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A27 ARUNDEL BYPASS ENVIRONMENTAL STUDY REPORT

HIGHWAYS ENGLAND

JUNE 2017

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Highways England

Revision 5

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1

INTRODUCTION AND OVERVIEW

1.1 THE PROJECT AND STAGE OF PROJECT

- 1.1.1 This Environmental Study Report (ESR) has been prepared to help inform the identification of scheme options, and the process towards selection of options that will be subject to public consultation, for proposed improvements to the A27 at Arundel. It forms part of the requirements of the Highways England Project Control Framework (PCF) Stage 1. PCF Stage 1 is the options identification phase, whereby all options are assessed. Refined options are then taken forward to PCF Stage 2 the Options Selection phase, when public consultation is carried out and the preferred option is selected.
- 1.1.2 The A27 corridor through Arundel has historically suffered from congestion and delays. Approaching Arundel from the west, the carriageway is reduced from a dual to single carriageway. It then passes through two roundabout junctions on the edge of the town before becoming a dual carriageway again at the A27/A284 Crossbush junction.
- 1.1.3 The key issues along the existing A27 alignment at Arundel are:
- Peak hour traffic congestion that is set to worsen with forecast development growth;
 - A high number of accidents and incidents;
 - Impact of congestion on local roads and north-south corridors such as the A284; and
 - Noise, heritage and community impacts.
- 1.1.4 At present ten different scheme options have been identified, including both on-line and off-line options. These are shown in Appendix A, Figure 1.2 and described in Chapter 3. As the project is still in an early stage of development, the number of options (and possible variants) is subject to change as more information becomes available.

1.2 THE LOCATION OF THE PROJECT

1.2.1 The A27 at Arundel is located in the county of West Sussex near the south coast of England, and provides a strategically important transport corridor linking Chichester and Worthing. The location and extent of the study area is shown below in Figure 1-1.

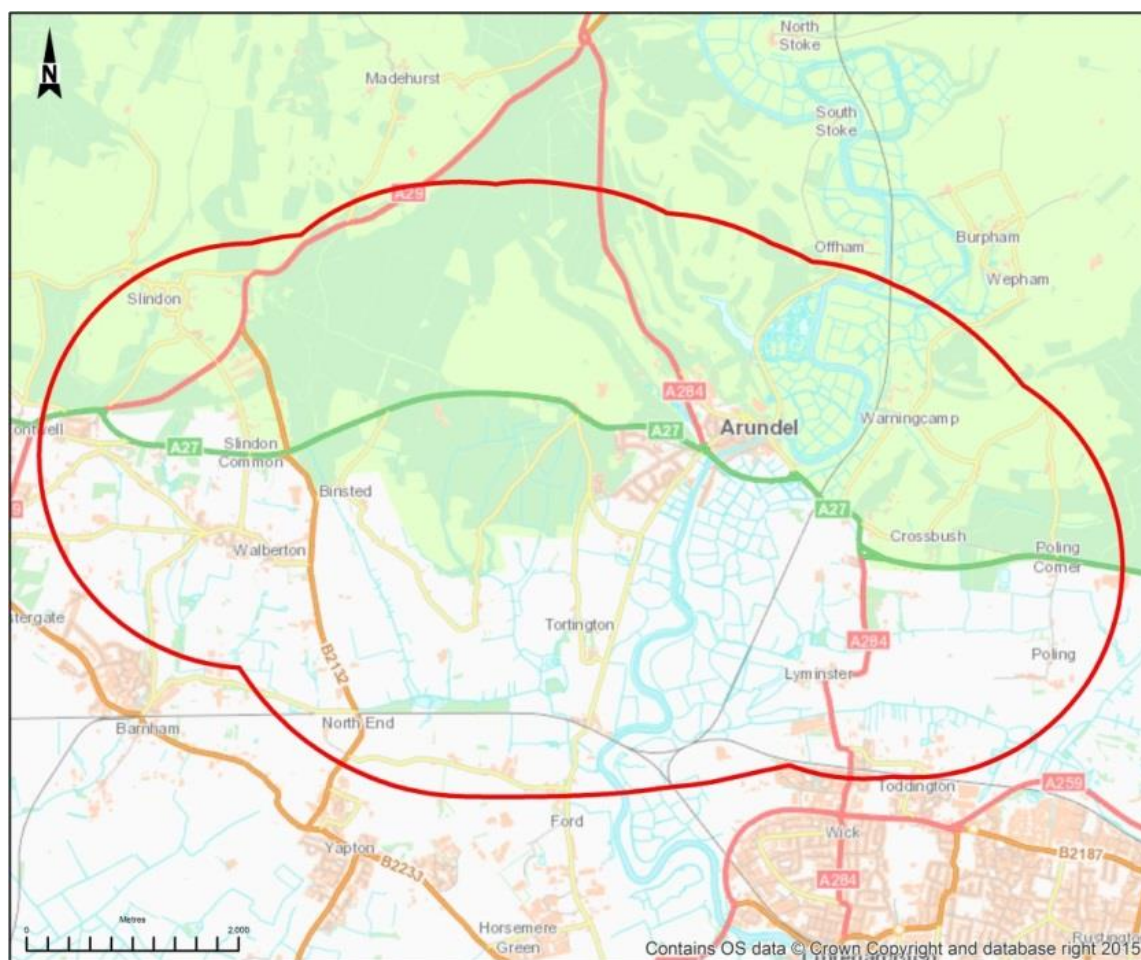


Figure 1-1 A27 Arundel Study Area

1.3 PURPOSE OF THE REPORT (INCLUDING REPORTING OF THE DETERMINATION PROCESS)

- 1.3.1 The ESR has been prepared to provide a broad overview of the environmental constraints and relative environmental benefits associated with the various options, including potential mitigation and compensation measures. Severe environmental constraints that would preclude further consideration of an option will be identified. This report also identifies the further assessment that is likely to be required if potentially severe effects are associated with any options.
- 1.3.2 The preferred option will be selected during PCF Stage 2, which will include further consideration of the environmental constraints. If the selected option requires statutory Environmental Impact Assessment (EIA), then that will be undertaken during PCF Stage 3, the preliminary design phase.

1.4 SCOPE AND CONTENT

- 1.4.1 The ESR considers ten options that have been identified to date. These are shown in Appendix A, Figure 1.2 and described in Chapter 3. The baseline information has primarily been obtained through desk studies from readily available information sources. Site visits have also been undertaken to obtain further information.
- 1.4.2 Stage 1 should be considered as a high level assessment and further monitoring and survey work will be required in PCF Stage 2 and 3 to inform the EIA. This will address data gaps identified within this ESR and the ESR for PCF Stage 2. These future monitoring requirements are set out in this ESR and the ESR at PCF Stage 2, once the number of options has been reduced, and more information is available on the option designs.
- 1.4.3 This ESR covers the following DMRB Volume 11, Section 3, topics:
- Air Quality
 - Cultural Heritage
 - Landscape
 - Ecology and Nature Conservation
 - Geology and Soils
 - Materials
 - Noise and Vibration
 - People and Communities
 - Road Drainage and the Water Environment

2 THE PROJECT

2.1 BACKGROUND TO THE PROJECT

- 2.1.1 Proposals to improve the A27 were previously considered as part of the South Coast Multi Modal Study (SoCoMMS, 2002) and the A27 Corridor Feasibility Study (2014).
- 2.1.2 The commissioning of the A27 improvement works follows the publication of the Autumn Statement and the Government's Road Investment Strategy (RIS) in December 2014. The RIS was informed by the A27 Feasibility Study which was published subsequently in March 2015. The RIS included highway improvement proposals for four parts of the A27, as follows:
- A27 Arundel: new dual carriageway bypass (or online option), subject to consultation with the South Downs National Park (SDNP) Authority, relevant local authorities and the publication of this and alternative options;
 - A27 Worthing and Lancing: improvements to capacity and junctions along the A27, subject to consultation with West Sussex County Council (WSCC) and the public;
 - A27 Chichester: improvements to safety and capacity on the Chichester Bypass; and
 - A27 East of Lewes: address safety, capacity, sustainability and accessibility issues on this stretch of the A27.
- 2.1.3 This report considers the A27 Arundel improvement, and the scheme options that have been identified to achieve the improvement.

2.2 REGULATORY FRAMEWORK AND THE PROJECT OBJECTIVES

NATIONAL POLICY

- 2.2.1 The Government's National Policy Statement for National Networks (NPSNN) outlines the requirement for (alongside the Government's policies for delivery) Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England. The Secretary of State will use the NPSNN as the primary basis for making decisions on development consent applications for national networks NSIPs in England.
- 2.2.2 The NPSNN sets out the Government's approach to decision making with regards to proposed improvements on the highways network, and indicates that improvements are vital to alleviate congestion. Paragraph 2.17 states:
- "It is estimated that around 16% of all travel time in 2010 was spent delayed in traffic, and that congestion has significant economic costs: in 2010 the direct costs of congestion on the Strategic Road Network in England were estimated at £1.9 billion per annum."
- 2.2.3 The NPSNN indicates that all projects should be subject to an options appraisal, and that this should consider viable modal alternatives and may also consider other options. Where projects have been subject to full options appraisal in achieving their status within Road or Rail Investment Strategies, or other appropriate policies or investment plans, option testing need not be considered by the examining authority or the decision maker. For national road and rail schemes, proportionate option consideration of alternatives will have been undertaken as part of the investment decision making process.
- 2.2.4 The National Planning Policy Framework (NPPF, 2012) is a consideration in decisions on

NSIPs, but only to the extent relevant to that project where the NPSNN does not provide advice. It does not contain specific policies for NSIPs where particular considerations can apply.

- 2.2.5 Relevant policies within both the NPPF and the NPSNN for each topic area are summarised in Section 5 of each topic chapter, as well as other relevant international and national legislation.

PROJECT OBJECTIVES

- 2.2.6 The A27 Arundel Bypass scheme is set out in the Road Investment Strategy 2015/6 to 2019/20. The objectives for this scheme were developed with regard to Highways England Delivery Plan and through stakeholder workshops. These objectives are:

- To enhance the capacity, connectivity (including all modes of transport) and the resilience provided by the A27 route in order to contribute positively to strengthening the local and regional economic base, facilitating housing allocations within the Local Plans and promoting economic growth.
- To improve the safety and personal security of travellers along the Arundel section of the A27 route for all road users including vulnerable road users.
- To improve road safety and reduce dis-benefits to communities and vulnerable road users on the wider local road network caused by longer distance traffic avoiding congestion on the A27.
- To reduce the community severance caused by the existing A27 through Arundel and improve links between local communities and to local services and facilities, particularly for tourism and access to railway stations and bus services.
- To deliver a high standard of design for any A27 improvement that reflects the quality of the landscape and setting of Arundel, and minimises the adverse environmental impact of new construction, including habitat loss and taking into account the following:
 - planning for climate change;
 - working in harmony with the environment to conserve natural resources and encourage bio-diversity;
 - protecting and enhancing countryside and archaeological environments; and
 - Reducing air and noise pollution.
- Recognising that any improvement would have a significant impact on the South Downs National Park (SDNP), and have regard to the purposes and special qualities of the National Park that the SDNP authority is seeking to preserve in designing and evaluating improvement options.

- 2.2.7 These objectives will be refined during PCF Stage 2, as the options are developed and additional baseline information becomes available.

2.3 ANY FURTHER SUPPORT OF GOVERNMENT POLICIES

- 2.3.1 The Department for Transport's (DfT) Command Paper 'Action for Roads' 2013 sets out its vision for the future of the road network and explains that Government is making a transformational investment in the road network to support the economy and the environment, and to build a network that is fit for the future.

- 2.3.2 The scheme was announced within the Roads Investment Strategy (2015-2020) and the

scheme is included in the Highways England Delivery Plan 2015 – 2020 which says that Highways England expect to make recommendations on the preferred routes for this scheme in 2017.

2.4 LAND USE SETTING AND LAND TAKE

- 2.4.1 The A27, which links a number of cities and towns along the south coast, reduces from a two-lane dual to single carriageway through Arundel, a small historic market town, located at the boundary between the South Downs and the coastal plain. The road skirts the southern edge of the SDNP on the eastern side of the town and lies within the Park boundary to the west of the town.



Figure 2-1 Viewpoint from Arundel Castle over Arun Valley

- 2.4.2 Arundel is located in a steep vale of the South Downs in West Sussex where it is overlooked by two famous landmarks; Arundel Castle (Figure 2-1) and Arundel Cathedral. The town is a major bridging point over the River Arun which runs through the eastern side of the town. Generally, the older part of the town lies to the north and is separated by the A27 from newer development to the south west of the historic town centre.
- 2.4.3 Land take will be required for all of the scheme options, although the offline options will require substantially more land take than the online option.

2.5 CONSTRUCTION, OPERATION AND LONG TERM MANAGEMENT

- 2.5.1 Construction, operational and long term management arrangements are not known at this stage. Any assumptions made within this assessment relating to the construction, operational or long-term management arrangements are based on prior experience of similar schemes.

3

ALTERNATIVES CONSIDERED

3.1 OPTIONS THAT HAVE BEEN EXAMINED

- 3.1.1 Ten options are currently being considered for the improvement works on the A27 Arundel.
- 3.1.2 The ten options are broadly separated into:
 - 3 Do minimum/Low cost options;
 - 1 Online improvement (with an offline section); and
 - 6 Offline bypass options.
- 3.1.3 Each option is described below and should be read in combination with Figure 3-1 which shows the location of each option.
- 3.1.4 Figure 16-1 shows the environmental constraints within the study area.

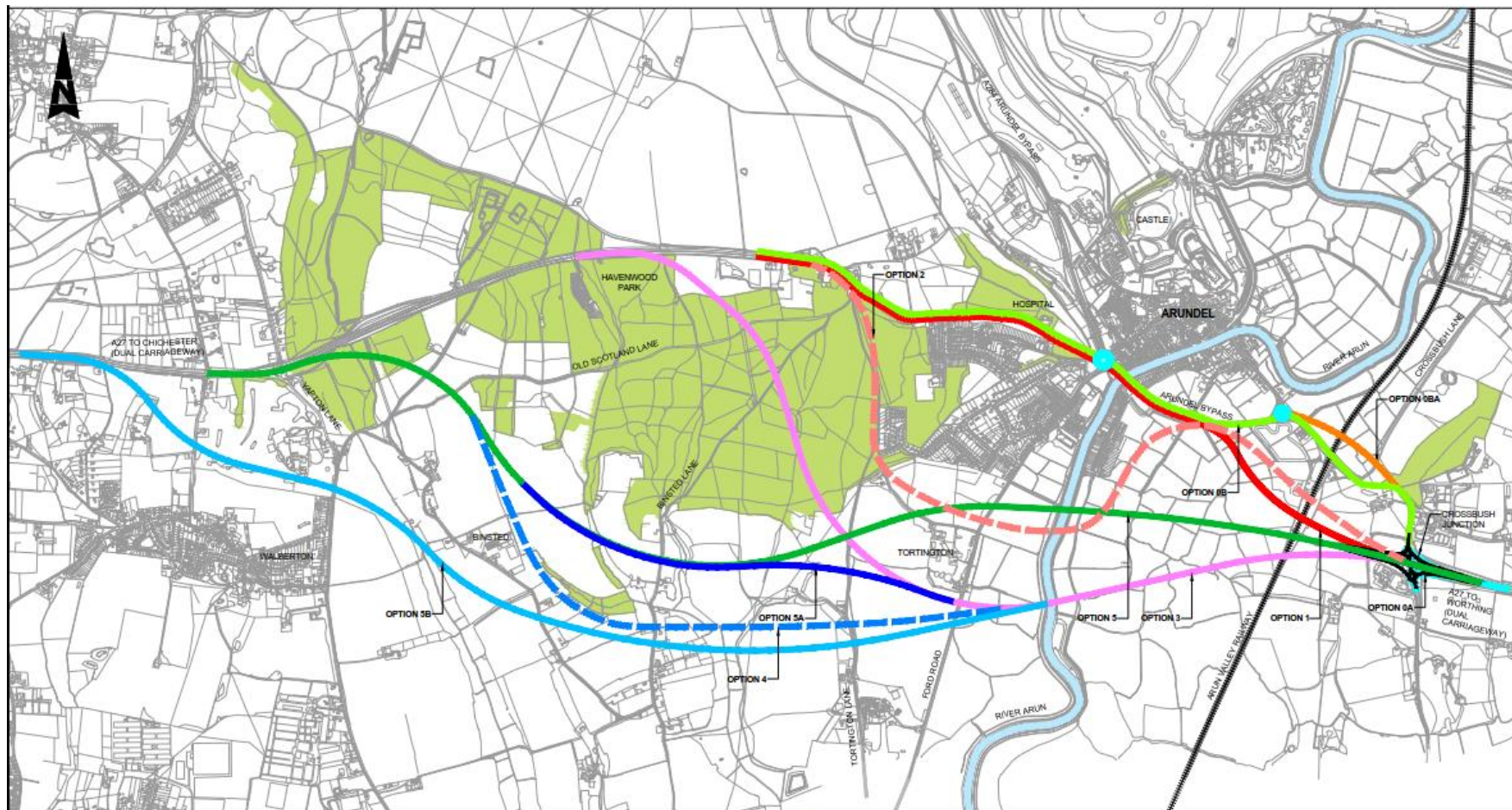


Figure 3-1 Indicative alignment of scheme options

3.2 DO MINIMUM LOW COST OPTIONS (OPTION 0A, 0B AND 0BA)

OPTION 0A

- 3.2.1 Option 0A consists of improvements to the Crossbush junction (alternatively known as the BBMM scheme) and at-grade improvements at the Ford Road Junction and the Causeway Junction. Option 0A is considered a do minimum or low cost option when compared to other options proposed. Option 0A is intended to alleviate a recognised bottleneck and improve safety in the area with minimal impact upon road users and local environment.
- 3.2.2 Option 0A is likely to reduce local congestion and queuing in the vicinity of the Crossbush junction, but will not address the traffic issues associated with the single carriageway sections of A27, which will have less capacity than demand at peak periods particularly in the medium and longer term.

OPTION 0B

- 3.2.3 Option 0B will consist of a narrowed urban dual all-purpose carriageway (D2UAP) (i.e. two lanes in each direction with a central reservation) corridor along the existing A27 alignment, in addition to junction improvements at Crossbush, Causeway and Ford Road roundabouts. Ancient Woodland is adjacent to both sides of the A27 for approximately 1.75 km. A shared cycle and pedestrian lane will be provided on one side of the dualled route. 0B involves entirely online improvements.

OPTION 0BA

- 3.2.4 Option 0BA incorporates the improvements to the Crossbush junction of Option 0A, the online widening regime of Option 0B, and also adds a new small offline section of road between, the existing access to Batworth Park House on the A27 and A27/The Causeway roundabout. A new railway bridge will be required over the Arun Valley Railway and a new underbridge will be required at Crossbush Lane.
- 3.2.5 Option 0BA would result in at least the same traffic improvements as option 0B, however, in addition, the small section of new off-line road, which would improve the alignment of the road (remove the existing kink), would improve average speeds, which would lead to improved flows and therefore lower congestion levels.

OPTION 1 – ONLINE IMPROVEMENT (AND OFFLINE SECTION)

- 3.2.6 Option 1 consists of online dualling of the existing A27 and junction improvements between the White Swan and Ford Road. Then a new offline two lane dual carriageway from Arundel Bypass to Crossbush Junction.

OPTION 2 – BYPASS OPTION, PASSING NEARBY EXISTING A27

- 3.2.7 Option 2 is an off-line route from the existing A27 alignment. This alignment is approximately 4.4km in length and commences from a proposed new interchange adjacent to The White Swan Public House to the west of Arundel on the existing A27 Chichester Road. The alignment then runs to the south adjacent to Tortington Lane and then south-eastwards towards the River Arun.
- 3.2.8 The alignment continues in a south east direction, and will require an overbridge at the River Arun. It then runs northwards to the existing A27 Arundel By-pass. This alignment then continues on to cross over the Arun Valley Railway on a new over bridge, and ties

into the existing A27 via a new grade separated interchange¹ at Crossbush Junction. Approximately 1 km of this option is sited within Ancient Woodland. Approximately 1.6 km of the alignment is within Flood Zone 3 as defined by the Environment Agency (EA), meaning there is a 1 in 100 or greater chance of flooding each year².

3.2.9 Option 2 would consist of a standard two lane dual carriageway along its entire length.

OPTION 3 – BYPASS OPTION (PREVIOUSLY KNOWN AS THE ‘PINK-BLUE’ ROUTE)

3.2.10 Option 3 is an off-line route from the existing A27 alignment. This option was also known as the “pink – blue route” from when the DfT issued a Preferred Route Statement and undertook public consultation in July 1993.

3.2.11 This alignment diverges from the A27 at Havenwood Park in a south east direction. It requires four new underbridges at Old Scotland Lane, Binsted Lane, Tortington Lane and at Ford Road. The alignment then runs eastwards and requires two new overbridges over the River Arun and then the Arun Valley Railway. The proposed alignment will then be joined to the existing A27 via new grade separated interchange at Crossbush Junction. Approximately 1.6km of this option is sited within Ancient Woodland and 1.75 km within Flood Zone 3. Option 3 would consist of a standard two lane dual carriageway corridor along its entire length.

OPTION 4 – BYPASS OPTION, AVOIDING MAJORITY OF SOUTH DOWNS NATIONAL PARK

3.2.12 This option commences near Yapton Lane and is aligned to reduce the potential adverse effects on Ancient Woodland, and the South Downs National Park (SDNP). The alignment continues in a south east direction, adjacent to the border to the SDNP, and will require four new underbridges at Binsted Lane (North), Old Scotland Lane, Binsted Lane (South) and at Ford Road. The alignment then continues east, similar to Option 3 and will require two new overbridges at the River Arun and at the Arun Valley Railway. The proposed alignment will then tie into the existing A27 via a new grade separated interchange at Crossbush Junction. Approximately 1.75 km of this option is sited within Flood Zone 3.

3.2.13 Option 4 will consist of a standard two-lane dual carriageway along its entire length.

OPTION 5 – BYPASS OPTION, MINIMISING FLOODPLAIN

3.2.14 Option 5 commences near Yapton Lane, and runs north of Tortington Priory. This is the off-line option that travels shortest distance over the floodplain, with approximately 1.5 km of the alignment sited within Flood Zone 3. The alignment then continues east, similar to Option 3 and will require two new overbridges at the River Arun and at the Arun Valley Railway. The proposed alignment will tie into the existing A27 via a new grade separated interchange at Crossbush Junction. 600m of this option is situated within Ancient Woodland. It is not possible to mitigate the loss of Ancient Woodland. A design is not yet available and therefore the current arrangement as shown in Figure 3.1 is the subject of assessment for the purposes of this report.

¹ Grade separation is the method of aligning a junction of two or more surface transport axes at different heights so they will not disrupt the traffic flow on other transit routes when they cross each other.

² Environment Agency Flood Map for Planning, available from: <http://maps.environment-agency.gov.uk>

OPTION 5A – COMBINATION OF OPTION 3 AND 5

3.2.15 Option 5A commences at Yapton Lane and follows the alignment of Option 5 until the route reaches Binsted Lane, when it diverges along a new alignment for a short distance to Ford Road, at which point it continues along the alignment proposed by Option 3. Approximately 600m of this option is situated within Ancient Woodland and approximately 1.75 km within Flood Zone 3. It is not possible to mitigate the loss of Ancient Woodland.

OPTION 5B – WESTERN TIE-IN, AVOIDING ANCIENT WOODLAND

3.2.16 Option 5B commences at Crossbush junction and initially follows the alignment proposed by Option 3. At Ford Road the route diverges along a new alignment and runs west between Tortington Priory and Tortington village, skirting south of Binsted Wood and running to the north of Walberton. The route ties in with the existing A27 alignment, north of the Hilton hotel and golf course and west of the existing junction with Mill Road/Tye Lane. Approximately 1.75 km is cited with EA Flood Zone 3 and no Ancient Woodland is within the proposed alignment.

TRAFFIC FORECASTING

3.2.17 Detailed traffic modelling is not available at this early stage of the design process. It will be undertaken at PCF Stage 2 and 3, once the number of options has been reduced, and more information is available on the option designs. High level forecasting exercises have been undertaken to inform the air quality and noise assessments that are based on historic traffic growth per annum of 1-2%. High level commentary on how each of the scheme options is likely to perform in traffic terms is described in Table 3-1. However, it should be noted that the predicted performance of each option will change as the design of the scheme options is refined and more detailed traffic model becomes available.

Table 3-1 - High Level Traffic Forecasting

OPTION	FORECAST
Option 0A	Likely to reduce congestion and queuing in the short term, although over the medium and long term congestion and queuing is anticipated to still occur. The new improvements are likely to allow traffic growth of up to 25% on all A27 links. However, the anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The single carriageway sections of A27 are likely to have less capacity than demand at peak periods.
Option 0B	Likely to result in a significant reduction in congestion and queuing. However, it is possible that some congestion and queuing may remain on certain routes.
Option 0BA	Likely to result in at least the same traffic improvements as Option 0B. However, in addition, the small section of new off-line road, which would improve the alignment of the road, would improve average speeds, which could lead to improved flows and therefore lower congestion levels.
Option 1	Likely to result in a significant reduction in congestion and queuing. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The improvements would accommodate for this during peak periods on the majority

OPTION	FORECAST
	of A27 links. However, it is possible that some congestion and minor delays may occur at Crossbush junction.
Option 2	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.
Option 3	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.
Option 4	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.
Option 5	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.
Option 5A	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.
Option 5B	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The option would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in

OPTION	FORECAST
	benefits to communities living close to the existing congested routes. This may include improvements in air quality and reductions in noise for communities within Arundel.

4 ENVIRONMENTAL ASSESSMENT METHODOLOGY

4.1 GENERAL APPROACH

4.1.1 This report follows the assessment approach in the DMRB Volume 11, and relevant Interim Advice Notes (IANs) (including IAN 125/15). Sections 1 and 2 of the DMRB describe the approach of Simple and Detailed Assessment and IAN 125/15 sets out the topic structure for ESRs.

4.2 SCOPING

4.2.1 An initial scoping exercise was undertaken as part of the PCF Stage 1 to determine the level of assessment that was appropriate at this early stage in the design process, and consider whether any topics could be scoped out, and the outcomes are reported in this section.

4.2.2 The scope for the assessment was discussed during consultations and liaison with the SDNP Authority, Historic England and Arun District Council.

4.2.3 Simple assessments, as defined by DMRB Volume 11, Section 3 where relevant, were proposed, which are appropriate and proportionate, considering the large number of scheme options and in view of the limited design information available. Due to the nature and variety of options proposed it was not possible to scope any topics out, but this will be considered again as the scheme is progressed and the number of options is reduced.

4.2.4 The level of assessment and proposed approach for each topic is summarised in Table 4-1.

Table 4-1: Environmental Topics and Level of Assessment

TOPIC	LEVEL OF ASSESSMENT
Air Quality	Simple Assessment. High level preliminary assessment based on DMRB, Volume 11, Section 3, Air Quality, May 2007; IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA 207/07); and the Institute for Air Quality Management (IAQM), Guidance on the Assessment of dust from demolition and construction, January 2014.
Cultural Heritage	Simple Assessment. High level preliminary assessment based on Historic England guidance, Historic Environment Good Practice Advice in Planning Note 3 (Historic England 2015); the Cultural Heritage Section (Volume 11, Section 3, Part 2) of the Design Manual for Road and Bridges (DMRB) (Highways Agency, 2007); Chartered Institute for Archaeologists (CIfA) Standard and Guidance for Historic Environment Desk-based Assessment (2014) and CIfA Code of Conduct (2014).
Landscape	Simple Assessment Based on IAN 135/10 Landscape and Visual Effects Assessment (Highways Agency

TOPIC	LEVEL OF ASSESSMENT
	2010); and the Guidelines for Landscape and Visual Impact Assessment (3rd Edition) (The Landscape Institute and Institute of Environmental Management and Assessment (GLVIA), 2013).
Ecology and Nature Conservation	Simple Assessment. Based on the guidelines for Ecological Impact Assessment (EclA) produced by the Chartered Institute of Ecology and Environmental Management (CIEEM).
Geology and Soils	Simple Assessment. High level assessment based on Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11 Geology and Soils, June 1993; CIRIA C552: Contaminated Land Risk Assessment – A Guide to Good Practice.
Materials	Simple Assessment High level assessment based on IAN 153/11 (Highways Agency, 2011) on the environmental assessment of material resources.
Noise and Vibration	Simple Assessment High level assessment of construction phase noise and vibration impacts in accordance with BS5228 -1&2; and qualitative assessment of operational phase impacts following guidance in DMRB.
People and Communities	Simple Assessment High level assessment based on the approach in IAN 125/15, which combines DMRB Volume 11, Section 3, Parts 6 (Land Use), 8 (Pedestrians, Cyclists, Equestrians and Community Effects) and 9 (Vehicle Travellers) into one assessment of People and Communities. The published guidance for these topics has been used.
Road Drainage and the Water Environment	Simple Assessment High level assessment based on DMRB Volume 11, Section 3, Part 10 (HD 45/09).

4.3 APPROACH TO ASSESSMENT

- 4.3.1 This section sets out the generic approach taken to the environmental assessment described in the ESR. Although there are methods and requirements specific to each assessment topic, the approach set out below is common to all topics and is in accordance with relevant guidance and best practice.
- 4.3.2 The environmental topic headings described in Section 3 of Volume 11 of the DMRB were amended most recently in 2015 IAN 125/15.) Highways England has not yet issued environmental topic advice notes to reflect all the new topic headings. For those topics that have not been updated, DMRB guidance as published in Section 3 will be used as relevant; the methodology has been set out in the topic chapter.
- 4.3.3 The Stage 1 assessment should be considered as a high level assessment of potential impacts. Impact assessments in the document will be supplemented through further surveys and investigation during PCF Stages 2 and 3 to support a Statutory Environmental Impact Assessment if required.
- 4.3.4 Examples of further surveys and investigation include:

- Ecological Surveys including protected species surveys;
- Cultural Heritage Setting Assessment and Desk Based Assessment;
- Landscape and Visual Impact Assessment;
- A site reconnaissance in order to determine any contamination or other ground issues;
- Assessment of traffic model data and traffic impacts on Air Quality;
- Additional Noise Surveys;
- Public Right of Way condition surveys;
- Flood Risk Assessment; and
- Arboriculture Assessment.

4.4 SIGNIFICANCE CRITERIA

- 4.4.1 The topic chapters provide an assessment of the potential of the project to have significant adverse environmental effects. The significance of an effect is a factor of the importance or value of the resource affected, and the magnitude of the impact upon it. Unless otherwise stated, guidance in DMRB Volume 11, Section 2, Part 5, was used to determine the value of an affected resource, the magnitude of impact and the significance of effect. Any use of other guidance has been explained and justified within the relevant assessment topic.
- 4.4.2 IAN 125/15 stressed that the prediction of significant effects does not require absolute certainty. Instead it is more about taking a reasonable view over likelihood. Furthermore, the determination of significance is only expected to be made using readily available information.
- 4.4.3 The overall significance of effects was assessed using the matrix in DMRB Volume 11, Section 2 Part 5, as detailed in Table 4-2. This approach to assessing significance is used throughout the assessments, unless specified in the topic chapter.

Table 4-2: Arriving at the Significance of Effects

		MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
		No change	Negligible	Minor	Moderate	Major
ENVIRONMENTAL VALUE (SENSITIVITY)	Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

4.5 MITIGATION AND ENHANCEMENT

- 4.5.1 Mitigation is defined as 'measures intended to avoid, reduce and, where possible, remedy significant adverse environmental effects' (DMRB Volume 11, Section 1, Part 7 (HA 218/08)). Enhancement measures are defined as 'measures over and above normal mitigation' (IAN 125/15).
- 4.5.2 Some initial mitigation and enhancement measures have been identified in the topic chapters, however, further measures will be considered at a later stage in the design process, once further design information is available.

5 AIR QUALITY

5.1 INTRODUCTION

- 5.1.1 This chapter presents the preliminary air quality assessment of the scheme options for the Arundel bypass Scheme, taking into consideration both construction and operation.
- 5.1.2 The Scheme has the potential to affect air quality as a result of emissions to air during construction and operation including:
- During Construction
 - Particulate Matter and Dust from construction from enabling works through to completion;
 - Exhaust emissions and dust from on and off site construction vehicle movements.
 - During Operation
 - Exhaust emissions from traffic on the local road network.

5.2 ASSESSMENT METHODOLOGY

- 5.2.1 The preliminary assessment of impacts has been made qualitatively with reference to the following guidance.
- DMRB, Volume 11, Section 3, Air Quality, May 2007
 - IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA 207/07);
 - IAN 175/13 Updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07);
 - Institute for Air Quality Management (IAQM), Guidance on the Assessment of dust from demolition and construction, January 2014.
- 5.2.2 IAN175/13 is currently under review. However, in the absence of a formal replacement IAN 175/13 is considered in this assessment.
- 5.2.3 In the absence of quantified traffic data, IAN185/14 relating to the provision of traffic data for air quality assessments is not applicable to this stage of the assessment. Similarly IAN 170/12 is not applicable in this qualitative assessment.
- 5.2.4 There is no specific guidance relating to the assessment of construction dust in the DMRB. Therefore, the guidance of the IAQM is adopted for this assessment.
- 5.2.5 The assessment of operational impacts will consider nitrogen dioxide (NO₂) and particulate matter (PM₁₀) only. These are the main pollutants emitted from road transport sources and are the main pollutants of concern. Other pollutants emitted from road transport sources and identified within the DMRB namely as carbon monoxide, benzene, and 1, 3-butadiene, are unlikely to have a significant impact as they are emitted at far smaller concentrations than the main pollutants of concern and therefore are scoped out of the assessment.

BASELINE

- 5.2.6 Baseline air quality has been assessed with reference to the air quality review and assessment reports prepared by Arun District Council under the requirements of the UK's Local Air Quality Management regime, supplemented by project specific diffusion tube monitoring. The diffusion tubes will monitor nitrogen dioxide and nitrogen oxides diffusion tubes.

CONSTRUCTION

- 5.2.7 The Institute of Air Quality Management (IAQM) guidance (IAQM, 2014) provides distance-based criteria for qualitatively assessing dust/particulate matter impacts from construction activities and their significance. The assessment has five stages:
- Definition of potential dust emission magnitude (termed dust emissions class);
 - Definition of the sensitivity of the area - Identification of specific sensitivities, the proximity and number of receptors (human and ecological), background PM₁₀ concentrations and site specific factors;
 - Assessment of the potential risks of impacts in the absence of mitigation;
 - Definition of site-specific mitigation measures; and
 - Assessment of whether significant effects are likely following mitigation.
- 5.2.8 The potential impacts during construction relate to dust soiling of surfaces, health impacts due to increased particulate (PM₁₀) matter, and dust coverage of sensitive ecological receptors. There is also the potential for traffic impacts during construction, due to worsening congestion from traffic management schemes. There are no specific ecological sites designated at local, national or international level in within 350m of construction works. However a number of designated sites are close to the route that may be taken as alternatives during the construction phase, namely the B2139 from Storrington to Fontwell. Consideration of this will be included in this preliminary assessment.
- 5.2.9 IAQM guidance explicitly states that the significance of effects should not be assessed prior to mitigation since such mitigation measures will be specified within a Construction Environmental Management Plan (CEMP) and are considered embedded within the Scheme. This reflects the DMRB recommendation of integrating mitigation measures into the CEMP reflecting the requirements of best practicable means (BPM). The IAQM 2014 guidance states that the significance of any residual effects will, in general, be 'not significant'. However, prior to the assessment of significance of effects, the IAQM guidance assesses the risk of impacts in the absence of mitigation. This risk is based on an assessment of the sensitivity of the area to dust and nuisance effects (based on the numbers of receptors, their individual sensitivity and distance from construction works) and the potential magnitude of the dust emissions (based largely on the scale of the works).
- 5.2.10 IAQM guidance suggests that risks be assessed for the various aspects of the construction phase. For this preliminary assessment, construction works are assessed as a single phase, with simple reference to the likely scale of construction dust emissions. Table 5-1 illustrates how the IAQM guidance assesses the risk of impacts.

