would be the introduction of new junctions that can have implications for spillage risk. B1122 Road Improvement (carriageway widening and levelling) would have limited implications for spillage risk. Precautionary containment features will be in place along the highway to further minimise the risk from spillages.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be of Insignificant Impact. This is relevant for options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be Insignificant (due to distance from the crossings). This is only relevant for options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed option Theberton East route) is considered to be of Low Significance. Note this is only relevant for sub-option Theberton East.

- Morphological effects (mino**r** magnitude in the primary study area/ negligible magnitude in the secondary study area):

The location of new watercourse crossings (assumed to be box culverts) and any new outfalls to allow for highway drainage would have a long term morphological effect on the receiving watercourses.

The significance of this impact for features considered to be of low importance (rivers being crossed, adjacent ponds) is considered to be Insignificant. This is relevant for options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance but in the secondary study area (designated sites more than 1 km downstream of the proposed routes) is considered to be of Insignificant Impact (due to distance from the crossings). This is only relevant for options Middleton Moor, Theberton East and Theberton West.

The significance of this impact for features considered being of very high importance and in the primary study area (Minsmere-Walberswick Heaths and Marshes SSSI approximately 800m downstream of the proposed sub-option Theberton East route) is considered to be of Significant Impact. Note this is only relevant for sub-option Theberton East.

- Potential loss of ponds (major magnitude):

In the case of the sub-options Middleton Moor, Theberton West and the B1122 Road Improvement the adjacent ponds may be lost as a result of the proposed developments. From a water environment perspective the loss of these ponds may have drainage implications (noting that there may be biodiversity impacts also).

Acknowledging that these features are of low importance the significance of this impact is considered to be of Low Significance. This is relevant for sub-options Middleton Moor, Theberton West and the B1122 Road Improvement only.

4.6.6.2 D2 New Route Option

This option crosses two Main Rivers that are designated under the WFD (Hundred River and River Fromus). It also crosses a number of minor field drains. There are seven ponds located adjacent to the route. The River Fromus is considered to be of High importance due to the

presence of European protected species (eels). All of the other watercourses are designated as Low importance.

Construction

- Silt-laden runoff (Minor magnitude):

Construction work will generate silt-laden runoff which could cause short term, temporary, but potentially acute pollution of the surface waters if it is allowed to drain to a receiving watercourse without appropriate treatment. Once it reaches the river, the reduced water quality could have secondary effects on the aquatic ecosystem (e.g. fish, macroinvertebrates). In the case of the proposed D2 Route Option there will be construction risks at watercourse crossing locations. In the case of the ponds along the route silt pollution is more isolated to adjacent ponds (and not downstream of them). In addition, muds deposited on the existing carriageways by existing construction vehicles may be mobilised in runoff and reach nearby watercourses depending on the drainage arrangement which is currently unknown.

The significance of this impact for features considered to be of low importance (rivers other than the Fromus being crossed, adjacent ponds) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of high importance (crossing of the River Fromus) is considered to be of Low Significance.

The significance of this impact for features considered to be of very high importance and in the primary study area (Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route) is considered to be Significant.

- Chemical / fuel contamination and spillages or leaks (moderate magnitude):

Construction processes could result in runoff contaminated with fuels and other pollutant substances (e.g. cement, paints, sealant, lime, etc.) which are either used or stored on site. In addition, there is also the potential risk of chemical and / or fuel spillages and leaks from plant and machinery. This could cause short term, temporary but acute pollution of the surface water environment if allowed to reach receiving watercourses in particular. Furthermore, secondary effects on the aquatic ecosystem could also occur as a result of the pollution incident. As with silt-laden runoff above, the risk to the water environment will be highest at crossing points and adjacent to ponds, although unknown land drains and surface water sewers could act as potential pathways to watercourses elsewhere.

The significance of this impact for features considered to be of low importance (rivers other than the Fromus being crossed, adjacent ponds) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of high importance (crossing of the River Fromus) is considered to be of Significant Impact.

The significance of this impact for features considered to be of very high importance and in the primary study area (Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route) is considered to be of Highly Significant Impact.

- Localised erosion of bed and banks (moderate magnitude):

Localised erosion of bed and banks of all crossed watercourses (Hundred River, Fromus and two field drains) may result during the construction period. The crossing of the Hundred River already exists on the B1119 yet it is assumed that strengthening work would be undertaken here and thus the effect may still result. In addition, should new outfalls associated to highway drainage be required there may be additional localised erosion.

The significance of this impact for features considered to be of low importance (rivers other than the Fromus being crossed) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of high importance (crossing of the River Fromus) is considered to be of Significant Impact.

The significance of this impact for features considered to be of very high importance and in the primary study area (Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route) is considered to be of Highly Significant Impact.

- Inappropriate disposal of waste on site (negligible magnitude):

Welfare services will be provided at the designated construction compound, and it is also expected and assumed that a limited number of portable toilets would be provided across the development working area. It is possible that waste from these facilities could leak or be transferred to the surface water environment. If it is not possible to connect these facilities to existing public foul sewers, waste water from these facilities will be regularly emptied by an appropriate specialist Contractor and disposed of off-site. Foul waste water from toilet and welfare facilities will not be discharged into a watercourse under any circumstances.

The significance of this impact for features considered being of low and high importance (all rivers being crossed, adjacent ponds, designated sites more than 1 km downstream of the proposed routes) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of very high importance and in the primary study area (Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route) is considered to be of Low Significance Impact.

Operation

- Water pollution from highway runoff (negligible magnitude):

The proposed options could result in new discharges (and changed discharges) of highway runoff into receiving watercourses from highway drainage. Surface water runoff from roads can contain pollutants such as hydrocarbons, heavy metals, inert particulates, litter and organic matter which can cause chronic pollution of the water environment if allowed to enter watercourses without the appropriate treatment / dilution.

Although the proposed D2 Route option would increase the surface area of impermeable road and thus the volume of highway runoff into local watercourses, only relatively low traffic flows (i.e. all less than 8,000 24 hour Annual Average Daily Traffic (AADT)) are predicted. These flows

are significantly below the threshold of 10,000 AADT that is widely accepted as the point where highway runoff can start to impact on receiving watercourses and thus a quantitative assessment would not be necessary during an impact assessment stage.

It is considered that appropriate levels of treatment will be applied during detailed drainage design in consultation with water quality specialists and thus the significance of this impact for features considered to be of low and high importance (all rivers being crossed, adjacent ponds, designated sites more than 1 km downstream of the proposed routes) is considered to be of Insignificant Impact.

The significance of this impact for features considered being of very high importance, and in the primary study area, Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 route is considered to be of a Low Significance Impact.

- Spillage risk from polluting substances (negligible magnitude):

Preliminary traffic figures indicate an increase in vehicles using the proposed D2 route (including HGVs). Given the location, near to the East Anglian coast and in a reasonably rural area, it is assumed that most HGVs using this route will be transporting goods that will be or have been carried by ocean-going craft (rather than being used locally) via the port of Lowestoft. Goods carried by ocean=going craft are typically not hazardous since carrying them on ocean=going craft is considered to be a high risk activity. Hence goods on the HGVs using the proposed highways would similarly not be carrying hazardous materials.

As much of the new D2 Route Option will be new there would be the introduction of new junctions that can have implications for spillage risk. Precautionary containment features will be in place along the highway to further minimise the risk from spillages. The significance of this impact for features considered being of low and high importance (all rivers being crossed, adjacent ponds) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of very high importance, and in the primary study area, Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route is considered to be of a Low Significance Impact.

- Morphological effects (minor magnitude):

The location of new watercourse crossings (assumed to be box culverts) and any new outfalls to allow for highway drainage would have a long term morphological effect on the receiving watercourses. This route crosses two Main Rivers (also both designated under the WFD) and a number of field drains. The significance of this impact is considered to be Insignificant.

The significance of this impact for features considered to be of low importance (rivers other than the Fromus being crossed, adjacent ponds) is considered to be of Insignificant Impact.

The significance of this impact for features considered to be of high importance (crossing of the River Fromus) is considered to be of a Low Significance Impact.

The significance of this impact for features considered to be of very high importance, and in the primary study area, Sizewell Marshes SSSI approximately 1km downstream of the proposed D2 New Route) is considered to be of Significant Impact.

- Potential loss of ponds (major magnitude):

In the case of this option the adjacent ponds may be lost as a result of the proposed developments. From a water environment perspective the loss of these ponds may have drainage implications, noting that there may be biodiversity impacts also.

Acknowledging that these features are of low importance the significance of this impact is considered to be of a Low Significance Impact.

4.6.7 Opportunity for Mitigation and Enhancement

Mitigation measures and design measures that could be utilised within the scheme are presented below.

4.6.7.1 Construction

- General measures:

It is recommended that construction work should be in accordance with best-practice measures issued by the Environment Agency (e.g. Getting Your Site Right: Industrial and Commercial Pollution Prevention (2004) and Pollution Prevention Guidelines (various dates)) and CIRIA (e.g. Report 648: Control of Water Pollution from Linear Construction Projects –Technical Guidance (2006)).

In addition, all work would have to be carried out under appropriate consents / permits / licences, if necessary. For example, should trade effluent (including silt-laden runoff) be discharged into a controlled water a Water Activity Permit from the EA, under the Water Resources Act 1991 (as amended) and the Environmental Permitting (England and Wales) 2010, would be required. Temporary and permanent Flood Defence Consent will be required from the EA to cross Main Rivers or install highway drainage outfalls on the banks of Main Rivers.

- Silt-laden runoff:

To mitigate silt-laden, silt management and control measures can be proposed (and set out in the Construction Environmental Management Plan (CEMP) or Silt Management Plan (SMP)). Works should be timed and undertaken to minimise the formation of silt laden runoff, with mitigation measures in place to intercept any that is generated so that it can be treated and discharged to ground or a watercourse to reduce the risk of adverse effects. For example, mud will be controlled at entry and exits to the site using wheel washes and / or road sweepers, or site compounds and stockpiles will be located away from surface water attributes.

Through utilisation of such mitigation it is considered that there would be a residual negligible impact.

- Chemical / fuel contamination and spillages or leaks:

In order to mitigate this risk a number of measures would be proposed and set out in a pollution prevention plan (and CEMP). This would include measures such as refuelling of plant will take place in a designated area at the site compound only, with any stored fuel in a bunded container and an isolated drainage system to trap any spill and an Emergency Response Plan would be prepared.

Through utilisation of such mitigation it is considered that there would be a residual negligible impact.

- Localised erosion of bed and banks:

From a design perspective it would be recommended that an open span structure be in-place at crossings of Main Rivers. However, should this not be feasible, it may be possible to design culverts that are environmentally sensitive e.g. oversize arch allowing a natural channel and to allow light in to a larger percentage of the covered channel.

Through utilisation of such approaches it is considered that there would be a residual Minor Impact.

As highlighted above, all work adjacent to watercourses would be carried out with the appropriate consent in place (either from the Environment Agency East Suffolk Internal Drainage Board (IDB) or Suffolk County Council who are the Lead Local Flood Authority LLFA).

4.6.7.2 Operation

- Water pollution from highway runoff and spillage risk from polluting substances:

It is recommended that an appropriate drainage system is selected to treat the surface runoff and act as a storage environment for highway spillages (slowing their conveyance to the attributes. An appropriate ‘treatment train’ should be provided to treat the runoff. This may include swales / grassed channels, surface flow wetlands, balancing ponds or sedimentation ponds. These features would ‘fit’ well in the rural landscape. The residual impact would remain negligible as a result of this mitigation.

- Morphological effects:

The morphological effects of resulting from the presence of new outfalls (for highway drainage) can be softened by sensitive design. For example, coir rolls can be utilised to soften the appearance of the headwall and allow vegetation to establish. The residual impact would still remain minor through inclusion of this mitigation.

- Potential loss of ponds:

To avoid this impact we recommend that the proposed routes do not go through ponds but are diverted around. If the ultimate route results in the loss of ponds nearby replacement ponds should be constructed and any adverse impact on drainage (e.g. surface and sub-surface flows) should be mitigated for. As a result of this it is considered that there would be a residual minor impact.