Table 5-1: Assessment of Risk Impacts during Construction

SENSITIVITY OF AREA	DUST EMISSIONS MAGNITUDE		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

OPERATION

- 5.2.11 Air quality assessments rely inherently on information on existing and future traffic flows to predict potential impacts. At this early stage in the assessment, the required traffic data is not available and therefore it is not possible to undertake a quantitative preliminary assessment of operational impacts. This information will be included at PCF Stage 3.
- 5.2.12 As such, the assessment is undertaken as a high level, qualitative review of the potential impacts of the scheme options. Professional judgement has been used to review the impacts from the available information and considers:
- the likely study area;
 - the sensitivity of the study area with regards to both ecological and human receptors;
 - the risk of exceedance of EU limit values and UK objectives for air quality;
 - the scheme study area in relation to a realignment (or widening) and receptor locations;
 - Qualitative comments on the traffic impacts provided by transport planners, based on their professional judgement of the scheme outcomes, including potential congestion relief and traffic reassignment between routes on the wider network.

5.3

STUDY AREA

- 5.3.1 The study area for the air quality assessment has been determined on the basis of professional judgement taking into account the extent of the physical works and discussions with transport planners as to the point at which any effects from the scheme are likely to fall below the DMRB criteria. The former is used to determine the study area for construction impacts and the latter is used for the operational study area.
- 5.3.2 During construction, the effects of dust emissions can, following IAQM guidance, be assumed to be negligible at distances greater than 350m from physical works and 100m from construction traffic routes (out to a distance of 500m from the site). This study area is relatively sparsely populated with the majority of sensitive receptors located within Arundel and along the A27. The scheme lies within the South Downs Natural Park a site designated for its landscape and associated wildlife value. However, no habitats sensitive to dust effects have been identified at this stage.
- 5.3.3 The operational study area for this high level assessment is presumed to extend:
- To the east along the A27 to the Crossbush junction;
 - To the west along the A27 to the Fontwell roundabout; and
 - To local roads feeding into the A27 from the north and south.
- 5.3.4 The study area includes the town of Arundel to the east and the village of Walberton to

the west. Ancient Woodland is located centrally within the study area, including Tortington Common with a few isolated houses. The scheme options all pass to the south of Arundel before re-joining the A27. The closest receptors to the scheme options are:

- Yapton Lane to the north of Walberton, <50m from Option 5B;
- Birch Close/Hazel Grove, <50m from Option 2; and
- Properties on Tye Lane, where Option 5B crosses it.

- 5.3.5 The only susceptible receptor identified within the study area is Arundel and District Community Hospital, approximately 50m to the north of the A27 (Chichester Rd). However, the potential for the scheme to affect flows across the wider area cannot be robustly discounted at this stage.

5.4 BASELINE CONDITIONS

- 5.4.1 Air quality in the study area is good, with both NO₂ and PM₁₀ concentrations being well below the air quality standard. Arun District Council, whose duty it is to monitor air quality under the Environment Act 1995, has not identified any need to monitor particulate matter as they consider there is little risk of exceedance of the standards within the district. Furthermore, there are no Air Quality Management Areas (AQMAs) declared in the district for either NO₂ or PM₁₀.
- 5.4.2 There are two AQMAs located outside of the district, the Storrington AQMA (Horsham DC), approximately 20km north east of the scheme options and the Worthing AQMA (Worthing BC) located 8 km east of the scheme options along the A27. Both were declared for exceedance of the UK's objective for annual mean nitrogen dioxide, due to high volumes of traffic on major roads and their associated exhaust emissions.
- 5.4.3 Air quality within Arun District Council is monitored by a network of non-automatic (NO₂ diffusion tubes) managed by the local authority. There are no automatic monitoring stations within the Council's boundaries. The council does not monitor particulate matter as it considers there is little risk of exceedance of the standards within the district. Monitoring of particulate matter in adjacent authorities, including Horsham DC, confirms that this is robust. The air quality in the district is good, with annual mean NO₂ concentrations in 2014 ranging from 12-25µg/m³. This is well below the annual mean objective of 40 µg/m³.
- 5.4.4 Eight of Arun District Council's monitoring sites lie within the study area and a summary of measurements taken at these sites is provided in Table 5-2. Annual mean NO₂ concentrations in 2014 ranged from 12-25µg/m³. This is well below the annual mean objective of 40 µg/m³.
- 5.4.5 The highest monitored values in the area were recorded at a roadside location on the section of A27 known as The Causeway. The roadside value in 2014 was 25µg/m³ as an annual mean, well below the UK/EU objective of 40µg/m³. The last exceedance of the annual mean objective for nitrogen dioxide was in 2010 where concentrations were recorded at the limit of 40 µg/m³. There is a general trend of decreasing concentrations at this and all other monitored locations in the study area and no anticipated risk of future exceedances of any objective.

Table 5-2 Summary of Air Quality Monitoring Undertaken by Arun District Council

SITE ID	EASTING (M)	NORTHING (M)	ANNUAL MEAN NO ₂ CONCENTRATION (µG/M ³)					
			2009	2010	2011	2012	2013	2014
Arundel High Street	501825	107165	20	23	18	17	18	14
A27 The Causeway	502337	106555	40	38	33	29	33	25
A27 The Causeway Hotel Façade	502337	106555	-	-	19	19	18	15
King Street	501478	107052	19	17	16	16	16	12
A27 Chichester Road	501320	106901	-	-	-	-	26	23
Priory Road	500886	106491	12	18	13	11	-	-
A27 The Causeway 2	502337	106555	38	40	35	34	-	-
Ford Road*	500301	104374	-	-	-	-	19	16
(-) no data available								

- 5.4.6 A project specific monitoring study was set up to establish a more spatially detailed air quality baseline. With particulate matter concentrations well below the standard, the study focussed on nitrogen dioxide emissions. A 12 month program was set up in January 2016, comprising one NO_x and 21 NO₂ diffusion tubes. Figure 5-1, shows the project specific diffusion tube monitoring locations.
- 5.4.7 As well as locating tubes along the existing road network, tubes were placed at possible intersections with the scheme options as well as on possible diversionary routes to the north via Storrington and its AQMA.



Figure 5-1: Project specific diffusion tube monitoring showing diffusion tube locations and scheme options. PCM links are shown as green dashed line.

- 5.4.8 The area around Arundel, including the Scheme, is included within the South East zone (UK0031) for Defra reporting of compliance with EU limit values for air quality. The latest report for 2015 indicates non-compliance with the limit value for annual mean NO₂ (40µg/m³) and compliance with all other limit values. The evidence base regarding compliance is provided by UK statutory monitoring networks, supplemented by Pollution Climate Mapping (PCM) modelling.
- 5.4.9 Sections of the A29 to the north and south of Fontwell are included in Defra's National Pollution Climate Mapping (PCM) modelling. Concentrations modelled for 2014 show concentrations well within the EU Limit values for NO₂ and PM₁₀. This is illustrated in Figure 5-1.

5.5 REGULATORY AND POLICY FRAMEWORK

- 5.5.1 The following legislation, policy and guidance documents are considered in this assessment.

AIR QUALITY STANDARDS AND REGULATIONS

- Air Quality Strategy for England, Wales, Scotland and Northern Ireland ³;
- Air Quality Strategy Statutory Instrument 2000 No.928, The Air Quality (England) Regulation 2000⁴;
- Statutory Instrument 2002 No.3043, The Air Quality (England)(Amendment) Regulation 2002⁵;
- Statutory Instrument 2010 No 1001, The Air Quality Standards Regulations 2010⁶; and
- Statutory instrument 2016/1184, The Air Quality Standards (Amendment) Regulations 2016⁷

PLANNING POLICY

- National Planning Policy Framework, 2012;
- National Policy Statement for National Networks, 2014

EUROPEAN AND NATIONAL LEGISLATION

- 5.5.2 The requirements of the 2008 EU Directive on ambient air quality and cleaner air for Europe (2008/50/EC) are transcribed into UK law by the Air Quality Standards Regulations. These Regulations place the Secretary of State under a duty to ensure that air quality limit values are not exceeded within specified zones by relevant dates. Where there is risk of limit values being exceeded, the Secretary of State is required to form and implement an action plan to ensure limit values would be met by the dates specified in the Directive. EU limit values are numerically identical to the UK's air quality objectives but

³ Defra (2007) Air Quality Strategy for England, Wales, Scotland and Northern Ireland

⁴ The Air Quality (England) Regulations, Statutory Instrument 2000/928, Environmental Protection, England

⁵ The Air Quality (England) (Amendment) Statutory Instrument 2002/3043, Environmental Protection, England

⁶ The Air Quality Standards Regulations, Statutory Instrument 2010/1001, Environmental Protection

⁷ The Air Quality Standards (Amendment) Regulations, Statutory Instrument 2016/1184, Environmental Protection

are statutory limits rather than policy targets. The pollutants of greatest concern in relation to the scheme are oxides of nitrogen and particulate matter, the objectives for which are presented in Table 5-3.

- 5.5.3 Under the requirements of the Environment Act 1995, the UK government has published an air quality strategy (Defra, 1997, revised in 2000 and 2007) which sets out air quality objectives for ambient air. The objectives are policy targets, expressed as maximum ambient (outdoor) concentrations not to be exceeded, either without exception or with a permitted number of exceedances within a specified timescale. The overall aim of the strategy is to achieve steady improvement in air quality over the objective implementation time scales and into the long term.
- 5.5.4 The Environment Act 1995 also set out the principles for Local Air Quality Management (LAQM) under which Local Authorities are required to review current and future air quality within their area against the air quality objectives. Where it is anticipated that an air quality objective will not be met, the Local Authority is required to declare an Air Quality Management Area (AQMA) and to produce an Action Plan in pursuit of the achievement of the air quality objectives. There are no AQMAs in the vicinity of the scheme.
- 5.5.5 The requirements of the 2008 EU Directive on ambient air quality and cleaner air for Europe (2008/50/EC) are transcribed into UK law by the Air Quality Standards Regulations. These Regulations place the Secretary of State under a duty to ensure that air quality limit values are not exceeded within specified zones by relevant dates. Where there is risk of limit values being exceeded, the Secretary of State is required to form and implement an action plan to ensure limit values would be met by the dates specified in the Directive. EU limit values are numerically identical to the UK's air quality objectives but are statutory limits rather than policy targets. The pollutants of greatest concern in relation to the scheme are oxides of nitrogen and particulate matter, the objectives for which are presented in Table 5-3.
- 5.5.6 Table 5-3 provides the details of the air quality objectives relevant to the assessment of the A27 Arundel bypass.

Table 5-3: Air quality objectives relevant to the assessment of the A27 Arundel bypass

POLLUTANT	AQS OBJECTIVE/ LIMIT VALUE	MEASURED AS
<i>Set for the protection of human health</i>		
NO ₂	200 µg/m ³	1hr mean; not to be exceeded more than 18 times per year
	40 µg/m ³	Annual mean
PM ₁₀	50 µg/m ³	24hr mean not to be exceeded more than 35 times per year
	40 µg/m ³	Annual mean

- 5.5.7 The Air Quality Regulations make clear that likely exceedances of the objectives should be assessed in relation to “the quality of the air at locations which are situated outside of buildings or other natural or man-made structures above or below the ground, and where members of the public are regularly present”. Air quality assessments should, therefore, focus on those locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. The assessment should not consider exceedances of the objectives at any location where relevant public exposure would not be realistic.

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS

- 5.5.8 The NPS NN (DfT, 2014) makes reference to air quality and requires all schemes with the

potential to affect air quality to undertake an air quality assessment that describes baseline air quality and future air quality with and without the proposed scheme.

- 5.5.9 The NPSNN states that air quality considerations are likely to be particularly relevant where schemes are proposed in areas where there are existing exceedances of air quality objectives or EU limit values, or sites designated for nature conservation. Moreover, the policy states that scheme will not be consented where they adversely impact on compliance with the 2008 EU Air Quality Directive.

NATIONAL PLANNING POLICY FRAMEWORK

- 5.5.10 The NPPF is relevant for NSIPs only where the NPSNN is silent on a particular topic. In relation to local air quality, the NPPF states (para. 124) that:

“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 impacts 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.”

- 5.5.11 For the scheme, this statement implies that whilst there are no AQMAs and hence air quality Action Plans, the development should not worsen the air quality, both as a standalone project or in conjunction with other projects.

5.6

DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

- 5.6.1 As this is a preliminary assessment there is currently insufficient information available to devise detailed site specific mitigation measures and the associated monitoring studies to test their effectiveness. Monitoring of NO₂ should be undertaken throughout the construction period.
- 5.6.2 Once operational the scheme is anticipated to improve traffic flows and reduce congestion, with associated improvement in air quality. As such, operational mitigation measures are unlikely to be required.
- 5.6.3 General construction methodologies are common to all road schemes. The following best practice measures will be required during construction. Once further detailed design information is available, any further site-specific mitigation will be identified.

SITE MANAGEMENT

- Records of dust and air quality complaints to be kept, including likely causes and mitigation measures to reduce impacts if appropriate;
- Keep site perimeter, fences etc. clean; and
- Monitoring of PM₁₀ at the site boundary using continuous meters with appropriate alert and trigger levels set.

SITE PLANNING

- Consideration of weather conditions, dust generating potential of material to be excavated prior to commencement of works;
- Plan site layout to maximise distance from plant / stockpiles etc. to sensitive receptors; and
- Dusty materials should be removed from site as soon as possible.

CONSTRUCTION TRAFFIC

- Loads entering and leaving the site with dust generating potential should be covered and wheel washing facilities made available;
- No idling of vehicles;
- Vehicles to comply with site speed limits (15mph on hard surfaces, 10mph on unconsolidated surfaces);
- Water assisted sweeping of local roads to be undertaken if material tracked out of site; and
- Install hard surfacing as soon as practicable on site and ensure that they are maintained in good condition.

SITE ACTIVITIES

- Exposed soils should be re-vegetated as soon as practicable. Near residential properties or sensitive ecosystems (<50m), use hessian/mulches etc. where not possible to re-vegetate or cover with topsoil;
- Minimise dust generating activities, particularly near residential receptors / sensitive ecosystems during prolonged dry, dusty weather unless damping / other suppressants are used;
- Ensure an adequate water supply to site and use water as dust suppressant where applicable;
- Ensure any site machinery is well maintained and in full working order;
- Ensure equipment available for cleaning spills etc. available at all times; and to reduce vapour emissions from spills; and
- Sand and aggregates should be stored away from sensitive receptors and screened / shielded. Similarly concrete batching should take place away from receptors.

5.6.4 The construction of the scheme has the potential to have significant construction traffic impacts from vehicle emissions. However, details are unknown at this time.

5.7

OVERALL ASSESSMENT

CONSTRUCTION

5.7.1 As set out in the assessment methodology, (Section 5.2), the significance of the effects of construction on human receptors is likely to be 'not significant' in relation to both dust soiling (nuisance) and human health as a result of increased PM₁₀ concentrations. However, there is a variation in the risk of impacts between the scheme options currently proposed. Due to the early stage in the design of the scheme options, there is very little information about proposed methodologies. Therefore, the assessment focuses mainly on potential construction and earthworks, as the need for demolition is currently unknown.

5.7.2 The sensitivity of the construction study area (as defined in paragraph 5.3.1) is assessed as being high along the A27 through Arundel, and low outside the town of Arundel. This is due to the high density of residential properties and the community hospital within Arundel (Options 1, 0A, 0B, 0BA and 2), and the comparatively low density of properties and rural nature of the scheme outside Arundel (Options 3, 4, 5 and 5A). Although the sensitivity of parts of the construction study area is high, the existing concentrations of PM₁₀ are low (<20 µg/m³), therefore the risk to human health through increased exposure to PM₁₀ is low. The scheme is partly located within the SDNP, however, no ecological receptors that are specifically sensitive to dust deposition effects have been identified at this stage.

- 5.7.3 Table 5-4 summaries the risk of dust impacts and the potential magnitude of the effects during construction for the different scheme options as per the IAQM guidance.
- 5.7.4 Traffic impacts as a result of the construction phase are likely to be greater for options with online elements (Options 0A, 0B, 0BA and 1) where congestion will increase due to traffic management, than for offline options. For online options, some diversion of traffic may be expected along alternative routes to avoid the delays due to potential congestion along the A27. It is possible that traffic will divert along the A283 to the north through Storrington, as well as congestion effects along the A27 to the east affecting the Worthing and Lancing AQMA. These effects may have an impact on the AQMA's through increased traffic emissions. Offline options minimise the risk of increased congestion apart from the entry and exit points of the schemes.

Table 5-4: Risk of dust impacts during construction

OPTION	AREA SENSITIVITY TO CONSTRUCTION IMPACTS (DUST SOILING)	MAGNITUDE OF DUST EMISSIONS	RISK OF IMPACTS	COMMENTS
Option 0A	Low (High)	Small	Low (Medium)	Online improvements only, so low risk except on the A27 either side of Ford Road junction where there are residential properties and risks of impacts are medium. Elsewhere risks are low.
Option 0B/0BA	Low (High)	Small/ Medium	Low (Medium)	Online junction improvements with dualling of the road, so medium risk of impact in and around Arundel, low outside of Arundel.
Option 1	Low (High)	Medium	Low (Medium)	Predominantly online improvements with off-line section at eastern end of the scheme. Grade separated junction at Ford Road junction, therefore, medium risk around the Ford Road junction, low risk elsewhere.
Option 2	Low (High)	Medium/ large	Low (Medium)	Mainly off-line but passes close to two sets of residential properties. Therefore, medium risk of impacts at the residential estates of Birch/Hazel Grove to the west and Fitzalan Road to the south of Arundel and low risk of impact for the majority of the extent.
Option 3	Low	Large	Medium	Wholly offline, away from sensitive receptors. However the size of the scheme gives it a large dust emissions magnitude. The overall risk of impacts is medium. There is a risk to ecological receptors, namely the Ancient Woodland from the earthworks required. Potential for traffic to divert to avoid congestion which may impact on AQMAs at Storrington and Worthing and Lancing.
Option 4	Low	Large	Medium	Wholly offline, away from sensitive receptors. However the size of the scheme gives it a large dust emissions magnitude. The overall risk of impacts is medium. Potential for traffic to divert to avoid congestion which may impact on AQMAs at Storrington and Worthing and Lancing.
Option 5/5A/5B	Low	Large	Medium	Wholly offline, away from sensitive receptors. However the size of the scheme gives it a large dust emissions magnitude. The overall risk of impacts is medium. Potential for traffic to divert to avoid congestion which may impact on AQMAs at Storrington and Worthing and Lancing.

Note: Entries in parentheses show localised impacts in built up areas around Arundel where residential properties are close to the road.

OPERATION

- 5.7.5 At this stage, in the absence of any detailed traffic information, a qualitative assessment of the operational traffic impacts has been undertaken.
- 5.7.6 Baseline PCM links indicate that roadside mean NO₂ concentrations on the A27 are well below the EU limit value. There are no roadside locations where the public is likely to be regularly exposed.
- 5.7.7 Overall, the combination of planned local development and proposed highway improvements is likely to lead to a growth in traffic. The mostly online improvements (Options 0A, 0B, 0BA and 1) are likely to see less of an improvement in air quality as a result, particularly at around the Ford road junction. This is due to the traffic remaining on the current alignment in close proximity to existing roadside properties which would outweigh any improvements in congestion. For the offline options (Options 2, 3, 4, 5 and 5A) these are all likely to result in an improvement in air quality in Arundel and along the existing A27 from the Crossbush junction through shifting of traffic away from these roads to the scheme. The results are summarised in Table 5-5 below.
- 5.7.8 Within the Worthing AQMA, all options are predicted to lead to an increase in vehicle flows along the A27 which may counteract any air quality improvements as a result of reduced congestion. This could lead to a worsening in air quality within the Worthing AQMA due to increased traffic flows. Within the Storrington AQMA there may be an improvement in air quality due to shifting of traffic south along the A27.

Table 5-5: Operational Traffic Assessment in both opening and future year scenarios.

OPTION	GENERAL TRAFFIC ASSESSMENT	AIR QUALITY COMMENT
Option 0A	Likely to reduce congestion and queuing in the short term, although over the medium and long term congestion and queuing is anticipated to still occur. The new improvements are likely to allow traffic growth of up to 25% on all A27 links. However, the anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The single carriageway sections of A27 are likely to have less capacity than demand at peak periods.	Slight Adverse - whilst the congestion is predicted to reduce in the short term, this is countered by the single carriageway giving less capacity than demand at peak period. Traffic growth in future years is likely to negate, if not worsen, any benefits from junction improvements.
Option 0B/0BA	Likely to result in a significant reduction in congestion and queuing. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The improvements would accommodate for this during peak periods on the majority of A27 links. However, it is possible that some congestion and queuing may remain on certain routes.	Neutral – improvements in flow from dualling would see a reduction in congestion and therefore potential improvements in air quality. However, at Ford Road junction the increase in flows are likely to negate the benefits of reduced congestion. Option 0BA may see a little improvement in properties at the roadside along existing A27 between Crossbush and Causeway junctions through diversion of the traffic off the current alignment onto the scheme. Traffic growth in future years is likely to reduce any benefits from reduced congestion.
Option 1	Likely to result in a significant reduction in congestion and queuing. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The improvements would accommodate for this during peak periods on the majority of A27	Neutral – improvements in air quality at the roadside are expected between Crossbush and Causeway junctions through diversion of the traffic off the current alignment onto the scheme. However, at the Ford Road junction the increase in flow risks negating any improvements from

OPTION	GENERAL TRAFFIC ASSESSMENT	AIR QUALITY COMMENT
	links. However, it is possible that some congestion and minor delays may occur at Crossbush junction.	reduced congestion. Traffic growth in future years is likely to reduce any benefits from reduced congestion.
Option 2	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The scheme would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes.	Slight positive – removal of traffic from Ford Road junction will result in improvements in air quality. However, there is a likely worsening in air quality at Hazel Grove at the western edge of Arundel due to the introduction of flows to the scheme. Further re-routing of local traffic may also benefit roadside properties. 40% growth in future year traffic may see a worsening in air quality at Hazel Grove as in the opening year.
Option 3	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The scheme would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes.	Moderate positive – off-line alignment which removes the traffic congestion around Crossbush junction and along existing A27 would result in significant improvement in air quality. Further re-routing of local traffic may also benefit existing roadside properties.
Option 4	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The scheme would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes.	Moderate positive – off-line alignment which removes the traffic congestion around Crossbush junction and along existing A27 would result in significant improvement in air quality. Further re-routing of local traffic may also benefit existing roadside properties.
Option 5/5A	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The scheme would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes.	Moderate positive – off-line alignment which removes the traffic congestion around Crossbush junction and along existing A27 would result in significant improvement in air quality. Further re-routing of local traffic may also benefit existing roadside properties.
Option 5B	This option would make congestion and queuing along the A27 very unlikely. Anticipated demand, based on traffic growth of 1-2% per annum, is an increase of 40% by 2041. The scheme would accommodate for this during peak periods on all A27 links. There would be some re-routing from local roads to the bypass resulting in benefits to communities living close to the existing congested routes.	Moderate positive – off-line alignment which removes the traffic congestion around Crossbush junction and along existing A27 would result in significant improvement in air quality. Further re-routing of local traffic may also benefit existing roadside properties by reducing traffic that passes them. Residential properties on Yapton Lane, to the north of Walberton are likely to experience a slight worsening in air quality due to the scheme.

5.7.9 With PCM modelled roadside concentrations well within the EU limit values, there is a low risk of any of the scheme options adversely affecting compliance with the EU Air Quality Directive.

- 5.7.10 With respects to ecological receptors, Options 2 and 3 are most likely to have a negative impact on the Ancient Woodlands to the west of Arundel. This is due to the introduction of roadside NOx emissions at locations that were previously not near a road.

5.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

- 5.8.1 At this early stage in the design, the detail is not available to help differentiate between options both for construction impacts as well as operational traffic impacts. The assessments are therefore based on assumptions fitting the level of detail provided and the professional judgement of the consultant. Predictions about option performance against future traffic demand, which forms part of the basis for the assessment, are not based on a detailed design, or traffic modelling. Once further design details and traffic data are available then a more detailed assessment can be made.

6

CULTURAL HERITAGE

6.1 INTRODUCTION

- 6.1.1 The assessment undertaken for this ESR is only intended to be a Simple Assessment, as defined by DMRB guidance, in order to reach an appropriate understanding of the effects of the proposed scheme on the historic environment, or to identify the need for a Detailed Assessment.
- 6.1.2 The historic environment comprises World Heritage Sites, Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens and Battlefields, Archaeological Sites (buried and earthworks), locally listed buildings / structures and the historic landscape.

6.2 ASSESSMENT METHODOLOGY

DATA COLLECTION

- 6.2.1 The principal sources of information consulted were historical and modern Ordnance Survey (OS) maps, although published and unpublished secondary sources were also reviewed. These include the following sources:
- Sussex Historic Landscape Characterisation;
 - West Sussex Historic Environmental Record;
 - West Sussex Record Office;
 - Historic England Archive;
 - Literature review of publicly available data including reports on any cultural heritage or archaeological interventions conducted in or close to the Study Areas; and
 - Historical Ordnance Survey Mapping.

TERMINOLOGY

- 6.2.2 The technical terminology applied to the assessment process in this document is based on that contained within Historic England guidance 'The Setting of Heritage Assets, Good Practice Advice in Planning: 3' (2015) and the Cultural Heritage Section (Volume 11, Section 3, Part 2) of the DMRB.

STANDARDS AND GUIDANCE

- 6.2.3 This assessment has been written in compliance with the Cultural Heritage Section (Volume 11, Section 3, Part 2) of the DMRB, NPPF and in accordance with the following relevant professional guidelines: The Chartered Institute for Archaeologists (CIfA) Standard and Guidance for Historic Environment Desk-based Assessment (2014) and CIfA Code of Conduct (2014).

SENSITIVITY OR IMPORTANCE OF THE ASSET

- 6.2.4 Initially, the sensitivity or importance of a heritage asset is judged in a neighbourhood, local, regional, national and international context, which results in the cultural heritage sensitivity of the asset being determined (Table 6-1).

Table 6-1: Criteria Used to Determine Importance of Heritage Assets

CULTURAL IMPORTANCE/ SENSITIVITY	CRITERIA
Very high (international)	World Heritage Sites; Sites of International Importance.
High (National)	Scheduled Monuments; Statutory designated Grade I and II* Listed Buildings Grade II listed buildings Registered Parks and Gardens Archaeological Notification Areas Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments Conservation Areas containing buildings that contribute significantly to its historic character And the settings of the above
Medium (Regional/ County)	Locally listed buildings (not on the Statutory List).
Low (Local/ Borough)	Archaeological sites and remains with a local or borough interest for education, cultural appreciation; Assets which contribute to local or cultural understanding of the area.
Negligible (Neighbourhood / Negligible)	Relatively numerous types of remains, of some local importance; Isolated find spots with no context; Areas in which investigative techniques have revealed no, or minimal, evidence of archaeological remains, or where previous large-scale disturbance or removal of deposits can be demonstrated.
Uncertain / Potential	Potential archaeological sites for which there is little information. It may not be possible to determine the importance of the site based on current knowledge. Such sites are likely isolated find spots, place names or crop marks identified on aerial photographs.

Source: adapted from DMRB

- 6.2.5 Table 6-1 above is a general guide to the attributes of cultural heritage assets and it should be noted that not all the qualities listed need be present in every case and professional judgement is used in balancing the different criteria.

POTENTIAL IMPACT

- 6.2.6 Paragraph 129 of NPPF states that the significance of the heritage assets should be taken into account when considering the impact of a proposal.
- 6.2.7 Harm to the significance of the asset is the basis of assessing impact. In order to assess the level of harm or potential impact of any future development on built heritage or buried archaeological remains and their settings, consideration has been afforded to:
- Assessing any impact and the significance of the effects arising from the development taking place within the study area;
 - Reviewing the evidence for past impacts that may have affected the archaeological sites of interest identified during the desk-based assessment; and
 - Outlining suitable mitigation measures, where possible at this stage, to avoid, reduce,

or remedy adverse impacts.

- 6.2.8 Significant impacts have been identified as those that would potentially harm the significance of the heritage asset. Each potential impact has been determined as the predicted deviation from the baseline conditions, in accordance with current knowledge of the site and the scheme options.
- 6.2.9 The level of harm is often difficult to define. However, substantial harm is taken to be ‘total loss of significance of a heritage asset’ (NPPF 2012, paragraph 133) which implies loss of the asset, loss of its heritage values and/or its setting. Furthermore, NPPF Planning Policy Guidance (revised 2014) states that ‘even minor works have the potential to cause substantial harm.’ It goes on to state ‘It is the degree of harm to the assets significance that is to be assessed rather than the scale of the development’. Consequently, this provides a baseline for varying levels of harm with less than substantial harm being, slight harm, or negligible, as defined in Table 6-2 below.

Table 6-2: Criteria Used to Determine Scale of Harm (Impact)

Level of Harm (Magnitude)	Description
Substantial harm (Major adverse)	
Complete destruction of the asset or its setting (i.e. total loss of significance); change to the asset or its setting resulting in loss to significance which fundamentally changes our ability to understand and appreciate the resource. Minor works which adversely impact on heritage values which are intrinsic to the significance of the asset/setting have the potential to cause substantial harm.	
Less than substantial harm (Moderate adverse to Negligible):	
Harm (Moderate adverse)	Change to the asset or setting (some loss of significance) resulting in an appreciable change in ability to understand and appreciate the resource. Some heritage interest remains unaffected.
Slight harm (Minor adverse)	Change to the asset or setting (some loss of significance) resulting in a slight change in ability to understand and appreciate the resource. Overall, the heritage interests remain unaffected.
Negligible	Negligible change or no material changes to the asset or setting. No real change in our ability to understand and appreciate the resource. The heritage interests remain unaffected.

Source: as taken from NPPF Para 132

- 6.2.10 The interaction between the importance of the heritage asset (Table 6-1) and the potential scale of harm (Table 6-2) produces the impact significance. This may be calculated using the matrix shown in Chapter 4, Table 4.3.
- 6.2.11 Impacts of moderate or above significance are regarded as significant impacts. Mitigation measures as appropriate at this stage of assessment are presented in Section 6.6.

6.3 STUDY AREA

- 6.3.1 This assessment has focused on the proposed scheme options although historic information for the surrounding area (known as the 200m inner study area) was considered in order to provide an essential contextual background (Figure 6.1). The presence of statutory designated heritage assets within a 1km study area was noted. This is for the purpose of assessing the impacts of the scheme options on the settings of those

assets which comprised Grade I, Grade II* and Grade II listed buildings, Scheduled Monuments, and Registered Parks and Gardens and Conservation Areas. An inner 200m study area from the outer limits of the proposed scheme options was searched for all types of heritage assets which in this instance includes standing structures, earthworks, below ground heritage assets, archaeological notification areas (area which define presently known and recorded areas of heritage sensitivity) in addition to historical landscapes (Figure 6.2).

6.4 SUMMARY OF BASELINE CONDITIONS

6.4.1 The baseline conditions are presented as tables in Appendix B and their locations are shown on Figures 6.1 and 6.2 (Appendix A). The order of the tables follows the study areas and the heritage assets are presented by type. There are no World Heritage Sites within the study area. Table 6-3 below, summarises the numbers of heritage assets by type in each option, and Table 6-4 describes the scheduled monuments, although these are not the only assets of national significance with listed buildings and conservation areas also being present. Neither should the importance of the potential for archaeological remains and their significance be overlooked.

Table 6-3 Summary of Heritage Assets in the 1km and 200m Study Areas

OPTION	SCHEDULED MONUMENTS	GRADE I LISTED BUILDING	GRADE II* LISTED BUILDING	GRADE II LISTED BUILDING	REGISTERED PARK AND GARDENS	CONSERVATION AREAS	NON DESIGNATED ASSETS (WITHIN 200M)	NON-DESIGNATED HISTORICAL LANDSCAPES (WITHIN 200M)	ARCHAEOLOGICAL NOTIFICATION AREAS (WITHIN 200M)
Option 0A	1	-	1	10	-	-	2	-	2
Option 0B/ 0BA / 1	5	4	6	198	1	1	11	1	4
Option 2	5	4	7	198	1	1	12	2	1
Option 3	4	-	2	24	-	1	10	3	4
Option 4	4	-	2	33	-	1	8	3	5
Option 5	5	-	4	174	-	1	11	3	5
Option 5A	4	-	2	30	-	1	8	3	5
Option 5B	1	1	3	49	-	1	4	3	2

Table 6-4 Summary of Scheduled Monuments in the 1km Study Area of each Option (cross marks presence of SM within the study area)

Listing Number	Scheduled Monument	Lies within 1km of Options
1005895	<p>Gblestubbs Copse Earthworks</p> <p>The earthworks in Gblestubbs Copse have a potential Prehistoric origin and contain important archaeological and environmental information relating to their construction and function, as well as the landscape in which they were built.</p>	OB; OBA; 1 to and including 5A
1012177	<p>Ringwork 400m NNW of Batworthpark House</p> <p>Early Medieval period fortifications built and occupied from the late Anglo-Saxon period to the later 12th century. The ringwork survives comparatively well despite having been damaged for part of its circuit and therefore retains considerable archaeological potential for the recovery of dating evidence, of evidence of structures in the interior and of evidence sealed beneath its banks of the land use prior to its construction.</p>	OA; OB; OBA: 1 to and including 5A
1003736	<p>Madehurst Wood Earthworks</p> <p>Earthworks in Madehurst Wood, 790m ESE of Chichester Lodge. The earthworks hold a high degree of potential for further archaeological investigation and contain important archaeological and environmental information relating to their construction and function, as well as the landscape in which they were built.</p>	3; 4; 5 and 5A
1021459	<p>Tortington Augustinian Priory</p> <p>A Late Medieval period Augustinian priory comprising the church, claustral buildings, ponds and part of the priory precinct lying just above the flood plain in the valley of the River Arun. Despite the removal of much of the above ground remains of the priory, it survives well as buried archaeological remains with great potential.</p>	OB; OBA: 1 to and including 5B
1005865	<p>Maison Dieu</p> <p>The Hospital of Holy Trinity Maison Dieu, Arundel, was founded in c.1380</p>	OB; OBA; 1; 2 and 5
1012500	<p>Arundel Castle</p> <p>A motte castle originating in the Medieval period with subsequent alterations. The monument survives well despite the slighting and rebuilding of some of the castle buildings after the Civil War. It is of an unusual twin bailey plan, illustrating the wide range of possible forms of this class of monument. The castle is well documented historically and the long history of its use and adaptation is well illustrated by a wide range of surviving features such as the Norman gatehouse and keep, the curtain wall, outer bailey and Civil War defences.</p>	OB; OBA; 1 and 2

THE POTENTIAL FOR HITHERTO UNKNOWN BELOW-GROUND HERITAGE ASSETS WITHIN THE SCHEME AREA

- 6.4.2 Previous archaeological investigations and find spots within the inner study areas for each option (Table B.34, Appendix B) can often be a good indication of the type of archaeological remains that may survive within undisturbed ground. From a review of the HER data, it has been determined that there is the potential for below-ground heritage assets associated with all archaeological and historical periods to be present within each option study area. These periods are: the Prehistoric comprising Neolithic, Palaeolithic, Mesolithic and Bronze Age; and the Historic comprising the Romano-British period, Medieval, Late Medieval and Post-medieval, through to the Industrial and Modern periods.
- 6.4.3 In particular the assessment has considered the impact of each option on areas of Ancient Woodland as this has the potential to conceal earthworks and below-ground archaeological remains associated with historical stock management.

IMPORTANCE OR SENSITIVITY OF HERITAGE ASSETS

- 6.4.4 The importance or the sensitivity of the individual heritage assets is presented in Appendix B. In summary it can be stated that all of the statutory designated heritage assets identified are of national or high importance and the non-designated assets present range from local (low) to regional (medium). No non-designated assets of national importance are recorded.

6.5 REGULATORY AND POLICY FRAMEWORK

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

- 6.5.1 The NPPF states that "The desirability of sustaining and enhancing the significance of heritage assets and putting them to viable uses consistent with their conservation; the wider social, cultural, economic and environmental benefits that conservation of the historic environment can bring; the desirability of new development making a positive contribution to local character and distinctiveness; and opportunities to draw on the contribution made by the historic environment to the character of a place" (DCLG 2012, Section 12, 126).
- 6.5.2 In determining applications, local planning authorities should require an applicant to describe the significance of any heritage assets affected, including any contribution made by their setting. The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant historic environment record should have been consulted and the heritage assets assessed using appropriate expertise where necessary. Where a site on which development is proposed includes or has the potential to include heritage assets with archaeological interest, local planning authorities should require developers to submit an appropriate desk-based assessment and, where necessary, a field evaluation (op cit, 128).
- 6.5.3 Local planning authorities should identify and assess the particular significance of any heritage asset that may be affected by a proposal (including by development affecting the setting of a heritage asset) taking account of the available evidence and any necessary expertise. They should take this assessment into account when considering the impact of a proposal on a heritage asset, to avoid or minimise conflict between the heritage asset's conservation and any aspect of the proposal (op cit, 129).

- 6.5.4 When considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset's conservation. The more important the asset, the greater the weight should be. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. As heritage assets are irreplaceable, any harm or loss should require clear and convincing justification. Substantial harm to or loss of a grade II listed building, park or garden should be exceptional. Substantial harm to or loss of designated heritage assets of the highest significance, notably scheduled monuments, protected wreck sites, battlefields, grade I and II* listed buildings, grade I and II* registered parks and gardens, and World Heritage Sites, should be wholly exceptional (op cit, 132).
- 6.5.5 Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets (op cit, 139).

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS (NPSNN) (2014)

- 6.5.6 The Secretary of State should take into account the desirability of sustaining and, where appropriate, enhancing the significance of heritage assets, the contribution of their settings and the positive contribution that their conservation can make to sustainable communities – including their economic vitality. The Secretary of State should also take into account the desirability of new development making a positive contribution to the character and local distinctiveness of the historic environment. The consideration of design should include scale, height, massing, alignment, materials, use and landscaping (for example, screen planting) (Section 5.130, 73).
- 6.5.7 When considering the impact of a proposed development on the significance of a designated heritage asset, the Secretary of State should give great weight to the asset's conservation. The more important the asset, the greater the weight should be. Once lost, heritage assets cannot be replaced and their loss has a cultural, environmental, economic and social impact. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Given that heritage assets are irreplaceable, harm or loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of a grade II Listed Building or a grade II Registered Park or Garden should be exceptional. Substantial harm to or loss of designated assets of the highest significance, including World Heritage Sites, Scheduled Monuments, grade I and II* Listed Buildings, Registered Battlefields, and grade I and II* Registered Parks and Gardens should be wholly exceptional (Section 5.131, 74).
- 6.5.8 Where the proposed development will lead to substantial harm to or total loss of significance of a designated heritage asset, the Secretary of State should refuse consent unless it can be demonstrated that the substantial harm or loss of significance is necessary in order to deliver substantial public benefits that outweigh that loss or harm, or alternatively that all of the following apply:
- The nature of the heritage asset prevents all reasonable uses of the site;
 - No viable use of the heritage asset itself can be found in the medium term through appropriate marketing that will enable its conservation; and conservation by grant-funding or some form of charitable or public ownership is demonstrably not possible;
 - Conservation by grant-funding or some form of charitable or public ownership is demonstrably not possible; and
 - The harm or loss is outweighed by the benefit of bringing the site back into use (Section 5.133 74).

PLANNING (LISTED BUILDINGS AND CONSERVATION AREAS (LBCA)) ACT 1990

- 6.5.9 When making a decision on all listed building consent applications or any decision on a planning application for development that affects a listed building or its setting, a local planning authority must have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses. Preservation in this context means not harming the interest in the building, as opposed to keeping it utterly unchanged. This obligation, found in sections 16 and 66 of the Planning (Listed Buildings and Conservation Areas) Act 1990 (1), applies to all decisions concerning listed buildings.
- 6.5.10 Section 72 of the Act places a duty upon the decision maker in determining applications for planning permission within conservation areas to pay “*special attention to the desirability of preserving or enhancing the character or appearance of that area*”.

ANCIENT MONUMENTS AND ARCHAEOLOGICAL AREAS ACT (AMAAA) 1979

- 6.5.11 The AMAAA largely relates to Scheduled Monuments and Section 61(12) defines sites that warrant protection due to their being of national importance as 'ancient monuments'. A monument is defined by the Act as "*any building, structure or work above or below the surface of the land, any cave or excavation; any site comprising the remains of any such building, structure or work or any cave or excavation; and any site comprising or comprising the remains of any vehicle, vessel or aircraft or other movable structure or part thereof.*"
- 6.5.12 Section 61 of the Act states that deliberate damage to a monument is a criminal offence and any works taking place within one require Scheduled Monument Consent from the Secretary of State.

HEDGEROW REGULATIONS 1997

- 6.5.13 Historic England states that hedgerows (like trees), can make an important contribution to the character of an area and may be historically (and occasionally archaeologically) important as indications of land use and previous ownership.
- 6.5.14 Important hedgerows are protected through the Hedgerow Regulations. A hedgerow is likely to be deemed 'important' if it is at least 30 years old and fulfils at least one of the following criteria:
- Marks all or part of a parish boundary that existed before 1850;
 - Incorporates an archaeological feature such as a scheduled monument;
 - Is completely or partly in or next to an archaeological site listed on the Historic Environment Record (HER), (formerly the Sites and Monuments Record);
 - Marks the boundary of an estate or manor or appears to be related to any building or other feature that is part of an estate or manor that existed before 1600;
 - Is part of a field system or appears to be related to any building or other feature associated with the field system that existed before the Inclosure Acts (that is, before 1865).

LOCAL PLANNING POLICY

6.5.15 The following policies in the Arun District Local Plan (2003) are applicable to this scheme, The Arun District Council is preparing a suite of documents as part of the Local Development Framework which will eventually replace the Local Plan. These are not yet adopted policy, however, and they are not referenced in this assessment.

ARCHAEOLOGY

6.5.16 Policy Area 16 There will be a presumption in favour of the preservation of scheduled and other nationally important monuments and archaeological remains. Development which adversely affects their sites or settings will not be permitted.

6.5.17 Additionally Policy Area 17 states that permission will not be granted for development that would be harmful to the significant archaeological interest of a site.

CONSERVATION AREAS

6.5.18 Policy Area 2 Planning permission will be granted for development which preserves or enhances the character or appearance of a Conservation Area or its setting.

6.5.19 Policy AB5 Where, in compelling circumstances, the District Planning Authority is minded to grant consent for demolition of a building in a Conservation Area as part of a redevelopment scheme, such consent will not be granted until detailed plans for redevelopment have been approved. Consent will be subject to a condition preventing demolition until a contract for the approved redevelopment scheme has been awarded.

LISTED BUILDINGS

6.5.20 Policy AB11 Where proposed new development is located within the setting of a Listed Building the District Planning Authority will require that the design and materials do not adversely affect the setting. New development which would adversely affect the setting of a Listed Building will not be permitted.

THE SETTING OF ARUNDEL

6.5.21 Policy Area 3: The Setting of Arundel states that - no development will be permitted which would adversely affect views of Arundel or its special setting. Additionally, development will not be permitted within the town of Arundel or beyond which would adversely affect the rural views outwards from the town. Development will not be permitted which would adversely affect the long distance views of Arundel Castle or Arundel Cathedral.

6.6

DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

6.6.1 It is proposed that, where viable, preliminary archaeological investigations are undertaken within the selected option to establish the nature, extent and survival of the hitherto unknown below-ground archaeological remains. This is likely to comprise a geophysical survey, on areas of green field, followed by an appropriate form of intrusive investigation or monitoring. Additionally, an archaeological watching brief should be maintained during any pre-construction geotechnical ground investigations. The results of these investigations can be used to devise a suitable programme of mitigation where applicable. Mitigation measures should be devised in consultation with the SDNP Authority Heritage Lead.

- 6.6.2 A building investigation following Historic England guidelines (Historic England 2006) will need to be undertaken for historic buildings subject to direct impacts even where these are not designated. This is likely to be necessary for the WWII Loopholed Wall (MWS7583) located within Option 1 that could be subject to demolition. The structure will require a programme of building investigation proportionate to the level of impact and value of the asset.
- 6.6.3 The scheme options will traverse a number of historic landscape areas that contain field boundaries protected under the Hedgerows Regulations Act (Section 16.10.14). Planning permission will need to be sought before any sections of these boundaries are removed and any archaeological mitigation will be devised in consultation with the SDNP Authority Heritage Lead.
- 6.6.4 Historic England guidelines (The Setting of Heritage Assets, Good Practice Advice in Planning: 3, 2015, pp12) for mitigation of the impact of a development on the setting of a heritage asset suggest that in the first instance impacts are best mitigated for either by relocation of the development or changes to its design. Where relocation of the development is not possible, good design alone may be capable of reducing the harm. A detailed setting assessment incorporating a historical landscape assessment should be undertaken for the option taken forward.
- 6.6.5 High quality design will be particularly important for the scheme options that may have an adverse effect on the setting of heritage assets. In addition to this the opportunity to enhance the affected assets should be explored. Again, this is something that could result from a detailed assessment following option selection.
- 6.6.6 Mitigation measures for impacts upon Arundel and Walberton Conservation Areas must also be devised in consultation with the Conservation Officer at Arun District Council. This will include heritage asset setting issues.

6.7 OVERALL ASSESSMENT

MAGNITUDE OF IMPACT (CHANGE)

BELOW-GROUND ARCHAEOLOGICAL REMAINS AND ARCHAEOLOGICAL EARTHWORKS

- 6.7.1 Full design proposals for each of the scheme options are as yet unknown and the magnitude of impact on buried archaeology will be largely influenced by the extent and depth of intrusive groundworks, the likely range of which are summarised below. A full description of the potential impacts on below-ground archaeological remains and earthworks for each section is presented in Table B34 in Appendix B.

Options 1, 0B, 0BA, 2, 3, 4, 5, 5A and 5B

- 6.7.2 The proposed scheme will cause disturbance during the construction phase through what is currently greenfield. Ground disturbance activities will include the widening of existing roads, the excavation of new roads and the excavation of associated services. Topsoil stripping for compounds, landscaping features and drainage ponds will also cause an impact. The removal of areas of Ancient Woodland will almost certainly disturb archaeological features relating to occupational activity and historic stock management from the Prehistoric Period onwards.
- 6.7.3 Generally, the degree of preservation and the extent of buried archaeological remains is unknown. However, it is likely that remains will survive within areas of previously undisturbed ground. Any impact on assets that may be present is likely to be major adverse (the loss of the asset), and given that sensitivity of the assets range from low

(local) to medium (regional), the greatest magnitude of impact could be Major adverse (Table 6.5).

Option 0A

6.7.4 Option 0A involves works to junctions which are located within an area which is largely developed. Intrusive groundworks in previously undisturbed ground have the potential to impact on previously unrecorded below-ground archaeological remains. No physical impact is predicted for known heritage assets.

BUILT HERITAGE (IMPACTS ON SETTING)

6.7.5 Potential adverse impacts upon the setting of designated assets are likely to include harm to the relationship between the asset and its setting so that the relationship is no longer readily appreciable; the interpretability of the significance of the asset is significantly reduced; a loss or reduction of rural tranquillity and/or where noise and air pollutants are likely to increase. The heritage assets subject to these impacts include options 1, 10B, 0BA, 2, 3, 4, 5, 5A and 5B and are listed in Table 6-6. The magnitude of the predicted impact ranges in degree from minor to major adverse.

6.7.6 Offline options have not been subject to a full site visit due to land access issues therefore the assessment presented within Table 6.6 should be considered preliminary.

6.7.7 As Option 0A consists of improvements to existing junctions, it is unlikely there will be an impact on the setting of heritage assets where the scheme is not present in views from, towards, through or across the setting. There will also not be additional noise or vibration pollutants that could adversely affect the settings. The scale of the works required suggests that this option would have a negligible impact upon the setting of the designated heritage assets, therefore there is no table of results associated with this option.

SIGNIFICANT EFFECTS

6.7.8 An assessment of the significance of the effects of all options on each individual earthwork and below ground heritage assets within the 200m inner study area is presented in Tables B35-B41 in Appendix B. Table 6-5 below provides a summary of these effects. The significance of the effect as a result of Option 5 ranges from slight to moderate adverse. For Options 0B, 0BA, and 1 the significance of the effect ranges between moderate to large adverse. For Options 2, 3, 4, 5A and 5B it ranges from moderate to very large adverse.

Table 6-5: Summary of the magnitude of impact and significance of effect of the scheme options on earthworks and known below-ground heritage assets within the 200m inner study area

OPTION	NUMBER OF HERITAGE ASSETS	SENSITIVITY OF THE ASSETS	MAGNITUDE OF HARM (IMPACT)	SIGNIFICANCE OF EFFECT	DURATION OF EFFECT
Option 0A	n/a	n/a	n/a	n/a	n/a
Option 0B/ 0BA and Option 1	5	3 Regional, 2 Local	Major Adverse	Moderate or Large	Permanent
Option 2	9	3 Regional, 5 Local	Major Adverse	Moderate, Large or Very Large	Permanent
Option 3	8	2, Regional. 5 Local	Major Adverse	Moderate, Large or Very Large	Permanent

OPTION	NUMBER OF HERITAGE ASSETS	SENSITIVITY OF THE ASSETS	MAGNITUDE OF HARM (IMPACT)	SIGNIFICANCE OF EFFECT	DURATION OF EFFECT
Option 4	7	2 Regional, 4 Local	Major Adverse	Moderate, Large or Very Large	Permanent
Option 5	2	2 Local	Moderate or Major Adverse	Slight or Moderate	Permanent
Option 5A	7	2 Regional, 4 Local	Major Adverse	Moderate, Large or Very Large	Permanent
Option 5B	4	2 Regional, 3 Local	Major Adverse	Moderate, Large or Very Large	Permanent

Table 6-6: Summary of the magnitude of impact and significance of effect of the scheme options on built heritage (setting) within the 1km study area

OPTION	BUILT HERITAGE ASSETS IN STUDY AREA LIKELY TO BE IMPACTED BY THE SCHEME	SENSITIVITY OF THE SETTING	MAGNITUDE OF HARM (IMPACT)	SIGNIFICANCE OF EFFECT	DURATION OF EFFECT
Option 0A	None	n/a	n/a	n/a	n/a
Option 0B	1 Grade II* Listed Building 1 Grade II Listed Building Arundel Conservation Area	Moderate and Very Substantial	Minor - moderate	Slight – Moderate Large adverse	Permanent
Option 0BA	1 Grade II* Listed Building 1 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate, Substantial and Very Substantial	Minor - moderate	Slight – Moderate Large adverse	Permanent
Option 1	1 Grade II* Listed Building 2 Grade II Listed Building Arundel Conservation Area (including Arundel Castle)	Moderate and Very Substantial	Minor - major	Slight – Moderate Large adverse	Permanent
Option 2	2 Grade II* Listed Building 3 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent
Option 3	2 Grade II* Listed Building 6 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate, Substantial and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent
Option 4	2 Grade II* Listed Building 19 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent
Option 5	2 Grade II* Listed Building 17 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate, Substantial and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent

OPTION	BUILT HERITAGE ASSETS IN STUDY AREA LIKELY TO BE IMPACTED BY THE SCHEME	SENSITIVITY OF THE SETTING	MAGNITUDE OF HARM (IMPACT)	SIGNIFICANCE OF EFFECT	DURATION OF EFFECT
Option 5A	2 Grade II* Listed Building 17 Grade II Listed Building Arundel Conservation Area (including Arundel Castle) 1 Scheduled Monument	Moderate, Substantial and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent
Option 5B	3 Grade II* Listed Building 49 Grade II Listed Building Walberton Conservation Area 1 Scheduled Monument	Moderate and Very Substantial	Minor - major	Slight – Very Large adverse	Permanent

6.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

- 6.8.1 Based on the limited design information available for the road improvements options, this high level assessment has identified that there could potentially be impacts ranging from slight adverse (not significant) to very large adverse (significant) on the setting of designated assets.
- 6.8.2 The setting assessment undertaken for this ESR has only been a simple assessment of the potential impacts from the proposed scheme options as required to reach an understanding of the effects of the scheme options and/or identify the need for a detailed assessment. Where there are considered to be effects to heritage assets, a more detailed assessment of the sensitivity of the setting and the magnitude of harm needs to be undertaken. Offline options have not been subject to a full site visit due to land access issues; therefore the impact on setting has only been assessed to a limited extent at this stage. A detailed assessment of setting would require a more in-depth assessment of the relationship between the assets and the historical development of the landscape. In addition, the simple setting assessment presented below has focussed on the most sensitive assets.
- 6.8.3 The potential for impacts on below-ground archaeology will also need to be assessed further as the physical extents of the scheme options are refined.

6.9 SUMMARY

- 6.9.1 Potential constraints associated with the proposed works in relation to cultural heritage are summarised below:
- Loss or disturbance to buried archaeological remains: the available evidence (detailed in Tables B34-B41 in Appendix B) suggests that there has been occupation/activity for all archaeological and historical periods within the vicinity of the scheme options and there is potential for currently unknown buried archaeological remains to be present within the footprint of all options. Archaeological investigative fieldwork could improve the understanding of the archaeological receptors. Where ground disturbance is required, this will afford the opportunity to investigate the significance of the known and unknown archaeological receptors; and
 - Changes in the setting of scheduled monuments, historic landscapes, conservation areas and built heritage assets (detailed in Tables B42-B49 in Appendix B): there is a potential for inter-visibility, historical and functional relationship between assets in the vicinity of the scheme options, and therefore careful design of any new structures and

landscaping design is required. Where affected heritage assets or their settings could be enhanced by returning these to an historic state (as consistent with historically valuable assets which still exists), facilitating views to related heritage assets or by facilitating the understanding of the historic environment through signage.

- No heritage assets of national importance, and therefore which merit preservation in-situ, are considered to be at risk of direct physical impact from the scheme options at this stage of assessment, although the setting of such assets will be subject to varying levels of impact.

7 LANDSCAPE

7.1 INTRODUCTION

- 7.1.1 This assessment provides a brief description and evaluation of the existing landscape resource and visual receptors in the vicinity of the scheme options for improvements to the A27 in Arundel. It identifies potential landscape and visual constraints, and makes a preliminary assessment of potential effects associated with each of the scheme options described in Chapter 3.
- 7.1.2 Landscape and visual effects have been assessed within the area from which the existing road and scheme options would be visible, i.e. the Zone of Visual Influence (ZVI) extended to include neighbouring features of special value. The study area includes several landscape and visual receptors with high sensitivity to change, notably the SDNP, Arundel Castle and Arundel Conservation Area, residential, and recreational receptors, which exist in close proximity to the scheme options. The term landscape is used to refer to landscape and townscape unless differentiated. Some of the scheme options are located partly within the SDNP.

7.2 ASSESSMENT METHODOLOGY

- 7.2.1 Landscape and visual assessments are separate, although linked, procedures. The assessment of the former is concerned with effects on the landscape resource and landscape character. Visual effects are assessed as one of the interrelated impacts on people. This Simple Assessment has been undertaken in accordance with guidance provided by Highways England in IAN 135/10 Landscape and Visual effects Assessment, (2010) and DMRB Volume 11 Section 3 Part 5 Landscape Effects (1993). It has also drawn on guidance from the Guidelines for Landscape and Visual Impact Assessment (GLVIA) (3rd Edition) published jointly by The Landscape Institute and Institute of Environmental Management and Assessment, 2013.
- 7.2.2 Receptor sensitivity, magnitude of change and evaluation of the significance of the landscape and visual effects arising from the scheme have been assessed using typical criteria from IAN 135/10.
- 7.2.3 Where this assessment indicates potentially large or moderate adverse (significant) effects could arise from one or more option, a detailed landscape and/or visual impact assessment should be undertaken. This will be based on sufficient design information to identify potential effects on high sensitivity landscape and visual receptors and inform mitigation during PCF Stage 2 and 3.
- 7.2.4 Landscape and visual effects have been assessed separately as follows:

LANDSCAPE

- Baseline conditions (Figures 7.4-7.9) for landscape have been described and evaluated in respect of character areas, quality, features and elements;
- The sensitivity of landscape with reference to its capacity to accommodate change arising from the scheme has been evaluated;
- An assessment of the magnitude of impacts on landscape features and character has been made, with reference to each option, including the scale and nature of change;

- Outline environmental measures have been proposed to reduce potential adverse effects;
- The significance of landscape effects has been evaluated; and
- Potential residual landscape effects have been identified.

VISUAL

- The baseline studies include establishing the ZVI, identification of visual receptors and their sensitivity to change;
- The assessment has considered the magnitude of visual impacts with reference to the scale and nature of change;
- Outline environmental measures have been proposed to reduce potential adverse effects;
- The significance of visual effects has been evaluated; and
- Potential residual visual effects for the main receptor groups have been identified.

SPATIAL AND TEMPORAL SCOPE

7.2.5 In accordance with IAN135/10 guidance, the spatial scope of the study area covers all of the proposed scheme options, the wider landscape context within which the scheme may influence landscape character and neighbouring features of special value, and the whole of the area from which the project could be visible. The study area for this assessment is an irregularly shaped area based on a combination of a minimum 1km offset from the scheme options extended to include the computer generated ZVI.

7.2.6 The temporal scope of the assessment is based on the following timescales:

- 2016 is the baseline year;
- 2022 will be the opening year when the scheme is in operation; and
- 2041 will be the 'design' year.

CONSULTATION

7.2.7 South Downs National Park Authority (SDNPA) was consulted in June 2015 regarding the proposed scheme options and potential landscape and visual impacts on adjoining areas of the SDNP. SDNPA advocated a “continuous landscape” approach to the development of design options and assessment of effects and not a “rigid boundary” approach as far as the boundary to the National Park is concerned. The SDNPA published landscape character assessment and visual appraisal guidance were discussed.

BASELINE STUDIES

7.2.8 Preliminary desk study and site analysis of the physical landscape (e.g. landform, vegetation) and spatial components (e.g. scale, key views) was undertaken to identify key landscape characteristics and features, key visual receptors, as well as broad site constraints and opportunities to be considered in the selection of options.

7.2.9 Preliminary baseline information was based on a combination of field survey and desk study, which was obtained from:

- The following published landscape character assessments at regional and local scale;

- National Character Areas (NCA) 125: South Downs NCA 126: South Coast Plain, Natural England;
- South Downs Integrated Landscape Character Assessment, Land Use Consultants for South Downs National Park (Updated 2011); and
- Landscape Character Assessment of West Sussex, updated March 2015;
- 1:25,000 Ordnance Survey Explorer Map 121 Arundel and Pulborough;
- Google Earth Pro;
- Government and local authority planning documents;
- National, County and District council landscape designations; and
- Site survey (undertaken in June 2015, January and August 2016).

7.2.10 Published landscape character assessments (WSCC and SDNPA), descriptions of landscape designations and findings from site survey have been used to describe and evaluate the quality and sensitivity of the landscape within the study area. The existing landscape character has been assessed for its sensitivity to change, and its capacity to accommodate change of the nature proposed. These descriptions have formed the basis upon which the magnitude of impacts and significance of effects have been judged.

7.2.11 The levels of sensitivity assigned to the landscapes (high, moderate or low) are based on criteria in Table 2 of Annex 1 of IAN135/10. Similarly, the determination of the levels of sensitivity of the visual receptors is based on Table 1 of Annex 2 of IAN135/10.

MAGNITUDE OF IMPACTS

7.2.12 Potential impacts on the landscape resource and visual amenity have been identified along with predicted magnitude. In considering the magnitude of impact on views and the surrounding landscape, proposals have been assessed in terms of their scale, spatial extent and massing. The magnitude of impact, which could be either adverse or beneficial, has been assessed using indicative criteria taken from IAN 135/10. Typical criteria descriptors of landscape and visual impacts are provided in Table 1 of Annex 1 and Table 1 of Annex 2 respectively.

SIGNIFICANCE OF EFFECT

7.2.13 The evaluation and significance of the landscape and visual effects of the scheme is derived by assessing the sensitivity of the landscape and visual receptors against the magnitude of impact [allowing for mitigation] as shown in Table 4-3. Typical descriptors for the significance of effect are described in IAN 135/10 Annex 1 Table 4 (Landscape) and Annex 2 Table 4 (Visual Effects).

7.2.14 The GLVIA notes "There are no hard and fast rules about what makes a significant landscape effect, and there cannot be a standard approach since circumstances vary with the location and context and with the type of proposal." When making a judgement about the significance of landscape effects it provides the following guidance:

- Major loss or irreversible negative effects, over an extensive area, on elements and/or aesthetic and perceptual aspects that are key to the character of nationally valued landscapes are likely to be of the greatest significance;
- Reversible negative effects of short duration, over a restricted area, on elements and/or aesthetic and perceptual aspects that contribute to but are not key characteristics of landscapes of community value are likely to be of the least

significance and may, depending on the circumstances, be judged as not significant; and

- Where assessments of significance place landscape effects between these extremes, judgements must be made about whether or not they are significant, with full explanations of why these conclusions have been reached.

7.2.15 In making a judgement about the significance of visual effects it advises the following points should be considered:

- Effects on people who are particularly sensitive to changes in views and visual amenity are more likely to be significant;
- Effects on people at recognised and important viewpoints or from recognised scenic routes are more likely to be significant; and
- Large-scale changes which introduce new, non-characteristic or discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view.

7.2.16 The significance of potential landscape and visual effects of the scheme options was derived by assessing the sensitivity of the landscape and visual receptors against the magnitude of impact using criteria in IAN135/10 as summarised in Table 7-1 below.

TABLE 7-1 SIGNIFICANCE OF EFFECT CATEGORIES

		MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
		No change	Negligible	Minor	Moderate	Major
LANDSCAPE / VISUAL SENSITIVITY	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

ILLUSTRATIVE TOOLS

7.2.17 The ZVI map, Figure 7.1, in Appendix A, is provided to give an indication of the extent of areas with potential views of any of the scheme options in the wider landscape. It is based on contour information shown on OS 1:25,000 Explorer Map 121 and adjusted following the site survey to take account of screening by buildings, local variations in landform, and vegetation.

7.2.18 Use of a ZVI map has the following limitations:

- There are a number of areas within the ZVI map from where there are potential views of the proposal, but which comprise land where the general public do not have access;
- There may be views of the scheme from outside the ZVI;
- It does not take account of the screening and/or filtering of views from all intervening features, such as buildings, trees and hedgerows; and
- It does not take account of the orientation of a viewer, for example, when travelling in a vehicle.

- 7.2.19 The combined effect of these limitations means that ZVI mapping tends to over-estimate the extent of visibility, both in terms of the land area from which the scheme would be visible, and the extent of visibility of the proposed scheme from a particular viewpoint.
- 7.2.20 Photograph and panorama images are presented in Figures 7.4 to 7.9, in Appendix A to illustrate an observer's view of the existing site from each of the representative viewpoint locations. All photographs have been taken with a Digital SLR bridge camera (Nikon 80) using a focal length that appropriately represents the landscape as seen by a person at that location. Panoramic views have been constructed using two or more digital photographs merged to create a panorama using photo-stitching software (ArcSoft Panorama Maker 4).



Figure 7-1 View point of Arundel Castle from River Arun (January 2016)

7.3 STUDY AREA

- 7.3.1 The study area incorporates the A27 corridor through Arundel and its immediate surroundings, and includes sensitive landscape and visual receptors of special value including the SDNP, Arundel Castle and Conservation Area and Monarch's Way long distance recreational trail. The extent of the study area is shown on Figure 7.1 Landscape Study Area in Appendix A.
- 7.3.2 The Study Area for the landscape and visual assessment is the combined ZVI for all of the scheme options.

7.4 BASELINE CONDITIONS

LANDSCAPE BASELINE

THE SITE AND SURROUNDING AREA

- 7.4.1 The A27, which links a number of cities and towns along the south coast, reduces from a two lane dual to single carriageway through Arundel. It passes through the southern edge, of the small historic market town which lies at the boundary between the South Downs and the coastal plain, at the foot of the chalk dip slope where the River Arun cuts through the Downs. The road skirts the southern edge of the SDNP on the eastern side of the town and lies within the Park boundary to the west of the town.

- 7.4.2 The town lies in a steep vale of the South Downs in West Sussex where it is overlooked by two famous landmarks; the substantial medieval Arundel Castle and Arundel Cathedral. The castle is situated on a prominent chalk bluff above the valley floor within the historic part of the town on the south facing slopes running down to the river and into the margins of the floodplain. The town is a major bridging point over the meandering River Arun which runs through the eastern side of the town. Generally, the older part of the town lies to the north and is separated by the A27 from newer development to the south west of the historic town centre.
- 7.4.3 To the north of the A27 the River Arun has deep meanders, across the flat valley floor with the South Downs rising steeply to the east and west. Within the valley floor a complex network of drains are the boundaries to small scale fields under pasture. South of the A27, the Arun valley floor widens and crosses the coastal plain towards Littlehampton and the sea. The valley floor has little enclosure from vegetation where its sides rise towards the coastal plain. There are long views along the valley floor with intervisibility between Littlehampton and Arundel to the east.

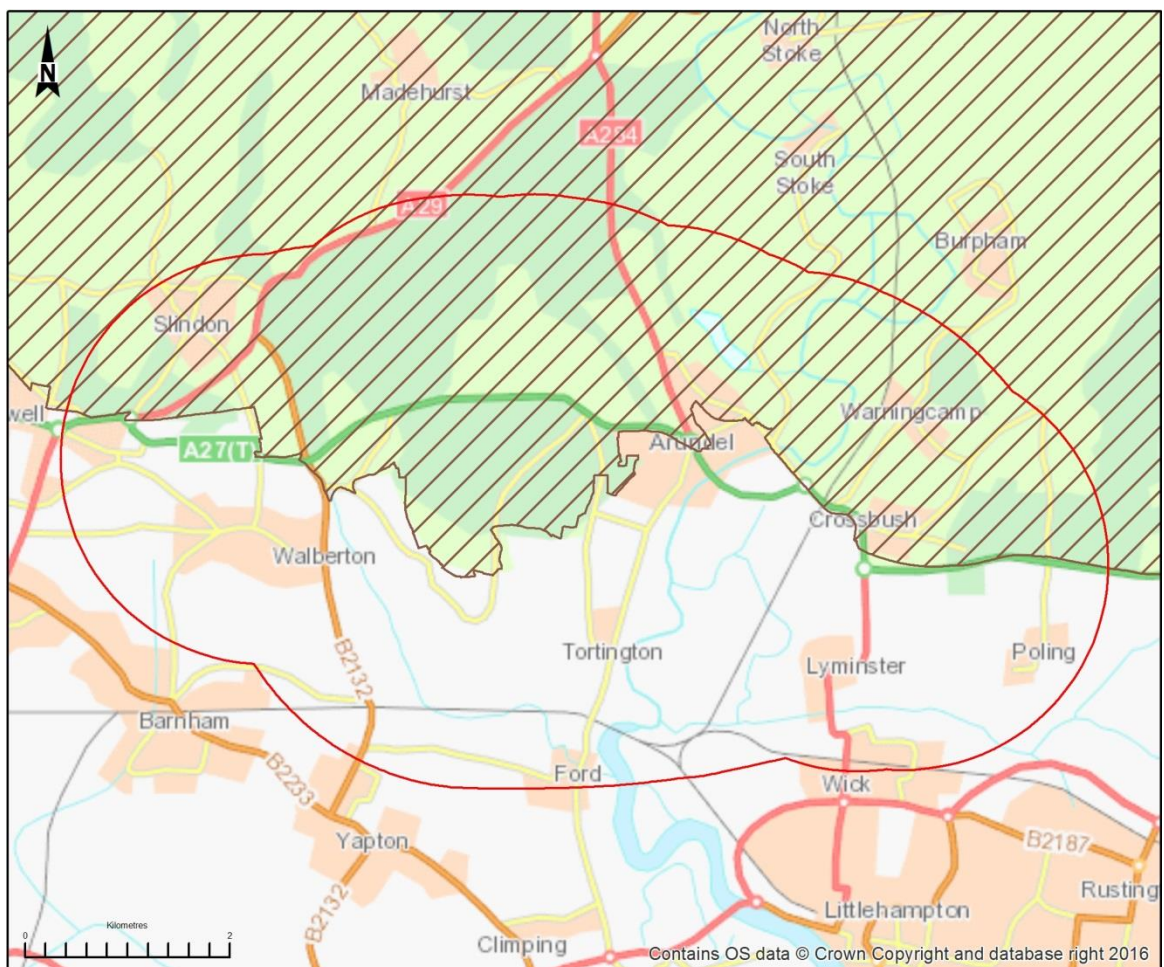


Figure 7-2 The scheme area in the wider context of the South Downs National Park

LANDSCAPE DESIGNATIONS

- 7.4.4 Landscape features and designations within the study area are shown on Figure 7.2 Landscape Context in Appendix A.

STATUTORY DESIGNATIONS

- 7.4.5 The South Downs was designated a National Park in 2010. The SDNP (as with all UK National Parks) are Category V protected areas as defined by the International Union for Conservation of Nature (IUCN) in the Guidelines of Protected Area Management Categories. The IUCN definition of Protected Areas Category V is defined as: “A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.” The IUCN definition of Protected Landscape aims to maintain the harmonious balance between people, landscapes and nature for now and for future generations.
- 7.4.6 The South Downs National Park received International Dark Sky Reserve (IDSR) - Bronze level status in 2016. Dark skies are a recognised Special Quality of the SDNP. Approximately 66% of the SDNP within the International Dark Sky Reserve boundary has Bronze Level skies or better with 3% at Silver. Within the SDNP, the IDSR encompasses the best quality skies, but has sufficient physical and policy buffering to protect it from over 90% of current and future threats. It has some impacts from light pollution and other artificial light disturbance. Bronze level skies offer people, plants and animals a respite from an otherwise degraded nocturnal environment. These are areas of public or private land possessing an exceptional or distinguished quality of starry nights and nocturnal environment that is specifically protected for its scientific, natural, educational, cultural, heritage and public enjoyment.
- 7.4.7 Several areas of Open Access land and Access Land in Woodland Areas, which were designated under the Countryside and Rights of Way Act (CROW) 2000, lie within the study area. Public rights of way (PROW) and access land rights and responsibilities are explained at <https://www.gov.uk/right-of-way-open-access-land/use-your-right-to-roam>.
- 7.4.8 Historic parkland landscape at Binsted Wood includes woodland at Stewards Copse and Tortington Common which is designated ancient semi-natural woodland. Ancient semi-natural woodland vegetation within the study area is of high value and is included in this section for its contribution to the overall landscape pattern.
- 7.4.9 The Arundel Conservation area, which includes most of the northern part of the town as well as Arundel Castle, lies between the A284 road and the River Arun. Chapter 6: Cultural Heritage addresses issues in relation to archaeology and heritage assets.
- 7.4.10 Chapter 8 Nature Conservation describes and assesses potential effects on areas designated as protected habitats and having high nature conservation value.

HISTORIC LANDSCAPE FEATURES

- 7.4.11 This assessment has considered views from the following selected historic features which are accessible to the public for outdoor recreation:
- Arundel Castle Grade II* and early and mid-19th century partly walled pleasure grounds developed from mediaeval earthworks and with surviving C16 and C17 features, and an extensive late 18th to 19th century walled park (Historic England Register of Parks and Gardens of Special Historic Interest, Grade II* Historic England

Register of Parks and Gardens of Special Historic Interest, list entry number 1000170). It lies approximately 0.6km north of the existing A27; and

- Arundel Park including Hiorne Tower (Grade II Historic England Register of Parks and Gardens of Special Historic Interest, list entry number 1027927). It lies approximately 1.1km north of the existing A27.

PUBLIC RIGHTS OF WAY

- 7.4.12 There are no National Trails within the study area. An extensive network of Public Rights of Way (PRoW) lies within the study area including the Monarch's Way, a long distance (990km) historic route, and a long distance PRoW along the western bank of the River Arun.
- 7.4.13 Minor lanes in the western part of the study area, which are often single track, are frequently used for recreation including walking, cycling and horse riding.

LANDSCAPE FEATURES

- 7.4.14 Broadly, land to the south of the A27 lies within Natural England's NCA 126 South Coast Plain, and land to the north is in NCA 121, Low Weald.
- 7.4.15 The study area lies within several landscape character areas (LCAs) described in the West Sussex Landscape Character Assessment (WSLCA). The key characteristics of each LCA area and its sensitivity are described below, with reference to the WSLCA.

WESTERN DOWNS LANDSCAPE CHARACTER AREA

- 7.4.16 This large area within the SDNP is characterised by enclosed valleys, wooded chalk uplands and a densely wooded escarpment. A strong sense of enclosure, seclusion and remoteness prevails.
- 7.4.17 The WSLCA notes that views from the Downs are highly sensitive to visually prominent development. This character area has high sensitivity to the impact of encroaching urban development, modern farm buildings, masts and pylons and new roads, reinforcing the cumulative visual impact of buildings and other structures. It also notes increasing traffic noise on the road routes across the Downs, due to increased recreational pressures, thereby eroding tranquillity.
- 7.4.18 The WSLCA Landscape Management Guidelines for this character area recommend carefully designed native tree and shrub planting is implemented around detracting features.
- 7.4.19 Landscape sensitivity is high. It is a nationally designated landscape of high quality with distinctive elements and features that could not be replaced.