4.6.8 Residual Impacts

The residual impacts of the potential impacts are presented below in Tables 4.6.6 and 4.6.7:

Table 4.6.6: Residual impacts pre and post mitigation for B1122 Local bypass option

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	**Significance (Pre-Mitigation)**	**Magnitude of Impact**	**Significance (Post-Mitigation)**
Construction				
Silt-laden runoff	Minor	Middleton Moor- Up to Low Significance	Negligible	Middleton Moor - Insignificant
		Theberton East- Up to Significant		Theberton East - Up to Low Significance
		Theberton West - Up to Low Significance		Theberton West - Insignificant
		B1122 Road Improvement- Insignificant		B1122 Road Improvement - Insignificant
Chemical / fuel contamination and spillages or leaks	Moderate	Middleton Moor - Up to Significant	Negligible	Middleton Moor - Insignificant
		Theberton East - Up to Highly Significant		Theberton East - Up to Low Significance
		Theberton West - Up to Significant		Theberton West - Insignificant

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	**Significance (Pre-Mitigation)**	**Magnitude of Impact**	**Significance (Post-Mitigation)**
		B1122 Road Improvement - Insignificant		B1122 Road Improvement - Insignificant
Localised erosion	Moderate	Middleton Moor - Up to Significant	Minor	Middleton Moor - Up to Low Significance
		Theberton East - Up to Highly Significant		Theberton East - Up to Significant
		Theberton West - Up to Significant		Theberton West - Up to Low Significance
		B1122 Road Improvement - n/a		B1122 Road Improvement - n/a
Inappropriate disposal of waste	Negligible	Middleton Moor - Insignificant Significance	Negligible	Middleton Moor - Insignificant Significance
		Theberton East - Up to Low Significance		Theberton East - Up to Low Significance
		Theberton West - Insignificant Significance		Theberton West- Insignificant Significance
		B1122 Road Improvement - Insignificant		B1122 Road Improvement - Insignificant
Operation				

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	**Significance (Pre-Mitigation)**	**Magnitude of Impact**	**Significance (Post-Mitigation)**
Water pollution from highway runoff	Negligible	Middleton Moor - Insignificant	Negligible	Middleton Moor - Insignificant
		Theberton East - Up to Low Significance		Theberton East - Up to Low Significance
		Theberton West - Insignificant		Theberton West - Insignificant
		B1122 Road Improvement - Insignificant		B1122 Road Improvement – Insignificant
Spillage risk from polluting substances	Negligible	Middleton Moor - Insignificant	Negligible	Middleton Moor – Insignificant
		Theberton East - Up to Low Significance		Theberton East - Up to Low Significance
		Theberton West - Insignificant		Theberton West – Insignificant
		B1122 Road Improvement - Insignificant		B1122 Road Improvement – Insignificant
Morphological effects	Minor	Middleton Moor - Insignificant	Minor	Middleton Moor – Insignificant
		Theberton East - Up to Significant		Theberton East - Up to Significant

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	**Significance (Pre-Mitigation)**	**Magnitude of Impact**	**Significance (Post-Mitigation)**
		Theberton West - Insignificant		Theberton West – Insignificant
		B1122 Road Improvement - Insignificant		B1122 Road Improvement – Insignificant
Loss of Ponds	Major	Middleton Moor - Up to Low Significance	Negligible	Middleton Moor – Insignificant
		Theberton East - n/a		Theberton East - n/a
		Theberton West - Up to Low Significance		Theberton West – Insignificant
		B1122 Road Improvement - Up to Low Significance		B1122 Road Improvement – Insignificant

Table 4.6.7: Residual impacts pre and post mitigation for D2 New route option

Potential impact	Pre-Mitigation		Post-Mitigation	
	Magnitude of Impact	**Significance (Pre-Mitigation)**	**Magnitude of Impact**	**Significance (Post-Mitigation)**
Construction				
Silt-laden runoff	Minor	Up to Significant	Negligible	Up to Low Significance
Chemical / fuel contamination and spillages or leaks	Moderate	Up to Highly Significant	Negligible	Up to Low Significance
Localised erosion	Moderate	Up to Highly Significant	Minor	Up to Low Significance
Inappropriate disposal of waste	Negligible	Up to Low Significance	Negligible	Up to Low Significance
Operation				
Water pollution from highway runoff	Negligible	Up to Low Significance	Negligible	Up to Low Significance
Spillage risk from polluting substances	Negligible	Up to Low Significance	Negligible	Up to Low Significance
Morphological effects	Minor	Up to Significant	Minor	Up to Significant
Loss of Ponds	Major	Up to Low Significance	Negligible	Insignificant

4.6.9 Options Summary

An assessment of the potential significance of impacts associated with each of the proposed B1122 and D2 sub-options has been undertaken. The assessment acknowledged the

importance of watercourses in the vicinity and downstream of the works and the magnitude of potential impacts associated with the scheme (accounting for likely best practice mitigation).

4.6.9.1 B1122

The assessment determined that B1122 Road Improvement is considered to have an insignificant impact on the surface water environment.

Impacts associated with sub-options Middleton Moor and Theberton West are considered to be of low significance. Impacts associated with sub-option Theberton East are considered to be significant. Given that sub-options Theberton West and Theberton East are alternatives, from a surface water environment we would recommend option Theberton West is taken forward. Impacts are potentially more significant for sub-option Theberton East given that it is substantially closer to the Minsmere-Walberswick Heath and Marshes SSSI (that lies approximately 800m downstream of a river crossing proposed by sub-option Theberton East).

4.6.9.2 D2

The assessment determined that impacts associated with the D2 route could be significant. The greatest risk is associated with potential impacts on the Sizewell Marshes SSSI. The second greatest risk is considered to be associated with the River Fromus, crossing river containing protected species (eel). Note that any new crossing of the river must not prohibit the movement of eel/ elvers.

4.6.9.3 B1122 vs D2

If B1122 were to include sub-option C rather than B we would recommend that the B1122 upgrades are undertaken rather than the new route. If Theberton East is included, then the relative risks to the Minsmere-Walberswich Heath and Marshes SSSI and Sizewell Marshes SSSI should be evaluated in detail to determine what would have the least environmental impact, potentially in consultation with Natural England. If they were found to have an equal impact on the designated sites we would recommend that the B1122 route is upgraded since it does not cross a river with protected species and is of a shorter length.

5 Mitigation Measure

5 Mitigation Measures – Noise Barriers

5.1 Introduction

It has been put forward by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue. Following this raised concern; noise barrier proposals with the inclusions of costing have been explored.

5.2 Noise Barriers

The proposed routes of the B1122 bypass and D2 sub-options will affect the noise levels experienced at properties in the vicinity of the routes. The large quantity of vehicles on the routes will generate a continuous stream of noise from the engine and tyres of the vehicles. Adverse or beneficial effects on present noise levels are dependent on the proximity of the property location to the proposed route. A preliminary calculation on where noise barriers may need to be constructed and the extent of the noise barriers is detailed below.

The lengths have been calculated using guidance from DMRB Volume 10 (5) titled *'Environmental Barriers: Technical Requirements'.* As can be seen in section 3.2 of the report, a 200m corridor was evaluated with Noise Sensitive Receptors (NSR) located at properties within this area. At a 200m distance the angle of view can be calculated to be approximately 89.1°, if a 3m high noise barrier is installed at the side of the highway. By taking this value, a degree multiplier of approximately two can be read off the graph below;

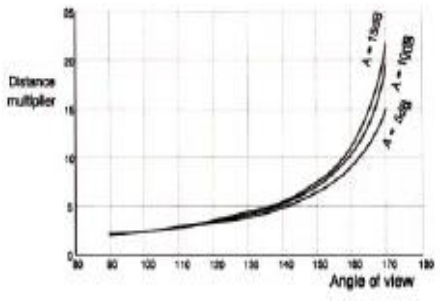

Figure 5.2.1: Graph representing distance multiplier compared to angle view of property DMRB, Volume 10, Section 5.

This graph is a rule of thumb that has been modified by the distance of the property from the road. It is also important to note that after 300m, the noise attenuation experienced with respect to the noise barrier is negligible in the rural location that the proposed routes are in. This is because soft ground such as countryside absorbs sound waves, attenuating the noise quickly over a distance.

Properties with a change in 3dB $L_{night, outside}$ or more have been deemed to be above the threshold levels where a Do-Minimum vs Do-Something comparison has been made. These are properties that need measures to reduce the effect of increased noise by the construction of the proposed routes with the worst case scenario excluding Sizewell related traffic. AECOM are proposing to mitigate these effects by the construction of three metre high timber fencing, commonly known as noise or acoustic barriers.

Table 5.2.2, below, details the evaluation of the data from the NSR's from the survey detailed in section 4.2 of the main report. A summary of the lengths can be found in Table 5.2.3. An explanation and relevant assumptions for the table can be found in the section after the tables.

Table 5.2.2: Indication of noise barrier location and length

Route	Length of fence (m)	No. of properties effected	Properties affected	Change in Noise (long term) (dB)	Difference in level of road (m)	Fill/Excavation
Theberton Bypass East (Option B)	400	21	Marsh End Bungalow NSR B1467	5.1	+5.05	Fill from 1000-1200 and then same level
Theberton Bypass West (Option C)	400	13	Theberton Grange NSR B1251	4.4	-5.17	Same level so full fence length needed
D2	0					

Table 5.2.3: Summary of lengths of noise barriers

Route	No. of noise barriers
Theberton Bypass East (Option B)	1 x 400m
Theberton Bypass West (Option C)	1 x 400m
D2	0

5.3 Assumptions

- A 400m length noise barrier has been assumed as a conservative length to protect the properties. This is considered a worst case scenario and the length could be reduced by the following:
    - Data on the proximity of residential properties in relation to the proposed route. The closer the property to the road the smaller the noise barrier can be in accordance with Figure 5.2.1.
    - Topography data between the properties and the road. This could allow a natural noise barrier to be created between the road and the property reducing the need for a noise barrier.
- A three metre high fence has been calculated to be the optimum height for the noise barrier. This is calculated from guidance from the DMRB Volume 10, Section 5, that noise barriers should be within two and five metres. This is also a readily available height for a fence panel.
- The noise barrier has been positioned in the most beneficial location to protect the respective property. This is affected by the curvature of the road and also the proximity of roundabouts and side road. This may skew the 400m length noise barrier to the left or right of the property, to allow the optimum protection to be achieved.
- The ‘Difference in Level of the Road’ column gives an indication of the gradient of the proposed routes. The ‘Fill/Excavation’ column allows the reader to interpret whether there is a need for additional fill or the need to excavate when constructing the new route. This may allow for a natural barrier to be formed protecting the properties.

6 Journey Times, Accidents and CO_2

6 Journey Times Accidents and CO2 Benefits

6.1 Introduction

This chapter sets out the traffic and economic assessment that has been undertaken for the B1122 between the A12 between Yoxford and Lover's Lane near Leiston and a proposed D2 route between the A12 south of Saxmundham and Lover's Lane bypassing the B1121 and B1119 roads.

Traffic data has been sourced from Suffolk County Council (SCC) and automatic traffic counts (ATC) and ATC and junction counts undertaken on behalf of EDFE in 2011.

There is very limited information regarding expected Sizewell C traffic and this has been sourced from the December 2012 consultation documents and knowledge from discussions with EDFE in the intervening period.

6.2 B1122 Traffic Data

Traffic volumes on the B1122 are significantly lower than the A12. Data obtained from EDFE surveys in May 2011 gave the flow data presented in Table 6.2.1. The Onner's Lane count was from an ATC although only Monday, Tuesday and Wednesday data were available. This count was used to factor the Friday MCTC data from 12hr to 24hr. The A12 permanent count site was used to factor from May data to average annual daily traffic (AADT). As the MCTC data was collected on a Friday the AADT factor was 0.884 whereas for the ATC data the factor was 1.039.

Table 6.2.1: B1122 Traffic volumes - 2011

Location		12hr (May) (0700-1900)		24hr (May)	AADT
	Bypass Section	NB	SB	2-Way	2-Way
A12 Junction	Middleton Moor	1,356	1,517	3,257	2,880
North of B1125	Middleton Moor	1,157	1,270	2,751	2,433
South of B1125	Theberton East/ West	2,074	2,209	4,855	4,293
South of Onner's Lane (ATC)	B1122 Road Improvement	2,101	2,112	4,776	4,963
Abbey Road north of Abbey Lane	B1122 Road Improvement	2,447	2,548	5,663	5,007

Traffic volumes on the B1122 between Sizewell (Lover's Lane) and the A12 are about 5,000 vehicles per day (vpd) south of the B1125 and 2,500-3,000 per day north of the B1125. The highest hourly 1-way volumes are about 350 vehicles per hour south of the B1125.

General traffic growth and Sizewell development traffic is expected to increase traffic by about 50% to 2024 of which general growth accounts for 20%. Even with this level of growth average traffic speeds are unlikely to be significantly affected due to the low hourly volumes which would still only reach around 500 vehicles per hour.

Only limited TrafficMaster data has been provided for the B1122 and data is only available for one direction. It is therefore not possible to generate a speed-flow relationship as has been done for the A12. The annual average data indicates that the average travel speed is 62kph. Given that traffic volumes are relatively low, even during peak periods, it is considered that the speed of traffic is unlikely to differ much from the annual average.

At the request of SCC, in the previous assessment of the B1122, the speed of all traffic on the proposed bypasses is assumed to be limited to the legal speed for HGVs which is 40mph on single carriageway all purpose roads. As this is equivalent to 64kph or just above the current observed average speed, any bypass options will provide very little time savings compared to the existing B1122. As the Middleton Moor bypass and the Theberton Bypass are longer than the section of route they are bypassing, there are likely to be time dis-benefits for traffic using these new sections of road.