DOWNLAND ARUN VALLEY LANDSCAPE CHARACTER AREA

- 7.4.20 This area of the SDNP comprises lush seasonal meadows on the broad valley floor and gently sloping sides with woodland on the steeper slopes. Prominent features include the elevated Arundel Castle and several chalk pits. Spectacular views are available from the north and from the valley sides. It mostly has an isolated, unspoilt character apart from the southern edge of this character area, which is influenced by the A27 trunk road.
- 7.4.21 This landscape has high sensitivity to change due to its openness and visual prominence of valley side slopes as well as the many intrinsic qualities of the valley floor. The WSLCA identifies key sensitivities are changes in important views including those of settlements

and landmarks, and any built development on the valley floor.

7.4.22 Landscape sensitivity is high. It is a nationally designated landscape of high quality.

FONTWELL UPPER COASTAL PLAIN LANDSCAPE CHARACTER AREA

7.4.23 This character area forms a transition between the open lower Coastal Plain to the south and the wooded Downs to the north. The landform is very gently undulating in the west and more intricate in the east. Over much of the area, strong networks of hedgerows, hedgerow trees and woodlands enclose small to medium-sized fields. The busy A27 cuts through the northern part of this character area between Fontwell and Arundel. Expansive views are available from the higher ground in the north. There are few urban influences on this area so it has a rural character.

7.4.24 The WSLCA notes major improvements to the A27 trunk road and the possibility of new roads are a key issue for change. It notes the landscape has high sensitivity to inappropriate or visually intrusive road improvements.

7.4.25 The WSLCA Landscape Management Guidelines recommend any new development is well integrated into the wider landscape using new woodland and hedgerow planting as appropriate.

7.4.26 Landscape sensitivity is high. It is a nationally designated landscape of high quality.

CHICHESTER TO YAPTON COASTAL PLAIN LANDSCAPE CHARACTER AREA

7.4.27 A large part of this low lying flat open landscape has been reclaimed from the sea, and remains below the current high spring tide level. It comprises a mainly flat, open landscape crossed by meandering rifes, and dominated by arable fields and modern farm buildings. It has a fragmented hedgerow and hedgerow tree pattern. The distinctive landscape character has been eroded by light industry in the Ford area. There are long views to Arundel, the Downs due to the relatively open character of much of this area.

7.4.28 Major road improvements and urban development pressures are key issues for change in this character area.

7.4.29 The WSLCA notes the landscape has high sensitivity to changes in transport infrastructure due to urban development pressure. Key views to the South Downs and Arundel have a high sensitivity to change. Landscape sensitivity is moderate.

LOWER ARUN VALLEY LANDSCAPE CHARACTER AREA

7.4.30 This character area extends from where the river leaves the downland at Arundel to where the floodplain pastures merge with the Coastal Plain. Stretches of the river Arun are tidal and contained by high engineered banks to control flooding, consequently there is little riverside vegetation. This LCA comprises extensive areas of drained pasture and floodplain through which the wide river meanders, gradually increasing in size to the south. The river is fed by rifes and dykes with adjacent reed beds. The railway line between Arundel and Littlehampton is prominent on embankment.

7.4.31 There are extensive high level views onto the area from the Downs and Arundel. There are key close dramatic views of Arundel from the south, which include the castle, Roman Catholic cathedral, parish church and clustered hillside housing. Seaward views are available from elevated locations. From the south there are long views over the river valley towards the Downs and Arundel.

- 7.4.32 The WSLCA notes improvement to the A27 is a key issue for change. Key sensitivities include change to the open character; loss of long views to Arundel and the Downs; and change to important views including those of settlements and landmarks.
- 7.4.33 The WSLCA Landscape Management Guidelines recommend the open nature and characteristic vegetation of the valley are considered in any future development, especially the landscape treatment of any A27 improvements. It promotes tree group planting on higher ground and on the edges of roads whilst maintaining views across the area.
- 7.4.34 Landscape sensitivity is high. The northern edge of the LCA lies within the SDNP. Overall, it is a distinctive landscape with a sense of place.

ANGMERING UPPER COASTAL PLAIN LANDSCAPE CHARACTER AREA

- 7.4.35 This LCA, which is bisected by the A27, forms a transition between the open lower Coastal Plain to the south and the wooded downs to the north. Despite the A27 trunk road along the boundary of the SDNP, it has a mostly undeveloped, rural character. It has a very gently undulating landform comprising farmland enclosed by woods with frequent hedgerows. The farmland includes small to medium-sized pastures and arable fields. Historic landscape features, including historic parklands, ancient semi-natural woodlands and earthworks exist within this LCA.
- 7.4.36 The WSLCA notes improvement to the A27 and new roads to be a potential key issue for change. Key sensitivities include the loss of the undeveloped rural character of the area, loss of rural rights of way network (tracks and byways) and inappropriate design and/or scale of road improvements.
- 7.4.37 Landscape sensitivity is high. Much of the character area is a nationally designated landscape of high quality with distinctive elements and a sense of place.

VISUAL BASELINE

- 7.4.38 Figure 7.3 in Appendix A illustrates the ZVI of the existing A27 and the combined options in order to represent the realistic maximum case scenario, i.e. the area where views would be available if all of the tallest structures in all of the scheme options were built. In reality, this would not happen and only one option would be constructed but this approach ensures all areas where changes to the existing view could arise are included in this assessment. It also shows the location of photographs from the representative residential and recreational receptor groups described below. Refer to Figures 7.4 to 7.8 in Appendix A for baseline views.
- 7.4.39 High sensitivity residential receptors within 1km of the scheme site could experience moderate adverse, noticeable changes to the existing view from the scheme at this distance. They include:
- Residential properties at Fitzalan Road, Ford Road, Priory Lane and Dalloway Road on the southern edge of Arundel;
 - Residential properties at Tortington;
 - Broomhurst Farm due south of Arundel;
 - Residential Properties at Binsted south west of Arundel; and
 - Residential properties at Lyminster between Arundel and Littlehampton.

- 7.4.40 High sensitivity recreational receptors include people visiting Arundel Castle and pleasure grounds, the historic town, and the bridge over the River Arun (refer to Figures 7.4 to 7.5). Views from the PRoW that are in close proximity to the scheme site are shown on Figures 7.6 to 7.9. These include Monarch's Way and the public footpath on the western bank of the River Arun.
- 7.4.41 Site survey confirmed views of the scheme site are not available from Open Access land or Access Land in Woodland Areas, therefore these areas are not considered further in the assessment.
- 7.4.42 Refer to Chapter 6 Cultural Heritage for consideration of the setting of Arundel Castle and pleasure grounds.

SDNP VIEWPOINTS AND LANDMARKS

- 7.4.43 This visual assessment has also considered selected representative viewpoint locations within the SDNP which are described in a detailed visual appraisal study published by the SDNPA titled 'View Characterisation and Analysis Study' (November 2015). The purpose of the SDNPA report is to analyse views to, from and within the SDNP in order to guide future planning and development management decisions by SDNPA and its partner authorities.
- 7.4.44 Guidance is provided for each SDNP viewpoint location using the study's 'Visual tools' and those that are relevant to this assessment include a 360 degree viewshed from Arundel Castle (SDNPA Viewpoint 50); a 360 degree panoramic photograph from Arundel River (SDNPA Viewpoint19); and landmark L36, Hiorne Tower.
- 7.4.45 360 degree viewsheds from the representative viewpoints (e.g. SDNPA Viewpoint 50) show areas visible at ground level as well as heights above which objects would become visible from those viewpoints, covering an area up to 35km from each viewpoint. Viewsheds from representative landmarks (e.g. SDNPA landmark L36, Hiorne Tower) include the zones of theoretical visibility from the representative landmark features. For publicly accessible landmarks, such as Hiorne Tower, 360 degree viewsheds have been produced showing areas that are visible from the landmark, as well as heights above which objects would become visible when viewed from these landmarks over an area up to 35km from the viewpoint. 360 degree panoramic photographs have been produced from selected representative viewpoints to demonstrate the range of characteristics of views associated with the SDNP (e.g. SDNPA Viewpoint19). They are used as a monitoring tool as well as illustrating the variety and quality of views across the park, landscape character areas and designation data (Scheduled monuments, SSSIs etc.).
- 7.4.46 The SDNP viewpoints correlate with the following viewpoints in this assessment:
- Viewpoint VP3 is located near Arundel Castle from High Street, close to SDNPA Viewpoint 50 (Grid ref. 501841, 107365). The castle is noted as a particularly distinctive landmark standing at a commanding position at the southern end of the Arun Valley (Refer to Figure 7.6 VP3 in Appendix A);
 - Viewpoint VP4 is located next to the Arundel River, Monarch's Way near SDNPA Viewpoint 19, which lies close to the A27/The Causeway roundabout on the south eastern edge of the town. It is a SDNPA photographic monitoring point selected for its view of Arundel Castle, and its relationship with the Downs, valley and settlement of Arundel. The A27 and roundabout are prominent in the view (Grid ref. 502333, 106730) (Refer to Figure 7.7 VP4 in Appendix A); and
 - Hiorne Tower, Arundel Park - landmark feature. Site survey confirmed no views of the existing A27 or the site of the scheme options are available from this location.

7.5 REGULATORY AND POLICY FRAMEWORK

LEGISLATION

COUNTRYSIDE AND RIGHTS OF WAY ACT (CROW) 2000

- 7.5.1 Several areas of Open Access land and Access Land in Woodland Areas, which were designated under the Countryside and Rights of way Act (CRoW) 2000, lie within the study area. PRoW and access land rights and responsibilities are explained at <https://www.gov.uk/right-of-way-open-access-land/use-your-right-to-roam>.

ENVIRONMENT ACT 1995

- 7.5.2 The SDNP has been designated for its outstanding landscapes and its rich variety of landscape character. Under the Environment Act 1995 a National Park Authority is required to ensure:
- The conservation and enhancement of the natural beauty, wildlife and cultural heritage of the National Park; and
 - The promotion of opportunities for the understanding and enjoyment of the National Park's special qualities by the public.

EUROPEAN POLICY

IUCN CATEGORY V: PROTECTED LANDSCAPE/SEASCAPE

- 7.5.3 National Parks are part of a global family of protected areas recognised and classified by the International Union for Conservation of Nature (IUCN). National Parks, AONBs and Heritage Coasts in England and Wales fall into Category V – Protected Landscapes. The IUCN definition of Protected Areas Category V is defined as:

“A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.”

- 7.5.4 The IUCN definition of Protected Landscape aims to maintain the harmonious balance between people, landscapes and nature for now and for future generations. https://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/gpap_category5/

THE EUROPEAN LANDSCAPE CONVENTION 2000

- 7.5.5 The European Landscape Convention (Florence: Council of Europe, 2000, ETS 1X6) defines 'Landscape' as “...an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.” It also recognises that all landscapes are potentially important, irrespective of location or condition and should be considered in any assessment of effects “*that the landscape is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as areas of high quality, in areas recognised as being of outstanding beauty as well as every day areas.*” <http://conventions.coe.int/Treaty/EN/Treaties/Html/176.htm>

NATIONAL POLICY

NPS NN

- 7.5.6 The NPS NN (DfT, 2014) paragraphs 5.150 – 153 provides landscape guidance for development within nationally designated areas and requires great weight to be given to conserving landscape and scenic beauty, noting a strong presumption against any significant road widening within such areas. Impacts on nationally designated areas must be considered, even when the scheme falls outside of their boundaries. Paragraph 5.154 states, “*The aim should be to avoid compromising the purposes of designation and such projects should be designed sensitively given the various siting, operational and other relevant constraints*”. If undertaking works in relation to, or so as to affect land in a National Park or AONB, it would need to comply with the respective duties in Section 11A of the National Parks and Access to Countryside Act 1949 and Section 85 of the CRoW 2000.
- 7.5.7 The NPSNN paragraph 5.160 states “Adverse landscape and visual effects to be minimised through the appropriate siting of infrastructure, design (including choice of materials) and landscaping schemes, depending on the size and type of proposed project. Materials and designs for infrastructure should always be given careful consideration.”

NPPF

- 7.5.8 The NPPF paragraph 115 refers to valued landscapes and in particular those protected by designations such as those within National Parks and AONBs. It recognises Landscape as being an important part of sustainable development and in particular its environmental role as a contributing factor in understanding the natural, built and historic environment. It attaches great importance to the design of the built environment and the need for good design which should contribute positively to making better places for people.
- 7.5.9 NPPF paragraph expects the planning system to protect and enhance valued landscapes. NPPF paragraph 123 notes the importance of tranquillity and requires planning policies and decisions aim to “*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*”.

LOCAL POLICY

WEST SUSSEX STRUCTURE PLAN 2001 - 2016

- 7.5.10 The West Sussex Structure Plan 2001 - 2016 saved policies provides a broad planning framework for the West Sussex area, although it does not form part of the adopted Development Plan any longer and has no formal status. The document acknowledges the exceptional character of West Sussex and contains a number of 'saved' strategic policies that provide for:
- Protecting and reinforcing the distinctiveness of the main NCAs;
 - Safeguarding the AONB;
 - Protecting woodlands and forests;
 - Protecting rivers, waterways and the coast;
 - Retaining the separate identity of towns and villages;

PROTECTING AND ENHANCING TOWNS, VILLAGES AND THE HISTORIC HERITAGE OF THE COUNTY. SOUTH DOWNS PARTNERSHIP MANAGEMENT PLAN (SDPMP) 2014-2019

7.5.11 The SDPMP provides the starting point for the development of the South Downs Local Plan, which is due for publication in September - October 2017. The following General Policies in the SDPMP are relevant to the scheme:

- The objective of General Policy 1 is to, "Conserve and enhance the natural beauty and special qualities of the landscape and its setting, in ways that allow it to continue to evolve and become more resilient to the impacts of climate change and other pressures.";
- General Policy 3 is intended to "Protect and enhance tranquillity and dark night skies."; and
- General Policy 40 seeks to "Manage the highway network and its infrastructure to integrate it more effectively into the landscape and reduce the impact of traffic on communities and visitors."

7.5.12 Due to the agreements formed in the South Downs National Park Partnership Management Plan the SDNPA empowers local authorities to provide a consistent and complimentary approach to reducing light pollution from Parish to County level. All local Highways Authorities in SDNPA have street lighting design policies on dark skies; all Local Authorities in and surrounding the SDNP have policies on light pollution and dark skies.

ARUN DISTRICT LOCAL PLAN 2003

7.5.13 Policy GEN3 Protection of the Countryside: Outside the Built-Up Area, states that the countryside should be safeguarded for its own sake. Development will not be permitted unless:

- (i) it meets the operational needs of agriculture, forestry, the extraction of minerals or the deposit of waste; or
- (ii) for quiet, informal recreation; or
- (iii) for the diversification of the rural economy; or
- (iv) for essential road schemes; or
- (v) it is in accordance with a policy in Section 2 and 3 of the plan referring to a specific use or type of development

7.5.14 Policy AREA9 AONB relates to the Sussex Downs before it became a National Park in 2011. It states, "*Development will not be permitted within the Sussex Downs AONB unless:*

- (i) *development is essential for agriculture, forestry, mineral extraction or disposal of waste, quiet informal recreation, rural diversification or essential community needs; and*
- (ii) *it is demonstrated that it would not be harmful to the visual quality and characteristics of the AONB; or*
- (iii) *in exceptional circumstances, it is demonstrated that the development meets national interests; no alternative site is available; and any harmful effects are minimised*

Development outside but near to the AONB will not be permitted where it would be unduly prominent in, or detract from, views into or out of the AONB."

7.5.15 The emerging local plan published in October 2014 is to be treated as a material

consideration in the determination of planning applications. The overriding Strategic Objective as set out in the Local Plan in landscape and visual terms is to protect and enhance the outstanding landscape, coastline, historic, built and archaeological environment, reinforcing the local character and identity. This overriding objective is supported by Policy DM 1: Protection of Landscape Character, which sets out the developments that would be permitted and makes particular reference to development adjoining or in close proximity to the SDNP planning authority boundary. The policy states, *"Development will be permitted where:*

- Landscape character, including its natural features, are conserved or enhanced;
- The historic character and development pattern of settlements is respected, taking into account their distinct identity and setting;
- Either individually or cumulatively development does not lead to actual or perceived coalescence of settlements or undermine the integrity or predominantly open and undeveloped character of the area; and
- It does not negatively impact upon the setting of, or upon views into and out of the SDNP.

7.5.16 All proposed development either adjoining or in close proximity to the SDNP planning authority boundary (see Proposals Map) shall have particular regard to the setting of and views in to and out of the SDNP.

7.5.17 Developments shall only be permitted where it can be demonstrated that there will be no or minimal negative visual impact on either the landscape character of Arun or the setting of and views into and out of the SDNP."

7.6

DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

DESIGN

7.6.1 Chapter 3 describes the scheme options under consideration for improvements to the A27. Whilst the horizontal alignment for the proposed junction improvements and carriageway widening are known, design information for the proposed built structures, signage, and lighting, which could have an impact on views as well as the surrounding townscape and rural landscape, is not available at this stage.

7.6.2 Options 2, 3, 4, 5, 5A and 5b could have significant landscape and visual impacts on the setting of Arundel from the floodplain, and in views from Arundel towards Littlehampton and the coast. Adverse visual impacts could not be mitigated satisfactorily because screen planting would not be in keeping with the open character of the floodplain.

7.6.3 It would be necessary to raise the level of the A27 across the Arun floodplain either on an earth embankment or viaduct with a new bridge over the River Arun.

7.6.4 A viaduct would be less of a physical barrier to the use of agricultural land and PRowS. It would be less visually intrusive and would allow views through the structure. In design terms a viaduct would sit well in this landscape if it extended the full width of the valley floor in a sinuous alignment and comprised a slender bridge deck supported on widely spaced slim columns.

7.6.5 In view of the prevalence of Ash within the highway boundary and its susceptibility to infection from *Chalara fraxinea* (Ash die-back disease) it would be advisable to reinforce the existing plantations with other locally occurring native tree species to ensure screening will be maintained if the disease spreads.

LANDSCAPE MITIGATION

- 7.6.6 The landscape and visual effects associated with the construction phase of a highway scheme are similar in their area of influence to the operational phase but cannot generally be mitigated, as it is not possible to screen the construction works completely. Whilst it is likely the construction effects would be generally more adverse where views of the exposed earthworks and the extended works area, including signage, traffic management, contractor's compounds etc., would be available they would temporary.
- 7.6.7 The extent of mature trees adjacent to the highway boundary represents a significant constraint during construction. During construction all existing tree, shrub and hedgerow planting within the highway estate would be retained wherever possible and protected in accordance with BS5837:2012. Any works affecting offsite vegetation, some of which is ancient semi-natural woodland, would require the agreement of the landowner as well as the relevant statutory authorities. Offsite vegetation would require protection throughout the construction period; long term monitoring of mature trees by a qualified arboriculturalist would be advisable following construction.
- 7.6.8 Construction working methods around tree roots should take account of arboriculture advice for the protection of all retained trees. Where site clearance and or excavation involves the cutting, loss or damage to roots within the highway boundary but associated with trees outside it, remedial works may be required to ensure the long term health and safety of the affected vegetation, or if necessary, replacement planting.
- 7.6.9 Permanent landscape mitigation proposals and enhancement measures would follow the guidance in the DMRB, Volume 10: Environmental Design and Management (Section 0: Environmental Objectives). The landscape proposals would be designed to complement the landscape elements and environmental functions of the adjoining soft estate and would comprise similar locally occurring desirable native species of trees, shrubs, wildflowers and grasses. The first principle of the landscape design would be to retain and protect as much of the existing highway screen planting as possible. The second principle would be to carry out new planting for landscape and visual mitigation and to replace any vegetation lost to construction of the improvements. Opportunities for landscape enhancement, such as additional planting to screen views of the A27 from adjoining rural land within the SDNP, or improvement through the management of any retained areas of vegetation, should also be considered.
- 7.6.10 Where practical, junctions between the proposed A27 improvements and existing side roads should protect the distinctive characteristics of the minor, narrow roads, such as Binsted Lane, Priory Lane, Old Scotland Lane and Tortington Lane. Generally, where roads such as these are narrow with an absence of kerbs and footpaths and are enclosed by tall hedgerows or woodland, the improvements should seek to retain or reproduce their characteristics as far as possible.

7.7 OVERALL ASSESSMENT

ASSESSMENT OF LANDSCAPE AND VISUAL EFFECTS

- 7.7.1 This assessment considers the potential impacts that would arise from the key features of each option in relation to high sensitivity landscape and visual receptors. Because landscape mitigation (screen planting or environmental barriers) cannot be guaranteed at this stage, potential effects are assessed without mitigation and the possible additional effects of mitigation are noted.
- 7.7.2 A detailed description of the scheme options is provided in Chapter 2. The main features that are relevant to this assessment are:
- All of the scheme options include either improvement to sections of the existing A27 and/or new sections of road that would lie within the SDNP;
 - All of the scheme options, except Option 0A, include new offline two-lane dual carriageways varying in length between 4.0km and 7.35km;
 - All of the scheme options pass through mature woodland at the western end of the scheme, some of which is ancient semi-natural woodland;
 - All options include junction improvements and/or new junctions at both ends of the route, some are grade separated and, except for Option 0A, all include a new railway bridge;
 - Options 0A, 0B, 0BA and 1 would require widening of the existing bridge over the River Arun near Ford. Options 2, 3, 4 and 5 include a new bridge over the River Arun and possibly a viaduct between 1,100m and 1,500m long across the Arun floodplain; and
 - Street lighting is proposed only at junctions and on sections of the A27 where lighting already exists.
 - It is considered unlikely that lighting proposals associated with options would produce a perceptible change to night time views from the SDNP IDSR and surrounding 2 Km Buffer Zone.
- 7.7.3 Each option, with the exception of Option 0A, includes new large-scale features that have the potential to damage the existing character or distinctive features in the surrounding landscape. The baseline studies in section 7.4 note the presence of several highly sensitive features including the SDNP and its special qualities, mature woodland (most of which is ancient semi-natural woodland), the Arun floodplain, high levels of tranquillity etc. all of which are highly valued and could not be replaced. These elements and features, combined with the undulating topography, create an intricate landscape composed of several locally distinctive character areas which are highly susceptible to change from the scheme. Similarly, there is the potential to affect visual amenity and views for several high sensitivity visual receptors including residential and recreational receptors, the iconic view of Arundel and Arundel Castle from the south, views over the Arun floodplain, and the setting of the SDNP.

MAGNITUDE OF IMPACT

- 7.7.4 The landscape and visual impact of each option and overall magnitude of impact are described below. Table 7-2, which represents graphically the magnitude of impact in relation to each high sensitivity receptor, follows this. By scoring the magnitude of effect on key landscape characteristics and views/visual amenity, it shows the range of impacts from each option and enables the impacts of the different options to be compared.

OPTIONS 0A, 0B AND 0BA

7.7.5 Landscape impacts would arise from the following actions:

- Increase in built form including the road widening, new road, earthworks, lighting, signage and traffic. The new section of road proposed under Option 0BA would lie within the SDNP and would include a new bridge over the Arun Valley Railway and a new underbridge at Crossbush Lane. The existing bridge over the River Arun;
- Option 0BA would also require the loss of up to 4ha of Ancient Woodland and an Ancient Tree (T140846), located in fields south east of the existing rail bridge;
- Loss of mature tree, shrub and hedgerow cover within the existing highway boundary;
- Loss of agricultural land including field boundaries and field pattern; and
- New mitigation planting.

7.7.6 The closely aligned new and existing A27 in Option 0BA would be separated by a narrow strip of severed agricultural land which would have an adverse effect on coherence and would be visible from adjoining areas of the SDNP.

7.7.7 Views of the scheme would be available from Monarch's Way Long Distance Path to the south east of Arundel (SDNPA Viewpoint 19 and 360 degree photographic monitoring point). Although the existing view is influenced by the A27, the proposed scheme would be closer to this location and would be prominent in the view. Panoramic views are available in all directions from this location, and the existing A27/The Causeway roundabout is an established but minor part of the overall composition

7.7.8 Mitigation (screen) planting adjacent to the scheme would be in keeping with the character of the surrounding landscape.

7.7.9 Overall, the magnitude of landscape impact within this landscape, part of which lies within the SDNP and has high sensitivity, is assessed to be minor adverse. Options 0A, 0B and 0BA would be in keeping with characteristic features and elements. The overall magnitude of visual impact on receptors which are of high and moderate sensitivity would be slight. This option would cause limited deterioration to the view. Adverse landscape and visual impacts could be partly mitigated with screen planting similar to the existing highway planting.

OPTION 1

7.7.10 Potential landscape impacts from the online improvements would be similar to Options 0A, 0B and 0BA.

7.7.11 Widening along the southern boundary of the A27 would necessitate the removal of tall hedgerows/scrub that screens it from views from residential and recreational receptors to the south of the A27 (refer to Figure 7.3 Viewpoint Locations in Appendix A). The improvements would extend through adjacent areas of ancient semi-natural woodland at the western end of the scheme. Whilst the highway planting could be replaced, loss of ancient semi-natural woodland could not be mitigated due to the time it would take to reach maturity. The retention of highway vegetation along the redundant section of the A27 near The Causeway roundabout would assist in screening the new road from the town and Monarch's Way National Trail. New screen planting would be required to mitigate views from the long distance River Arun footpath to the south.

7.7.12 Views of the scheme would be available from Monarch's Way National Trail to the south east of Arundel (SDNPA Viewpoint 19 and 360 degree photographic monitoring point).

Although the existing view is influenced by the A27, the proposed scheme would be further away from this location and would be partly screened by mitigation planting. By year 15 when mitigation planting had formed a screen there would be a minor beneficial impact from the scheme in views towards The Causeway roundabout.

- 7.7.13 Views of the scheme from Arundel Castle grounds (SDNPA Viewpoint 50 / SDNPA 360 degree Viewshed) would be substantially screened by the castle walls allowing only brief glimpses of the new offline section, new railway overbridge and the existing section of the A27 east of the River Arun bridge. It is likely views of the scheme would be available from within the castle.
- 7.7.14 Potential impacts on landscape character and landscape resources would be reduced by undertaking most of the improvements within the existing highway corridor, which lies outside the SDNP boundary. The new section of offline dualling would not have a negative effect on tranquillity levels which are low due to the existing A27 and Arun Valley railway. Compared to Options 3, 4 and 5, the close alignment of the new offline section to the existing A27 would reduce landscape and visual impacts on the Arun floodplain.
- 7.7.15 The magnitude of landscape impact within this high sensitivity landscape is assessed to be slight adverse. The scheme would be in keeping with characteristic features and elements. The magnitude of visual impact on receptors which are of high and moderate sensitivity would be slight adverse. The scheme would cause limited deterioration to the view. Adverse landscape and visual impacts could be partly mitigated with screen planting similar to the existing highway planting.

OPTION 2

- 7.7.16 Landscape impacts would arise from the following actions:
- Loss of landscape features and elements from the route of the proposed 2 lane dual carriageway;
 - New earthworks, lighting, signage infrastructure, and A27 overbridges would be uncharacteristic noticeable new features;
 - Loss of up to 14ha of mature woodland at Binsted Wood (ancient semi-natural woodland); and
 - Loss of agricultural land including field boundaries and field pattern.
- 7.7.17 At the western end of the scheme there would be direct negative effects on landscape elements and features within the SDNP that could not be replaced or mitigated. The distinctive character of woodland areas would be eroded; loss of up to 14ha ancient semi-natural woodland cannot be mitigated due to the time it would take for replacement woodland to reach the same level of maturity. Tranquillity, which is one of the National Park's special qualities, would be lost and could not be mitigated.
- 7.7.18 The new route would adversely affect the field pattern composed of small-scale rectangular fields enclosed by low hedges, and would have a negative effect on coherence. Small areas of severed land would be unsuitable for agricultural use, and their inclusion into adjoining fields would disrupt further the distinctive historic field pattern.
- 7.7.19 The new road would be a prominent and uncharacteristic feature in the River Arun floodplain. Although the route of the River Arun footpath would be retained in its current alignment, the prevailing tranquillity and sense of remoteness would be eroded.
- 7.7.20 Views of the scheme from Arundel Castle grounds (SDNPA Viewpoint 50 / SDNPA 360 degree Viewshed) would be substantially screened by the castle walls allowing only brief

glimpses of it in areas where the existing A27 is visible. It is likely views of the scheme would be available from within the castle.

- 7.7.21 The new road and traffic would be prominent in the foreground of views towards Arundel Castle from the south where it would detract from the attractiveness and composition of existing views.
- 7.7.22 Extensive views of the proposed scheme and traffic in the Arun Valley floodplain would be available from the Arundel Conservation Area from properties that currently have long views to the south over the pastoral river landscape towards the coast. Woodland planting would be incongruous in this landscape, and would not screen views from higher ground effectively.
- 7.7.23 Views of the scheme would be available from dwellings at Arundel, Torton Hill, Tortington Lane and Crossbush where it would become a noticeable feature of the view.
- 7.7.24 The scheme would become the dominant feature in views from the River Arun footpath and could not be mitigated. Visual amenity, i.e. the pleasantness of the view, would be lost over extensive sections of the route from where there are panoramic views looking north towards Arundel and the Chalk Downs in the distance.
- 7.7.25 The overall magnitude of landscape impact within this landscape which has high sensitivity is assessed to be moderate adverse. There would be noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements.
- 7.7.26 Overall, the magnitude of visual impact on several high sensitivity receptors would be major. There would be perceptible damage to views from highly sensitive receptors that could not be mitigated.

OPTION 3

- 7.7.27 Potential landscape and visual impacts would be broadly similar to those arising from Option 2.
- 7.7.28 The route would bisect Binsted Wood resulting in the irreplaceable loss of up to 24ha of mature woodland (ancient semi-natural woodland) and significant disturbance to woodland paths, rides and PRoWs. Negative effects on the distinctive woodland character of areas adjoining the route and reduced levels of tranquillity could not be mitigated. Loss of ancient semi-natural woodland from the landscape cannot be mitigated due to the time it would take for replacement woodland to reach the same level of maturity.
- 7.7.29 Loss of agricultural land including field boundaries and field patterns would arise. The new route would adversely affect the established pattern and grain of the landscape near Tortington and within the River Arun floodplain which is characterised by small-scale irregular shaped fields enclosed by low hedges. Small areas of severed land would not be suitable for agricultural use; their inclusion into adjoining fields would alter the distinctive historic field pattern.
- 7.7.30 The new road would be a large scale, prominent and uncharacteristic feature in the open, expansive Arun Valley landscape. Here it would be raised either on embankments or a viaduct across the floodplain and the River Arun with a new bridge over the Arun Valley Railway. The prevailing tranquillity and sense of remoteness would be eroded. The impact of the new road on the Arun Valley landscape could be lessened if it was set on an open viaduct which would allow the landscape and views to continue through the structure instead of siting it on an embankment.

- 7.7.31 At the western end of the scheme there would be direct effects on landscape elements and features within the SDNP. Loss of tranquillity in this area, which could not be mitigated, would adversely affect one of the SDNP's special qualities, its tranquil and unspoilt places.
- 7.7.32 Although views of the scheme from Arundel Castle grounds (SDNPA Viewpoint 50 / SDNPA 360 degree Viewshed) would be substantially screened by the castle walls the new road would be prominent within the floodplain from locations where views would be available, including from within the castle. Views of the scheme could not be mitigated with screen planting, which would be uncharacteristic in the open Arun floodplain.
- 7.7.33 The new road and traffic would be prominent in views from the River Arun footpath resulting in a loss of visual amenity over extensive sections of the route where panoramic views of Arundel and the Chalk Downs are currently available.
- 7.7.34 Extensive elevated views of the proposed scheme and traffic across the Arun Valley floodplain would be widely available from Arundel's historic core from several residential properties. Long views to the south over the pastoral river landscape towards the coast would be broken by views of the road, traffic and lighting in the middle distance. Mitigation screen planting would be incongruous in this landscape, and unlikely to screen views effectively from higher ground.
- 7.7.35 Views of the scheme would be available from dwellings at Arundel, Torton Hill, Tortington Lane and Crossbush where it would become a noticeable feature of the view.
- 7.7.36 Overall, the magnitude of landscape impact within this landscape which has high sensitivity is assessed to be moderate adverse. There would be noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements.
- 7.7.37 The overall magnitude of visual impact on several high sensitivity receptors would be major adverse. There would be perceptible damage to views from highly sensitive receptors that could not be mitigated.

OPTION 4

- 7.7.38 Option 4 (length 6.85km) commences further west than Option 3 following the route of Option 5 in order to minimise impacts on the SDNP. Similar to Options 5 and 5a, it would also require the loss of up to 6ha ancient semi-natural woodland at Binsted Wood. The eastern section of the route would follow almost the same alignment between Ford Road and Crossbush Junction as Option 3 in order to minimise impacts on the Arun floodplain. Potential landscape and visual impacts in this area would be broadly similar to Option 3.
- 7.7.39 The western section of the scheme would lie close to but mainly outside the boundary of the SDNP. It would lie within a complex small-scale landscape comprising small fields under pasture, large-scale arable fields, hamlets, farmsteads and glasshouses. Mitigation planting would be appropriate in this context. The impact on landscape resources would be greater than for Options 2 and 3 due to the length of the route.
- 7.7.40 The overall magnitude of landscape impact within this landscape which has high sensitivity is assessed to be moderate adverse. There would be noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements.
- 7.7.41 Overall, the magnitude of visual impact on several high sensitivity receptors would be major. There would be perceptible damage to views from highly sensitive receptors that

could not be mitigated.

OPTION 5

- 7.7.42 Option 5 (length 6.5km) is the straightest offline route commencing further west than Option 3 in order to affect a smaller area of the SDNP and require the loss of up to 6ha ancient semi-natural woodland at Binsted Wood. The eastern section of the route would follow a similar alignment between Ford Road and Crossbush Junction as Option 2, and would produce similar landscape and visual impacts.
- 7.7.43 The western section of the scheme would lie within the SDNP close to woodland at Binsted Wood. It would lie within predominantly flat arable land to the east of steeply undulating land at Binsted (Binsted hidden valleys), and would cross large-scale fields thereby disrupting the field pattern and field boundaries. Mitigation planting would be appropriate in this context. The impact on landscape resources would be greater than for Options 2 and 3 due to the length of the route.
- 7.7.44 The magnitude of landscape impact within this landscape which has high sensitivity is assessed to be moderate adverse. There would be noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements.
- 7.7.45 The magnitude of visual impact on several high sensitivity receptors would be major adverse. There would be perceptible damage to views from highly sensitive receptors that could not be mitigated.

OPTION 5A

- 7.7.46 Option 5A follows the same route as Option 5 from the western end of the scheme up to Binsted Lane the impacts would be the same for both options.
- 7.7.47 5A is partly within the SDNP and would require the loss of up to 6ha of Ancient Woodland at Binsted Wood. It would lie within predominantly flat arable land to the east of steeply undulating land at Binsted (Binsted hidden valleys), and would cross large-scale fields thereby disrupting the field pattern and field boundaries. Mitigation planting would be appropriate in this context.
- 7.7.48 East of Binsted Lane 5A is located on the same alignment as Option 3, and follows the same route to Crossbush Junction. It would have the same landscape and visual impacts at Option 3 on its western section.

OPTION 5B

- 7.7.49 Option 5B (length 7.35km) is the longest offline route extending further west and south to avoid the SDNP and ancient semi-natural woodland. The eastern section of the route would follow the same alignment as Option 3 between the River Arun and Crossbush Junction where it would have the same adverse landscape and visual impacts.
- 7.7.50 The western section of the option would include a grade-separated junction with the existing A27 dual carriageway. Mature woodland on the northern edge of Potwell Copse would be removed from the footprint of the route and there would be direct impacts on two detached residential properties that lie within the Copse. Continuing eastwards the route bisects large-scale flat arable fields at Hooe Farm to cross Tye Lane on an overbridge to the north of Walberton. Although mitigation (woodland screen planting) would be appropriate in this location, the overbridge and traffic could not be screened.