AECOM revisited guidance and assumptions on speed flow curves and the appropriate approach to take given lack of data and the relatively low overall traffic volumes even with development related traffic. The limit on car speed in the DS scenarios has been removed. This increases the benefits.

6.3 B1121 / B1119 (D2 Bypass route) Traffic Data

The proposed D2 option provides an alternative route to the B1121 and B1119. For Sizewell C HGV traffic it also provides an alternative and much shorter route than the A12/B1122.

Traffic data for the B1119 has been obtained from SCC and EDFE. The SCC survey indicates that the 2-way traffic volume is some 3,000 vpd.

The EDFE junction survey at the B1119/B1121 in Saxmundham gave an equivalent AADT flow of 5,600 although this may be due to there being a Waitrose supermarket just to the east of this junction off the B1119.

The D2 route would provide an alternative route to the B1121 between the A12 (south) and Saxmundham. At its junction with the A12 an EDFE 2011 turning count gave an equivalent AADT 2-way flow of 2,650 vpd on the B1121 compared to 4,730 at the junction with the B1119. The difference in volumes between these two junctions is likely to be due to traffic travelling to/from the B1121 connecting Saxmundham with the A1094 and Aldeburgh. It is assumed that the majority of the 2,650 vpd at the A12 end of the B1121 will be travelling to/from Saxmundham.

The third road that a D2 would bypass is Abbey Lane which connects the B1119 and B1122. From an EDFE 2011 count at the B1122 junction the daily volume on this road is just 530 vpd. It is likely that the majority of this traffic is travelling to/from the B1119 west although there is a caravan park off this road.

Based on existing traffic volumes and assumptions about traffic origin and destinations it is considered that the proposed D2 route would attract the volumes of existing traffic set out in Table 6.3.1. For the economic assessment these would be increased to account for background and development traffic in the three forecast years.

Table 6.3.1: Estimated existing traffic volumes using proposed D2 route

D2 Section	AADT (2-way)
Between the A12 and B1121*	2,500
Between B1121 and B1119**	2,500
Between B1119 and Abbey Lane	3,000
Between B1119 and B1122	500

*assuming no transfer from B1119 west of Saxmundham

**assumes 500 vpd remain on existing B1119 into Saxmundham

As with the B1122 only limited TrafficMaster data have been provided for the B1121 and B1119 routes and data are only available for one direction. It is therefore not possible to generate a speed-flow relationship as has been done for the A12. The annual average data indicates that the average travel speed is about 54kph. Given that traffic volumes are relatively low, even during peak periods, it is considered that the speed of traffic is unlikely to differ much from the annual average. Given this, it has been assumed that the speed on the B1121/B1119/Abbey Lane is 54kph throughout the whole length of route between the A12 and B1122.

As for the B1122 bypass options SCC have requested that the assumed speed of all vehicles on the D2 route will be limited to the maximum legal speed of HGVs e.g. 40mph (64kph). As the proposed route is shorter than existing routes (particularly for Sizewell HGV traffic) it is expected that there will be time savings attributable to the D2 route although these would be lower than assuming cars and LGV speeds would be consistent with DMRB speed-flow relationships.

6.4 Growth Data

To obtain future year traffic volumes the TEMPRO version 6.2 database has been used to extract growth in trips from 2012. To these trip end growth factors fuel and income adjustment

factors are applied using the current version of factors in the January 2014 version of the WebTAG databook.

Data for three forecast years have been derived:

- 2020 – Scheme Opening
- 2024 – Assumed Sizewell 'C' peak construction year
- 2031 – First forecast year without Sizewell 'C' construction traffic

Applying the above growth process results in the forecast two-way AADT volumes as detailed in Table 6.4.1 and 6.4.2. There is forecast growth of about 35% to 2031.

Table 6.4.1: B1122 Annual average daily traffic volumes

	2011	2020	2024	2031
Section 1 – Middleton	2433	2729	2881	3283
Section 2 - Theberton	4293	4816	5084	5793

Table 6.4.2: B1121 & B1119 Annual average daily traffic volumes

	2011	2020	2024	2031
Section 1 - B1121 (A12 to B1121)	2,649	2,972	3,137	3,575
Section 2 - B1121 (B1121 to D2)	4,731	5,307	5,603	6,384
Section 3 - B1121 (D2 to B1119)	4,731	5,307	5,603	6,384
Section 4 - B1119 (B1121 to D2)	3,008	3,374	3,562	4,059
Section 5 - Abbey Lane (B1119 to B1122)	531	596	629	717

6.5 Sizewell C Construction (Development) Traffic

There is only limited information available from the EDFE 2012 consultation documents. Based on what is stated in these the following summarises what information is provided and what assumptions has been included within the assessment.

6.5.1 Car trips

No detail is provided within the EDFE consultation documents as to how many car trips are likely to be generated by Sizewell C construction.

EDFE are proposing a 1000 space on-site car park. In discussions with EDFE during 2013 AECOM considered that a 1000 space car park would be used by around 1200 cars per day for commuting purposes based on shift patterns, i.e. about 2400 single trips.

It is considered by EDFE that the majority of car trips from the A12 south and A12 north will use the proposed park and ride sites.

AECOM have assumed that commuting trips using the on-site car park will originate from the following areas:

- 25% from areas east of the A12;
- 25% from areas west of the A12;
- 25% using the A12 south; and
- 25% using the A12 north.

There would also be car trips on business/visitor purposes which have not been defined by EDFE but have been assumed to be 200 two-way trips per day at peak construction. 66% of Business/Visitor trips have been assumed to originate from the A12 south and 34% from the A12 north.

6.5.2 LGV trips

During the construction peak EDFE have estimated that there would be on average 170 visits (340 movements), with the busiest day being some 50% higher than this, i.e. 255 visits (510 movements). EDFE do not provide any assessment of where these LGV trips will originate.

This assessment has used the average daily volume of 170 and assumed that 66% originate from the A12 south and 34% from the A12 north.

6.5.3 HGV trips

During the construction peak EDFE have estimated that there would be between 100 and 300 HGV deliveries per day with the busiest day being some 50% higher than this. EDFE expect that 85% of HGVs would originate from the A12 south and 15% from the A12 north.

The assessment has uses the upper average daily volume of 300 HGV deliveries (600 1-way trips) and assumed 85% originate from the A12 south and 15% from the A12 north.

6.5.4 Bus trips

EDFE do not provide any indication as to the number of bus trips that are expected to be generated during construction. EDFE are proposing two park and ride sites on the A12 and some direct buses from Ipswich and from Saxmundham railway station.

For the purposes of this assessment it has been assumed that the P&R frequency is every fifteen minutes or four buses per hour in each direction at both sites between 0600 and 2400. It has been assumed that there are two buses per hour between Ipswich and Sizewell and one bus per hour from Saxmundham.

6.5.5 Combined trips

Although construction related traffic is likely to vary by day and hour it has been assumed for assessment purposes that traffic volumes will be constant across each day. The majority of Sizewell trips will occur between 0600 and 2400 and it will be assumed that volumes are evenly spread across each of these 18 hours. This results in the following construction related trips in 2024:

Table 6.5.1: Assumed hourly Sizewell C Trips (2024)

Route	Car	LGV	HGV	Bus	Total Vehicles (hourly by direction)	Total Vehicles (daily both directions)
A12 Four Villages	24	6	14	6	**50**	**1814**
B1122*	29	3	17	4	**53**	**1896**
B1119	32	6	0	7	**46**	**1640**
D2 Route**	32	6	17	11	**66**	**2384**

*It is assumed that all Sizewell C construction HGV trips will access the site via the B1122.

**It is assumed that all Sizewell C construction HGV and Bus trips will use the D2 route.

6.6 Benefits

This section of the report details the assessment of the B1122 and the D2 scheme options. The assessment has been undertaken using the DfT's TUBA program. This uses a number of scheme specific inputs regarding traffic volumes, trip distance and travel times to determine economic benefits over a sixty year period.

For the B1122 and the roads that would be bypassed by the D2 route option there is only some very limited ATC data available based for one week in November 2010 and hence there is not the same breakdown in flow available as there is for the A12. Using data from the B1119 ATC site, located between Saxmundham and Leiston, Table 6.6.1 provides a breakdown of traffic proportions within each TUBA time period.

Table 6.6.1: Breakdown of traffic by time period

Time Period	Description	Hours	2-way Flow (Nov 2010)	Proportion of Weekly flow
1	AM Peak	0700-1000	3,059	16.2%
2	PM Peak	1600-1900	3,387	18.0%
3	Inter-Peak	1000-1600	6,199	32.9%
4	Off-peak	1900-0700	2,111	11.2%
5	Weekend	ALL	4,083	21.7%
	Weekly Flow		**18,839**	**100%**

These proportions were applied to the AADT volume in each of the forecast years to generate time specific flow data. These proportioned AADT volumes were then factored by 365 to obtain equivalent annual volumes.

Benefits of the B1122 scheme will be generated by changes in travel time and distance for vehicles using part, or all, of the new route compared to using existing roads.

There are three distinct sections of bypassed route:

- Middleton
- Theberton East
- Theberton West (the western scheme commences west of the B1125 junction whereas the shorter eastern scheme commences east of this junction.)

For each of these sections the existing average speed has been derived from the available TrafficMaster speed data. This gave the following average speeds along each of the three sections:

- Middleton 62.9 kph
- Theberton East 61.6 kph
- Theberton West 62.8 kph

As the Theberton West bypass commences west of the B1125 it will not be used by traffic that travels between the B1125 and B1122 east, which is where the majority of B1125 travels to and from. The traffic volumes on the Theberton West bypass will therefore be similar to those on the

Middleton bypass. The volume of traffic on the Theberton East bypass will be higher than that on the western option as it will pick up the B1125 traffic.

Benefits of the D2 scheme will be generated by changes in travel time and distance for vehicles using part, or all, of the new route compared to using existing roads.

There are five distinct sections of bypassed route:

- B1121 – A12/B1121 junction to D2/B1121 junction
- B1121 – D2/B1121 junction to B1119 junction
- B1119 – B1121 junction to D2 tie-in
- B1119 – On-line section
- Abbey Lane – B1119 junction to B1122 junction

For each of these sections the existing average speed is assumed to be 54kph as per TrafficMaster data and it is assumed that this will remain constant over the forecast years as traffic volumes are relatively low.

As for the B1122 bypass options SCC have requested that the assumed speed of all vehicles on the D2 route will be limited to the maximum legal speed of HGVs e.g. 40mph (64kph). As the proposed route is shorter than existing routes (particularly for Sizewell HGV traffic) it is expected that there will be time savings attributable to the D2 route although these would be lower than assuming cars and LGV speeds would be consistent with DMRB speed-flow relationships.

Traffic from the south using the D2 route is also assumed to use the A12 for the section between the B1121 junction and the western end of the D2 route rather than the B1121 itself. The average speed (annual) on the A12 is between 47 and 57mph from TrafficMaster data, or about an average of 83kph.

6.6.1 Route Distances, Travel Times and Traffic Volumes

The traffic volumes input to TUBA are for the three forecast years including the Sizewell C development trips which are assumed to occur in 2020 and 2024 but not in 2031 as it is assumed that construction will be complete by this year. Table 6.6.1 and 6.6.2 give the total traffic volumes by section of route for the Do Minimum scenario. This traffic is formed of three vehicle types: car, LGV and HGV.

Table 6.6.1: B1122 Do Minimum (Without Scheme) Traffic Volumes

Existing Route (DM Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – Middleton	1690	1.612	3550	4777	3283
Section 2 – Theberton East	2630	2.563	5637	6980	5793
Section 3 – Theberton West	3110	2.971	3550	4777	3283

Table 6.6.2: B1121-B1119 Do Minimum (Without Scheme) Traffic Volumes

Existing Route (DM Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 - B1121 (A12 to B1121)	1,000	1.11	3,293	4,442	3,575
Section 2 - B1121 (B1121 to D2 tie-in)	500	0.56	5,628	6,907	6,384
Section 3 - B1121 (D2 to B1119)	600	0.67	5,628	6,907	6,384
Section 4 - B1119 (B1121 to Abbey Lane)	4,600	5.11	3,725	5,203	4,059
Section 5 - Abbey Lane (B1119 to B1122)	2,200	2.44	947	2,270	717
	8,900	**9.89**			

Traffic volumes are also required for the Do Something (With Scheme) scenario for the proposed schemes (B1122 and D2 route) and the existing route. These volumes are provided in Table 6.6.3 and 5.6.4. As the number of houses in both Middleton and Theberton is very small it assumed that all relevant existing traffic will use the new bypasses. The travel times shown are for light vehicles. Although the D2 route commences at its junction with the A12, for assessment purposes the starting point is considered to be where traffic is likely to re-route which is considered to be the A12/B1121 junction. Therefore Section 1 of the D2 bypass route option is the A12**.**

Table 6.6.3: B1122 Do Something (With Scheme) Traffic Volumes

Bypass (DS Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – Middleton	1635	1.110	3550	4777	3283
Section 2 – Theberton East	2750	1.890	5637	6980	5793
Section 3 – Theberton West	3200	2.173	3550	4777	3283

Table 6.6.4: B1121-B1119 Do Something (With Scheme) Traffic Volumes

D2 Bypass (DS Option)	Distance (m)	Time (mins)	2020 AADT	2024 AADT	2031 AADT
Section 1 – A12 (B1121 to D2 tie-in)	1100	0.79	3,625	5,345	3,373
Section 2 - A12 to B1121	850	0.80	3,625	5,345	3,373
Section 3 - B1121 to B1119	1,900	1.78	3,625	5,345	3,373
Section 4 - B1119 to Abbey Lane	2,300	2.16	4,186	5,937	4,048
Section 5 - B1119 to B1122	2,100	1.97	1,382	2,976	675
Total	**8,250**	**7.50**			
Existing Route (DS Option)					
Section 1 - B1121 (A12 to B1121)	1,000	1.11	168	177	201
Section 2 - B1121 (B1121 to D2)	500	0.57	2,503	2,642	3,011
Section 3 - B1121 (D2 to B1119)	600	0.67	6,324	6,676	7,607
Section 4 - B1119 (B1121 to D2)*	2,200	2.44	570	602	686
Section 5 - Abbey Lane (B1119 to B1122)	2,200	2.44	35	37	42
Total	**6,500**	**7.23**			

*Section 4 is the existing B1119 between Saxmundham and the D2 tie-in.

6.6.2 Calculated Benefits

Table 6.6.5 provides a breakdown of benefits for each of the two combined B1122 schemes, i.e. Middleton + Theberton East and Middleton + Theberton West with values given in £000s discounted to 2010 in 2010 prices and assume a standard sixty year assessment period from the opening year of 2020. TUBA indicates that benefits of the combined schemes would be £13.56million and £13.38 million for the east and west schemes respectively.

Table 6.6.5: B1122 Benefit Summary Table (£000's)

	Middleton + Theberton East	**Middleton + Theberton West**
Greenhouse Gases	-123	-136
Economic Efficiency: Consumer Users (Commuting)	1740	1666
Economic Efficiency: Consumer Users (Other)	5994	5731
Economic Efficiency: Business Users and Providers	5609	5739
Wider Public Finances (Indirect Taxation Revenues)	339	380
Present Value of Benefits (PVB)	**13559**	**13380**

Table 6.6.6 provides a breakdown of benefits for the proposed D2 scheme with values given in £000s discounted to 2010 in 2010 prices and assume a standard sixty year assessment period from the opening year of 2020. TUBA indicates that benefits of the scheme would be £10.2 million.

Table 6.6.6: D2 Benefit Summary Table (£000's)

	D2
Greenhouse Gases	-103
Economic Efficiency: Consumer Users (Commuting)	699
Economic Efficiency: Consumer Users (Other)	2,565
Economic Efficiency: Business Users and Providers	6,704
Wider Public Finances (Indirect Taxation Revenues)	325
Present Value of Benefits (PVB)	**10,190**

6.7 Accidents

The existing B1122 bypassed sections are essentially rural type roads with 30mph limits on parts of these sections. As 'rural' roads with this speed limit are not defined in WebTAG for the purposes of this assessment they have been classified as roads with a 60mph limit throughout.

Sixty year discounted accident benefits in 2010 prices are calculated to be £4.836 million for the B1122 East schemes and £3.857 for the B1122 West schemes as given in Table 6.7.1 with the number of accidents saved over the sixty year period ranges calculated to be 127 and 98 respectively.

Table 6.7.1: B1122 Accident costs and benefits

	B1122 East	B1122 West
Benefit Summary (£000s)		
Total Without-Scheme Accident Costs	12,432	9,670
Total With-Scheme Accident Costs	7,594	5,813
Total Accident Benefits Saved by Scheme	**4,836**	**3,857**
Accident Summary		
Total Without-Scheme Accidents	182.1	140.8
Total With-Scheme Accidents	87.5	66.5
Total Accidents Saved by Scheme	**94.6**	**74.2**
Casualty Summary		
Total Without-Scheme Casualties (Fatal)	4.1	3.2
(Serious)	34.8	26.9
(Slight)	245.5	189.8
Total With-Scheme Casualties (Fatal)	3.4	2.6
(Serious)	19.4	14.8
(Slight)	118.3	90.0
Total Casualties Saved by Scheme (Fatal)	**0.7**	**0.6**
(Serious)	**15.4**	**12.2**
(Slight)	**127.2**	**99.8**

The existing B1121 and B1119 roads bypassed by a D2 bypass are essentially rural type roads with a short section in Saxmundham that would be classed as ‘urban’ on which posted speeds are 40mph or lower.

Sixty year discounted accident benefits in 2010 prices are calculated to be £5.1 million as given in Table 6.7.2 with the number of accidents saved over the Sixty year period ranges calculated to be 103.

Table 6.7.2: D2 Accident costs and benefits

	D2
Benefit Summary (£000s)	
Total Without-Scheme Accident Costs	18,498
Total With-Scheme Accident Costs	13,404
Total Accident Benefits Saved by Scheme	**5,094**
Accident Summary	
Total Without-Scheme Accidents	270.8
Total With-Scheme Accidents	167.9
Total Accidents Saved by Scheme	**102.9**
Casualty Summary	
Total Without-Scheme Casualties (Fatal)	6.1
(Serious)	51.8
(Slight)	365.1
Total With-Scheme Casualties (Fatal)	5.4
(Serious)	35.2
(Slight)	226.7
Total Casualties Saved by Scheme (Fatal)	**0.7**
(Serious)	**16.6**
(Slight)	**138.4**

6.8 Carbon

Carbon emission data have been determined using the TUBA economic assessment software. Traded and untraded emissions data are available on a yearly basis in terms of tonnes and monetary costs. The monetary costs/benefits are provided in the TUBA economic output tables of which a summary is provided in Table 6.6.5 and 6.6.6. These indicate a cost in terms of additional greenhouse gases due to higher fuel consumption as traffic speeds are generally higher in the Do Something scenario.

7 Construction Cost Estimate

7 Construction Cost Estimates

7.1 Introduction

This chapter looks at the costs of construction for the five options detailed in Chapter 2 above. The costs are estimates only based on the information available when this report was written. The costs follow new road design guidelines provided in the DMRB and all required elements for constructing a new road have also been included.

The proposed estimates should only be used as an indication of the possible costs that can be incurred for each route option and these might differ following further detailed investigation.

7.2 Methodology and Assumptions

The proposed estimates have been based on current rates appropriate to 1Q 2014.

7.3 Routes

Table 7.3.1 Summary of construction cost estimates

Route	Carriageway	Length in metre	Design in months*	Construction in months*	Non highway land required area (sq m)	No of structures	Cost Estimate
D2	Single	7183	9	24	302,960	8	£54,851,385
Theberton East	Single	2726	6	12	73,550	3	£9,109,718
Theberton West	Single	3172	6	12	93,140	3	£13,343,242
Middleton Moor	Single	1644	6	12	44,260	2	£6,081,473
Yoxford Roundabout	NA	NA	3	6	3,480	0	£5,270,648

Scheme Development and Construction Programme

An estimated construction programme has been defined based on previous AECOM design and construction work. The programme shows the approximate years in which the design and construction will take place but the durations of these may alter depending on extent of the further work. A summary of the construction programme for each scheme is shown in Table 1.

Capabilities on project:
Transportation

Please note that durations stated above, Table 7.3.1, for design and construction months are to take place in the years noted below.

Table 8: Summary of construction programmes

Activity	D2	Theberton East	Theberton West	Middleton Moor
Carry out Preliminary Design and consultation	2014	2014	2014	2014
Announce Preferred Route	2015	2015	2015	2015
Carry out Detailed Design	2015/2016	2016	2016	2016
Public Inquiry	2016	2016	2016	2016
Order Publication Period and CPO	2017	2017	2017	2017
Award of Tender	2018	2018	2018	2018
Construction Period	2018-2020	2018/2019	2018 - 2020	2018/2019
Open to Traffic	2020	2020	2020	2020

8 Summary and Conclusion

8 Summary and Conclusion

8.1 Summary

Analysis of the multiple disciplines that would be affected by the proposed Sizewell routes has been undertaken with outcomes of this being predominantly positive. From the discussions throughout the report, the more favoured options are largely the bypass options of B1122 rather than the D2 route that is proposed to be located on open Greenfield sites. To summarise the finding in each of the categories investigated in this document, the following is a distillation of tables and accompanying text.

8.2 Costs

An estimated construction programme has been defined based on previous AECOM design and construction work. The programme shows the approximate years in which the design and construction will take place but the durations of these may alter depending on extent of the further work.

Table 8.2.1 Construction cost estimate summary

Route	Carriageway	Length in metre	Design in months*	Construction in months*	Non highway land required area (sq m)	No of structures	Cost Estimate
D2	Single	7183	9	24	302,960	8	£54,851,385
Theberton East	Single	2726	6	12	73,550	3	£9,109,718
Theberton West	Single	3172	6	12	93,140	3	£13,343,242
Middleton Moor	Single	1644	6	12	44,260	2	£6,081,473
Yoxford Roundabout	NA	NA	3	6	3,480	0	£5,270,648

8.3 Traffic

There is a detailed traffic assessment of the B1122 and D2 scheme options. The assessment has been undertaken using the DfT's TUBA program. This uses a number of scheme specific inputs regarding traffic volumes, trip distance and travel times to determine economic benefits over a sixty year period.

The existing roads bypassed by the B1122 bypass and D2 bypass are essentially rural type roads, with 30mph limits on parts of these sections and a short section in Saxmundham that would be classed as 'urban' on which posted speeds are 40mph or lower. Sixty year discounted accident benefits in 2010 prices are calculated to be £4.836 million for the B1122 East bypass, £3.857 for the B1122 West bypass and £5.1 million for the D2 bypass. The number of accidents saved over the sixty year period ranges calculated to be 127 for B1122 East bypass, 98 for B1122 West bypass and 138 for the D2 bypass.

The following table is taken from the traffic reporting;

Table 8.3.1 D2 Accident costs and benefits

	B1122 East	B1122 West	D2
Benefit Summary (£000s)			
Total Without-Scheme Accident Costs	12,432	9,670	18,498
Total With-Scheme Accident Costs	7,594	5,813	13,404
Total Accident Benefits Saved by Scheme	**4,836**	**3,857**	**5,094**
Accident Summary			
Total Without-Scheme Accidents	182.1	140.8	270.8
Total With-Scheme Accidents	87.5	66.5	167.9
Total Accidents Saved by Scheme	**94.6**	**74.2**	**102.9**
Casualty Summary			
Total Without-Scheme Casualties (Fatal)	4.1	3.2	6.1
(Serious)	34.8	26.9	51.8

	B1122 East	B1122 West	D2
(Slight)	245.5	189.8	365.1
Total With-Scheme Casualties (Fatal)	3.4	2.6	5.4
(Serious)	19.4	14.8	35.2
(Slight)	118.3	90.0	226.7
Total Casualties Saved by Scheme (Fatal)	**0.7**	**0.6**	**0.7**
(Serious)	**15.4**	**12.2**	**16.6**
(Slight)	**127.2**	**99.8**	**138.4**

8.3 Carbon

Carbon emission data has been determined using the TUBA economic assessment software. Traded and untraded emissions data are available on a yearly basis in terms of tonnes and monetary costs. The monetary costs/benefits are provided in the TUBA economic output tables of which a summary is provided in the report. These indicate a cost in terms of additional greenhouse gases due to higher fuel consumption as traffic speeds are generally higher in the B1122 bypasses.

8.4 Environment Assessment Summary

A Transport Analysis Guidance (Web TAG) and the Design Manual for Roads and Bridges (DMRB) Volume 11 section 3 were one of the main sources used to undertake the Environmental Assessment for the proposed bypasses. The assessment carried out evaluated the potential significance of impacts, for the proposed bypasses, in:

8.4.1 Air Quality

Air Quality Assessment Summary Table

The air quality analysis of the Sizewell schemes show improvement to the air quality for the majority of routes with all receptors detecting air levels far below air quality objective /EU Limit Value.

A large change in environmental issues was observed for Theberton West and D2 route due to the significant reduction in NO_2 levels predicted.

Although the long term affects show an improvement in area quality, it has also been mentioned that the initial short term effects of the construction may result in high levels of particulate matter emissions and dust. Notwithstanding this, if the correct mitigation measures are put in place, the impact could be significantly reduced.