- 7.7.51 Between Tye Lane and Binsted the proposed route would lie within Avisford Golf Course, an attractive mature parkland landscape, before crossing the steep hidden wooded valley at Binsted. The road/earthworks/retaining structures and overbridge necessary to cross this small-scale undulating landscape would introduce uncharacteristic large-scale features that would cause widespread damage to its distinctive character and elements. There would be a noticeable deterioration in views from nearby PRoWs, residential properties at Walberton and Binsted and Avisford Golf Course. People at Avisford Golf Course would experience loss of visual amenity and general enjoyment of the rural landscape which could not be mitigated.
- 7.7.52 The route would head southeast between Binsted Church and Tortington crossing through small fields/paddocks/horticultural nurseries lying close to residential properties. The pattern would be lost and it is unlikely the severed land would be viable for agricultural or horticultural use. Adverse visual impacts would arise in relation to several rural residential properties, including Tortington Manor where the road and traffic would be prominent in the foreground of the view of Arundel and the SDNP. Although mitigation planting could be undertaken to screen views of the road and traffic from Tortington Manor, it would obscure highly valued views of these features and the wider landscape.
- 7.7.53 Tranquillity would be lost, which despite the close proximity of the existing A27, is high in the rural landscape over most of the route.
- 7.7.54 The magnitude of landscape impact within this landscape which has high sensitivity is assessed to be moderate adverse. There would be noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. The magnitude of visual impact on several high sensitivity receptors would be major. There would be perceptible damage to visual amenity and views from several highly sensitive receptors that could not be mitigated.

SUMMARY OF IMPACTS

- 7.7.55 An early indication of magnitude of impact on high sensitivity landscape and visual receptors is scored in Table 7-2 below based on criteria for landscape and visual impacts provided in IAN 135/10 Table 1 of Annex 1 and Table 1 of Annex 2 respectively.

TABLE 7.2 MAGNITUDE OF IMPACT ON HIGH SENSITIVITY LANDSCAPE AND VISUAL RECEPTORS

THE MAGNITUDE OF IMPACT IS DENOTED BY THE FOLLOWING COLOURS:

	Major Adverse		Moderate Adverse		Minor Adverse		Negligible Adverse		No Change
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RECEPTOR	Option 0A	Option 0B	Option 0BA	Option 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 5A	OPTION 5B
LANDSCAPE										
South Downs National Park										
Mature woodland (including ancient semi-natural Woodland)										
Arun Floodplain – flat open landscape with far-reaching views										
Topography – hidden valleys at Binsted										
Areas of high tranquillity										
Winding hedged or wooded lanes within Binsted Wood										
VIEWS/VISUAL AMENITY										
Views from the South Downs National Park										
Views within the setting of the South Downs National Park										
Iconic view of Arundel (including the castle and Roman Catholic church)										
Views from the historic town over the Arun floodplain										

TABLE 7.2 MAGNITUDE OF IMPACT ON HIGH SENSITIVITY LANDSCAPE AND VISUAL RECEPTORS

THE MAGNITUDE OF IMPACT IS DENOTED BY THE FOLLOWING COLOURS:

	Major Adverse		Moderate Adverse		Minor Adverse		Negligible Adverse		No Change
--	---------------	--	------------------	--	---------------	--	--------------------	--	-----------

RECEPTOR	Option 0A	Option 0B	Option 0BA	Option 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 5A	OPTION 5B
Views from the Arun floodplain to the historic town and the coast										
Views from long distance PRowS – Monarch’s Way, River Arun footpath										
Views from residential properties in Arundel north of A27										
Views from residential properties south of A27 (Ford, Binsted, Tortington)										
Views from recreational facilities (Avisford Golf Course)										

SIGNIFICANCE OF EFFECT

7.7.56 The assessment considers there will be direct, irreversible adverse effects on the landscape resource throughout the scheme and immediate surrounding area for all of the scheme options. Direct, as well as indirect effects on aesthetic and perceptual aspects of this highly valued landscape will extend into the SDNP in areas with visibility of the project. Tranquillity, which is high in rural areas away from the existing A27, would be lost and could not be mitigated.

7.7.57 The assessment has identified the likelihood of significant visual impacts on several residential and recreational receptors within the study area. The project would introduce new large-scale non-characteristic, intrusive elements into views that could not be fully mitigated.

7.7.58 Some of the scheme options would create a noticeable change to views from the SDNP, the historic core of Arundel, residential properties, Monarch’s Way and the River Arun footpath long distance trails and the expansive Arun floodplain.

7.7.59 The following table provides a summary of significant residual impacts likely to arise from

the each option in relation to landscape and visual receptors. It takes into account the sensitivity of the receptor to change and the degree or magnitude of change for that receptor.

Table 7-3 Summary of Impacts by Option on Landscape and Visual Receptors

OPTION	IMPACTS	SENSITIVITY	MAGNITUDE	SIGNIFICANCE
0A, 0B AND 0BA	<p>Landscape impacts:</p> <p>Increase in built form including road widening, new road, earthworks, lighting, signage and traffic</p> <p>Loss of mature tree, shrub and hedgerow cover within the existing highway boundary ancient semi-natural woodland for Options 0B and 0BA)</p> <p>Loss of agricultural land including field boundaries and patterns</p> <p>New mitigation screen planting</p>	High	Minor Adverse	Moderate (Slight)
	<p>Visual impacts:</p> <p>Views of the scheme from Monarch's Way National Trail</p> <p>Views of the scheme from Arundel Castle grounds (Option 1)</p>	High and Medium	Minor Adverse	Slight (Negative)
1	<p>Landscape impacts:</p> <p>Increase in built form including road widening, new road, earthworks, lighting, signage and traffic</p> <p>Loss of mature tree, shrub and hedgerow cover within the existing highway boundary (and possibly Ancient semi-natural woodland for Option 1)</p> <p>Loss of agricultural land including field boundaries and patterns</p> <p>New mitigation planting</p>	High	Minor Adverse	Moderate (Negative)
	<p>Visual impacts:</p> <p>Views of the scheme from Monarch's Way National Trail</p> <p>Views of the scheme from Arundel Castle grounds (Option 1)</p>	High and Medium	Minor Adverse	Slight (Negative)
2	<p>Landscape impacts:</p> <p>Increase in built form including road widening, new road, earthworks, lighting, signage and traffic</p> <p>Loss of Ancient semi-natural woodland at Binsted Wood</p> <p>Loss of wooded lanes in the vicinity of the new road with severed access to PRow's for recreational use from dwellings in the vicinity of Torton Hill</p> <p>Loss of agricultural land including field boundaries and patterns</p> <p>Introduction of a new large scale, prominent and uncharacteristic feature in the Arun Valley landscape</p>	High and Medium	Moderate Adverse	Large (Negative)

OPTION	IMPACTS	SENSITIVITY	MAGNITUDE	SIGNIFICANCE
	Loss of tranquillity of SDNP and River Arun footpath New mitigation screen planting			
	Visual impacts: Views of scheme and associated traffic from residential properties, Arundel Conservation Area, SDNP, River Arun footpath	High	Major Adverse	Large (Negative)
3	Landscape impacts: Increase in built form including the road widening, new road, earthworks, lighting, signage and traffic Loss of tranquillity in the SDNP Loss of Ancient semi-natural woodland at Binsted Wood Disturbance to woodland paths, rides and PRowS Loss of agricultural land including field boundaries and patterns New mitigation screen planting	High	Moderate Adverse	Moderate (Negative)
	Visual impacts: Views of scheme and associated traffic from residential properties, Arundel Conservation Area, SDNP, River Arun footpath.	High	Major Adverse	Large (Negative)
4	Landscape impacts: Increase in built form including the road widening, new road, earthworks, lighting, signage and traffic. Loss of agricultural land including field boundaries and patterns New mitigation screen planting	High	Moderate Adverse	Moderate (Negative)
	Visual impacts: Views of scheme and associated traffic from residential properties, Arundel Conservation Area, SDNP, River Arun footpath	High	Major Adverse	Large (Negative)

OPTION	IMPACTS	SENSITIVITY	MAGNITUDE	SIGNIFICANCE
5 AND 5A	<p>Landscape impacts Option 5 and 5A:</p> <p>Increase in built form including road widening, new road, earthworks, lighting, signage and traffic</p> <p>Loss of Ancient semi-natural woodland at Binsted Wood</p> <p>Loss of wooded lanes and severed access to PRowS for recreational use from dwellings in the vicinity of Torton Hill</p> <p>Loss of agricultural land including field boundaries and patterns</p> <p>Introduction of a new large scale, prominent and uncharacteristic feature in the Arun Valley landscape</p> <p>Loss of tranquillity in the SDNP</p> <p>Loss of tranquillity on River Arun footpath</p>	High	Moderate Adverse	Moderate (Negative)
5B	<p>Landscape impacts Option 5B</p> <p>Increase in built form including new grade separated junction and two lane dual carriageway, earthworks, lighting, signage and traffic</p> <p>Loss of woodland at Potwell Copse</p> <p>Extensive loss of land within Avisford Golf Course and adverse effects on recreational amenity</p> <p>Effects on the undulating topography of the Binsted 'hidden valleys' from earthworks and retaining structures</p> <p>Removal of residential properties</p> <p>Loss of agricultural land including field boundaries and patterns</p> <p>Introduction of a new large scale, prominent and uncharacteristic feature in the Arun Valley landscape</p> <p>Loss of tranquillity in areas adjoining the SDNP</p> <p>Loss of tranquillity on River Arun footpath</p>	High	Moderate Adverse	Moderate (Negative)
5, 5A AND 5B	<p>Visual impacts Options 5, 5A and 5B:</p> <p>Views of scheme and associated traffic from residential properties, Arundel Conservation Area, SDNP, Monarch's Way, River Arun footpath</p>	High	Major Adverse	Moderate (Negative)

7.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

- 7.8.1 This preliminary assessment considers whether potential negative impacts will arise from the scheme options in relation to nearby landscape and visual receptors that have high sensitivity, including the SDNP. It is based on 2D design information and has not considered aspects that could have landscape and/or visual effects such as the extent of land required, the location and appearance of new structures and earthworks, lighting etc.

- 7.8.2 When more design information is available regarding the alignment, earthworks, structures and lighting in PCF Stage 2 and 3 a detailed landscape and/or visual impact assessment should be undertaken to understand whether significant effects could be avoided or reduced by changing the design and/or providing landscape mitigation, and if not, what significant residual effects would arise.

8

NATURE CONSERVATION

8.1 INTRODUCTION

- 8.1.1 This chapter provides a preliminary assessment of potential impacts on ecological receptors as a result of the A27 Arundel Improvements. The assessment considers ten outline scheme options and has been completed without any detailed design information.
- 8.1.2 The term 'Survey Area' is used in this assessment to denote the envelope encompassing all ten scheme options where field survey work was conducted. The term Study Area denotes a wider area beyond the Survey Area which was used as a search area for desk study information. These terms are further explained below.

8.2 ASSESSMENT METHODOLOGY

DESK STUDY METHODOLOGY

- 8.2.1 A desk study was undertaken to obtain and review records of protected and notable species and habitats and designated nature conservation sites within defined Study Areas drawn from the outer limit of all ten scheme options (excluding the western end of scheme option 5B – see Section 8.8) as follows:
- International statutory designated sites - 10km radius extending to a 30km radius for Special Areas for Conservation (SACs) designated for bats;
 - National statutory and non-statutory designated sites - 2km; and
 - Protected and notable species - 2km.
- 8.2.2 These Study Areas were considered suitable to account for the Zone of Influence (Zoi), which reflects the scale and type of the proposed development options. The Study Areas are also based on guidance on undertaking ecological assessment provided in the Design Manual for Roads and Bridges (DMRB). Protected and notable species desk study records were reviewed for the period 2005 to 2015 (a 10 year historical data set).
- 8.2.3 The designated sites included within this desk study search were as follows:
- United National Education, Scientific and Cultural Organisation (UNESCO) Biosphere Reserves;
 - SAC/cSAC;
 - Special Protection Areas (SPA)/pSPA;
 - Ramsar sites;
 - Sites of Special Scientific Interest (SSSI);
 - National Nature Reserves (NNR);
 - Local Nature Reserves (LNR); and

→ Local Wildlife Sites (LWS)⁸.

8.2.4 The following data sources were used, contacted and/or reviewed:

- Ordnance Survey mapping;
- A bespoke data search provided by Sussex Biodiversity Records Centre (SxBRC) for a 2km radius around all scheme options;
- Multi Agency Geographic Information for the Countryside (MAGIC);
- Natural England's Ancient Woodland Inventory (AWI) and Priority Habitat maps (contained in MAGIC data);
- The Woodland Trust's Ancient Tree Hunt map for the UK; and
- Publicly available aerial imagery.

8.2.5 Protected and notable habitats and species were considered if they were listed on any of the following pieces of statute or conservation registers:

- Annex 1 or Annex 2 of the Habitats Directive (Council Directive 92/43/EEC);
- Schedules 1, 5 or 8 of the Wildlife and Countryside Act, 1981 (as amended);
- Species and Habitats of Principal Importance in England, Section 41 of the Natural Environment and Rural Communities Act 2006;
- Sussex BAP;
- Birds of Conservation Concern (Eaton et al. 2015);
- Joint Nature Conservation Committee (JNCC) Conservation Designations for UK Taxa spread sheet containing details of species listed as National Notable, Nationally Rare or Nationally Scarce; and
- Important Hedgerows as defined by The Hedgerows Regulations 1997.

EXTENDED PHASE 1 HABITAT SURVEY METHODOLOGY

8.2.6 An Extended Phase 1 Habitat Survey was undertaken by two suitably experienced ecologists between 12th and 14th January 2016. The Phase 1 Habitat report is included in Appendix C. The Survey Area incorporated each proposed scheme options and a 50m radius around each scheme option boundary. 50m was selected as a proportionate radius to detect potentially important habitats for animal and plant species adjacent to the proposed scheme options in order to undertake a provisional impact assessment and without knowledge of detailed Scheme design proposals. It is noted that an additional survey area may be required when potential impacts are more fully understood and the preferred options has been identified in PDF Stage 3. Access was limited to approximately 20% of the Survey Area due to land access restrictions (see section 8.8 below).

8.2.7 The Phase 1 Habitat Survey followed standard methodology published by the JNCC (2010). This methodology is a standardised technique for rapidly obtaining baseline ecological information over a large area of land. All habitat types present on site were recorded and dominant plant species were recorded in accordance with standard

⁸ LWS have now superseded Sites of Nature Conservation Importance (SNCI) in Sussex.

nomenclature.

- 8.2.8 In accordance with best practice, the standard survey methodology was extended to consider and include evidence of, or potential for, protected or notable species. Any incidental records or evidence of species were target noted and each habitat was evaluated for its potential to support protected or notable species.

FAUNAL AND FLORAL SPECIES SURVEY

- 8.2.9 Targeted surveys for faunal and floral species were not undertaken to inform this assessment at PCF Stage 1. A provisional assessment on possible impacts on faunal and floral species has been provided by consideration of broad habitat suitability for different species. In instances where habitats could not be viewed as a result of any land access, a precautionary assessment was undertaken with species presence being assumed.
- 8.2.10 Further detailed species survey work may be required at PCF Stage 2 and 3 to accurately determine species presence or likely absence and to define the scale and magnitude of possible ecological impacts.

ASSESSMENT OF IMPACTS

- 8.2.11 The value of ecological receptors which were identified using desk based research and/or field survey data are categorised according to the guidelines for Ecological Impact Assessment (EclA) produced by the Chartered Institute of Ecology and Environmental Management (CIEEM).
- 8.2.12 The value of sites, habitats, species assemblages and populations of species was evaluated with reference to both their importance in terms of 'biodiversity conservation' value (which relates to the need to conserve representative areas of different habitats and the genetic diversity of species populations) and their legal status.
- 8.2.13 A review of the legislation, policy and the sensitivity of the ecological receptor was undertaken and the value of the receptor was determined within a geographical context on the following basis:
- International;
 - National (England);
 - Regional;
 - Authority Area (e.g. County or District);
 - Local or Parish; and
 - Site (i.e. within the Survey Area).
- 8.2.14 Accordingly, Table 8-1 (adapted from criteria proposed by Ratcliffe, 1977; and CIEEM, 2006) outlines the criteria to be taken into consideration for evaluating the value of both habitats and species in this assessment.
- 8.2.15 Given the preliminary nature of design information, the fact that this assessment is not based on detailed species and habitat survey work, and the fact that access could not be obtained to large parts of the Survey Area, a precautionary baseline has been built up. Receptors have been valued on a 'reasonable worst case' basis. Where a precautionary valuation has been undertaken this is fully justified in the impact assessment.
- 8.2.16 It is impractical and inappropriate for an ecological assessment to consider every habitat and species that may be affected by proposed works. Accordingly, a threshold value was

set and all ecological receptors that are of the threshold value of 'Local' value or higher will be included for consideration. These receptors are described as Valued Ecological Receptors (VER).

Table 8-1: Criteria to be considered when identifying Valued Ecological Receptors

VALUE/ IMPORTANCE	CRITERIA
International (European)	<p>Habitats</p> <p>An internationally designated site or candidate site (SPA, provisional SPA, SAC, candidate SAC, Ramsar Site, Biogenetic/Biosphere Reserve, World Heritage Site) or an area that would meet the published selection criteria for designation. A viable area of a habitat type listed in Annex I of the Habitats Directive, or smaller areas of such habitat, which are essential to maintain the viability of a larger whole.</p> <p>Species</p> <p>Any regularly occurring population of internationally important species, threatened or rare in the UK (e.g. a UK Red Data Book species or a species listed on Section 41 of the Natural Environment Research Council (NERC) Act or of uncertain conservation status or of global conservation concern as defined by the IUCN. A regularly occurring species population which exceeds or approaches the threshold for national importance.</p>
National	<p>Habitats</p> <p>A nationally designated site, SSSI, NNR, Marine Nature Reserve (MNR) or a discrete area, which would meet the published selection criteria for national designation (e.g. SSSI selection guidelines). A viable area of a priority habitat (Habitat of Principle Importance (HPI)), as identified in Section 41 of the NERC Act, or smaller areas of such habitat essential to maintain wider viability.</p> <p>Species</p> <p>A regularly occurring, regionally or county significant population / number of an internationally/nationally important species. Any regularly occurring population of a nationally important species, threatened or rare in the region or county (consult the Local Biodiversity Action Plan (LBAP) or relevant guidelines for selection of county wildlife sites). A feature identified as of principal importance in Section 41 of the NERC Act.</p>
Regional	<p>Habitats</p> <p>Sites that exceed the county-level designations, but fall short of SSSI selection criteria. Viable areas of key habitat identified in the regional LBAP or smaller areas of habitat essential to maintain wider viability.</p> <p>Species</p> <p>Any regularly occurring, locally significant population of a species listed as being nationally scarce, which occurs in 16 of 100 10 km² in the UK or in a regional BAP. A regularly occurring, locally significant population/number of a regionally important species. Sites maintaining populations of internationally/nationally important species that are not threatened or rare in the region or county.</p>
Authority Area (e.g. County or District)	<p>Habitats</p> <p>Sites recognised by local authorities, e.g. Sites of Importance for Natural Conservation (SINCs) and Sites of Ecological or Geographical Interest (SEGIs). County / district sites that the designating authority has determined meet the published ecological selection criteria for designation, including (LNR). A viable area of habitat identified in county / district BAP. A diverse and / or ecologically valuable hedgerow network. Semi-natural Ancient Woodland greater than 0.25 ha.</p> <p>Species</p> <p>Any regularly occurring, locally significant population of a species listed in a county/district BAP due to regional rarity or localisation. A regularly occurring, locally significant population of a county/district important species. Sites supporting populations of internationally/nationally/regionally important species that are not threatened or rare in the region or county, and not integral to maintaining those populations. Sites/features scarce in the county/district or that appreciably enrich the county/district habitat resource.</p>

VALUE/ IMPORTANCE	CRITERIA
Local	<p>Habitats</p> <p>Areas of habitat that appreciably enrich the local habitat resource (e.g. species-rich hedgerows, ponds). Sites that retain other elements of semi-natural vegetation that, due to their size, quality or the wider distribution within the local area, are not considered for the above classifications.</p> <p>Species</p> <p>Populations/assemblages of species that appreciably enrich the biodiversity resource within the local context. Sites supporting populations of county/district important species that are not threatened or rare in the region or county, and are not integral to maintaining those populations.</p>
Site (Immediate Local Area or Village importance)	<p>Habitats</p> <p>Areas of heavily modified or managed vegetation of low species diversity or low value as habitat to species of nature conservation interest.</p> <p>Species</p> <p>A good example of a common or widespread species.</p>
Negligible	No intrinsic ecological value.

8.2.17 This ecological assessment has been undertaken in accordance with the guidelines published by the CIEEM. This guidance states that an ecologically significant impact is defined as:

"...an impact (negative or positive) on the integrity of a defined site or ecosystem and/or the conservation status of habitats or species within a given geographical area".

8.2.18 In this assessment, the term ecological integrity applies to designated conservation sites (e.g. SSSIs) and is defined as follows:

→ "The integrity of a site is 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 levels of populations of the species for which it was classified" (Office of the Deputy Prime Minister, 2005)⁹.

8.2.19 Based on CIEEM's interpretation of guidance set out in the EC Habitats Directive, 'conservation status' is determined by:

→ "For habitats, conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area; and

→ For species, conservation status is determined by the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area" (CIEEM, 2006: p. 37).

8.2.20 This approach determines whether or not an impact is significant simply on the basis of its characteristics as they affect the integrity of the receptor, and takes no account of the

⁹ Under the NPPF (DCLG, 2012) the planning guidance on biodiversity is still to be regarded as material.

value of the receptor. However, within the scheme options ecological impacts will only be considered on VERs. Therefore, if an impact is found to be Not Significant at the threshold level of Local value, it has been scoped out of this assessment, unless there are legal implications associated with the impact.

- 8.2.21 It should be noted that in line with the guidance issued by CIEEM, an impact which has been considered as Significant in ecological terms is the same as Significant in EIA terms.

8.3 STUDY AREA

- 8.3.1 The ten scheme options are located along or immediately adjacent the A27 carriageway to the south of Arundel, with some partly located within the SDNP. The land surrounding the offline options comprises predominantly farmland with large areas of woodland and occasional residential developments.
- 8.3.2 Option 0A consists of improvements to the Crossbush junction and at-grade improvements at the Ford Road Junction and the Causeway Junction. This Option comprises small linear belts of woodland bordering grassland fields/farmland to the north and south, and hedgerows bordering grassland fields to the west.
- 8.3.3 Option 0B and Option 1 include linear belts of Ancient Woodland (forming the southern boundary of Rewell Wood Complex LWS and northern boundary of Binsted Wood Complex LWS) and semi-natural broadleaved woodland, hedgerow and grassland verges to the north and south of the A27 carriageway at the eastern and western extents of the Survey Area. Option 1 differs slightly from Option 0B as it departs from the existing A27 carriageway corridor towards the eastern extent of the Survey Area where it crosses farmland for approximately 800m before re-joining the A27 carriageway near to Crossbush Junction.
- 8.3.4 Option 0BA is very similar to Option 0B but includes a short section of route (approximately 600m) that departs from the existing A27 carriageway corridor (and Option 0B) towards the eastern extent of the Survey Area where it crosses farmland for approximately 600m before re-joining the A27 carriageway (and Option 0B) near to Crossbush Junction. This option would involve the loss of up to 4.4ha of Ancient Woodland.
- 8.3.5 Option 2 runs adjacent to Tortington Lane towards the western extent of the Survey Area, and would involve the loss of up to 14ha of Ancient Woodland, and then runs east across the River Arun and over large areas of farmland bordered by a network of ditches and hedgerows where it re-joins the A27 carriageway at Crossbush Junction.
- 8.3.6 Option 3 runs south-east through up to 24ha of Ancient Woodland (forming the majority of the Binsted Wood Complex LWS) for approximately 1.6km and then runs east across the River Arun and over large areas of farmland bordered by a network of ditches and hedgerows where it re-joins the A27 carriageway at Crossbush Junction.
- 8.3.7 Options 4 and 5 are similar whereby they both run (from east to west) through 6.6ha and 6ha of Ancient Woodland respectively (forming part of the Binsted Wood Complex LWS) for approximately 0.6km and then east across the River Arun and over large areas of farmland bordered by a network of ditches and hedgerows where it re-joins the A27 carriageway at Crossbush Junction. Option 4 is located further south of Option 5 and 5A at its western extent.
- 8.3.8 Option 5A includes the western half of Options 5 and the eastern half of Option 3 with a short section of route (approximately 500m) that links the two together. Option 5A will cross farmland bordered by a network of ditches and hedgerows. Similar to Option 5,

Option 5A would involve the loss of up to 6ha of Ancient Woodland.

- 8.3.9 Option 5B includes the eastern half of Option 3 and is then closely aligned with Option 4 and crosses the same habitats including the River Arun. However, from Binsted Lane westwards, it runs south of Binsted Wood and passes to the west of Binsted (as opposed to the east of Binsted for Option 4). Option 5B then crosses farmland and the B2132 directly north of Walberton where it re-joined the existing A27. Option 5B was identified late in the assessment process and thus its western end falls outside the area where Phase 1 Habitat Survey was undertaken (see Section 8.8). Unlike the other offline options Option 5B does not involve the loss of any Ancient Woodland.

8.4 BASELINE CONDITIONS

DESK STUDY FINDINGS

DESIGNATED SITES

- 8.4.1 Table 8-2 summarises each of the designated sites in the Study Area (defined in Section 8.2 above) and their proximity to the ten scheme options.
- 8.4.2 The Survey Area is not part of a UNESCO Biosphere Reserve. The nearest such reserve is the Brighton and Lewes Downs Biosphere Reserve which is over 10 km away.
- 8.4.3 Three SACs designated for bats were identified within 30km of all scheme options. These are: Ebernoe Common SAC which is located approximately 19km north of the scheme options; The Mens SAC which is located approximately 15.3km north of the scheme options; and Singleton and Cocking Tunnels SAC which is located approximately 14km north-west of the scheme options. Two bat species, barbastelle (*Barbastelle barbastellus*) and Bechstein's (*Myotis bechsteini*) were identified as the primary reason for the selection of these SACs either as primary or non-primary qualifying features as defined by the Conservation of Habitats and Species Regulations 2010.
- 8.4.4 No statutory designated sites of international importance (not designated for bats) were identified within 2km of the scheme options (see Table 8-2). However, Arun Valley SAC, SPA and Ramsar site is located approximately 6.8km to the north of the scheme options and hydrologically connected to them by the River Arun.
- 8.4.5 The Arun Valley SAC, SPA and Ramsar site consists of low-lying grazing marsh with a rich flora and fauna assemblage. Southern parts of this SAC/SPA/Ramsar site are fed by calcareous springs, while to the north, where the underlying geology is greensand and the water is more acidic. The history of management of the fields, and their water levels, determines the plant communities present, with drier fields dominated by meadow grasses (*Poa* sp.), crested dog's-tail (*Cynosurus cristatus*) and perennial rye-grass (*Lolium perenne*). In wetter areas, rushes, sedges and tufted hair-grass (*Deschampsia cespitosa*) are more frequent. Ungrazed fields have developed into fen, scrub or woodland. Fen areas consist of common reed (*Phragmites australis*), reed sweet-grass (*Glyceria maxima*) and greater tussock-sedge (*Carex paniculata*), often with scattered elder and willow scrub. On firmer ground, there is alder (*Alnus glutinosa*), willow (*Salix* sp.), and birch, oak and hazel woodland on the driest ground. The ditches and margins between grazing marsh fields have a very rich aquatic flora and invertebrate fauna. The Arun Valley SAC / SPA / Ramsar site supports important numbers of wintering waterbirds, which feed in the wetter, low-lying fields and along ditches.
- 8.4.6 The Arun Valley SPA qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting internationally important populations of Bewick's swan (*Cygnus columbianus bewickii*) which is listed on Annex I of the Bird Directive. In addition, the SPA qualifies

under Article 4.2 of the same directive by regularly supporting over 20,000 waterfowl (a range of different species).

- 8.4.7 The Arun Valley Ramsar site is designated for its presence of British Red Data Book (BRDB) threatened (and endangered) invertebrate species, nationally rare and scarce plant species, diverse flora within ditches across the site, assemblages of waterfowl of international importance and presence of the northern pintail (*Anas acuta*) at levels of national importance.
- 8.4.8 The Arun Valley SAC is primarily designated for the presence of Ramshorn snail (*Anisus vorticulus*). The site comprises one of the largest populations of this species in the UK.
- 8.4.9 The Duncton to Bignor Escarpment SAC predominantly consists of mature beech woodland situated on the steep scarp face of the South Downs, with occasional parcels of ash woodland, scrub and grassland. The site comprises a diverse mollusc assemblage and rich floral community with rare plant species present including white helleborine (*Cephalanthera damasonium*), yellow bird's-nest (*Monotropa hypopitys*), green hellebore (*Helleborus viridis*) and limestone fern (*Gymnocarpium robertium*). This SAC is primarily designated for the presence of the Habitats Directive Annex 1 habitat type *Asperulo-Fagetum* beech forests.
- 8.4.10 Arundel Park SSSI is within 2km of all scheme options; the nearest being Option 1 which is approximately 0.5km north. Arundel Park SSSI is renowned as one of the most important sites in the country for invertebrates including a number of protected / notable species. Fifteen species present here have been classified as endangered and under threat of extinction, including the rare field cricket (*Gryllus campestris*) and the beetle (*Laemophloeus monilis*). The site also comprises a diverse breeding bird community, particularly over-wintering wildfowl such as gadwall (*Anas strepera*) and pochard (*Aythya ferina*). The site comprises a mosaic of species-rich chalk grassland, marsh grassland, scrub and semi-natural broadleaved and mixed woodland. A rich floral community has also been recorded at Swanbourne Lake towards the south of the site. The site also supports at least 25 breeding butterfly species including the duke of burgundy, brown argus (*Aricia agestis*) and chalk hill blue (*Lysandra coridon*). A rare mollusc (*Pseudamnicola confusa*) has also been recorded in the reedbeds within the site.
- 8.4.11 Fairmile Bottom SSSI was identified within 2km of scheme options 3, 4, 5 and 5A; the nearest being Option 4 approximately 1.5km north. This SSSI is designated for beech woodland, yew woodland and oak woodland with areas of species-rich chalk grassland and notable invertebrate communities.
- 8.4.12 Five non-statutory designated sites of county importance were identified within 2km of Options 0B, 1, 2, 3, 4 and 5. Four non-statutory designated sites of county importance were identified within 2km of Options 0A & 0BA. A summary of the features underpinning the designation of these LWS is provided in Table 8-2.
- 8.4.13 Options 2, 3, 4 and 5 are situated within Binsted Wood Complex LWS. Options 0A and 1 are situated along the northern boundary of Binsted Wood Complex LWS. All scheme options except Options 0A, 0BA, 5A and 5B are situated along the southern boundary of Rewell Wood Complex LWS.
- 8.4.14 Binsted Wood Complex LWS comprises a mixture of Ancient Woodland, recent woodland, conifer plantation, species rich pasture and old tracks. The mix of habitats and geology gives rise to a diverse flora. The paths and rides are especially species rich and Scotland Lane supports an outstanding wet ride flora that includes at least 11 species of sedge including long-stalked yellow-sedge (*Carex viridula ssp. brachyrhyncha*), a county rarity at its only recorded West Sussex location. This is the largest block of ancient semi-natural woodland south of the South Downs in Sussex. Oak (*Quercus* sp.) and hazel (*Corylus*

avellana) woodland is the predominant habitat type of this complex. Oak dominates the canopy with birch and sweet chestnut (*Castanea sativa*) and an irregular understory of hazel. Sweet chestnut coppice dominates in some areas. The ground flora is mostly bracken (*Pteridium aquilinum*) and bramble (*Rubus fruticosus*) with carpets of bluebell (*Hyacinthoides non-scripta*) and wood anemone (*Anemone nemorosa*). Early-purple orchids (*Orchis mascula*) occur in abundance and have been counted in thousands in Ash Piece. The rare adder's-tongue fern (*Ophioglossum vulgare*) has also been recorded here. There is a rich butterfly fauna including ringlet (*Aphantopus hyperantus*), silver-washed fritillary (*Argynnis paphia*), white admiral (*Limenitis camilla*) and purple emperor (*Apatura iris*). Freshwater cockles and glow-worms (*Lampyris noctiluca*) have also been recorded.

- 8.4.15 Rewell Wood Complex LWS comprises ancient semi-natural woodland, worked sweet chestnut coppice, conifer plantation, beech (*Fagus sylvatica*) plantation and species-rich chalk grassland. Wide rides and glades support a rich flora and butterfly fauna. The disused gravel pits are of entomological importance. The semi-natural woodland comprises predominantly oak, beech, ash (*Fraxinus Excelsior*), field maple (*Acer campestre*) and hazel. The woodlands comprise dense carpets of bluebells with wood spurge (*Euphorbia amygdaloides*), honeysuckle (*Lonicera periclymenum*), pignut (*Conopodium majus*), bugle (*Ajuga reptans*) and early-purple orchid. Many of the wide rides and woodland glades support species-rich chalk grassland including the rare white mullein (*Verbascum lychnitis*). There is an extremely rich butterfly fauna including dingy skipper (*Erynnis tages*), grizzled skipper (*Pyrgus malvae*), green hairstreak (*Callophrys rubi*), duke of burgundy (*Hamearis lucina*), pearl-bordered fritillary (*Boloria euphrosyne*), white admiral and purple emperor and a rare species of moth called the drab looper (*Minoa murinata*). Rewell Wood also supports a good population of dormice (*Muscardinus avellanarius*) and approximately six pairs of nightjar (*Caprimulgus europaeus*) which breed annually.
- 8.4.16 Options 0B and 0BA are situated within or immediately adjacent Arun Valley, Watersfield to Arundel LWS.
- 8.4.17 Arun Valley, Watersfield to Arundel LWS comprises the River Arun and its floodplain which includes largely wetland grassland habitat including good quality semi-improved grassland HPI and coastal and floodplain grazing marsh HPI. A large network of ditches also intersects the site. The site is considered to be of great botanical interest comprising a large number of protected and notable plant species including marsh-mallow, cut-grass (*Leersia oryzoides*), sharp-leaved pondweed (*Potamogeton acutifolius*), small water-pepper (*Polygonum minus*), common meadow-rue (*Thalictrum flavum*), mare's-tail (*Hippuris vulgaris*), fan-leaved water-crowfoot (*Ranunculus circinatus*), frogbit (*Hydrocharis morsus-ranae*), arrowhead (*Sagittaria sagittifolia*), tubular water-dropwort (*Oenanthe fistulosa*), pink water-speedwell (*Veronica catenata*), ivy-leaved duckweed (*Lemna trisulca*) and fat duckweed (*L. gibba*), fox sedge (*Carex vulpina*) and narrow-leaved water-dropwort (*Oenanthe silaifolia*). Black Poplar (*Populus nigra*) trees are also present within the site. The site is also considered to be of ornithological interest as it supports a number of wetland bird species including breeding redshank (*Tringa totanus*), lapwing (*Vanellus vanellus*), snipe (*Gallinago gallinago*) and yellow wagtail (*Motacilla flava*), and in winter attracts large numbers of waders and wildfowl, including snipe, teal (*Anas crecca*) and bewick's swan (*Cygnus columbianus*). The grasslands are considered particularly important feeding grounds for whimbrel (*Numenius phaeopus*) on spring passage. The reedbeds along the River Arun and ditches are also a major stronghold of breeding reed warblers (*Acrocephalus scirpaceus*). The site also supports a number of notable invertebrate species including a water snail (*Pseudamnicola confuse*), hairy dragonfly (*Brachytron pratense*), and the marsh-mallow colonies support a rare weevil (*Apion sorror*).

HABITAT INVENTORY DATA

8.4.18 The following habitats, which are mapped on Natural England's habitat inventory data sets, were present in the Survey Area:

- Coastal and floodplain grazing marsh – relatively large areas of this habitat type have been mapped by Natural England on both west and east floodplains of the River Arun to the south of Arundel. The metadata accompanying the Natural England mapped information notes that there is 'insufficient information to establish [the] hydrological regime and ornithological interest' of the coastal and floodplain grazing marsh. Thus the entire area that has been mapped may not be all of high nature conservation value and needs to be verified;
- Coastal saltmarsh – a single area present on the east bank of the River Arun in the vicinity of Tortington; and
- Ancient Woodland – large areas of AWI woodland, including both ancient semi-natural woodland and ancient replanted woodland are present, mainly to the west of Arundel. The majority of this AWI woodland is located in one of the designated sites in Tortington Common or Binsted Wood areas. Further detail is provided in the Designated Site section of this chapter. Another area of AWI woodland is north west of Arundel in an area called the Waterwoods, between the A27 road and the London Road/Arundel Bypass.

8.4.19 To the east of Arundel, either side of the River Arun, Natural England Geographic Information System (GIS) information shows a large area referred to as 'good quality semi-improved grassland' habitat. Guidance accompanying the Natural England GIS information states that Natural England has low confidence in this data because the habitat classification is based on survey information greater than ten years in age. It is unclear what character or condition of grassland is present without further survey information to validate the Natural England mapped data.