Table 8.5.1 Overall evaluation of local air quality significance

Key Criteria Questions	Yes / No				
	Middleton Moor	Theberton East	Theberton West	B1122 Road Improvement	D2 Route
Is there a risk that environmental standards will be breached?	No	No	No	No	No
Will there be a large change in environmental conditions?	No	No	Yes	No	Yes
Will the effect continue for a long time?	N/A	N/A	N/A	N/A	N/A
Will many people be affected?	No	No	No	No	No
Is there a risk that designated sites, areas, or features will be affected?	No	No	No	No	No
Will it be difficult to avoid, or reduce or repair or compensate for the effect?	N/A	N/A	N/A	N/A	N/A

8.4.2 Noise

Noise analysis has predicted that in the initial stages of use of which the road will be used by a higher flow of traffic due to the Sizewell C construction, noise levels will be higher than currently. It has been predicted that the short term noise levels caused by the construction vehicles will exceed the threshold levels and that this concern can be significantly reduced through the introduction of acoustic barriers.

Following this, it is expected that long term effects of the bypasses will also exceed the threshold levels. As a result, further investigation will need to take place to mitigate this, such as investigation into realignment of the carriageway in order to avoid populated areas, introduction of low noise resurfacing and acoustic barriers. It has been predicted that once these measures have been introduced to the scheme, the short and long term noise level will be unlikely to exceed the threshold levels.

Analysis undergone in the form of TAG analysis summarised that Theberton West was most favoured as having the least effect on noise.

Table 8.5.2 Noise assessment

Route	Qualitative Impacts	Assessment	Potential Mitigation	Residual Effects With Mitigation
Theberton East	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
Theberton West	This scheme will increase noise levels at NSRs directly facing the proposed option in Theberton in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier	Insignificant
D2 New Option	This scheme will increase noise levels at NSRs directly facing the proposed option in the short term due to the increases in traffic associated with the Sizewell construction.	Significant	Acoustic barrier; Reconsidering the route alignment as far as possible from highly populated area in Harts Hall, Saxmundham	Insignificant

8.4.3 Biodiversity

Biodiversity investigations of the B1122 and D2 routes have concluded that the impact of the construction and use of the proposed roads on biodiversity is minimal. The investigation predicted the possibility for plants and wildlife to be affected by the reduced woodlands.

Following this, there is a small chance of increased mortality of animals such as birds, bats, badgers and otters. With management of the affected animal species and woodland, the effect of this may be considerably reduced.

Particular concern was raised over the design of culverts. The current designs embody the use of embankment to carry the new roads. In certain areas the embankments, where they cross water courses would need careful consideration during detailed design to take into account the effect on aquatic species.

It was also discussed in the biodiversity section that it may not be possible for route D2 to be adequately mitigated due to its positioning across Greenfield sites.

8.4.4 Landscape

Landscape analysis of the proposed schemes concluded that it is likely that visual amenity and landscape character will be affected by all routes. Where land cover is significantly reduced, such as the Theberton routes, the effect on visual amenity will be slight to large. It has been suggested that it may be necessary to put in place multiple mitigation measures to reduce the impact on the landscape. These may include the plantation of shrubs and trees to build on the current character of the landscape.

Table 8.5.3 Landscape assessment summary table

Route	Assessment	Mitigation	Residual Effects With Mitigation
Sizewell – Do Minimum			
Landscape Character	**Neutral – Slight Adverse**	**-**	**Neutral – Slight Adverse**
Visual Amenity	**Neutral – Slight Adverse**	**-**	**Neutral – Slight Adverse**
Sizewell- D2			
Landscape Character	Large Adverse	Reinstatement of boundary planting, structure screen planting	Moderate Adverse
Visual Amenity	Moderate to Large Adverse		Moderate to Large Adverse
Sizewell – B1122			
Landscape Character	Large Adverse	As Above	Large Adverse
Visual Amenity	Slight to Large Adverse	As Above	Slight to Large Adverse

8.4.5 Heritage

The heritage review of assets within the vicinity of the proposed routes identified a total of twenty-six assets within 300m of the proposed route of D2, two of which are directly affected and

one within the area. Following this, a total of twenty-eight assets have been identified within 300m of the proposed B1122 schemes. As a result of the proposed route, both negative and positive effects were identified. In some cases, removal of assets will be required to position the carriageway, where as in other locations, the routes will provide a reduction of traffic conserving the areas further. It will be possible to put mitigation measures in place to reduce the impact of the proposed route on the heritage of the sites such as screening.

Further evaluation of the affected assets will be required to reach a conclusive result.

Table 8.5.4 Heritage assessment summary table- D2

Asset	Qualitative Impacts	Assessment	Mitigation	Residual Effects With Mitigation
Scatter of red tile (12)	Part or complete removal due to bypass.	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
Cropmark (16)	Part or complete removal due to bypass	Slight Adverse	Simple Assessment followed by additional evaluation if required.	Slight Adverse
Hurts Hall (5)	Effects on the setting of the asset	Slight Adverse	Photographic recording, use of screening	Slight Adverse
Saxmundham	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial
Leiston	Reduction of traffic in the Conservation Area	Slight Beneficial	N/A	Slight Beneficial

8.4.6 Water

The investigation undertaken to determine the effects caused by the Middleton Moor and Theberton West bypasses will be of Insignificant Impact. This differed from the effects predicted for Theberton East and Route D2 which measured as of Significant Impact.

A major impact for the proposed routes was a loss of ponds. The mitigation measure advised to reduce this is to divert the route around the pond. If however, this is not possible, replacement ponds could be constructed to reduce any impact on drainage. In doing this, the effect of the impact can be reduce to minor.

Potential moderate impacts to the sites were identified as contamination from fuel and chemicals and localised erosion. It has been suggested that this will be minimised by establishing an appropriate drainage system for surface water and highway spillages. These measures may include swales/ grass channels, surface flow wetlands, balancing ponds or sedimentation ponds. These will fit in well with the rural landscape of the site and reduce visual impact. The result of introducing these mitigations will make the impact negligible.

8.5 Mitigation Measures

Following the raised concern by SCC that mitigation measures regarding the noise due to the proposed scheme developments is a significant issue, preliminary design of noise barriers has been carried out and incorporated into costings.

It can be seen that Theberton East Option B and Theberton West Option C both would need an installation of a noise barrier to protect properties affected by the proposed route. The D2 option would not need noise barriers within this preliminary study. This would need developing at the preferred route stage of the project.

8.6 Conclusion

From the foregoing tabulated and reported information there will clearly need to be further work towards the assessment and design of a suitable bypass scheme in appropriate stages for route to the proposed Sizewell C development. To address the need for a route to the proposed site, bypass options around villages of Middleton Moor and Theberton were considered. A further route was also considered to the south west of the Sizewell site in the form of route D2.

On a cost basis, the Middleton Moor and Theberton routes would be significantly less to construct than the D2 route option. The accident benefits for the D2 route have been estimated as £5.1 million with 103 accidents saved over a sixty period.

Strong benefits have been predicted for the overall air quality for both the D2 route and local bypass routes. This benefit is a result of reduced levels of particulates and Nitrogen Dioxide and is envisaged to take place during and after construction with a low likelihood of the air quality exceeding the air quality objective /EU Limit Value. Noise levels will be reduced significantly by the proposed routes providing that the appropriate mitigation measures are put in place. These mitigations will mainly be required in locations where woodland is removed and embankments are positioned.

Landscape results have shown adverse effects for all routes as a result in the increase of visual impact. This impact could be reduced providing that the carriageway and structures designed will reduce the visual impact on the landscape.

Biodiversity has stated the effects from all sites will be minimal although slightly more adverse for the D2 route given its position on Greenfield sites and across multiple water crossings. Through further investigation and more sensitivity in design, this affect could be reduced further.

It was concluded that the proposed carriageway is likely to affect the water perspective of the analysis due to the high amount of water crossing situated along all routes. The result of this revealed that all routes were affected from negligible impact to major impact. With appropriate mitigation measures, this can reduce the impact to negligible to minor.

The Heritage review concluded that multiple assets would be affected by the proposed D2, Theberton and Middleton Moor routes, with two directly positioned at the location of the carriageway. The impact of this can be significantly reduced by the introduction of screening.

Much work has been done in this report on the design of the individual schemes. This has helped to provide reliable and detailed scheme estimates. For the village bypass routes, effects would be minimal with most avoidable by the introduction of mitigation measures outlined throughout the report. For many environmental sectors, the preferred option has been outlined as Theberton West as this route brings reduced air levels, a lower impact on noise and water. Yoxford Roundabout would be an essential addition to the village bypasses as it will allow the proposed construction vehicles access to the site avoiding tight curvature of the route.

As a result, the D2 scheme being positioned on what is currently agricultural land, the proposed route provides more negative effects to sectors such as landscape and biodiversity. Mitigation measures have the potential to reduce the impact significantly as previously outlined. The significantly high comparative cost of the D2 route would need to be tested further to establish cost/ benefit ratios over a specified period in order to make further decisions on its development.

It is suggested that for selected schemes, comprehensive work on design refinement, costings and appropriate traffic work including cost/benefit ratio analysis are carried out in order to decide on a proposed scheme approach.

9 Next Steps

9 Next Steps

9.1 Consultation with the Environment Agency

9.1.1 Introduction

When selection of appropriate schemes has been made, following SCC's examination of the findings of this report, it is recommended that arrangement and attendance of a meeting with the Environment Agency (EA) regarding possible flood arches and other requirements for bridges on the River Fromus, the Hundred River and the Minsmere River flood plains. Following on from the discussions it will be possible to home in on the most effective structures from a cost and performance perspective.

The principle structures that are proposed on the flood plain for the Sizewell C routes consist of;

Route	**Structure**
D2	D2 Culvert/bridge
D2	D2 pond culvert
D2	D2 culvert crossing
B1122 Middleton Moor	Extended culverts
B1122 Theberton East	Theberton East culvert
B1122 Theberton West	Theberton West culvert

The flood plain details for these routes can be seen in Figure 9.1.2.1 and Figure 9.1.3.1 below. The structures mentioned above fall into Zone 2 and 3 of the flood plain assessment categories. There are also a number of culverts on each scheme, all of which will need to be discussed in detail.

9.1.2 Route D2

Figure 9.1.2.1 D2 River Fromus and Hundred River Flood Plain Detail

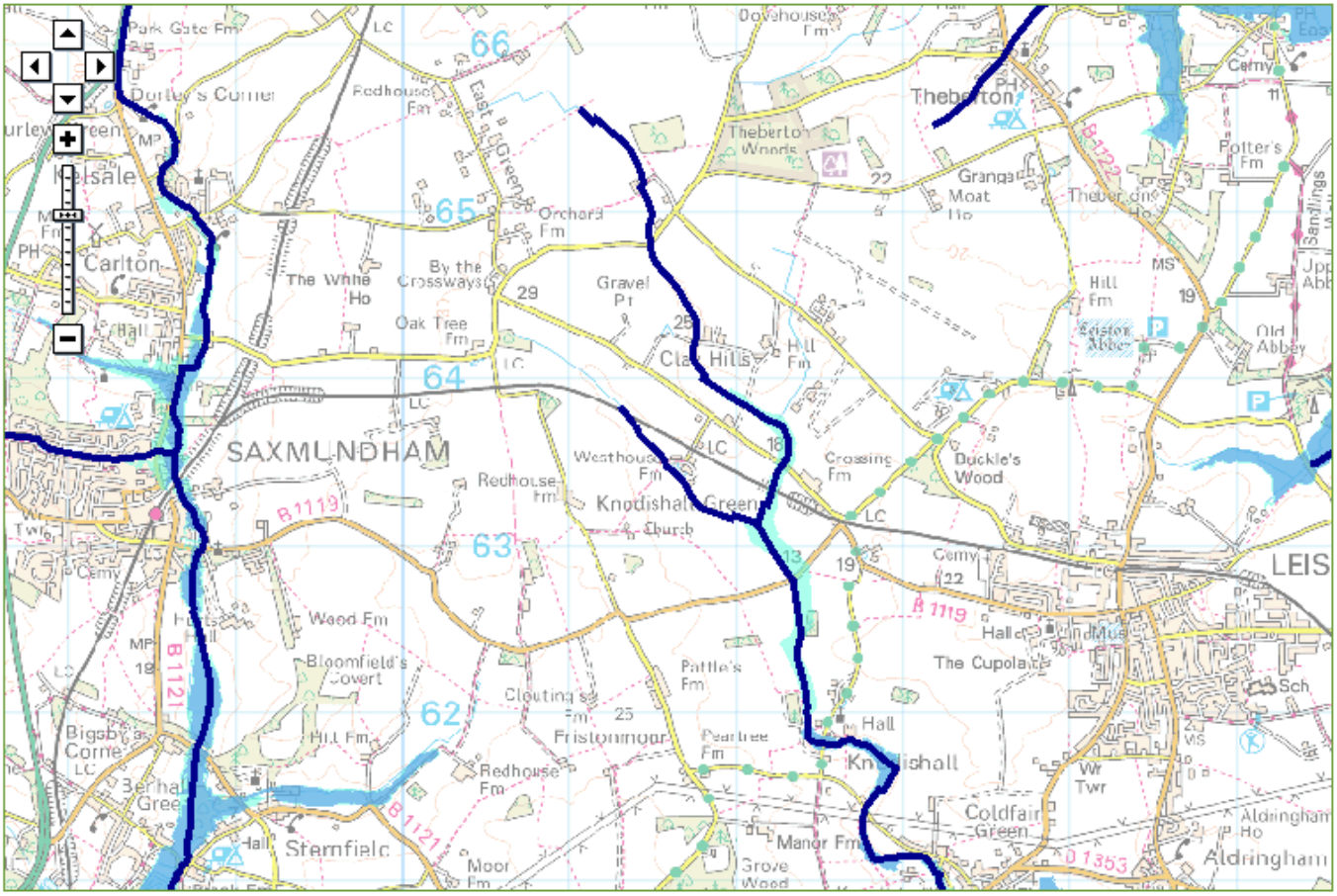

Figure 9.1.2.1 shown above illustrates the flood plain detail for the River Fromus and the Hundred River. The following structures present within the flood plain are:

- The D2 culvert/bridge
- The D2 pond culvert
- The D2 culvert crossing

9.1.3 Route B1122

Figure 9.1.3.1 B1122 Minsmere New Cut and Minsmere Old River Flood Plain Detail

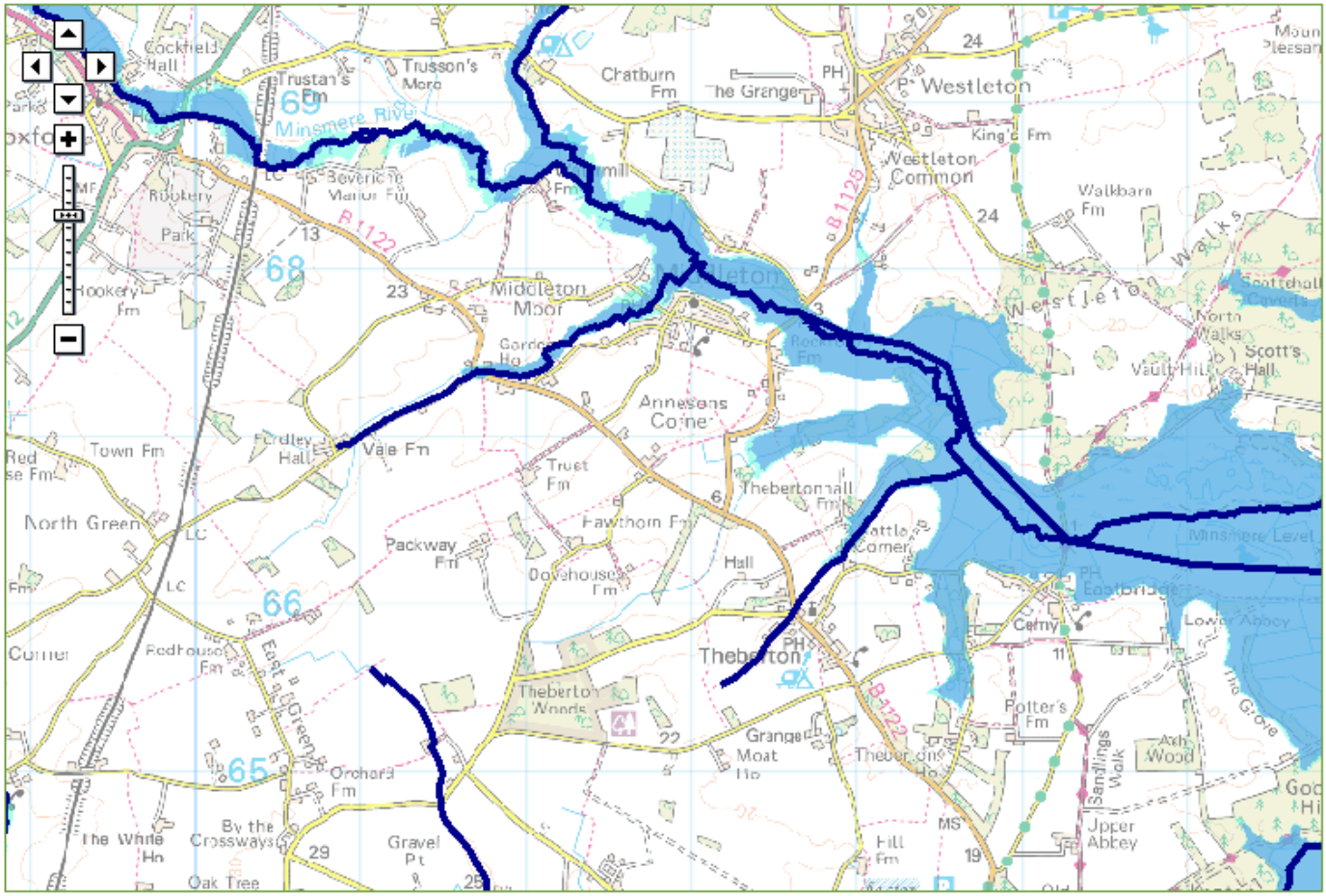

Figure 9.1.3.1 shown above illustrates the flood plain detail for the Minsmere New Cut and Minsmere Old River. The following structures present within the flood plain are;

In the flood plain detail shown above in figure 9.1.2 the following structures in these are;

- The B1122 Middleton Moor extended culverts
- The B1122 Theberton East culvert
- The B1122 Theberton West culvert

9.2 Environment Agency Guidance

The EA recommend that pre application discussions take place for developments. EA will usually provide comments at the planning application stage on FRAs (unless indicated otherwise by

Environment Agency Planning Liaison/Sustainable Places team in the area where the development is proposed).

The main concerns of the EA are:

- Ensuring that the design of the site drainage system meets the aims of sustainable drainage management, and does not increase, and where practicable reduces, the current runoff from the site
- If the proposal is within the Byelaw Distance of a Main River sea defence, or flood defence structure, then formal consent for the proposal may also be required from the EA.
- Prior to carrying out a FRA, developers should contact the Environment Agency and other operating authorities (such as the Lead Local Flood Authority in unitary or county councils or Internal Drainage Board as appropriate) to establish whether information is available relating to flood risk at the site they propose to develop. Account should also be taken of local knowledge of flooding held in the community. EA records of flooding are not exhaustive and the absence of information does not mean that a site will not flood[51].

9.3 Statutory Undertakers

It will be necessary to consult early with the major Statutory Undertakers for the project once preferred routes are established. For the A12 Sizewell C schemes the following authorities were approached;

- BT Openreach
- Essex and Suffolk Water
- GTC
- Independent Pipelines and Power Networks
- National Grid Gas Distribution (below 2 bar)
- Ericsson Plant
- UK Power Networks
- Virgin Media

Clearly there will be other authorities with equipment situated in the A12 carriageways, verges and in the side roads. Once selected schemes are identified for further research there will be a need to conduct NRSWA C3 searches which will reveal necessary plant diversion routes and indicative costs (these will replace those in the existing report which are consultant's estimates only).

[51] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311502/LIT_9193.pdf

9.4 Cost Benefit Analyses

Once selected schemes have been identified for further examination, it will be necessary to conduct further traffic analysis with a view to identify the correct cost/benefit ratios utilising the costs from the revised structural and utilities estimates. It will not be possible to identify the ultimate ratios until the correct costs have been identified from the rounds of consulting with EA and Statutory Undertakers identified above.

9.5 Scheme Delivery

From the Scheme Development and indicative Construction Programmes in Section 3 of this report it will be seen that packages of design and preparation works are required to be carried out in order to keep the project on track for delivery (open to traffic) in 2020. For all the options it would be preferable to have a Preferred Route announcement in 2015. For this reason it is recommended that discussions with all parties should commence as soon as possible, with a view to defining the optimum scheme and taking it forward for ultimate construction and delivery.

10 Further Investigative Study

10.1 Assessment Summary

The preceding chapters of this report have drawn out all the relative benefits for the three bypass combinations; Middleton Moor & Theberton East, Middleton Moor & Theberton West and D2 under comparisons dictated within the December 2013 scheme brief. Following further investigative instructions from Suffolk County Council in October 2014, this section deals with further comparison of the three bypass options. The purpose of the following text is to compare the cost and environmental benefits for each proposed bypass option. The proposed Yoxford Roundabout is one option that has been assessed to construction vehicles to access the site avoiding tight restrictions of the existing A12/B1122 junction. However, detailed environmental study has not carried out for the roundabout, in accordance with the original brief.

Within the environmental section, the three route options have been compared under the headings of;

- Community Impacts
- Mitigation Measures
- Net Benefits
- Restrictions on the B1122
- Summary

For convenience of reporting Middleton Moor has been grouped with either Theberton East or Theberton West for this environmental summary.

10.1 Sizewell C, Route D2 and B1122 Community Impacts and Mitigation

Community Impacts	Middleton Moor & Theberton East	Middleton Moor & Theberton West	D2
Segregation	Bypass cuts through farmland- 13 fields affected	Bypass cuts through farmland-16 fields affected	Bypass cuts through farmland- 33 fields affected
	Enclosing properties by road corridors of old B1122 and new bypass		Access to two properties affected
Mitigation	Access to any severed farmland will be provided	Access to any severed farmland will be provided	Access to any severed farmland will be provided
			Alternative access to properties provided via new connecting roads.
Pedestrian Amenity	1 pedestrian footpath affected	3 pedestrian footpaths affected	11 pedestrian footpaths affected
Mitigation	Stiles provided to connect footpaths at carriageway crossings	Stiles provided to connect footpaths at carriageway crossings	Stiles provided to connect footpaths at carriageway crossings or provide alternative routes
Cyclist Amenity			1 cycleway affected
			Cyclists required to use 3 new roundabout along the mainline
Mitigation			Gate provided to connect cycleways at carriageway crossing
Driver Delay	Access to properties will be slightly diverted potentially causing delays	Access to properties will be slightly diverted potentially causing delays	Access to properties will be slightly diverted potentially causing delays
			Short delays due to queuing at roundabouts
Mitigation	Providing new junctions along the mainline to decrease potential delays to the driver	Providing new junctions along the mainline to decrease potential delays to the driver	Providing new junctions along the mainline to decrease potential delays to the driver
Community Visual Impact	Properties on the south west side of Middleton Moor and east of Theberton will be affected	Properties on the south west side of Middleton Moor and west of Theberton will be affected	Properties in the towns of Saxmundham and Leiston will be affected

10.1 Community Impacts

The community impacts section details the potential impacts of the three chosen proposed bypass combinations and any mitigation that could reduce the effects. The assessment covers: segregation, pedestrian amenity, cyclist amenity, driver delay and community visual impacts associated with the routes.

10.1.1 Segregation

All three bypass combinations cut through farmland previously unaffected by the road corridor; however the amount of fields affected by the proposed route differs. The Middleton Moor & Theberton East route effects 13, Middleton Moor & Theberton West – 16 and D2 – 33.

Due to the close proximity of the proposed route, the Middleton Moor & Theberton East option would enclose properties of Theberton within a road corridor of the new bypass and the existing B1122 thus segregating these dwellings from the rest of the village.

Bypass D2 would affect access to two properties, where the new road would sever the existing access to these properties as well as any surrounding farmland.

From a segregation point of view the better option for a bypass is that of Middleton Moor & Theberton West, even though this route severs 3 more fields than that its eastern counterpart. However, it does not segregate any properties from their land or villages unlike the Middleton Moor & Theberton East option.

10.1.2 Pedestrian Amenity

Each of the route options would affect at least 1 Public Right of Way; however the number of footpaths impacted upon differs for each bypass. The D2 bypass has the highest number of pedestrian footpaths impacted, with a total of 11 Public Rights of Way affected.

The Middleton Moor & Theberton East and Middleton Moor & Theberton West options affect the least amount of footpaths, with 1 and 3 Public Rights of Way impacted upon respectively. Therefore it is obvious that the Middleton Moor and Theberton East route is therefore preferable with respect to pedestrian amenity.

10.1.3 Cyclist Amenity

One of the major impacts upon cyclists occurs on the D2 bypass. This option would sever an existing cycleway. It also requires cyclists to use 3 new roundabouts in order to reach their destination.

The Middleton Moor & Theberton East route combination would cut through Church Road; although not a designated cycleway, this route is commonly used by cyclists wishing to access the northern end of the village.

The Middleton Moor & Theberton West alternative would not impact negatively on any cyclists using the proposed bypass options. Therefore this option would be the most beneficial in terms of cyclist amenity.