8.4.20 Reference to the Woodland Trust's Ancient Tree Hunt Interactive Map¹⁰ has indicated the presence of multiple ancient, veteran and notable trees within close proximity to the Scheme Options. This includes:

- A single ancient tree in close proximity to Option 0BA. This tree, numbered T140846, is recorded as a fallen oak with a girth of 5.02m and is located at grid reference TQ 02722, 06366.
- A veteran tree in close proximity to Options 2, 3, 4, 5, 5A and 5B. This tree, numbered T53560 is recorded as a pedunculate oak and is located on Tortington Lane at grid reference TQ 0014 0569.
- A veteran tree in close proximity to Options 4, 5 and 5A. This tree, numbered T100187 is recorded as a pedunculate oak and is located within Avisford Park Golf Course at grid reference SU 9765 0630.
- A veteran tree in close proximity to Option 5B. This tree, numbered T96091 is recorded as an oak and is located south of Binsted Lane at grid reference SU 98191 06616.

¹⁰ Woodland Trust (undated). Ancient tree hunt [on-line] <http://www.ancient-tree-hunt.org.uk/discoveries/interactivemap/> (accessed February 2017)

- A cluster of eight veteran and notable trees in close proximity to Options 5 and 5A. These were located within Binsted Wood Tortington Common and comprise the following:
- Pedunculate oak (Notable Tree T46988) at grid reference SU 9908 0636;
 - Pedunculate oak (Veteran Tree T62275) at grid reference SU 9909 0629;
 - Pedunculate oak (Veteran Tree T60152) at grid reference SU 9916 0626;
 - Pedunculate oak (Veteran Tree T469912) at grid reference SU 9917 0624;
 - Pedunculate oak (Veteran Tree T62887) at grid reference SU 9925 0617;
 - Pedunculate oak (Veteran Tree T100892) at grid reference SU 99148 06121;
 - Pedunculate oak (Notable Tree T100893) at grid reference SU 99098 06113;
and
 - Pedunculate oak (Veteran Tree T25562) at grid reference SU 9892 0620.

Table 8-2: Statutory and Non-Statutory Designated Sites

SITE DESIGNATION	SITE NAME	APPROX. DISTANCE (KM) AND ASPECT FROM SCHEME OPTIONS								KEY HABITAT TYPE
		0A	0B & 0BA	1	2	3	4	5 & 5A	5B	
SAC	Singleton and Cocking Tunnels	14km north-west	14km north-west	14km north-west	14km north-west	14km north-west	14km north-west	14km north-west	14km north-west	Man-made structure
SAC	The Mens	15.3km north	15.3km north	15.3km north	15.3km north	15.3km north	15.3km north	15.3km north	15.3km north	Woodland / wood pasture
SAC	Ebernoe Common	19.2km north	19.2km north	19.2km north	19.2km north	19.2km north	19.2km north	19.2km north	19.2km north	Woodland / wood pasture
Ramsar site, SAC & SPA	Arun Valley	6.8km north	6.8km north	6.8km north	6.8km north	6.8km north	6.8km north	6.8km north	6.8km north	Inland water bodies, wetland and humid grassland.
SSSI	Arundel Park	2km north-west	0.5km north	0.5km north	1km north	2km north	2km north	0.9km north	1.0km north	Chalk grassland and variety of woodland.
SSSI	Fairmile Bottom	> 5km north-west	2.9km north-west	2.9km north-west	2.3km north-west	2km north	1.5km north	2km north	2km north	Yew woodland, yew scrub and chalk grassland.
LWS	Binsted Wood Complex	2km west	Immediately Adjacent	Immediately Adjacent	Crossed by this option	Crossed by this Option	Crossed by this Option	Crossed by this Option	0.25km north	Mixture of Ancient Woodland and recent woodland.
LWS	Poling Copse	0.4km north east	0.25km north	0.25km north	0.4km north east	0.4km north east	0.4km north east	0.4km north east	0.5km north east	A large block of Ancient Woodland.
LWS	Warning camp Hill and New Down	2km north east	1.8km north	1.8km north	2km north east	2km north east	2km north east	1.8km north	1.8km north	Herb-rich chalk grassland and a small area of ancient, semi-natural woodland.
LWS	Rewell Wood Complex	1.7km north-west	Within or adjacent Option	Within or adjacent Option	Within or adjacent Option	Within or adjacent Option	Within or adjacent Option	Within or adjacent Option	0.3km north	Diversity of habitats including ancient semi-natural woodland, worked Sweet Chestnut coppice, conifer plantation, beech plantation and species-rich chalk grassland.
LWS	Arun Valley, Watersfield to Arundel (includes Arundel Wetland Centre)	0.5 km north-west	Within or adjacent to Option	Within or adjacent to Option	0.4 km north	0.5 km north	0.5 km north	0.3 km north	0.3km north	Extensive tract of wetland, wet grassland, network of ditches and unimproved meadows.

PHASE 1 HABITAT SURVEY

8.4.21 The Survey Area supports 11 habitat types. The relationship between different Phase 1 Habitat types and the various scheme options is shown in Table 8-3 below.

Table 8-3: Phase 1 Habitat types within each scheme option (✓ = habitat present)

PHASE 1 HABITAT TYPE	SCHEME OPTIONS							
	0A	0B & 0BA	1	2	3	4	5 & 5A	5B
Semi-natural broadleaved woodland	✓	✓	✓	✓	✓	✓	✓	✓
Semi-natural broadleaved woodland (AWI woodland)		✓	✓	✓	✓	✓	✓	
Coniferous plantation woodland					✓			
Scattered broadleaved trees	✓	✓	✓	✓	✓	✓	✓	✓
Dense/ continuous scrub / scattered scrub	✓	✓	✓	✓	✓	✓	✓	✓
Poor semi - improved grassland	✓	✓	✓	✓	✓	✓	✓	✓
Semi-improved neutral grassland		✓	✓	✓	✓	✓	✓	✓
Arable		✓	✓	✓	✓	✓	✓	✓
Intact species-poor hedge, defunct species-poor hedge and species-poor hedge and trees	✓	✓	✓	✓	✓	✓	✓	✓
Running / standing water	✓		✓	✓	✓	✓	✓	✓
Buildings and hard-standing			✓	✓	✓	✓	✓	✓

- 8.4.22 Habitats and their location are described in full in the Phase 1 Habitat Survey Report included in Appendix C. Habitats are mapped on the Phase 1 Habitat Survey map (Figure 8.1, Appendix A).

PROTECTED / NOTABLE SPECIES ASSESSMENT

- 8.4.23 The Study Area has the potential to support various protected and notable species. Protected and notable species records collated during the desk study and habitat assessments undertaken during the Extended Phase 1 Habitat survey are summarised below and described in full in Appendix C. No targeted species surveys have been undertaken. However, these may be required at PCF Stage 3, when a preferred option is confirmed, in order to describe the ecological baseline to inform the EIA.

INVERTEBRATES (TERRESTRIAL AND AQUATIC)

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.24 A number of invertebrate species are protected from killing or injury under the Wildlife & Countryside Act (1981) as amended. A number of invertebrate species are also listed as Species of Principal Importance (SPI)¹¹, and/or are IUCN Red List species and Sussex BAP Priority Species including the duke of burgundy and stag beetle (*Lucanus cervus*).

DESK STUDY

- 8.4.25 The desk study identified over 1000 invertebrate records comprising 405 species. These records comprised four beetle species, 122 moth species, 272 butterfly species, two true fly species and five hymenopteran species.
- 8.4.26 The majority of records were from Arundel Wetland Centre¹²; Fairmile Bottom SSSI; Wykehurst Park Grounds, Rewell Wood Complex LWS and Binsted Wood Complex LWS which intersect or immediately border the scheme options.
- 8.4.27 Three invertebrate species listed under Schedule 5 of the Wildlife & Countryside Act (1981) as amended have been previously recorded within study area. These species were the brown hairstreak (*Thecla betulae*) butterfly, stag beetle and a large number of pearl-bordered fritillary butterfly records within Rewell Wood Complex LWS.
- 8.4.28 Five IUCN Red List species were also recorded within the study area, many of which were within Rewell Wood Complex LWS: the grizzled skipper, dingy skipper, the white admiral and the small heath (*Coenonympha pamphilus*) butterflies, and the phantom hoverfly (*Doros profuges*).

FIELD SURVEY

- 8.4.29 Notable invertebrates species recorded in the desk study are likely to be associated with the following Phase 1 Habitat types: broad-leaved semi-natural (ancient) woodland, semi-improved grassland (particularly that which is of floodplain grazing marsh HPI quality) and running and standing water. Given the extensive nature of these habitats it is probable

¹¹ Species of Principal Importance are those listed on Section 41 of the Natural Environment and Rural Communities Act, 2006.

¹² Wildfowl and Wetlands Trust (WWT) Reserve

that a range of protected and notable invertebrate species occur within the Survey Area.

PROVISIONAL VALUATION

- 8.4.30 Following a precautionary approach, given the number of desk study records of protected and notable invertebrate species including those in within Rewell Wood Complex LWS, wetland and (assumed) floodplain grazing marsh HPI habitats which are located either within or immediately adjacent to all scheme options, invertebrates are considered likely to be of up to County value. Invertebrate communities are likely to be present in arable, poor semi-improved grassland, which is likely to support a high conservation value invertebrate community. All other Phase 1 Habitats types are unlikely to exceed Local value.
- 8.4.31 Further detailed surveys of key habitats likely to support notable or protected invertebrates species will be required in order to fully evaluate invertebrate communities that may be present. These surveys should be undertaken when a more refined scheme design is available.

WHITE CLAWED CRAYFISH

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.32 The white-clawed crayfish (*Austropotamobius pallipes*) is protected under the Conservation of Habitats and Species Regulations 2010 (as amended) and under Schedule 5 of the Wildlife and Countryside Act (WCA) 1981 (as amended). White clawed crayfish is an SPI.

DESK STUDY

- 8.4.33 No desk study records were supplied by Sussex Biological Records Centre (SBRC) for this species.

FIELD SURVEY

- 8.4.34 Ditches that contain water all year round and ponds throughout the Survey Area were considered to provide suitable foraging opportunities and breeding conditions for white clawed crayfish. Such water bodies occur near to all scheme options. There were no white-clawed crayfish records in the data set provided by SBRC and information suggesting that the species is locally extinct in West Sussex. That said, without detailed access to individual water bodies there remains a small possibility that isolated populations could remain. If present (although unlikely), a viable population of white-clawed crayfish would be likely to be of up to County value.
- 8.4.35 Should impacts on water bodies and watercourses be envisaged, further desk study information from the Environment Agency (EA) should be requested. Targeted habitat assessment work should be undertaken to identify the potential for this species to occur in the Survey Area.

GREAT CRESTED NEWT

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.36 Great crested newt (*Triturus cristatus*) (GCN) is protected under the Conservation of Habitats and Species Regulations 2010 (as amended) and Schedule 5 of the WCA 1981 (as amended). GCN is also an SPI and a Sussex BAP Priority Species.

- 8.4.37 It is illegal to deliberately capture, injure or kill GCN, to intentionally or recklessly disturb them, or to deliberately take or destroy their eggs. It is also illegal to damage, destroy or intentionally or recklessly obstruct access to a breeding or resting place used by a GCN. All life stages of GCN are afforded the same level of protection.

DESK STUDY

- 8.4.38 The desk study identified multiple GCN records clustered around three locations in the Study Area. All records also indicated evidence of breeding activity (e.g. eggs and young). The most recent records were from 2013.
- 8.4.39 The records were either from ditches surrounding fields near the village of Poling approximately 1.2km east of the scheme options or from a pond near Walberton approximately 1.0km south west of the scheme options. It is not possible to confirm presence or absence on the basis of this data alone.

FIELD SURVEY

- 8.4.40 The terrestrial habitats present throughout the Survey Area and near all scheme options, including woodland, scrub and hedgerows, provide suitable shelter, foraging and hibernating opportunities for GCN.
- 8.4.41 The network of waterbodies directly west of Arundel Station, immediately south of the A27 carriageway are likely to be sub-optimal for GCN given their use for commercial angling.
- 8.4.42 Other smaller ponds, likely to be ephemeral in nature, were recorded within woodland parcels immediately adjacent the A27 carriageway, and in Winchers Copse and Barn's Copse south of the A27 carriageway. These were considered to provide foraging and breeding opportunities for GCN.
- 8.4.43 The lack of access to waterbodies meant that the habitat could not be inspected in detail and no waterbodies could be scoped out as having negligible potential for GCN. For this reason, it is assumed that all standing water habitat present within the Survey Area and near to all scheme options may support GCN.

PROVISIONAL VALUATION

- 8.4.44 Following a precautionary approach, and given that GCN are widespread in West Sussex, the GCN population in the Survey Area and in close proximity to all scheme options is likely to be of Local value. However, if large metapopulations of GCN are found in the Study Area these may be likely to be of at least County value.
- 8.4.45 Further detailed habitat assessment and possible presence/absence surveys for GCN will be required in order to determine an accurate value for this receptor.

REPTILES

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.46 The four common native reptiles: grass snake (*Natrix natrix*), common lizard (*Zootoca vivipara*), slow worm (*Anguis fragilis*), and adder (*Vipera berus*) are partially protected under the Wildlife and Countryside Act 1981 (as amended). Under this legislation it is illegal to intentionally kill or injure a reptile. The four widespread reptile species are also SPIs.
- 8.4.47 Other UK reptile species namely smooth snakes (*Coronella austriaca*) and sand lizards

(*Lacerta agilis*) have additional protection under the Conservation of Habitats and Species Regulations 2010 (as amended) and the Wildlife & Countryside Act 1981 (as amended). The known UK distribution of these species identified within the desk study does not overlap with the study area¹³.

DESK STUDY

- 8.4.48 The desk study identified 87 reptile records within the study area, comprising all four widespread native reptiles including; slow worm, common lizard, grass snake and adder. The most recent records were from 2014.
- 8.4.49 The majority of records were near the River Arun near the town of Littlehampton approximately 2km south of the Survey Area. The nearest records comprising all widespread native reptile species were in Rewell Wood, Binsted Wood and Paines Wood situated within or immediately adjacent to all scheme options.

FIELD SURVEY

- 8.4.50 The habitats present within the Survey Area, including woodland and associated glades and rides, scrub, hedgerows and grassland were considered to provide suitable foraging, basking, shelter and hibernating opportunities for reptiles. It is therefore considered highly likely that reptiles occur within the Survey Area. Woodland glades within Binsted Wood, and areas of rough grassland, ditches and hedgerows bordering fields east and west of the River Arun in particular were considered to be of high potential for reptiles.

PROVISIONAL VALUATION

- 8.4.51 Suitable habitats with the potential to support widespread reptile species are likely to be frequent and widespread throughout the Study Area. Those habitats such as rough grassland verges and arable field edges are unlikely support reptile populations of more than Local value because they are commonplace habitat types in the Survey Area and are only likely to support a low abundance of reptiles. However, high quality reptile habitats, potentially supporting large reptile populations may be present at a few key locations. If large populations comprised of several reptile species are present, these are likely to be of at least County value.
- 8.4.52 Further reptile surveys will be required in order to determine their presence or likely absence, species diversity and population size, before an accurate baseline valuation can be completed.

BREEDING BIRDS

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.53 The majority of UK bird species are protected under the Wildlife and Countryside Act (1981) as amended. It is illegal to intentionally kill, injure, or take any wild bird, or take or destroy an egg of any wild bird. It is also an offence to damage or destroy the nest of any wild bird (whilst being built, or in use). A number of bird species are also listed as SPIs, and/or are Birds of Conservation Concern, Red List or Amber List species and Sussex BAP Priority Species.

¹³ UK distribution maps for this species are published by Amphibian and Reptile Conservation <http://www.arc-trust.org/smooth-snake>

- 8.4.54 Some bird species have extra protection and are listed in Schedule 1 of the WCA 1981 (as amended). It is illegal to intentionally or recklessly disturb a bird listed on Schedule 1 while it is nest building, or at a nest containing eggs or young, or disturb the dependent young of such a bird.

DESK STUDY

- 8.4.55 The desk study identified 1997 records of 28 bird species protected under the Schedule 1 of the WCA 1981 (as amended). These records included numerous Red List and Amber List Species. The majority of desk study records, particularly wetland and reedbed specialist species, were from the Wildfowl and Wetland Trust Arundel Wetland Centre (which forms part of Arun Valley, Watersfield to Arundel LWS).
- 8.4.56 Desk study records of farmland specialists such as corn bunting (*Emberiza calandra*) and turtle dove (*Streptopelia turtur*) were present in agricultural land north and south of the A27 carriageway at Arundel. Multiple desk study records of barn owl (*Tyto alba*) were present throughout the Study Area within or immediately adjacent all scheme options.
- 8.4.57 Desk study records of woodland specialists such as the hawfinch (*Coccothraustes coccothraustes*) and lesser spotted woodpecker (*Dendrocopos minor*) were present in Binsted and Paines Wood which is situated within or immediately adjacent all scheme options. The common crossbill (*Loxia curvirostra*) was also recorded in Rewells Wood which is situated immediately adjacent to the scheme options.

FIELD SURVEY

- 8.4.58 Phase 1 Habitat types and locations with greatest potential to support notable and protected bird species included: Ancient Woodland within Binsted Wood and Rewell Wood; scrub and hedgerows along field margins particularly directly east and west of the River Arun, and grassland (including reedbeds and coastal and floodplain grazing marsh east and west of the River Arun). It is possible that wet grassland in the Survey Area may support wetland specialists including Bewick's swan for which Arun Valley SPA is designated for. Mature or veteran trees within areas of Ancient Woodland and scattered within fields or along field boundaries, and old buildings were considered suitable to support nesting barn owl.

PROVISIONAL VALUATION

- 8.4.59 The majority of intensive farmland in the Survey Area is likely to support a common assemblage of birds of no more than Local value. However, Ancient Woodland at Binsted Wood, Paines Wood and Rewell Wood and wetland and river habitat which are located partly within all scheme options may support aggregations of notable or protected species and may be of up to County value or above.
- 8.4.60 Further surveys in respect of breeding birds will be required in order to determine the presence or likely absence of notable and protected species and to confirm key locations where these species occur, and thus an accurate value of the scheme options for breeding birds.

BATS

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.61 All UK bat species are protected under the Conservation of Habitats and Species Regulations (2010) as amended and under the WCA 1981 (as amended). Various bats species are also listed as SPIs. Bats are subject to the same legal protection as outlined

for GCN.

DESK STUDY

- 8.4.62 The desk study identified 35 confirmed or likely bat roosts within the Study Area. The most recent records were from 2015. Desk study records for confirmed or likely bat roosts were identified for five bat species. These were common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), brown long-eared (*Plecotus auritus*), serotine (*Eptesicus serotinus*) and barbastelle (*Barbastella barbastellus*).
- 8.4.63 Bat roost locations were widely distributed within the Study Area. The majority of bat roost records were from the area around Slindon Common and Slindon Wood approximately 1km west of the Survey Area. Common pipistrelle roosts were also found around Arundel Castle approximately 0.4km north of the Survey Area. Barbastelle roosts were recorded within Poling Copse and Slindon Common / Wood, approximately 1km east and west of the Survey Area respectively.

FIELD SURVEYS

- 8.4.64 The habitats present within the Survey Area, particularly woodland edges, hedgerows and ditches were considered to provide suitable foraging and commuting opportunities for bats.
- 8.4.65 Ancient Woodland at the western end of the Survey Area including Paines Wood, Ash Piece, Binsted Wood, Stewards Copse, Tortington Common, Winchers Copse, Singers Piece, Goblestubbs Copse and Rewell Wood is likely to contain numerous mature and veteran trees which are likely to support a bat roosts. A field towards the western end of the Survey Area contained multiple scattered veteran oak tree which had high bat roost potential. Such habitats may support uncommon species of bat such as the barbastelle bat.
- 8.4.66 A number of buildings within the Survey Area including the White Swan and the Arundel Cricket Pavilion exhibited features which are likely to support a bat roost (e.g. loose roof tiles, hanging tiles with gaps and timber framed, pitched roofs with gaps permitting access to the roof void). Numerous other buildings in the Survey Area which could not be viewed owing to access may also have high bat roost potential.
- 8.4.67 In addition, areas of Ancient Woodland and the network of hedgerows and ditches within the Survey Area were considered to provide likely high quality foraging opportunities for bats, and commuting routes linking potential roosting sites and foraging grounds.
- 8.4.68 The diverse range of habitats present in the Survey Area and particularly: large expanses of Ancient Woodland; veteran and ancient trees; wetlands; and old buildings collectively have high potential to support a bat population of conservation importance (e.g. a bat population containing uncommon species or a high diversity of species).

PROVISIONAL VALUATION

- 8.4.69 Small bat roosts of common species, if present, are likely to be of up to Local value. Large, maternity roosts of rare species such as barbastelle, if present, are likely to be of at least County value. The landscape of hedgerows, wetlands and Ancient Woodland has the potential to support a bat population of high nature conservation importance including rare and uncommon species which may be of above County value.
- 8.4.70 Further surveys and detailed roost confirmation and activity surveys will be required in order to determine the presence or likely absence of rare species, and thus an accurate value of the bat population in the Survey Area.

HAZEL DORMOUSE

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.71 Hazel Dormouse (*Muscardinus avellanarius*) are protected under the Conservation of Habitats and Species Regulations (2010) as amended and under the Wildlife and Countryside Act (1981) as amended. Dormice are also listed as an SPI. Dormouse is subject to the same legal protection as outlined for GCN and bats.

DESK STUDY

8.4.72 The desk study identified 488 dormouse records within the study area. The most recent records were from 2014. The majority of records were from Paines Wood, Ash Piece and Rewell Wood which form large areas of Ancient Woodland towards the western extent of the Survey Area.

FIELD SURVEY

8.4.73 The Ancient Woodland towards the western end of the Survey Area, north and south of the A27 carriageway including Paines Wood, Ash Piece, Binsted Wood, Stewards Copse, Tortington Common, Winchers Copse, Singers Piece, Goblestubbs Copse and Rewell Wood were considered to provide suitable breeding, foraging, shelter and hibernating opportunities for dormice. The Survey Area comprised an extensive hedgerow network. However the majority of hedgerows appeared very gappy with limited commuting opportunities. Occasional hedgerows including those adjacent to Ford Road and Tortington Lane exhibited fewer gaps and were considered to provide suitable foraging and commuting opportunities for hazel dormouse. Given the presence of recent desk study records and the availability of suitable habitat, it is highly likely that dormice occur within the Survey Area.

PROVISIONAL VALUATION

8.4.74 It is likely that a large population of hazel dormouse occurs in the Survey Area. Dormouse is nationally rare but is relatively widespread in Sussex and thus dormouse populations in the Survey Area are likely to be of Local value. If a very large population were found to be present in the large Ancient Woodlands which are present in the Survey Area this may be of a higher value as it may act as a core population area increasing the resilience and viability of more marginal dormouse habitats in its vicinity.

8.4.75 Further dormouse surveys will be required in order to determine the presence or likely absence of this species and, if present, its population size and likely value.

OTTER

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.76 Otters (*Lutra lutra*) are protected under the Conservation of Habitats and Species Regulations (2010) as amended and under the WCA 1981 (as amended). Otter are also listed as an SPI and a UK/Sussex BAP Priority Species. It is subject to the same legal protection as GCN, bats and dormouse.

DESK STUDY

8.4.77 The desk study data contained no records of otter.

FIELD SURVEY

8.4.78 The River Arun and the large ditch that runs parallel to the River Arun were considered to provide suitable foraging and commuting opportunities for otters. Use of the river by otters may be limited due to the lack of sheltering opportunities – few old trees, little concealing habitat and sparse vegetation cover was noted along most of the river corridor. The complex network of ditches bordering many of the surrounding fields and waterbodies across the Survey Area is likely to provide extensive and high quality foraging and commuting opportunities for otter.

PROVISIONAL VALUATION

8.4.79 Otter is a wide ranging species and is known to be increasing in population nationally. The land encompassed by the Survey Area would be likely to support a small number of otter territories given their wide ranging behaviour and their relatively large territory size. On the basis of these factors the assumed otter population in the Survey Area may be of up to Local value if the species is present. However, if one or more breeding holts were confirmed or the Survey Area is proven to facilitate otter movement along the Arun Valley, the otter population could be valued at a higher level.

8.4.80 Further otter survey will be required in order to determine the presence or likely absence of otter in the Study Area.

WATER VOLE

LEGAL PROTECTION AND CONSERVATION STATUS

8.4.81 Water voles (*Arvicola amphibius*) are protected under the WCA(1981) as amended, and are also listed as an SPI and a UK/Sussex BAP Priority Species.

8.4.82 It is illegal to possess, control or sell water voles or to intentionally kill, injure or take water voles. It is also an offence to intentionally or recklessly damage, destroy or obstruct access to a place that water voles use for shelter or protection or disturb water voles whilst using such a place.

DESK STUDY

8.4.83 The desk study identified 1382 water vole records within the study area. The most recent record is from 2015. The majority of the records were from Arundel Wetland Centre approximately 2.0km north of the Survey Area. There were also several records from a variety of streams and ditches towards Poling approximately 1.5km east of the Survey Area.

FIELD SURVEY

8.4.84 No targeted water vole field surveys were undertaken. Running water and standing water habitats within the Survey Area including occasional ditches along many of the field boundaries and the scattered ponds recorded throughout the Survey Area were considered to provide suitable foraging and burrowing opportunities for water vole.

8.4.85 Occasional ditches, particularly those demarcating field boundaries to the east and west of Tortington were considered to provide some moderate foraging and burrowing opportunities for water voles. A number of ditches surrounding Tortington could not be accessed but may have suitable habitat for water vole.

8.4.86 However, the majority of ponds and ditches were considered likely to be ephemeral,

drying up for most of the year. In addition, many ditches particularly those running parallel to the A27 carriageway were considered to provide very limited foraging opportunities given the absence of suitable aquatic and marginal vegetation.

PROVISIONAL VALUATION

- 8.4.87 Water vole is a rare and declining mammal in England. Should a population of water vole be present within the Survey Area, and given the large amount of potentially suitable water vole habitat this may be of at least County value.
- 8.4.88 Further surveys in respect of water voles will be required in order to determine the presence or likely absence, and thus derive an accurate valuation.

BADGER

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.89 Badgers are protected under the Protection of Badgers Act 1992. It is illegal to wilfully take, kill, injure or ill-treat a badger, or possess a dead badger or any part of a badger. Under the Act their setts are also protected against obstruction, destruction, or damage in any part.

DESK STUDY

- 8.4.90 There were no badger records in the desk study data which suggests that there are no badgers present at the time the data was collected.

FIELD SURVEY

- 8.4.91 No incidental evidence of badger field signs (hairs, latrines, dung pits, snuffle holes, mammal paths or scratching posts) or setts were recorded during the Phase 1 Habitat Survey. However, no thorough survey was undertaken owing to land access constraints. The habitats present within the Survey Area including woodland, scrub, hedgerows and grassland were considered to provide suitable foraging opportunities for badger. The woodland habitats in particular were considered to provide suitable sett building opportunities. It is probable that badgers, including their setts, occur within the Survey Area at a number of locations.

PROVISIONAL VALUATION

- 8.4.92 Badgers are common and widespread in West Sussex (and in England) and, for this reason, the population of badger in the Survey Area is unlikely to be of more than Local value.
- 8.4.93 Further survey in respect of badgers will be required in order to determine the presence or likely absence, and to provide an accurate valuation for this species.

OTHER PROTECTED AND NOTABLE SPECIES

LEGAL PROTECTION AND CONSERVATION STATUS

- 8.4.94 Hedgehog (*Erinaceus europaeus*), brown hare (*Lepus europaeus*), harvest mouse (*Micromys minutus*) and common toad (*Bufo bufo*) are all SPIs. The brown hare is a Sussex BAP Priority Species.

DESK STUDY

8.4.95 The desk study identified multiple records of hedgehog, brown hare and harvest mouse and common toad throughout the study area, particularly in Binsted Wood, Paines Wood and Rewells Wood which intersect or immediately border all scheme options.

FIELD SURVEY

8.4.96 The habitats present within the Survey Area, particularly woodland and arable farmland and to some extent hedgerows and grassland were considered to provide suitable breeding shelter, foraging and commuting opportunities for these species.

PROVISIONAL VALUATION

8.4.97 An accurate valuation of possible populations of these species cannot be undertaken without further habitat assessment survey data.

8.5 REGULATORY AND POLICY FRAMEWORK

8.5.1 The regulatory and policy framework of relevance for this ecological assessment is as follows:

- Wildlife and Countryside Act 1981 (as amended);
- The Conservation of Habitats and Species Regulations 2010 (as amended) (Habitat Regulations);
- The Countryside and Rights of Way Act 2000;
- The Natural Environment and Rural Communities (NERC) Act 2006;
- The Protection of Badgers Act 1992;
- The Hedgerow Regulations 1997;
- National Planning Policy Framework 2012;
- National Networks National Policy Statement 2014;
- Design Manual for Roads and Bridges (DMRB) 1992 (as amended);
- The UK Post-2010 Biodiversity Framework 2012; and
- The Sussex Biodiversity Action Plan.

8.5.2 The Survey Area includes parts of two Sussex Biodiversity Partnership Biodiversity Opportunity Areas (BOAs):

- BOA 19 - Climping to Houghton – which targets (among other objectives) wetland habitat management, restoration and creation, woodland management and restoration, conservation of farmland birds and woodland butterflies and floodplain restoration and reconnection; and
- BOA 20 Arundel Park – which targets chalk grassland management, restoration and creation, woodland management and restoration and conservation of woodland butterflies.

8.5.3 The Survey Area lies partly inside the SDNP boundary which terminates at the northern edge of Arundel town but includes most of Paine's Wood, Binsted Wood and Tortington Common. The SDNP has a range of nature conservation objectives including:

- To conserve and enhance the cultural heritage and large areas of high-quality and well-managed habitat to form a network supporting wildlife throughout the landscape.

8.5.4 The South Downs Way Ahead Nature Improvement Area is approximately 4.0km north and 4.0km east of the Survey Area. Nature Improvement Areas are a landscape scale approach to nature conservation introduced by the Government as part of the Natural Environment White Paper. The South Downs Way Ahead Nature Improvement Area objectives include:

- Walk the Chalk - to broaden the South Downs Way National Trail as a semi-natural corridor and improve the natural qualities of the route;
- Linking the Fragments - to achieve real improvements to the conservation and management of chalk grassland at the heart of the matrix of downland habitats; and
- Valuing the Chalk - to attribute environmental, economic and social values to the benefits and services provided by chalk downland.

8.5.5 The strategy document: 'Our plan to protect and increase biodiversity' (Highways England 2015) sets out the Highways England Biodiversity Plan, includes several objectives relevant to this assessment. In particular it aims to achieve 'no net loss' of biodiversity by 2020, to work with conservation stakeholders and to contribute to the aims of Nature Improvement Areas in England.

8.6 DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

8.6.1 This section identifies mitigation and enhancement measures that are recommended based on the preliminary impact assessment provided in this ESR. At this stage of the assessment process and without information from detailed surveys or detailed design, only broad recommendations of likely mitigation requirements are possible. Further surveys would be necessary at more detailed stages of design to confirm the exact mitigation requirements necessary for individual scheme options and to address specific impacts. In broad terms the following hierarchical approach to mitigation should be adopted – this approach is strongly supported by guidance in the DMRB and national planning policy:

- Firstly, measures to avoid adverse ecological impacts (for example, the re-siting of construction compounds, or adjustments in road alignment, etc.) should be exhausted;
- Where an adverse impact cannot be avoided, options to ameliorate or reduce an adverse impact should be implemented;
- As a last resort, measures that compensate for the loss of the particular ecological resource that is affected should be considered. For example, like-for-like replacement of lost habitats; and
- Compensation approaches may include enhancement of existing habitats by improved management and long-term monitoring.

GENERAL MITIGATION AND COMPENSATION MEASURES

8.6.2 General mitigation measures, falling into one or more of the above categories, which

would help to reduce the magnitude and significance of potential construction and operational impacts are¹⁴:

MITIGATION

- Avoidance of protected habitats through design;
- Optimal timing of works to avoid key periods for particular species, such as avoidance of the bird nesting season for habitat clearance;
- Translocation and/or exclusion of species (under appropriate licences/agreements) where required from the scheme option footprint to pre-prepared receptor sites to minimise impacts of habitat loss and species mortality;
- Appropriate design and use of lighting to minimise impacts on bats and other light sensitive species;
- The use of screening during construction to minimise the spread of noise, dust, lighting, etc. and the use of fencing to temporarily exclude species by restricting access into particular areas (such as reptile exclusion fencing);
- Re-establishing connectivity between habitats affected by road construction and incorporation of features within the detailed design which would restore connectivity for protected species whose habitat has been fragmented by the road;
- Appropriate landscaping and re-landscaping of all new roadside verges and disturbed habitat specifically for species known to be present in the area (where suitable for network and safety priorities). All landscaping should use species of local provenance;
- Installation of surface water run-off attenuation and treatment features to ensure water discharged to watercourses would not compromise the conservation value of the watercourse or the species that live within it;
- Implementation of general construction environmental best practice. This could include, but is not limited to, providing tool box talks for construction staff informing them of key ecological constraints within the area, the damping of haul routes to minimise the spread of dust, the use of drip trays and spill kits when refuelling vehicles and ensuring that open trenches are not left over night without safe means of egress for animals that may fall into them; and
- Production of a CEMP documenting all mandatory ecological avoidance and mitigation measures and methodologies and identifying those responsible for implementation.

COMPENSATION

- Habitat creation: either through the translocation of existing habitats or seed banks; the enhancement of existing habitat; and/or the planting of new habitat;

ANCIENT WOODLAND

8.6.3 Aside from Options 0A and 5B all other scheme options will result in loss of Ancient Woodland habitat (see Table 8-4). Option 3 would result in the loss of markedly significantly larger areas of Ancient Woodland than all other scheme options. In particular, Binsted Wood Complex LWS is thought to be the largest block of ancient semi-

¹⁴ The following measures only constitute the proposed generic mitigation. At this stage it is not possible to determine detailed mitigation measures.

natural woodland south of the South Downs in Sussex and is of extremely high nature conservation value for this reason.

- 8.6.4 The preferred Scheme Option should be designed to avoid any adverse impacts on Ancient Woodland given that this habitat is irreplaceable and therefore losses cannot be compensated for. The loss of Ancient Woodland will be partially compensated for through a combination of measures which will be agreed in advance with Natural England and will be consistent with their standing advice on Ancient Woodland¹⁵. Ancient Woodland soils, dead wood and coppice stools will be salvaged and translocated to new broad-leaved woodland creation areas. Whilst not replicating the Ancient Woodland that will be lost, the creation of new woodland will result in an overall increase in size of the surrounding woodland network which would improve woodland connectivity within the wider landscape by connecting isolated and fragmented woodland parcels, thereby enhancing wildlife corridors and improving commuting and foraging opportunities for a variety of protected and notable species. Other measures such as the removal of invasive species and reinstatement of a coppicing regime may also be implemented.
- 8.6.5 It should be noted that there are no set rules for the levels of mitigation and compensation required for loss of Ancient Woodland, therefore every instance should be treated on a case by case basis and with agreement from Natural England. At this stage in the assessment process it is not possible to provide a definitive ratio for provision of compensation habitat. Further detailed botanical survey work and consultation with stakeholder organisations are required in order to determine appropriate compensation requirements. This survey and consultation work will be carried out in 2017.

AWAWTable 8-4: Likely loss of Ancient Woodland associated with each option

OPTION	AREA (HA) OF ANCIENT WOODLAND LOSS
0A	0
0B	3.49
0BA	4.46
1	5.29
2	14.17
3	24.31
4	6.6
5	6.06
5A	6.06
5B	0

¹⁵ Natural England (13th October 2014). Ancient woodland and veteran trees: protecting them from development. [on-line] <https://www.gov.uk/guidance/ancient-woodland-and-veteran-trees-protection-surveys-licences> (accessed January 2017).