10.1.4 Driver Delay

Option D2 is the only one of the bypass options that includes roundabouts within the proposed route. The three roundabouts are expected to cause minor delays to drivers due to unavoidable queuing at times.

Either of the Middleton Moor & Theberton options will have the least effect with regards to driver delay; therefore either option would be the most beneficial.

10.1.5 Community Visual Impacts

All of the route options will cause visual impacts to communities as the road corridors will intrude in the views of many properties. The Middleton Moor & Theberton East option will affect views from properties on the south west side of Middleton Moor and the eastern side of Theberton. The Middleton Moor & Theberton West option will affect properties of Middleton Moor and Theberton on the south west and western sides of the two villages respectively. Out of the two options however, the Middleton Moor & Theberton West bypass would visually affect less of the community.

The route with the least visual impacts upon the communities is D2. This is due to the bypass crossing large amounts of open arable land and therefore not passing through villages along its route. However, the route does impair some of the views from scattered properties in Leiston and Saxmundham.

10.2 Mitigation Measures

To reduce the impact of the bypasses upon the community, certain measures will be implemented. The mitigation proposed for each of the impacts are as follows:

10.2.1 Segregation Mitigations

Access to fields intercepted by any of the three alternatives will be provided as part of mitigation measures for this community impact. To lessen the impacts on the two properties affected, an alternate road is proposed with access to/from the new bypass and any nearby farmland.

10.2.2 Pedestrian Amenity Mitigations

Route D2 affects 11 footpaths. Mitigation measures for this community impact involve either supplying stiles at carriageway crossing points to connect the two halves of the severed footpaths or provision of an alternative route for pedestrians. For only two of the 11 footpaths impacted, it is deemed infeasible to just provide stiles. These footways are located around the proposed Saxmundham Rail Bridge where the footpath will be diverted over or under the structure.

Provision of stiles at the carriageway crossing points for the four footpaths on the Middleton Moor & Theberton East and Middleton Moor & Theberton West options would provide suitable mitigation.

10.2.3 Cyclist Amenity Mitigation

As with the footpaths mentioned earlier, the severed cycleway on the D2 route would be reconnected by providing a gate at the carriageway crossing point.

In the village of Theberton there is scope to provide a segregated cycleway on Church Road to minimise the impacts of the new route. This mitigation would allow cyclists to safely gain access to the northern end of the village.

10.2.4 Driver Delay Mitigation

New junctions would provide suitable connections to replace or reconnect the accesses to affected properties. This solution is appropriate to all route options.

10.3 Net Benefits

The net benefits section summarises the main benefits and potential impacts of the proposed bypasses compared to the current alignment on the B1122. The assessment covers the construction costs, community severance and environmental factors associated with the bypass solutions Middleton Moor & Theberton East, Middleton Moor & Theberton West, and route D2.

10.3.1 Air Quality

The positive quantity for the Total Net Present Value (TNPV) indicates a net beneficial impact (i.e. an improvement in air quality) over the lifetime of the scheme. The most beneficial in terms of TNPV are the bypass options; Middleton Moor & Theberton East, and Middleton Moor & Theberton West, with the respective monetary changes in air quality being £114,982 and £109,970.

The modelling suggests that all the receptors located on the existing B1122 will either experience no change or an improvement in air quality. All three route options will not exceed any of the air quality objects set out by Suffolk County Council.

The WebTAG local air quality assessment results for the options:

- Including Sizewell C Traffic: -59PM_{10} and -519NO_2 for the Middleton Moor & Theberton East option
- Including Sizewell C Traffic: -61PM_{10} and -538NO_2 for the Middleton Moor & Theberton West option
- Including Sizewell C Traffic: -54PM_{10} and -307NO_2 for the D2 option

The Middleton Moor & Theberton West route has lower scores than the other two options; this indicates an improvement in air quality for this specific route compared to the others. The D2 option has the least improvement; the route is also the longest of the three resulting in higher regional emissions.

10.3.2 Noise

The noise impact from traffic on the three bypass options has been assessed and summarised within the Net Benefits table included below.

Irrespective of whether the impacts of the bypasses are short or long term the Middleton Moor & Theberton West route is more beneficial compared to the other two options; the percentage of dwellings significantly affected is less with 52% in the short-term and 5% in the long-term. Whereas route D2, and the Middleton Moor & Theberton West options significantly affect 68% and 69% in the short-term and 9% and 7% in the long-term respectively.

From the monetary valuation of the noise impacts described in section 4.2.12, the Middleton Moor & Theberton West route has a higher NPV (Net Present Value) at just under £93,000 than the other options. Route D2, and the Middleton Moor & Theberton East options have NPV values of £84,000 and £8,000 respectively (Figure 4.2.1).

The annoyance evaluation for the bypasses shows that the Middleton Moor & Theberton West route has the biggest reduction compared to the other two options; Middleton Moor & Theberton East and D2 (Figure 4.2.2).

10.3.3 Biodiversity

The main effects of the proposed routes upon the biodiversity in the area can be found in section 4.3.19 of the main report. All routes have similar impacts to the environment namely; fragmenting natural features, disturbing the habitats of fauna and crosses existing water courses, however the severity of these differs.

The least adverse option, in terms impact upon biodiversity is the Middleton Moor & Theberton East route, with only slight to moderate adverse effects. The other two options; Middleton Moor & Theberton West, and the D2 route have moderate adverse effects and moderate to large adverse effects respectively.

The Middleton Moor & Theberton East route crosses only one tributary of the Old Minsmere River and through two areas of woodland; Rattla corner and the Greenhouse/Fox Grove/Browns plantation. Whereas the Middleton Moor & Theberton West option crosses two tributaries of the river and through the three wooded areas of Yew Tree corner, Plumtreehills Covert and the Greenhouse/Fox Grove/Browns plantation. The D2 route, which has the largest effect upon the biodiversity of the area, crosses both the rivers Fromus and Hundred. As well as fragmenting smaller wooded areas this option passes through the ancient woodland of Buckles Wood and has the potential to pollute the Alde and Ore estuaries.

10.3.4 Landscape

Landscape Character

All of the bypass options have the potential to effect locally important destinations and landscape character. However, the Middleton Moor & Theberton East bypass combination has the greater adverse impact on the Yox Valley Special Landscape Area (SLA) than the other routes.

Both the Middleton Moor & Theberton East and Middleton Moor & Theberton West combinations would have large adverse effects within the first year due to the fragmentation of the surrounding landscape resulting in the direct loss of wooded areas and arable farmland. Of the two, the Middleton Moor & Theberton East bypass has a larger adverse effect due mainly to the greater

loss of woodland. Mitigation for this option is unlikely to reduce the effects due to the permanent change on the landscape character and physical features, therefore making Middleton Moor & Theberton West less destructive.

The route D2 is considered to have large adverse impacts upon the landscape mainly due to the loss of trees and boundary vegetarian at proposed junctions and slip roads. However, with the mitigation measures of replacing lost planting and adequate landscape measures, the adverse effect of this option is expected to decrease to moderate within fifteen years.

Visual Amenity

All the route options have similar effects on visual amenity, these range from slight to largely adverse. Of the three proposed routes D2 has the greatest impact causing a moderate to large adverse effect.

Both the Middleton Moor & Theberton East and Middleton Moor & Theberton West options would have slight to largely adverse effects to the dwellings around the village of Middleton Moor. Largely adverse effects would impact on the properties situated on the south west side of Middleton Moor; this is due to the bypass being situated in the foreground views of the dwellings. Slight impacts would be due to distant views of the new road corridor from the properties scattered along the B1122 alignment.

The Middleton Moor & Theberton East route will impact on the properties of Theberton more than that of the west bypass option; this is because of the close proximity of the route to the dwellings on the eastern side of the village. This option also would impact on the views from the Sandlings Walk Long Distance Path (SWLDP), within Suffolk's AONB, and could potentially create medium to longer distance of the road corridor. As well as impacting the SWLDP, this bypass option would also be visible from a large number of Public Rights of Way, causing visual disturbances to users of these routes.

Although route D2 passes through mostly countryside, it comes into contact with outlying houses situated in the towns of Saxmundham and Leiston, as well as a number of scattered properties. The residents of these properties would experience large adverse effects of their visual amenity due to the close proximity of the bypass to their dwellings. Like the Middleton Moor & Theberton East option, D2 intersects a large amount of Public Rights of Way and would cause immediate and large impacts on the visual amenity of the users. Unlike the other two routes, the D2 option would also have a visual impact upon railway and road users. This includes the new bypasses being visible for the users of the line between Saxmundham and Leiston, and the road users of the western section of the B1119. Due to all the reasons detailed above, the D2 route would have the most impact on the visual amenity of the area due to the wide range of people it would affect.

10.3.5Heritage

All of the route options have merits regarding reduction in traffic volume; this is to be expected as the new bypasses would redirect a majority of the traffic away from the towns and villages.

The Middleton Moor & Theberton East option diverts traffic away from the villages of thus reducing the impact of the traffic upon the buildings. A total of 13 listed building are located within the villages; five in Middleton Moor and eight in Theberton. The bypasses are expected to enhance the historic environments by reducing the vehicle emissions, noise and pollution providing a slight benefit to both villages.

The Middleton Moor & Theberton West option has all the advantages of the Middleton Moor & Theberton East route but unlike the other option also negatively impacts on the Grade I listed Theberton Hall. The Hall faces south, the direction the proposed bypass is situated from the property thus impacting it visually and aurally. It is because the new route does not physically affect Theberton Hall that this impact is considered to be a minor negative.

The D2 option negatively impacts more heritage assets than any other option namely; an area of red tile, cropmark and a Grade II listed building. The route would pass over the area where red tile was previously found which could potentially result in the loss of any undiscovered remains. This bypass option also passes very close to, if not through, the site of a visible crop mark. The potential impacts upon the Grade II listed building of Hurts Hall are visual and aural; this is due to the location of the proposed bypass running to the south/southeast which is the direction the reception rooms face. All the impacts mentioned above are considered minor negatives and would have slight adverse effects upon the features. Although this option has several negatives, it also positively affects the conservation areas of Saxmundham and Leiston by reducing the traffic volume and thus emissions.

10.3.6Water

Providing the mitigation measures are adhered to, the significance for the Middleton Moor & Theberton West option is considered as low. From a water environment perspective, this option is the most beneficial as has the least impact.

The Middleton Moor & Theberton East option differs from the Middleton Moor & Theberton West as is located substantially closer to the Minsmere-Walberswick Heath and Marshes SSSI; 800m downstream. Due to the close proximity of the SSSI, the main impact would be contamination/ pollution due to surface runoff/spillage which would majorly impact on water quality downstream. Route D2 could impact upon the movement of protected species (eels/elvers) due to the new culvert needed at the River Fromus crossing as well as potentially having an impact on the Sizewell Marshes SSSI.

The two options, Middleton Moor & Theberton East and D2 both have the potential to significantly impact on the water environment. However, in order to distinguish the more beneficial option, further study should be completed into the magnitude of the effects within the Sites of Special Scientific Interest for both routes.

10.3.7 Community Impacts

The community impacts for the three bypasses have been assessed and summarised. The sections included within community impacts are as follows; segregation, pedestrian amenity, cyclist amenity, driver delay and community visual impacts.

Although the D2 option causes the least visual impacts on the community due to the location of the proposed bypass, it would also cause the most impact in terms of pedestrian amenity, cyclist amenity and driver delay. The bypass crosses through 11 footpaths and a cycleway, which although mitigation measures are proposed, would impact on the community more than the other two options. In this case the increase in driver delay is due to the three proposed roundabouts, which would cause delays due to queuing and also impact negatively on the cyclists using this route.

The Middleton Moor & Theberton East and Middleton Moor & Theberton West options both create the least delay to drivers and impact on cyclists. The latter option causes the least segregation to the community amongst the routes, whereas the other creates the most. The Middleton Moor &Theberton East option has the least impact upon pedestrian amenity; only disrupting 1 Public Right of Way to its western counterpart‘s 3 footpaths. However the eastern bypass has the largest visual impact upon the community and causes the biggest community segregation due to the close proximity of the road corridor. The Middleton Moor & Theberton West option is therefore the best in terms of community impacts.