PROTECTED AND NOTABLE SPECIES AND HABITAT MITIGATION AND COMPENSATION MEASURES

- 8.6.6 Should Option 3 and to a lesser extent Option 2 be progressed these options would bisect Paine's Wood, Binsted Wood and Tortington Common which is presently all semi-natural woodland (much of it AWI woodland as already discussed). Should Options 4 and 5 be progressed these options would bisect Rewell Wood which is also all semi-natural woodland (AWI woodland). For certain faunal species, including bats and dormouse, this may fragment their populations on the east and west sides of these scheme options. The introduction of a road in an area which is currently semi-natural habitat may also introduce mortality on these animal populations caused by vehicle collision. Vehicle collision with faunal species has both a nature conservation and a road safety implication. Collision with large mammals such as deer and badger may be especially detrimental to road users. Increased mortality of certain species (e.g. rarer bat species which occur at low population density) may lead to localised extinction. Impacts on large wooded areas should be strictly minimised. Should woodland losses be unavoidable, the requirement for fencing, bespoke animal crossing structures including wildlife bridges and culverts or other measures to control and facilitate animal crossing of the new road cannot be ruled out. Natural England may require such structures when considering a licence for impacts on legally protected species. Mitigation requirements potentially comprising wildlife friendly structures are considered likely to be significantly more extensive for Options 3 and 2 than all other scheme options. Any mitigation proposals will be linked to the Requirements of the Development Consent Order.
- 8.6.7 Road schemes are particularly damaging to barn owl which is a low, slow flying species affected by collisions with vehicles. Barn owls are protected under Schedule 1 of the Wildlife and Countryside Act, 1981 (as amended) and therefore where a Scheme Option bisects the territory of a barn owl, potentially severing important foraging sites and nesting locations and increasing the risk of death and injury from vehicle collisions, mitigation for impacts on barn owl may involve provision of artificial roost boxes greater than 1.0km from the Scheme to comply with best practice approaches.
- 8.6.8 Widening of the existing A27 crossing or installation of a new crossing over the River Arun could result in disturbance affecting riparian species including otters and could result in disturbance or act as a barrier impeding migration of bird and fish species using the River Arun for commuting, potentially impeding bird species migrating to / from the Arun Valley SAC, SPA and Ramsar. Installation of a new bridge could potentially affect the hydrology and morphology of the watercourse and indirectly impact surrounding habitats including coastal and floodplain grazing marsh HPI which potentially provides important foraging opportunities to a host of protected and notable species. At this early stage of assessment and without detailed survey data the potential impacts on protected and notable species and species specific mitigation requirements are not currently known. However, mitigation requirements as described above are considered likely to be markedly more extensive for Options 2, 3, 4, 5 and 5A than all other scheme options as a new crossing over the River Arun will likely be required.
- 8.6.9 In relation to biodiversity enhancement, considering the nature conservation aims and objectives of the nearby Nature Improvement Areas, the BOAs which include parts of the Survey Area, the SDNP biodiversity aims, and HE's plan to protect and increase biodiversity, the following measures should be considered alongside development of a detailed scheme option:
- Creation of new areas of woodland with parcels of existing farmland north and west of Options 4 and 5, adjacent to retained areas of Ancient Woodland. Once established this woodland would complement the existing connecting Ancient Woodland, and provide an array of opportunities for many species particularly for bats and dormice;

- Installation of safe wildlife crossings including green or land bridges¹⁶, bat cross-over points¹⁷ and dormouse rope bridges¹⁸ towards the western extent of the Survey Area would encourage the safe movement and interchange of a variety of species particularly dormice and bats between the areas of Ancient Woodland north and south of the A27 carriageway thereby potentially averting the fragmentation of dormouse populations and severance of bat commuting routes;
- Enhancement of river/ field drainage to improve the condition of potential coastal and floodplain grazing marsh directly east and west of the River Arun. This would likely result in an increase in plant and invertebrate species diversity and potentially provide improved foraging opportunities for wetland bird species;
- Seeding of highway embankments with the aim of improving plant species and invertebrate species diversity leading to an overall enhancement of the Nature Improvement Area.

BIODIVERSITY OFFSETTING

- 8.6.10 Consideration should be given to using a biodiversity offsetting approach which employs a metric to quantify the area of required compensatory habitat creation. The Defra biodiversity offsetting metric (Defra, 2012) is the current nationally recognised system for undertaking offsetting assessments. Adoption of a metric to quantify habitat compensation would allow progress towards achievement of Highways England's 'no net loss' target to be quantified. Ancient Woodland is an irreplaceable habitat and, following Defra guidance, should be excluded from biodiversity unit calculations. Any compensation offered to address impacts on this habitat will be agreed direct with Natural England as stated under the section on Ancient Woodland.
- 8.6.11 A key principle of biodiversity offsetting is to actively engage with local biodiversity stakeholders to identify possible strategic biodiversity enhancement opportunities (e.g. Biodiversity Opportunity Areas, Natural England agri-environment funding). This will ensure that any required ecological compensation measures, as well as opportunities for enhancement, are spatially targeted and designed to complement existing conservation measures which will increase their efficacy.

MONITORING AND MANAGEMENT POST-CONSTRUCTION

- 8.6.12 A post-construction monitoring programme would be carried out during the first five years after construction (the initial maintenance period) to assess establishment of the ecological mitigation measures, help inform future management and, if necessary, allow for the implementation of remedial measures.
- 8.6.13 An ecology aftercare plan would be developed based on the mitigation provided during the construction stage and the long-term objectives of the mitigation. This plan would be developed during the detailed design stage and form part of the ecological information to be submitted as part of the application for Development Consent. It would provide an auditable record of the various mitigation commitments identified, and the requirements for regular maintenance of the mitigation features to ensure that their goals are achieved.

¹⁶ NDMP (National Dormouse Monitoring Programme) (2009). Dormouse bridge report Wildwood, Kent. IN: The Dormouse Monitor, Winter 2009. NDMP Dormouse bridges

¹⁷ Berthinussen, A. & Altringham, J. (2012a). Do bat gantries and underpasses help bats cross roads safely? PLoS One 7 (6)

¹⁸ Bright, P., Morris, P. & Mitchell-Jones, A. J (2006). The dormouse conservation handbook. English Nature

It would feed into the Environmental Masterplan for the preferred Option, which would be developed in accordance with DMRB Volume 10 to show all existing and proposed environmental aspects of the Option including environmental barriers, proposed planting / seeding and its functions, biodiversity and natural conservation, noise attenuation, heritage conservation and enhancement, flood attenuation, water courses and quality controls. This information would be fed into the Highways England environmental information system (EnvIS). The aftercare plan would bring together requirements outlined in any draft European Protected Species Licences prepared as part of the DCO process and a 'letter of no impediment' sought from Natural England.

- 8.6.14 Monitoring mitigation measures are essential to identify appropriate habitat creation, management and monitoring methods to employ on other projects, and to serve as a database and benchmark from which future highways schemes can benefit. Should any ecological mitigation be identified as failing by the monitoring surveys, undertaking remedial works to ensure that the mitigation achieves its objectives may be necessary. Where necessary, monitoring results should be made available to other Highways England project teams. It may be appropriate to secure monitoring via a CEMP or Handover Environmental Management Plan.

8.7 OVERALL ASSESSMENT

- 8.7.1 This section presents a provisional analysis of potential ecological impacts that are likely to arise during construction and operation, taking into consideration the following parameters: positive / negative effect, magnitude, extent, duration, reversibility, and timing / frequency. A detailed ecological assessment should be undertaken for the preferred scheme option at PCF Stage 3 and can only be undertaken once the detailed design information is available and specific impacts are more fully understood.
- 8.7.2 At the generic environmental assessment level, construction impacts are generally considered to be temporary effects from site activities and operational impacts to be the permanent effects resulting from the scheme options. For this assessment, impacts that occur at the construction stage including land-take and habitat loss (either temporary or permanent) are considered under construction impacts. All impacts are defined in the relevant sections.
- 8.7.3 The following generic adverse construction impacts would be likely to occur without suitable mitigation:
- Permanent and temporary habitat loss;
 - Habitat fragmentation;
 - Habitat degradation;
 - Direct and indirect mortality of animals and plants caused by site clearance and construction;
 - Direct and indirect disturbance from construction activities including visual, noise and lighting; and
 - Pollution caused by use of hazardous materials and incidental release of chemicals.
- 8.7.4 The following generic adverse operational impacts would be likely to occur without suitable mitigation:
- Air quality effects resulting from vehicular emissions;
 - Disturbance effects resulting from increased noise, light and movement;
 - Water contamination from surface water drainage from roads and areas of hard

standing; and

→ Mortality associated with road traffic collisions.

- 8.7.5 The assessment of ecological impacts assumes that all mitigation measures outlined in Chapter 5 - Air Quality; Chapter 11 - Noise and Vibration and Chapter 14 - Road Drainage and the Water Environment would be successfully implemented. It further assumes that successful best construction practice measures would be implemented to prevent accidental spillage of construction pollutants into watercourses and that dust arising from construction activities would be controlled. Lastly, the assessment assumes that design measures would be embedded in the scheme design to control the frequency and volume of water flows in and around the scheme so that they are not impacted beyond baseline conditions.
- 8.7.6 Habitat loss estimates are approximate and may be inaccurate. They are provided for comparative purposes only. Accurate habitat loss calculations will be undertaken when a detailed scheme design is available for a preferred scheme option at PDF Stage 3.

STATUTORY DESIGNATED SITES

- 8.7.7 An Assessment of Impacts on European Sites (AIES) following DMRB guidance is provided in Appendix D. The closest international statutory designated sites are Arun Valley SAC, SPA and Ramsar site which are approximately 6.8km north of the scheme options, and Duncton to Bignor Escarpment SAC approximately 6km north of the scheme options. Indirect impacts and effects on the ecological integrity of these international statutory designated sites, particularly habitat degradation (for example, dust deposition and air quality impacts) are not considered likely to occur for any of the scheme options primarily because these European Sites are too distant for indirect impacts to be adverse.
- 8.7.8 Arun Valley Ramsar site, SAC and SPA are immediately adjacent the River Arun which crosses the Survey Area. However this European Site is located upriver from all scheme options and therefore indirect impacts and effects, particularly habitat degradation associated with pollution run-off are not anticipated. Although unlikely, the AIES has not been able to discount the possibility of the following impacts at this preliminary assessment stage: obstruction or disturbance of bird flight lines along the River Arun to the Arun Valley SPA and Ramsar site caused by bridge or viaduct construction. In addition, wetland habitat in the Survey Area is supporting habitat for waterfowl using the Arun Valley SPA and Ramsar site. Further survey work and consideration of detailed design information will be required to conclude upon these where these potential impacts are significant effects.
- 8.7.9 Following guidance set-out in the DMRB, indirect impacts on SACs with bat qualifying features that are within 30km of a road scheme should be considered. Three such SACs are present in 30km of the Survey Area: Ebernoe Common SAC; The Mens SAC; and Singleton and Cocking Tunnel SAC. Given the distance of these SACs from all proposed scheme options and the wide availability of suitable foraging, commuting and roosting opportunities closer to these SACs than in the vicinity of any scheme option indirect impacts are unlikely. However, in the absence of detailed design information it is not possible to definitively conclude that there will be no 'likely significant effects' on the ecological integrity of these European Sites. This is because (although unlikely) it may be possible that there are Bechstein's bats or barbastelle bat populations in the vicinity of the Survey Area which may be of supporting value to these SACs. Further analysis of this impact will be required when detailed bat survey data is available to inform an assessment of the potential significance of any effects.
- 8.7.10 The scheme options are not situated within or immediately adjacent to any SSSIs or NNRs, the nearest such site is Arundel Park SSSI which is approximately 500m north of

Option 0B, 0BA and 1; and approximately 1-2km north of options 0A, 2, 3, 4, 5, 5A and 5B. On the basis of proximity, direct impacts and effects are not anticipated on any statutory designated site. The DMRB does not require consideration of air quality impacts for any sites located greater than 200m from a proposed road scheme nor are there any hydrological links between SSSIs and NNRs and any scheme option. It is anticipated that indirect construction impacts such as dust, noise, vibration and temporary lighting will dissipate a short distance from all scheme options and thus adverse effects on a national statutory designated site are unlikely. No potential indirect effects on these sites have been reported in the provisional assessments reported in Chapter 5 – Air quality; Chapter 11 – Noise and vibration; or Chapter 14 – Road Drainage and the Water Environment. This assessment will need to be reviewed and updated when detailed construction methods are available and a preferred scheme option is selected.

NON-STATUTORY DESIGNATED SITES

- 8.7.11 All scheme options except for Option 0A are situated within or in close proximity to non-statutory designated LWSs. There is a potential for both direct and indirect impacts on five LWSs. The level of impact on non-statutory designated sites varies between the scheme options. The five LWSs are listed in Table 8-2.
- 8.7.12 There is scope for possible impacts on Binsted Wood Complex LWS, Rewell Wood Complex LWS and Arun Valley, Watersfield to Arundel LWS as discussed below.
- 8.7.13 In relation to Poling Copse LWS, and Warning camp Hill and New Down LWS, no scheme option will result in direct land take from these sites. In addition, the closest point of any scheme option to any of these sites is 250 m (scheme options 0A and 0BA are 250m from Poling Copse LWS). It is unlikely that there will be indirect effects on any of these three LWS sites because there is no hydrological connectivity between the A27 and these LWSs and beyond 200m from an air pollution source, the DMRB confirms that air quality impacts associated with operation traffic or construction may be discounted.

SCHEME OPTION 0A

- 8.7.14 The nearest non-statutory designated site to this scheme option is Poling Copse LWS. Impacts on this LWS are considered unlikely as already discussed in 8.7.13.

SCHEME OPTION 0B, 0BA & 1

- 8.7.15 Binsted Wood Complex LWS is located immediately south of the scheme options and Rewell Wood Complex LWS is immediately north of the scheme options. The widening of the existing A27 carriageway to a dual carriageway proposed as part of this scheme option is likely to result in the permanent loss of a narrow belt of Ancient Woodland habitat along the northern edge of Binsted Wood Complex LWS and southern edge of Rewell Wood Complex LWS of up to 3.4ha for Options 0B, 4.4 for 0BA and approximately 5ha for Option 1. This impact would be likely to compromise the ecological integrity of both LWSs and may result in a significantly adverse effect at up to the County level.
- 8.7.16 Arun Valley, Watersfield to Arundel LWS is located immediately north of the Scheme Options. The widening of the existing A27 carriageway to a dual carriageway proposed as part of this Option 0B is likely to result in the permanent loss of good quality semi-improved grassland HPI and coastal and floodplain grazing marsh HPI along a narrow belt towards the southern edge of the LWS. Option 0BA bisects the LWS and would result in significantly larger areas of habitat loss from this LWS. This impact would be likely to compromise the ecological integrity of the LWS and may result in a significantly adverse effect at up to the County level.

SCHEME OPTION 2

- 8.7.17 Binsted Wood Complex LWS is located partly within Option 2. Option 2 is an off-line route from the existing A27 alignment joining Tortington Lane. It is likely to result in the permanent loss of a small area of the north-east corner of Binsted Wood Complex LWS. In addition, the widening of Tortington Lane would also likely result in the permanent loss of habitat towards the western edge of Binsted Wood Complex LWS. Collectively approximately 14.1ha of this LWS would be removed. This impact would be likely to compromise the ecological integrity of the LWS and may result in a significantly adverse effect at up to the County level.

SCHEME OPTION 3

- 8.7.18 Binsted Wood Complex LWS is located partly within Option 3. Option 3 is an off-line route from the existing A27 alignment which continues in a south east direction through the centre of Binsted Wood Complex LWS. Up to 24ha of this LWS would be removed. This magnitude of loss would be likely to lead to a significantly adverse impact on this LWS at up to the County level.

SCHEME OPTION 4

- 8.7.19 Binsted Wood Complex LWS is located partly within Option 4. Option 4 is an off-line route from the existing A27 alignment which commences further west and circumnavigates the majority of Binsted Wood Complex LWS. This Option would likely result in the permanent loss of up to 6.6ha of Ancient Woodland towards the north-west corner of Binsted Wood Complex LWS. This magnitude of habitat loss would be likely to affect the integrity of this LWS. It would be a significantly adverse effect at up to the County level.

SCHEME OPTION 5 & 5A

- 8.7.20 Binsted Wood Complex LWS is located partly within Options 5 and 5A. Options 5 and 5A are off-line routes which circumnavigate the majority of Binsted Wood Complex LWS

(similar to Option 4). This would likely result in the permanent loss of approximately 13ha of Ancient Woodland habitat towards the north-west corner of Binsted Wood Complex LWS. These impacts would be likely to result in an adverse impact from on the ecological integrity of this LWS which would be significant at up to the County level.

SCHEME OPTION 5B

8.7.21 Binsted Wood Complex LWS is located approximately 0.25 km north of Binsted Wood Complex LWS. No habitat loss would occur from Binsted Wood Complex as a result of construction of Scheme option 5B. It is also unlikely that construction or operation of scheme option 5B would result in air quality impacts on Binsted Wood Complex LWS for reasons already outlined. However, Option 5B crosses a small stream which drains Binsted Wood Complex LWS near to Meadow Lodge. Although Option 5B is downstream of Binsted Wood Complex LWS potential adverse hydrological impacts on the LWS cannot be ruled out without detailed design information. These aquatic impacts may be adverse and significant at up to the County level.

HABITATS

WOODLAND AND SCRUB

- 8.7.22 All scheme options (except Option 0A and 5B) would result in the permanent loss of Ancient Woodland comprising both semi-natural broadleaved woodland and coniferous plantation AWI types. These potential habitat losses are the same as those reported under non-statutory sites.
- 8.7.23 The conservation status of Ancient Woodland is dependent on maintaining, amongst other things, its extent and species composition and connectivity to similar habitat. As Ancient Woodland cannot be recreated the loss would remain a permanent adverse effect that is likely to be significant at up to the County level.
- 8.7.24 The loss of Ancient Woodland from Binsted Wood Complex LWS and Rewell Wood Complex LWS already reported in the 'Non-Statutory Designated Sites' section above would be likely to compromise the conservation status of Ancient Woodland as a habitat type which is likely to result in significantly adverse impact at up to the County level.
- 8.7.25 All scheme options would also be likely to result in the permanent loss of small and narrow areas of semi-natural broadleaved woodland bordering the A27 carriageway. Loss of relatively small areas of semi-natural broad-leaved woodland associated with any scheme option is unlikely to affect the conservation status of this habitat type and is unlikely to result in an adverse impact above the Local level which would be unlikely to be a significant effect.
- 8.7.26 All scheme options would also likely result in the permanent loss of dense and scattered scrub, particularly bordering the A27 carriageway. Scrub is a common and widespread habitat type throughout the Survey Area and wider surroundings. Loss of relatively small areas of scrub associated with any scheme option is unlikely to affect the conservation status of this habitat type and is unlikely to result in an adverse impact above the Site level which would be unlikely to be a significant effect.

HEDGEROW

8.7.27 All scheme options would result in the permanent loss of hedgerow habitat both bordering the A27 carriageway and forming field boundaries which are crossed by different scheme options. However, significantly longer lengths of hedgerow would be lost as part of Options 2, 3, 4, 5 and 5A. Loss of this hedgerow habitat associated with all scheme

options could potentially affect the ecological integrity and function of the hedgerow network as a wildlife corridor. This would be likely to result in an adverse impact of at least Local level which would be likely to be a significant effect.

GRASSLAND

- 8.7.28 All scheme options, in particularly options 0B, 0BA and 1 would result in the permanent loss of species-poor grassland habitat predominantly recorded along the A27's existing carriageway verges. Poor semi-improved grassland is a common and widespread habitat type throughout the Survey Area and wider surroundings. Loss of this habitat type associated with any scheme option is unlikely to affect the conservation status of this habitat type and is unlikely to result in an adverse impact above the Site level which would be unlikely to be a significant effect.
- 8.7.29 All scheme options (except Option 0A & 0B) would result in the permanent loss of semi-improved neutral grassland habitat, which was assumed to be present in pasture fields and along arable field margins within the Survey Area. This habitat type potentially includes coastal and floodplain grazing marshes which is a HPI. HPis are nationally declining habitat types which the Government has identified as priorities for conservation. Loss of HPI grassland may affect the conservation status of this habitat type and is likely to result in an adverse impact which may be significant at the County level or above and which would be a significant effect.

WATERCOURSES

- 8.7.30 Scheme options 2, 3, 4, 5, 5A and 5B all require a new bridge to be constructed across the River Arun. This is likely to lead to permanent loss of riparian vegetation and potentially also adverse impacts on in stream morphology and hydrology. No detailed scheme design information is available but such a bridge may also require flood protection measures both up and down stream, further affecting the hydrology and morphology of the watercourse. This is likely to lead to a significantly adverse effect on the conservation status of river habitat in the River Arun. However, it is not possible to conclude at what geographic level this effect would be significant without detailed scheme design information including hydrological modelling.

WATERBODIES

- 8.7.31 All scheme options (except option 0A) could result in the permanent loss of both dry and wet ditches which were recorded running parallel to the A27 carriageway and adjoining minor roads and along many field boundaries within the wider farming landscape. In the absence of detailed survey information it is assumed that this habitat type is of high ecological interest and, therefore, its loss associated with any scheme option, may compromise the conservation status of this habitat type. Furthermore, the removal of this habitat type could potentially have knock-on hydrological effects to adjacent habitat types particularly areas of coastal and floodplain grazing marsh HPI. This impact would likely result in an adverse impact which may be significant at up to the County level.

OTHER HABITATS

- 8.7.32 Potential losses of all other Phase 1 Habitat types associated with the scheme would be unlikely to lead to an adverse effect above the Site level which would not be likely to result in a significant effect. Such habitats include arable, improved grassland and standing which are of low or negligible nature conservation interest as plant habitats.
- 8.7.33 The potential for significant impacts on habitats within the study area is shown in Table 8-5.

Table 8-5 Potential for Significant Habitat Impacts

HABITAT TYPE	OPTIONS										Comments / Recommendations	
	0A	0B	0BA	1	2	3	4	5	5A	5B		
Semi-natural Broad-leaved Woodland	x	x	x	x	x	x	x	x	x	x	x	The preferred option should address potential impacts on Ancient Woodland consistently with guidance provided in the NPSNN.
Semi-natural Ancient Woodland	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	x	The preferred option should address potential impacts on Ancient Woodland consistently with guidance provided in the NPSNN.
Dense and scattered scrub	x	x	x	x	x	x	x	x	x	x	x	
Hedgerow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Species Poor Improved Grassland	x	x	x	x	x	x	x	x	x	x	x	
Semi - improved Neutral Grassland	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	The preferred option should address potential impacts on Ancient Woodland consistently with guidance provided in the NPSNN.
Riparian Vegetation and Running Water	x	x	x	x	✓	✓	✓	✓	✓	✓	✓	
Waterbodies	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

✓ Significant impacts likely

X No significant impacts anticipated

PROTECTED AND NOTABLE SPECIES

8.7.34 In the absence of detailed protected and notable species survey data, it is not possible to accurately determine the impacts resulting from each of the scheme options. Therefore a precautionary approach has been used to assess the magnitude of impacts often assuming species presence where there is no data to validate likely absence of a species. Further survey and assessment will be required in order to accurately determine the impacts and magnitude of impacts for protected and notable species.

INVERTEBRATES (TERRESTRIAL AND AQUATIC)

8.7.35 All scheme options would likely result in the permanent loss of habitats that are potentially utilised by protected and notable invertebrate species. These habitats include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS, and potentially also certain areas of scrub, grassland, hedgerow and running and standing water.

8.7.36 Option 0A may result in adverse impacts on protected and notable species, but given that only small areas of habitat are likely to be removed, and that no Ancient Woodland habitat is likely to be lost, this impact is unlikely to result in an effect that would be significant above the Local level.

8.7.37 Relatively large areas of potentially suitable invertebrate habitat are likely to be permanently lost as a result of all other proposed scheme options. It is probable that this will result in a significantly adverse effect on invertebrate conservation status, however, the geographical level at which such an effect would be significant will depend on what

assemblages of invertebrates are affected. scheme option 3 would likely result in an adverse effect significant at the County level given the loss of Ancient Woodland. Other scheme options may result in an effect which would be significant at up to the County level.

GREAT CRESTED NEWT

- 8.7.38 All scheme options would likely result in the permanent loss of terrestrial and aquatic habitats that are potentially utilised by GCN for breeding, foraging and hibernating. Habitats identified of highest potential importance for GCN include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS and the complex of ditches and waterbodies south of Arundel.
- 8.7.39 Options 0A and 0B would result in relatively minor losses of terrestrial and aquatic GCN habitat and it is probable that, although an adverse impact on GCN conservation status, the resulting effect would only be likely to be significant at the Local level.
- 8.7.40 In contrast, large areas of potentially suitable terrestrial and aquatic GCN habitat are likely to be permanently lost as a result of all other proposed scheme options. These impacts are also likely to compromise GCN conservation status and are likely to result in a significantly adverse effect. However, the geographical level at which such effect would be significant will depend on the number and size of GCN populations which are affected. Option 3 would likely result in the highest magnitude adverse impact on GCN given the large area of Ancient Woodland habitat that would be removed. It is probable that this would result in an adverse effect significant at the County level. Effects arising from other scheme options may also be significant at up to the County level.

REPTILES

- 8.7.41 All scheme options would likely result in the permanent loss of habitats that are potentially utilised by reptiles for basking, commuting, foraging and hibernating. Habitats identified of highest potential importance for reptiles include large area of semi-natural grassland either side of the River Arun and woodland edges and rides associated with Binsted Wood Complex LWS and Rewell Wood Complex LWS.
- 8.7.42 As with other impacts, options 0A and 0B would involve relatively small losses of reptile habitat and it is probable that this would not compromise reptile conservation status and would be unlikely to be a significant effect.
- 8.7.43 Other scheme options all involve large losses of potential reptile habitat. It is probable that this will result in an significantly adverse effect on reptile conservation status, however, the geographical level at which such an effect would be significant will depend on the diversity and size of reptile populations which are affected. If large populations or populations of several reptile species are affected this could result in an effect which is significantly adverse effect at up to the County level.

BREEDING BIRDS

- 8.7.44 Loss of breeding and foraging habitats for commonplace bird species and losses of bird habitat associated with options 0A and 0B are only likely to be adverse at the Site level which would not be significant. This is because of the common and widespread nature of such species and/or the relatively small areas of habitat affected.
- 8.7.45 All other scheme options would likely result in the permanent loss of habitats that are potentially utilised by protected and notable breeding birds. Habitats identified as being of greatest potential importance for these bird species include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS and grassland and

wetland habitats near to the River Arun. It is probable that loss of habitat in these areas will result in a significantly adverse effect on breeding bird conservation status, however, the geographical level at which such an effect would be significant will depend on what species are affected. Option 3 would likely result in an adverse effect significant at the County level given the loss of Ancient Woodland. Other scheme options may result in an effect which would be significant at up to the County level.

BATS

- 8.7.46 Loss of foraging and roosting habitats for bats associated with Options 0A and 0B are likely to be relatively small. However, if roosts of rare species are affected this may compromise bat conservation status resulting in a significantly adverse effect at up to the County level.
- 8.7.47 All other scheme options would likely result in the permanent loss of relatively large areas of bats roosting, commuting and foraging habitat. Habitats identified of highest potential important for bats include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS and wetland and grassland habitat close to the River Arun. Mature trees and old buildings affected by these scheme options may also support a roost of a rare bat species which would be of high conservation value.
- 8.7.48 It is probable that losses of potential foraging and commuting habitat and loss of potential roosts associated with all scheme options (excluding 0A and 0B) will result in a significantly adverse which may compromise bat population conservation status. However, the geographic level at which such an effect would be significant is likely to vary markedly between different schemes and for different species and to this end it is difficult to provide a generalised assessment without detailed survey data. For example, if particularly rare bat species is present in areas of Ancient Woodland, the loss of this habitat and fragmentation of bat populations may result in an impact that would be significant above the County level. For losses of smaller areas of habitat affecting more commonplace species this may result in effects that are significantly adverse at no more than the Local level.
- 8.7.49 Recent studies by Leeds University have shown that lighting and noise and vibration associated with operational road schemes and physical severance of bat habitat caused by expanses of roadway may lead to negative effects on bat populations either side of a road. These impacts may also be significantly adverse and would be of highest magnitude if one of the operational schemes were to pass through semi-natural habitat such as the Ancient Woodland in Binsted Wood Complex LWS, Rewell Wood Complex LWS and along the River Arun. The geographic level at which such an effect would be significant is likely to vary markedly between different schemes and for different species.

DORMICE

- 8.7.50 All scheme options would likely result in the permanent loss of habitats that are potentially utilised by dormice. Habitats identified of highest importance for dormice include Ancient Woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS which may provide important foraging and nesting opportunities. Hedgerows across the Survey Area may also provide foraging, nesting and commuting opportunities for dormouse.
- 8.7.51 Options 0A and 0B are likely to result in relatively small areas of habitat loss affecting dormouse and are unlikely to lead to significant effects on dormouse conservation status.
- 8.7.52 For all other scheme options, given the large area of suitable dormouse habitat that could be permanently lost, there is likely to be a significantly adverse effect on dormouse conservation status. The geographical level at which such an effect would be significant will depend on the size of the affected dormouse population and the extent to which

populations of dormouse are fragmented by road construction. If a large dormouse population is affected, or if severance of key dormouse movement routes is of a high magnitude, this could be a significantly adverse effect at up to the County level. Option 3 has the highest potential for a significantly adverse effect given the extensive loss of Ancient Woodland which is a high quality dormouse habitat.

OTTER

- 8.7.53 Options 0A and 0B are likely to result in relatively small areas of habitat loss affecting otter and are unlikely to lead to significant effects on otter conservation status.
- 8.7.54 Other scheme options are likely to result in the permanent loss of terrestrial habitats that are potentially utilised by otters for movement, shelter and breeding. Habitats identified as being of highest potential importance to otter include wetland habitat adjacent to the River Arun. Construction of all other scheme options may also lead to disturbance of otters using watercourses across the Survey Area. This may result in severance of otter movement routes – particularly those associated with the River Arun where bridge crossings are proposed. These impacts are likely to lead to a significantly adverse effect on otter conservation status. Given that otter is a relatively widespread species in Sussex and that English otter populations are on the increase, these impacts are unlikely to be significant at the County level.

WATER VOLE

- 8.7.55 All scheme options (except options 0A & 0B) would likely result in the permanent loss of habitats that are potentially utilised by water voles for shelter, foraging and breeding. Habitats identified as potentially significantly important for water voles are the wet ditches which were recorded running parallel to the A27 carriageway and those connected to the River Arun.
- 8.7.56 Given the extent of suitable habitat that is likely to be permanently lost as a result of all proposed scheme options (except options 0A & 0B), water voles if present within the study area could be directly impacted for example through destruction of burrows and loss of foraging habitat. In addition, road construction may sever connections between water vole colonies located either side of the Survey Area. These impacts are likely to result in a significantly adverse impact on water vole populations. Given the rarity of water vole and long term decline in this species in England, such impacts would be likely to be significant at least at the County level.

BADGER

- 8.7.57 All scheme options would likely result in the permanent loss of habitats that are possibly utilised by badgers potentially resulting in the damage / destruction to badger setts. Habitats identified as of highest potential importance for badgers with a high probability of setts being present include woodland within Binsted Wood Complex LWS and Rewell Wood Complex LWS. Option 3 contains habitat with the highest likelihood of affecting badger setts.
- 8.7.58 Where the operational road crosses existing badger clan territories or truncates badger paths, badgers may frequently attempt to cross the new carriageway. This may result in high levels of badger mortality which would deplete location populations and may even lead to loss of badger populations in close proximity to the operational scheme.
- 8.7.59 Badger is a widespread and relatively common species in Sussex and badger conservation status is unlikely to be affected by any scheme option. Nonetheless construction and operation may result in a significantly adverse impact but this is unlikely to be above the Local level.

FURTHER SURVEYS REQUIRED

- 8.7.60 Further ecological survey and assessment will be required once the number of options has been reduced and the designs refined, in order to undertake a complete ecological assessment of the impacts.
- 8.7.61 Protected species survey could potentially be required for the following groups and potential other species groups should suitable habitat be identified once land access is gained:
- Invertebrates (terrestrial and aquatic);
 - GCN;
 - Reptiles;
 - White-clawed Crayfish;
 - Breeding Birds;
 - Bats;
 - Dormice;
 - Otter;
 - Water Vole; and
 - Badger.
- 8.7.62 There may also be a requirement to undertake invasive species surveys, and propose measures to prevent the spread of these species.

8.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

DESK STUDY

- 8.8.1 Data provided by biological records centres is often subject to the spatial coverage of biodiversity recording schemes, many of which are carried out by volunteer surveyors. This data frequently does not include negative survey data (data showing where surveys have occurred and species absence has been proven likely). In particular, certain areas (e.g. nature reserves) have been heavily recorded whereas other areas (e.g. private farmland) have not been well studied. For this reason, in this assessment the absence of desk study records for a particular species has not been taken to indicate species absence. In all instances, the presence or absence of desk study records has been used alongside habitat data and the known/anticipated species distributions to infer whether these species may be present. Where doubt exists a precautionary assessment has been undertaken by assuming possible presence.

SURVEY LIMITATIONS

- 8.8.2 The survey was restricted to areas within publicly accessible highway or footpaths. Inaccessible areas were therefore mapped from adjacent land boundaries during this visit, with the aid of desktop information such as aerial photographs and OS maps. Land access was restricted immediately east and west of the River Arun, within many fields containing grazing livestock and along arable field margins. A detailed assessment of the grassland habitat type within these fields could therefore not be undertaken. Using a precautionary approach these grasslands were identified as semi-improved neutral grassland although it is probable that a proportion of them are in fact improved grassland and a small proportion of them may be unimproved grassland. In addition, land access was restricted along the A27 carriageway towards the eastern and western ends of the

study area due to the dual carriageway having limited areas of clearance between the carriageway and its boundary. The habitat types (predominantly woodland) were therefore identified and mapped using information obtained from a vehicle driving along the A27 carriageway. The extent and coverage of the site survey is considered adequate to enable a preliminary EclA. Further survey data may be required to facilitate a robust assessment when a detailed scheme design is selected.

- 8.8.3 Targeted surveys for faunal and floral species were not considered necessary at this early stage in scheme option development as general guidance on likely ecological impacts may be provided by consideration of broad habitat suitability for different species. In instances where habitats could not be viewed as a result of any land access, a precautionary assessment was undertaken and species presence was assumed. Once a preferred option is selected at PCF Stage 3, further detailed species survey work may be required to accurately determine species presence or likely absence and to accurately define the scale and magnitude of possible ecological impacts.
- 8.8.4 As a result of changes to the outline scheme options at a late stage in the assessment process, the outer edge of the Survey Area has increased in size beyond the area where survey work was undertaken. As a result of this, land between the village of Binsted and Walberton was not surveyed for the Phase 1 Habitat Survey. Desk study information and aerial photography have been used to classify these habitats and their nature conservation value has been inferred using this data which is considered robust for an options appraisal assessment which is intended to identify key ecological issues.
- 8.8.5 The Extended Phase 1 Habitat Survey was carried out during January. As such, seasonal variations could not be observed and potentially only a selection of all species that occur within the Survey Area will have been noted. The Extended Phase 1 Habitat Survey therefore provides a general assessment of potential nature conservation value. However, it is considered that the combination of biological records from the desk study and the site visit provides an accurate representation of the various species and habitat types present or potentially present within the Survey Area.
- 8.8.6 The Extended Phase 1 Habitat Map Figure 8.1 has been reproduced from field notes and plans. Whilst this provides a sufficient level of detail to fulfil the requirements of a preliminary EclA, the map is not intended to provide exact locations and distributions of key habitats. Furthermore the habitats and the management of the habitats are likely to change over time.

ASSESSMENT LIMITATIONS

- 8.8.7 The assessment considers ten scheme options and has been completed without detailed design information. For this reason, the ecological impact assessment is provisional. Through use of detailed desk study information and by adopting a precautionary approach to assessment, it is not considered likely that any key issues have been omitted. However, the severity of and magnitude of ecological impacts may change when more advanced information is available concerning the scheme design footprint, the likely construction programme and the construction methodology.

9

GEOLOGY AND SOILS

9.1 INTRODUCTION

- 9.1.1 This chapter provides a high level assessment of potential interactions between the development options detailed in Chapter 3 and geology and soils. This chapter also assesses potential effects on contaminated land receptors, as land contamination can impose constraints on a proposed development.