Table 10.3.1: Middleton Moor & Theberton East Advantages

Route Option	Advantages	Evidence
Middleton Moor & Theberton East	Air quality improvement for the village of Middleton Moor	Air Quality: Net Value Change of £114,982 along the B1122 - a reduction of 519 T/y in NO_2 and 59 T/y in PM_{10} 3 receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Least effects on biodiversity	With slight to moderate adverse effects, this route option has the least effects upon the biodiversity
	Least effects on Heritage assets within the villages of Middleton Moor and Theberton	Positive effect on 5 listed buildings within Middleton Moor and 8 listed buildings within Theberton by reducing the volume of traffic flow Enhances the historic environment of the two villages due to reduction in vehicle emissions, noise and pollution
	Positive impacts on the community	Creates the least impact upon pedestrian amenity Creates the least impact upon cyclist amenity Causes the least delay to drivers
	Lowest construction costs	£15,191,190.98 for the bypass
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)
	Reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £123,000

Table 10.3.2: Middleton Moor & Theberton East Disadvantages

Route Option	Disadvantages	Evidence
Middleton Moor & Theberton East	Air quality deterioration for parts of the village of Theberton	1 receptor will experience a deterioration of more than 5% due to the new route alignment
	Noise Levels	9 properties have been identified as having a significant impact upon their noise level
	Potential damage to the biodiversity	Slight to Moderate Adverse effects: Crosses tributary of the Old Minsmere River would require a new culvert and an extention to existing Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Loss of amenity land	Larger adverse effects on landscape character than any other option Loss of sections of Yox Valley Special Landscape Area
	Visual Amenity	Enclosing settlements by road corridors Close proximity to properties to the northern of Theberton Large adverse effects to some properties within Middleton Moor Moderate adverse effects to users of the Sandlings Walk Long Distance Path Considerable disruption to immediate views for many public rights of way Larger impacts to visual amenity than any other option
	Potential impact to water environment	More impact upon water environment due to closer proximity to the Minsmere-Walberswick Heath and Marshes SSSI (800m downstream of the proposed crossing)
	Negative Impacts on the community	Creates the most visual impact within the community due to close proximity of the road Creates the most segregation due to separating properties from the rest of the community via a road corridor

Table 10.3.3: Middleton Moor & Theberton West Advantages

Route Option	Advantages	Evidence
Middleton Moor & Theberton West	Air quality improvement for the villages of Middleton Moor & Theberton	Air Quality: Net Value Change of £109,970 along the B1122 - a reduction of 538 T/y in NO_2 and 61 T/y in PM_{10} Three receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Noise Levels	6 properties have been identified as having a significant impact upon their noise level.
	Positive impacts on the heritage within Middleton Moor and Theberton	Positive effect on 5 listed buildings within Middleton Moor and 8 listed buildings within Theberton by reducing the volume of traffic flow Enhances the historic environment of the two villages due to reduction in vehicle emissions, noise and pollution
	Least impact to water environment	Post-Mitigation impacts- insignificant; silt-laden runoff, chemical contamination, water pollution from runoff, morphological effects and loss of ponds
	Least impact on the community	Creates minor segregation amongst the community Creates minor impact upon cyclist amenity Causes minor delays to drivers
	Construction costs	£19,424,714.86 for the bypass
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)
	Largest reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £136,000

Table 10.3.4: Middleton Moor & Theberton West Disadvantages

Route Option	Disadvantages	Evidence
Middleton Moor & Theberton West	Potential damage to the biodiversity	Moderate Adverse effects: Crosses two tributaries of the Old Minsmere River would require new culverts for each Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Visual Amenity	Large adverse effects to the visual amenity of some properties within Middleton Moor
	Negative impact on Theberton Hall	Grade 2 listed building would experience visual and aural intrusion due to the location of the proposed bypass
	Smaller reduction in greenhouse gasses	Reduction in greenhouse gas emissions by £103,000

Capabilities on project:
Transportation

Table 10.3.5: D2 Advantages

Route Option	Advantages	Evidence
D2	Air quality improvement for the villages of Middleton Moor & Theberton	Air Quality: Net Value Change of £62,949 along the B1122 - a reduction of 307 T/y in NO_2 and 54 T/y in PM_{10} Two receptors will experience an improvement of more than 5% No exceendences of air quality objectives at sensitive receptors
	Noise Levels	3 properties have been identified as having a significant impact upon their noise level
	Positive impacts within the towns of Saxmundham and Leiston	Conservation Areas in Saxmundham and Leiston will experience reductions in the volume of traffic passing through the towns leading to a decrease in vehicle emissions, noise and pollution
	Least visual impact for the community	Of the three options, visually effects the community the least
	Removes HGVs from Middleton Moor and Theberton	17 HGVs per hour are estimated to use the B1122 during 2024 (Sizewell C's construction year)

Table 10.3.6: D2 Disadvantages

Route Option	Disadvantages	Evidence
D2	Air quality deterioration for parts of Saxmundham	2 receptors will experience deterioration of between 1% and 2.5%
	Potential damage to the biodiversity	Moderate to Large Adverse effects: Crosses rivers Fromus and Hundred would require two new culverts Direct impact to ancient woodland of Buckles Wood causing direct habitat loss Potential impacts downstream upon the Alde and Ore Estuaries Loss of habitat for Badgers, nesting birds, bats and common reptiles Fragmentation of numerous hedgerows, woodlands and ponds GCN (Great Crested Newts) populations are present within the area
	Loss of amenity land	Moderate adverse effects on landscape character Large adverse effects within the first year: loss of boundary vegetation and small pockets of trees
	Visual Amenity	Moderate to large adverse effects on visual amenity Large adverse impacts to some properties to the south of Saxmundham and north east of Leiston Large adverse impacts to the users of many public rights of way
	Negative impacts on Heritage assets along the route	Potential loss of remains of red tile previously discovered in the area Partial loss of cropmark due to location of bypass route Visual and aura006C intrusion upon the property of Hurts Hall -a grade 2 listed building
	Potential impact to water environment	Potential impacts on the Sizewell Marshes SSSI Impact upon the movement of protected species (eel) in River Fromus
	Largest impact on the community	Disrupts 11 footpaths Disrupts 1 cycleway Requires cyclists to use 3 roundabouts Causes the biggest delay of drivers due to potential queuing at proposed roundabouts Affects access to two properties Cuts through farmland Impacts on the visual amenity of properties situated within Saxmundham and Leiston
	Largest construction costs	£54,851,384.55 total for the bypass

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10.4 Restrictions on the B1122

Table 10.4.1 Restrictions within Middleton Moor and Theberton

B1122 Route Comparisons			
Restrictions	**Middleton Moor**	**Theberton East**	**Theberton West**
HGVs Transferred to new bypass per 24 hours: 2024 (Sizewell Construction Year)	786	877	877
HGVs Transferred to new bypass per 24 hours: 2035 (After Sizewell Construction)	220	327	327
Pinch Points removed (m) -lengths of existing road below 6m wide	428	1392	1392
Number of speed limits replaced by scheme	2	1	1
Speed Limits (mph)	30/40	30	30

10.5 Comparison of Potential Net Environmental Benefits by band width

Properties were identified in band widths from the existing road in order to identify potential relief from noise, vibration, air quality, dust and other effects. The tables' 10.6.1-10.6.3 contains the numbers of properties potentially affected from the existing route and bypasses.

Table 10.5.1 Band Width benefits with Middleton Moor bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Middleton Moor				
Properties in existing road band	24	38	42	42
Properties in new road band	7	11	12	23
Net Benefits Indicated - properties (no)	17	27	30	19

10.5.2 Band Width benefits with Theberton East bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Theberton East				
Properties in existing road band	46 (+C)	59 (+C)	79 (+C)	83 (+C)
Properties in new road band	0	6	38	85 (+C)
Net Benefits Indicated - properties (no)	46 (+C)	53 (+C)	41 (+C)	-2

10.5.3 Band Width benefits with Theberton West bypass

Route Option	Band Widths			
	50m	100m	200m	300m
Theberton West				
Properties in existing road band	46 (+C)	59 (+C)	79 (+C)	83 (+C)
Properties in new road band	0	0	22	50
Net Benefits Indicated - properties (no)	46 (+C)	59 (+C)	57 (+C)	33 (+C)

The (+C) indicates that Theberton Church is included within the count of properties which would experience benefits from either of the Theberton bypass routes.

The noise level values associated with the banding widths in Table 10.6 are shown below. The values are set as a guide only and it is still the case that further work will be needed to provide absolute noise values in due course.

Traffic flow : 5,000 vehicles over the 18-hour period 06:00 to midnight
Mean Traffic Speed = 70 km/h
%Heavy vehicles = 10%

Propagation: Rural setting predominantly flat open ground typically grassland.
Receiver height: 4m above ground – typically 1st floor level.

Calculated differences in Noise Levels

From the extreme front of the bands at 50m from road centreline at 1m from the facades of dwellings to the back of the bands at 300m from the road centreline it is calculated that there will be a difference in receptor noise levels of around 12.0 dB(A) $L_{A10,18h}$.

Route D2

In order to accurately model the effects of Route D2 construction on B1122 and the construction of band levels in this situation, there would have to be considerable additional traffic modelling work, beyond the scope of this document.

However estimated daily construction related trips on the B1122 (with the D2 route in place) are currently estimated to be 1036 one-way car trips (i.e. 518 in each direction) and 116 one-way LGV trips.

10.6 Summary

The table in section 10.5 shows the potential restrictions imposed if the bypass routes were not built. The data is based on the assumption that all HGVs will transfer to the new bypass routes and not remain on the existing routes through the villages. If the bypasses were not constructed, the number of HGVs on the existing B1122 both during and after the Sizewell C construction period would be unacceptable.

The tables in section 10.6 show clearly that of the two bypass options for Theberton, the western route has more benefits than that of its eastern counterpart. For all of the band widths, the Theberton West bypass has positive benefits compared to that of the existing B1122 route. Although the Theberton East option has benefits over the existing route, the 300m band width impacts two more properties than the existing B1122. Like the Theberton West option, the Middleton Moor route benefits properties, whichever band width they fall in.

The existing road also has stretches of pinch points and speed limits which would impact on the efficiency of the journey times for HGVs. This would therefore have a knock on impact on any other vehicle using the existing road. The pinch points are defined as lengths of road under the widths of 6m, which are therefore likely to cause congestion and unsafe conditions for passing traffic. Theberton has more than three times the lengths of pinch points than Middleton Moor and therefore has the potential to cause more congestion if a new route was not constructed to bypass it.

Speed limits are in place within the Middleton Moor and Theberton which would slow traffic from 60mph to 30/40mph and 30mph respectively. Outside of the villages the existing B1122 speed limit is 60mph; therefore it can be assumed the new bypasses would keep this speed restriction also. However, under Highways Agency ruling HGVs are restricted to 40mph on single carriageway roads.

The restrictions within the villages would impact on the journey times of vehicles travelling to and from Sizewell C in addition to the communities of Theberton and Middleton Moor would experience and increase in the amount of HGVs passing through their centres on a daily basis during and after Sizewell C’s construction.

The environmental summary is condensed into the following tables which group the various bypass options for comparison.

Environmental and Cost Estimate Comparison

Route Option	Summary	Cost Estimate (£millions)
Yoxford Roundabout	The Yoxford roundabout is an essential element of the proposed improvements. Environmental work has not been carried out at this stage.	5.271
with		
Middleton Moor & Theberton West	This grouping of bypass proposals is the most beneficial in the categories of; air quality, noise, landscape, water and community impacts. In terms of air quality, this option has the largest reduction in NO_2 and PM_{10} of 538 and 61 tonnes per year which has a net value of £109,970. The NPV for noise for this bypass is much higher at just under £93,000 than any option. In the long term this route reduces the amount of properties affected to 5% and also reduces the annoyance evaluation from residents. It was deemed that due to the location of the proposed bypass, it would have the least impact upon the landscape character and overall visual amenity of the area. This route is positioned furthest away from any SSSI and therefore compared to the alternatives, reduces the likelihood of contamination via spills making it the best option for maintaining water quality. The last category is that of community impacts. Although the option had the same amount of benefits as the Middleton Moor & Theberton East; it did not score as the worst option for any of the subcategories within community impacts unlike the latter.	19.425
Middleton Moor & Theberton East	This grouping of bypass proposals also has many environmental benefits in the categories of; biodiversity, heritage, community impacts and construction costs. In terms of biodiversity, the route has the least effect on the environment with impacts of slight to moderately adverse. 13 listed buildings from within the villages of Theberton and Middleton Moor would encounter a positive impact due to the reduction in the flow of traffic through the villages. In terms of community impacts, this route creates the least impacts upon the following: pedestrian amenity, delay to drivers and cyclist amenity. The other major benefit of this option is that is has the smallest construction costs of all the routes. However, the potential negative impacts of this route combination include the deterioration of a receptor by more than 5%.	15.191

	9 properties within Theberton and Middleton Moor have been identified as this route having significant impacts upon them.	
D2	The main advantages of this route include improving the air quality and noise levels within Middleton Moor and Theberton by reducing traffic in the two villages. Of the three proposed routes and route combinations it creates the least community visual impacts due to the location of the bypass not severing any villages. However the route also has many disadvantages over the other two proposed options namely: large effects on biodiversity, moderate effects on landscape character, adverse effects on visual amenity, negative impacts upon heritage in the area, impacts upon the water environment, large community impacts and high construction costs.	54.851

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Appendix