9.2 ASSESSMENT METHODOLOGY

- 9.2.1 This assessment has been undertaken in accordance with the principles of:
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5: Assessment and Management of Environmental Effects, dated August 2008; and,
 - Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11: Geology and Soils, dated June 1993.
- 9.2.2 This chapter comprises Stage 1 of the assessment methodology set out in DMRB Volume 11, Section 3, Part 11. The objective at this stage is to identify attributes of importance (e.g. geology, geomorphology, soils), and the significance of potential effects upon them, to be taken into account when refining the development options.
- 9.2.3 To help meet this objective, a Phase 1 Preliminary Risk Assessment (PRA) has been undertaken to establish baseline conditions in the study area and assess potential interactions with geology and soils (including potential land contamination) during the construction and operational phases of the development options junction.
- 9.2.4 The baseline conditions of the site have been identified with reference to the following sources of information:
- Envirocheck® Report, no. 65341276_1_1, dated 11 March 2015;
 - British Geology Survey (BGS) BGS 1:50,000 Series Geological Map Sheet No. 317/332 'Chichester and Bognor' (Solid and Drift ed.), 1996;
 - British Geology Survey online 'Geology of Britain' Viewer (<http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer/>);
 - British Geological Survey web-hosted Onshore GeoIndex (<http://www.bgs.co.uk/geoindex/>);
 - Environment Agency, 2016. What's in your backyard? Groundwater Source Protection Zones Map (<http://apps.environment-agency.gov.uk/wiyby/37833.aspx>);
 - Natural England, 2010. Agricultural Land Classification map London and the South East (ALC007) (<http://publications.naturalengland.org.uk/category/5954148537204736>).); and
 - HAGDMS, Highways England, Geotechnical Data Management System, <http://www.hagdms.co.uk>.

LAND CONTAMINATION

- 9.2.5 The potential for land contamination within the study area has been assessed in accordance with the principles of the Environment Agency report CLR11: Model

Procedures for the Management of Land Contamination. In accordance with current UK Government guidance, qualitative risks on land contamination are assessed using a 'Source-Pathway-Receptor' approach, where the following definitions apply:

- Source/ hazard: a substance or situation which has the potential to cause harm or pollution;
- Pathway: means by which a source/ hazard can reach and impact upon a receptor; and
- Receptor: that which may be adversely affected by the presence of the source/ hazard.

9.2.6 Such an approach recognises that risks from site-based contaminants can only exist where all three components are present, constituting a complete contaminant linkage. This approach forms the basis of the methodology used in this assessment.

9.2.7 Risks have then been evaluated in accordance with the methodology set out in CIRIA C552: Contaminated Land Risk Assessment – A Guide to Good Practice. This involves qualitative classification of the consequence and probability associated with each identified potential contaminant linkage. The classifications are then compared to determine the contaminant linkage risk.

9.2.8 The framework for determining the classification of consequence, of consequence, presented in full in CIRIA C552, is summarised in Table 9-1. The classification does not account for the probability of the consequence being realised. The 'severe' classification relates only to acute risks (arising from short-term exposure). The 'medium' classification relates to chronic harm (and, both of may constitute 'significant harm' under Part 2A.

Table 9-1: Qualitative Risk Assessment – Classification of Consequence

CLASSIFICATION	DEFINITION
Severe	Short term (acute) risks to human health, likely to result in significant harm. Short-term risk of pollution of sensitive water resource. Short-term risk to a particular ecosystem or organism forming part of such ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or organism forming part of such ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or to the environment.
Minor	Harm, not necessarily significant, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health. Easily repairable effects of damage to buildings, structures and services.

9.2.9 The framework for determining the classification of probability, presented in full in CIRIA C552, is summarised in Table 9-2.

Table 9-2: Qualitative Risk Assessment – Classification of Probability

CLASSIFICATION	DEFINITION
High Likelihood	There is a contaminant linkage and an event that appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	It is probable that an event will occur. Whilst not inevitable, it is possible in the short term and likely over the long term.
Low Likelihood	Circumstances are possible under which an event could occur, but it is not certain that (even over a long time period) such an event would occur.
Unlikely	It is improbable that an event would occur even in the very long term.

9.2.10 Once the consequence and probability have been determined for a potential contaminant linkage, these have been compared using the matrix shown in Table 9-3 to produce a risk category ranging from 'very high risk' to 'very low risk'.

Table 9-3: Qualitative Risk Assessment – Risk Category

		CONSEQUENCE			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/ Low Risk
	Likely	High Risk	Moderate Risk	Moderate/ Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/ Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/ Low Risk	Low Risk	Very Low Risk	Very Low Risk

9.2.11 A site walkover was undertaken by a WSP | Parsons Brinckerhoff engineer on 29 June 2015 to obtain recent site photography and identify current land uses and any potential sources of land contamination.

VALUE (SENSITIVITY)

9.2.12 A value (or 'sensitivity') has been assigned to geological, geomorphological and soil attributes in accordance with the principles established in Volume 11, Section 2, Part 5 of the DMRB.

9.2.13 Following consideration of the potential for post-construction effects, such as the remobilisation of contaminative substances following ground disturbance during the construction process, a value has also been assigned to the potential contaminated land receptors identified in the conceptual site model (CSM).

9.2.14 Assigning sensitivity relies on reason, professional judgement, and the advice of appropriate organisations (Volume 11, Section 2, Part 5 of the DMRB).

9.2.15 The values (and typical descriptors) assigned to attributes and contaminated land receptors are defined Table 9-4.

MAGNITUDE OF IMPACT (DEGREE OF CHANGE)

9.2.16 Magnitude of impact (and typical descriptors) are defined in Table 4-3 (Chapter 4), adapted from Volume 11, Section 2, Part 5 of the DMRB. Assigning magnitude of impact relies on reason, professional judgement, and the advice of appropriate organisations (Volume 11, Section 2, Part 5 of the DMRB).

SIGNIFICANCE OF EFFECT

9.2.17 The significance of effects is determined using the matrix in DMRB Volume 11, Section 2 Part 5, detailed in Table 4-3 (Chapter 4).

Table 9-4: Defining the Value (Sensitivity) of Attributes and Contaminated Land Receptors

VALUE (SENSITIVITY)	ATTRIBUTES			CONTAMINATED LAND RECEPTORS		
	Geology & Geomorphology	Soils	Controlled Waters	Built Environment	Construction Workers	End Users
High	Nationally important geological or geomorphological features (SSSI) or mineral resources.	Good to excellent quality agricultural land.	Principal aquifer beneath site, and/or major surface water in close proximity.	Buildings of high historic value or other high sensitivity.	Extensive earthworks including demolition of buildings.	Residential development, allotments, play areas.
Medium	Regionally Important Geological Sites (RIGS) (also known as Local Geological Sites) or mineral resources.	Poor to moderate quality agricultural land.	Secondary aquifer beneath site and/or minor surface water in close proximity.	Buildings, including services and foundation.	Limited to moderate earthworks.	Landscaping or public open space.
Low	No geological or mineral features of importance in close proximity.	Very poor quality agricultural land. Made ground with little potential for farming use.	Aquitard or aquiclude beneath site. No surface water body in close proximity.	Not applicable.	Minimal disturbance of ground.	'Hard' end use (e.g. industrial use, road, car park).

9.3 STUDY AREA

- 9.3.1 A study area for the assessment of effects on geology and soils is not specified in the DMRB. The study area specified in the Research and Development Publication 66¹⁹ which states that off-site features within an area up to 250 m from the site boundary should typically be considered within the hazard identification stage of site assessment.
- 9.3.2 For the purposes of this chapter, the study area is defined as the land within 250 m of the maximum extent of the proposed development options. However, where considered appropriate, ground conditions and potential contaminated land sources and receptors farther afield have been considered, with a focus on development of a robust conceptual site model.

9.4 BASELINE CONDITIONS

GROUND CONDITIONS

MADE GROUND

- 9.4.1 The study area comprises rural and agricultural land, and groundcover consists primarily of topsoil. Where residential or commercial developments exist, shallow areas of made ground are expected. It is also feasible that local areas of artificial ground exist in the agricultural land (e.g. where depressions have been filled to aid farming).
- 9.4.2 The study area contains minimal ground workings and generally comprises unworked ground. There are, however, areas of current and historical surface ground workings, including surface mineral workings and a cutting associated with the Arun Valley Railway.
- 9.4.3 BGS logs indicate localised areas of made ground associated with existing developments, typically comprising clay, silt, and sand, gravels of chalk and flint, and ash, to a maximum recorded depth of 2.75 m below ground level (b.g.l.).

SUPERFICIAL GEOLOGY

- 9.4.4 The study area contains Raised Marine Deposits (clay, silt, sand and gravel) associated with the River Arun. BGS borehole records describe this as estuarine alluvium, typically comprising interbedded silt and clay, to a depth of up to 30 m b.g.l.
- 9.4.5 To the east and west of the River Arun, superficial deposits, where present, comprise Raised Beach Deposits (sand and gravel) and Head deposits (clay, silt, sand and gravel). BGS borehole records describe the Raised Beach Deposits as clayey silty sand with flint gravel, present to depths of up to 5 m b.g.l. The Head deposits are described as flint gravels with varying clay, silt, and sand components.
- 9.4.6 There are occasional Raised Storm Beach Deposits (gravel). Superficial deposits are generally absent within the northwest of the study area, which forms part of the SDNP.
- 9.4.7 A map of the superficial geology of the site area can be seen in Figure 9.2 in Appendix A.

¹⁹ Research and Development Publication 66: Guidance for the Safe Development of Housing on Land Affected by Contamination (EA/NHBC, 2008)

SOLID GEOLOGY

- 9.4.8 The majority of the study area is underlain by the London Clay Formation (clay, silt, and sand) and the Lambeth Group (clay, silt, and sand). The offline development options also intersect the Spetisbury Chalk Member (chalk).
- 9.4.9 Published stratigraphy indicates that the Lambeth Group underlies the London Clay Formation, and both are underlain by the Spetisbury Chalk Member.
- 9.4.10 BGS borehole records from within the study area describe the London Clay Formation as stiff silty clay and the Lambeth Group as very stiff, closely fissured, slightly silty clay. The Spetisbury Chalk Member is described as Grade V chalk, recovered as very weak gravel-sized chalk fragments and soft sandy putty chalk.
- 9.4.11 A map of the bedrock geology of the site area can be seen in Figure 9.1 in Appendix A.

DESIGNATED SITES

- 9.4.12 There are no geological Sites of Special Scientific Interest or Regionally Important Geological Sites (also known as Local Geological Sites) within the study area.

SOIL QUALITY

- 9.4.13 The study area contains Grade 3 (good to moderate) and Grade 4 (poor) agricultural land as classified under the Agricultural Land Classification (ALC) system; with some areas primarily in non-agricultural use (e.g. the wooded areas within SDNP), and a small proportion of land classified as agricultural Grade 1 (excellent).²⁰ The study area may therefore contain a proportion of Best and Most Versatile (BMV) agricultural land.
- 9.4.14 The leaching potential of the soil ranges from low (soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or the soils have the ability to attenuate diffuse pollutants) to high (soils which readily transmit liquid discharges because they are shallow or susceptible to rapid flow directly to rock, gravel or groundwater). Soils with a higher leaching potential may act as an element in a potential contaminant linkage; for example, as a migratory pathway for a contaminative substance or as a contaminative substance source to which construction workers or end users may be exposed.
- 9.4.15 With respect to Soils Associations, indicative estimates of background soil chemistry provided in the Groundsure report are as listed. Current or historical land uses with the potential to affect soil chemistry, including metals concentrations in soil, are described in detail in the section, 'Potential for Land Contamination'.

→ Arsenic	<15-25 mg/kg;
→ Cadmium	<1.8 mg/kg;
→ Chromium	<60-90 mg/kg;
→ Nickel	15 30 mg/kg; and

²⁰ The Agricultural Land Classification map on which this review is based (published in 2010) is part of a series at 1:250 000 scale and is not sufficiently accurate for use in the assessment of individual sites.

→ Lead <100 mg/kg.

GROUNDWATER

- 9.4.16 The superficial deposits are classified by the EA as Secondary A Aquifers. The Spetisbury Chalk Member is a Principal Aquifer, and the Lambeth Group is a Secondary A Aquifer. The London Clay Formation is an aquiclude.
- 9.4.17 There are no groundwater Source Protection Zones (SPZs) within the study area. There is one groundwater abstraction licence within the study area (Licence No. 10/41/412201), associated with Havenwood Caravan Park.

SURFACE WATER

- 9.4.18 The major surface water feature within the study area is the River Arun (a Primary River), which transects the study area and flows south towards the English Channel. There are a great many Secondary and Tertiary channels throughout the study area associated with agriculture or draining the wooded area in the northwest.
- 9.4.19 There are three surface water abstraction licences within the study area (Licence Numbers 10/41/144010, 10/41/411020 and 10/41/411102) each associated with the irrigation of agricultural land.

HISTORICAL LAND USE

- 9.4.20 Historical land use within the study area is summarised in Table 9-5.

Table 9-5: Summary of Historical Land Use

ASPECT	MAP DATES	COMMENTS
Undeveloped rural land and woodland	1876	The earliest available County Series maps show undeveloped rural land and woodland. An active gravel pit is shown in mapping published in 1896.
Farm houses / residential properties	1876 – present	Occasional farm houses / residential properties present throughout the study area.
Arun Valley Railway	1876 – present	Arun Valley Railway, orientated northeast-southwest, passes through the eastern part of the study area.
A27 (historical)	1876-2002	The road network from which the existing A27 was developed, including Chichester Road on the northern boundary of the study area and other unnamed roads, are present in County Series mapping from 1876.
A27 (current)	2002 – present	The current A27 configuration, including Crossbush Roundabout, appears in 2002.

- 9.4.21 Arun Valley Railway, which intersects the eastern part of the site, and Arundel Station, was constructed prior to 1876.
- 9.4.22 There is an obsolete fuel retail site (formerly Arundel Service Station) situated < 100 m north of the site. It is unclear from historical mapping when this was first constructed.
- 9.4.23 There are six historical landfill sites with the study area in records held by the EA, all of which are situated in the northern part of the study area and are reported to have accepted inert waste only. Licences for these were last issued in January 1976. Closure dates are unknown. Where these feature in records of non-operational landfill sites held by the BGS, they are considered to present 'no risk to aquifer'.

CURRENT LAND USE

- 9.4.24 The majority of the study area comprises agricultural land or woodland. The River Arun and its subsidiary channels are present within the study area, flowing south towards the English Channel. Arun Valley Railway, orientated northeast-southwest, traverses the eastern part of the study area, east of the River Arun.
- 9.4.25 Arundel Railway station is situated in the eastern part of the study area, at the intersection between Arun Valley Railway and the current A27 alignment.
- 9.4.26 At Crossbush Roundabout, the existing A27 directs traffic north and west, through Arundel and past the wooded area in the northwest. There are a number of other access roads and lanes within the study area; the most important being Ford Road, which connects Arundel with Tortington to the south.
- 9.4.27 Arundel Fire Station is situated on Ford Road, approximately 400 m southwest of the A27. There is also a gas valve compound situated on Ford Road, approximately 1 km southwest of the A27. There are two electricity substations on Fitzalan Road, 300 m southwest of the A27 and 100 m north of the A27; and another 100 m south of the A27/A284 roundabout in Arundel. These features are within the study area.
- 9.4.28 There is an active fuel retail site (Crossbush Service Station) situated on the study area boundary near close to Crossbush Junction. This first appears in historical mapping published in 2002.
- 9.4.29 Arundel Arboretum, a nursery and garden services centre, is situated adjacent to the A27 within the wooded area in the northwest. Industrial repairs and servicing, potentially involving vehicles or other machinery, are undertaken at this site. Just south of Arundel Arboretum, within Havenwood Park, there is a water pumping station.
- 9.4.30 Arundel is the site of a number of industrial land uses based within 100 m of the northern study area boundary. These include substations, telecommunications, microelectronics, a vehicle repair, testing and servicing garage, a gunmakers, and a number of storage and distribution warehouses.

POTENTIAL FOR LAND CONTAMINATION

- 9.4.31 Where land has been contaminated as a result of former industrial processes, this has the potential to be a constraint on all development options. Consideration is also given to the potential for any post-construction impacts, due to the potential for remobilisation of contamination within ground disturbed by construction processes.

SOURCES

- 9.4.32 The localised made ground in areas of existing development, provenance and quality unknown, is a potential source of land contamination.
- 9.4.33 There is a potential for discharges to have occurred from the current and historical fuel retail sites and from vehicles using the road network. Any discharges are likely to be hydrocarbon based and include diesel fuels and lubricants. Although evidence of hydrocarbon discharge was not observed during the site walkover, discharges have the potential to have impacted drainage routes, which may not be fully competent. The direction of groundwater flow is likely to be south and west, towards the River Arun and south coast, transporting potential contaminants away from the proposed developments options.

- 9.4.34 Arun Valley Railway and Arundel Station are potential sources of contaminative substances including hydrocarbons, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), solvents, ethylene glycol, creosote, herbicides, ferrous residues, metal fines, asbestos, ash and fill, and sulphates.
- 9.4.35 The electricity substations are potential sources of PCBs and oils associated with possible electrical equipment, plant, interceptors, and oil storage tanks.
- 9.4.36 The historical landfills are potential sources of landfill gas (primarily methane and carbon dioxide, with possible traces of hydrogen sulphide, organosulphur compounds, and ethene), leachate containing ammonia, organics including phenols and PAHs, and inorganics including cyanides, sulphates, and heavy metals.
- 9.4.37 The industrial estate situated north of the study area, containing a vehicle garage, is a possible source of wide ranging contaminative substances including metals and metal compounds, acids and alkalis, asbestos, solvents, PAHs, hydrocarbon fuels and additives, ethylene glycols, polymerised glycols and ethers, and detergents.
- 9.4.38 The study area is situated within a Radon Affected Area, as defined by the Health Protection Agency, with 5-10% of properties above the Action Level. As the proposed scheme junction development options do not involve the construction of enclosed spaces where radon may accumulate, no potentially significant effects are expected to arise from radon exposure and radon is not considered further in the assessment.
- 9.4.39 Regional mapping provided by Zetica for West Sussex indicates that the study area is contained within an area of 'low' risk for unexploded ordnance (up to 10 bombs per 1000 acres). In general, in low risk areas, further action to mitigate the risk is considered prudent, although not essential.
- 9.4.40 No further potentially contaminative current or historical land uses have been identified within the study area.

CONCEPTUAL SITE MODEL

- 9.4.41 On the basis of the PRA, preliminary conceptual site model (CSM) has been developed. The CSM is presented in Table 9-6.

Table 9-6: Conceptual Site Model

SOURCE	PATHWAY(S)	RECEPTOR(S)	CONSEQUENCE	PROBABILITY	RISK
Made ground; fuel retail sites; highways; railway land; electrical substations; historical landfills; industrial land.	Ingestion, inhalation and dermal contact with contaminated soil; inhalation of windblown dust.	Construction workers	Medium	Unlikely	Low Risk
	Lateral migration of aqueous and dissolved contaminants via groundwater flow or preferential pathways.	Surface waters	Medium	Unlikely	Low Risk
	Vertical migration of aqueous and dissolved contaminants through made ground strata or via preferential pathways.	Groundwater	Medium	Unlikely	Low Risk
	Chemical attack and degradation.	Buildings (buried concrete structures)	Mild	Unlikely	Very Low Risk

ATTRIBUTE IMPORTANCE (SENSITIVITY)

The attribute importance (sensitivity) assigned to the identified environmental attributes and contaminated land receptors are shown in Table 9.7. The attribute importance levels are defined in Table 9-4.

Table 9-7: Attribute Importance

ATTRIBUTE / CONTAMINATED LAND RECEPTOR	JUSTIFICATION	ATTRIBUTE IMPORTANCE (SENSITIVITY)
Geology and Geomorphology	The study area does not lie within an area where nationally important geological or geomorphological features have been recorded (geological SSSIs) and there are no RIGS (also known as Local Geological Sites) within the study area.	Low
Soil	The area in which the scheme options are situated is primarily of agricultural Grades 3-4, with some areas of land primarily in non-agricultural use (i.e. wooded areas within SDNP), and a small proportion of land of agricultural Grade 1.	Medium
Groundwater	The superficial deposits, where present, are Secondary Aquifers. The Lambeth Group bedrock, which underlies much of the study area, is a Secondary Aquifer. The Spetisbury Chalk Member is a Principal Aquifer. A proportion of soils within the study area have a high leaching potential. There is one groundwater abstraction licence within the study area (License No. 10/41/412201), associated with Havenwood Caravan Park.	High
Surface Water	There is a Primary River within the study area (i.e. the River Arun). There are a large number of channels associated with agricultural or draining the wooded area to the northwest, including a segment classed as a Primary River. There are three surface water abstraction licences within the study area associated with agriculture.	High
Built Environment	The study area includes the existing A27.	Medium
Construction Workers and End Users	It is assumed that best practice will be adhered to throughout construction. The proposed future land use (i.e. a highway) is considered unlikely to expose end users to land contamination	Low

9.5

REGULATORY AND POLICY FRAMEWORK

9.5.1 Policies and regulations of relevance to this assessment are as follows:

- National Planning Policy Framework, Department for Communities and Local Government, March 2012;

- National Networks National Policy Statement (DfT, 2014);
- The Contaminated Land (England) (Amendment) Regulations 2012;
- Contaminated Land Statutory Guidance, Department for Environment, Food and Rural Affairs (Defra), April 2012;
- Technical Guidance to the National Planning Policy Framework, Department for Communities and Local Government, March 2012;
- DMRB Volume 11, Section 2, Part 5 Assessment and Management of Environmental Effects, August 2008;
- DMRB Volume 11, Section 3, Part 11 Geology and Soils, June 1993;
- Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66. Environment Agency / National House-Building Council. Volume 1. 2008;
- Model Procedures for the Management of Land Contamination (CLR11), Defra, 2004;
- Environmental Protection Act 1990, Part 2A, Section 78;
- Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2003 (SI 2003/3243);
- Water Resources Act 1991 (SI 57) (as amended by the Water Act 2003); and
- Highways Act 1980 Section 105A.

9.6

DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

- 9.6.1 Ground investigation work is required to characterise the existing ground conditions in relation to the CSM (to include consideration of soil, groundwater, ground gas, and geotechnical parameters). The works should be completed in accordance with BS10175:2011, CLR11, and other relevant standards and guidance. The information obtained must be utilised in the design and construction phases.
- 9.6.2 A Construction Environmental Management Plan (CEMP) is required which will outline the mitigation, control, and monitoring measures to be put in place to minimise the impact of the development options on ground conditions, land quality and water resources during the construction process.
- 9.6.3 Construction work is to proceed in adherence to the following documents:
- Protection of Workers and the General Public during the Development of Contaminated Land, HSE, 1991. This document establishes the key principles to take into account when designing and implementing work on contaminated sites to ensure the proper protection of the health and safety of employees and others who may be affected by such work; and
 - A Guide to Safe Working on Contaminated Sites, R132, CIRIA, 1996. This document is similar to the HSE document but also includes checklists to help in the preparation of health and safety risk assessments and the development of safe working practises, etc.
- 9.6.4 There is some potential for soils to be retained and re-used, either as part of the development options, landscape works, or elsewhere. The geochemical suitability of the soils for re-use would be assessed based on an appropriate waste assessment.

9.7 OVERALL ASSESSMENT

- 9.7.1 The objective of this high level assessment is to assess the significance of the potential effects of the proposed junction development options on soils, geology, and geomorphology; and to consider interactions between the proposed junction development options and potentially identified contaminated land receptors, thereby informing the selection of a preferred junction development option. Potential effects are summarised in Table 9-8. The likely impacts are based on a conservative assessment and represent the likely worst case scenario. The PRA indicated that the study area is unlikely to contain significant sources of contaminative substances. Effects on contaminated land receptors are therefore likely to be similar for the range of proposed development options. The scheme options are also expected to have similar impacts on geology, geomorphology, and soil.

GEOLOGY AND GEOMORPHOLOGY

- 9.7.2 With no geological SSSIs or RIGS (also known as Local Geological Sites) within the study area, there will be no change to these of Attribute or Contaminated Land Receptor Magnitude of Significance of geological and geomorphological attributes.
- 9.7.3 The effects of the development options on geological and geomorphological attributes will therefore be **neutral** in both the construction and operational phases.

SOILS

- 9.7.4 The offline options entail agricultural land take during construction, the extent of which is as yet undetermined and dependent upon the preferred development option. The affected agricultural land is primarily of ALC Grades 3-4 and may therefore comprise BMV land. It is conservatively assumed in this assessment that the loss of BMV agricultural land may exceed 50 ha. This impact of this would be **moderate adverse** during construction with **no change** during operation.
- 9.7.5 The effect of the offline options on soils is expected to be **slight to moderate** during construction and **neutral** during operation.
- 9.7.6 The online options entail minimal agricultural land take during construction. Impacts to soils are therefore expected to be **negligible adverse** during construction with **no change** during operation.
- 9.7.7 The effect of the online options on soils is expected to be **neutral or slight** during construction and **neutral** during operation.

GROUNDWATER

- 9.7.8 There is a potential for the construction process to create new migratory pathways for contaminative substances. The PRA indicates the study area is unlikely to contain significant sources of contaminative substances. The creation of migratory pathways is therefore unlikely to lead to a viable contaminant linkage. **No change** to is expected.
- 9.7.9 The effects of the development options on groundwater are therefore expected to be **neutral** in both the construction and operational phases.
- 9.7.10 Any future ground investigation data resulting in substantial change to the CSM may change this effect level at the detailed design stage.

SURFACE WATERS

- 9.7.11 There is a potential for the construction process to mobilise soil contamination during construction, with possible impacts on surface waters. The PRA indicates the study area is unlikely to contain significant sources of contaminative substances. It is therefore unlikely that existing surface water quality will be adversely impacted by land contamination. **No change** to is expected.
- 9.7.12 The effects of the development options on surface waters are expected to be **neutral** in both the construction and operational phases.

BUILT ENVIRONMENT

- 9.7.13 Chemicals that are destructive to concrete (e.g. sulphates and acids) have the potential to constrain the design of the development options. However, it is assumed that laboratory data will be available at the detailed design stage to characterise the concentrations of these substances in soil and groundwater and that suitable construction materials resistant to any such substances would be used. **No change** to the built environment is expected.
- 9.7.14 The effects of the development options on the built environment will therefore be **neutral** in both the construction and operational phases.

CONSTRUCTION WORKERS AND END USERS

- 9.7.15 Potential impacts to human health during construction, arising from possible oral, inhalation, or dermal exposure to substances in shallow soils, will be mitigated by adherence to best practice and guidance presented in the following documents:
- Protection of Workers and the General Public during the Development of Contaminated Land, HSE, 1991; and
 - A Guide to Safe Working on Contaminated Sites, R132, CIRIA, 1996.
- 9.7.16 The PRA indicates the study area is unlikely to contain significant contamination sources. Therefore, no exposure pathways relevant to end users in the operational phase are expected. **No change** to construction workers and end users is expected.
- 9.7.17 The effects of the development options on construction workers and end users will therefore be **neutral** in the construction and operational phases respectively.

9.8 SUMMARY OF EFFECTS

- 9.8.1 Effects are summarised in Table 9-8.

Table 9-8: Summary of Effects

ASPECT	SENSITIVITY OF ATTRIBUTE OR CONTAMINATED LAND RECEPTOR	MAGNITUDE OF IMPACT	SIGNIFICANCE OF EFFECT	SIGNIFICANCE OF EFFECT
			CONSTRUCTION PHASE	OPERATIONAL PHASE
Geology and Geomorphology	Low—no geological or mineral features of importance in close proximity.	No change.	Neutral	Neutral

Soil	Medium—study area is primarily agricultural land of ALC Grades 3-4.	Minor to Moderate adverse—some loss of agricultural land of ALC Grades 3-4.	Neutral or Slight (0A, 0B, 0BA, & 1) Slight to Moderate (3, 5, 05A, & 5B)	Neutral
Groundwater	High—superficial geology is Secondary Aquifer; bedrock includes Secondary and Principal aquifer.	No change—no source (the creation of new migratory pathways is unlikely to lead to a viable pollutant linkage).	Neutral	Neutral
Surface Water	High—Principal River (River Arun) is within study area.	No change—no known source (mobilisation of contaminants leading to surface water contamination is therefore considered to be unlikely).	Neutral	Neutral
Built Environment	Medium—no buildings but M271, A33/A35, Redbridge Flyover, etc.	No change—availability of laboratory data at detailed design stage will aid selection of construction materials.	Neutral	Neutral
Construction Workers and End Users	Low—minimal disturbance of ground; 'hard' end use (i.e. road and roundabout).	No change—adherence to best practice during construction; 'hard' end use (i.e. road and roundabout).	Neutral	Neutral

OPTIONS 0A AND 0B

- 9.8.2 These options involve online improvements to the existing carriageway. This is likely to entail minimal topsoil stripping and no significant land take or earthworks.
- 9.8.3 The online options are expected to have **neutral** effects on geology, geomorphology, groundwater, surface water, the built environment, and construction workers and end users; and a **neutral or slight** effect on soil; during construction.
- 9.8.4 The online options are expected to have **neutral** effects on geology, geomorphology, soil, groundwater, surface water, the built environment, and construction workers and end users; during operation.

OPTIONS 0BA AND 1

- 9.8.5 These options involve online widening of the existing carriageway and the construction of short offline links in the vicinity of Arundel Railway Station. This will entail minor agricultural land take, topsoil stripping, earthworks, and soil disturbance.
- 9.8.6 These options are expected to have **neutral** effects on geology, geomorphology, groundwater, surface water, the built environment, and construction workers and end users; and a **neutral or slight** effect on soil; during construction.
- 9.8.7 These options are expected to have **neutral** effects on geology, geomorphology, soil, groundwater, surface water, the built environment, and construction workers and end users; during operation.

OPTIONS 3, 5, 5A, AND 5B

- 9.8.8 These options involve the major new offline carriageways. This will entail major agricultural land take, topsoil stripping, earthworks, and ground disturbance.
- 9.8.9 These options are expected to have **neutral** effects on geology, geomorphology, groundwater, surface water, the built environment, and construction workers and end users; and a **slight or moderate** effect on soil; during construction.
- 9.8.10 These options are expected to have **neutral** effects on geology, geomorphology, soil, groundwater, surface water, the built environment, and construction workers and end users; during operation.

9.9 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

- 9.9.1 At this early stage of the design it is not possible to confirm ground conditions and areas of contamination. An intrusive ground investigation should be undertaken to confirm the anticipated ground conditions, confirm the absence of significant sources of contamination and obtain information necessary to permit detailed design, such as testing associated with determining the appropriate concrete class to be utilised. Future proposed ground investigation should also aim to determine waste classification and the re-use potential of soils.

10 MATERIALS

10.1 INTRODUCTION

- 10.1.1 This chapter assesses the effects associated with use of materials and generation of waste associated with the scheme options. It is based on guidance in IAN 153/11 (Highway Agency, 2011) on the environmental assessment of material resources.
- 10.1.2 The assessment of materials considers the use of material resources and the generation and management of waste. It is not within the scope of this assessment to assess the direct energy use associated with operation of the network.
- 10.1.3 Material resources include the materials and construction products required for implementation of the scheme options, both in terms of raw materials and manufactured items. The assessment does not consider the impacts of the production or manufacture of those materials, as this is subject to a separate assessment at source.

10.2 ASSESSMENT METHODOLOGY

- 10.2.1 The guidance in IAN 153/11 states that a 'Simple Assessment' should be undertaken before detailed design. The simple assessment assembles data and information that is readily available to address potential effects identified before detailed design information is available. This level of assessment would usually be undertaken at the Scoping stage, however as the scheme options being assessed within this ESR are preliminary, the assessment undertaken below broadly follows this approach and is limited in scope due to the lack of information at this design stage.
- 10.2.2 There is no topic specific significance criteria used in the DMRB for the assessment of materials and waste. Therefore this assessment follows the methodology set out in Chapter 4 of this ESR. The sensitivity of the receptor is dependent on the capacity of the local environment to provide materials or dispose of waste (i.e. the capacity of available waste management infrastructure). Predicted quantities of materials to be used and the waste forecasts, based on professional judgement, have been used to identify the magnitude of an impact.
- 10.2.3 The material requirements and waste generated by the ten scheme options is not known due to the limited design information available at this early stage in the design process. Furthermore, material sources are unknown. Calculations of waste arisings (for instance for the earth works balance) will be developed by the construction contractor for the preferred option, once it has been selected. This Chapter therefore provides a high level assessment of the impacts associated with materials use and waste generated by the scheme options.

10.3 STUDY AREA

- 10.3.1 The study area comprises the anticipated maximum physical extent of the scheme options. To identify existing waste management infrastructure, the study area for the baseline was extended to include the locations of waste management facilities and associated transportation networks within WSCC and the SDNP Authority.
- 10.3.2 Some impacts on materials and waste may occur off site, or possibly outside of the UK. This includes the depletion of non-renewable resources, the production of waste at the point of extraction of minerals or during the manufacturing process and transport. As

these stages of the process are likely to have been subject to an environmental assessment, they have not been included within the scope of this assessment. The assessment will consider the more immediate effects and impacts resulting from the use of materials and generation of waste associated with the scheme options.

10.4 BASELINE CONDITIONS

MATERIALS

10.4.1 The scheme options will require materials to create new carriageways and the widening of existing ones. Options are likely to vary significantly in terms of material usage due to their differences in scale but are likely to use the same broad categories of materials, primary materials, for example aggregates, or secondary, recycled materials brought in from off site, possibly produced by another nearby construction project. A summary of the likely materials to be used for all of the scheme options is provided in Table 10-1.

WASTE

10.4.2 The scheme options will result in the production of surplus material which may need to be disposed of as waste. In the case of this scheme surplus material is likely to require disposal from excavations for new carriage ways or carriage way widening, any material from the demolition of existing infrastructure, and materials bought to site that are not used for their original purpose (such as damaged or over-ordered goods). A summary of the likely waste to be used for all of the scheme options is provided in Table 10-1.

Table 10-1: Summary of materials and waste that have the potential to generate significant effects

SCHEME PROCESS	TYPE	POTENTIAL USE	POTENTIAL WASTE
Site Clearance	Concrete		✓
	Bricks		✓
	Concrete/Bricks Mix		✓
	Wood		✓
	Bitmac (road planings)		✓
	Iron and Steel		✓
	Mixed metals		✓
	Plastics		✓
	Soil and Stone		✓
	Type 5 A (topsoil/turf)		✓
	Type 2 (general excavation/fill)		✓
	Type 4 (landscaping/topsoil)		✓
	Type 6F1 & 2 (aggregates)		✓
	Vegetation		✓
Site Construction	Concrete	✓	✓
	Bricks	✓	✓
	Wood	✓	✓
	Bitmac		
	<i>Base, binder and wearing courses</i>	✓	✓

SCHEME PROCESS	TYPE	POTENTIAL USE	POTENTIAL WASTE
	<i>SLX tack coat</i>	✓	
	Iron and Steel	✓	✓
	Mixed Metals	✓	✓
	Plastic	✓	✓
	Soil and Stone		
	<i>Type 1 (803 sub-base/capping)</i>	✓	✓
	<i>Type 503 (pipe bedding)</i>	✓	✓
	<i>Type 505 (pipe filter material)</i>	✓	✓
	<i>Reclaimed Hedging Stone</i>	✓	
	<i>Type 5 A (topsoil/turf)</i>	✓	✓
	<i>Type 2 (general excavation/fill)</i>	✓	✓
	<i>Type 4 (landscaping/topsoil)</i>	✓	✓
	Vegetation	✓	
	Site Operation/ Maintenance	Concrete	✓
Bricks		✓	✓
Wood		✓	✓
Bitmac			
<i>Base, binder and wearing courses</i>		✓	✓
<i>SLX tack coat</i>		✓	✓
Iron and Steel		✓	✓
Mixed Metals		✓	✓
Plastic		✓	✓
Soil and Stone			
<i>Type 5 A (topsoil/turf)</i>		✓	✓
<i>Type 2 (general excavation/fill)</i>		✓	✓
<i>Type 4 (landscaping/topsoil)</i>		✓	✓
<i>Type 6F1 & 2 Aggregates</i>		✓	✓
<i>Type 1 (803 sub-base / capping)</i>		✓	✓
<i>Type 503 (pipe bedding)</i>		✓	✓
<i>Type 505 (pipe filter material)</i>		✓	✓
Reclaimed Hedging Stone		✓	✓
Vegetation		✓	

10.4.3 The West Sussex Waste Local Plan states that the county produces over 2 million tonnes of waste every year, which consists of the following:

- Municipal Solid Waste – 433,000 tonnes;
- Commercial and Industrial waste – 605,000;
- Construction, Demolition and Excavation Waste – 949,000 tonnes;

- Hazardous Waste – 30,400 tonnes; and
- Agricultural Waste – no published data.

10.4.4 Construction and demolition waste accounts for the largest proportion of the waste stream in the UK. In 2010, this was approximately 67% of the total waste produced in the UK (Defra, 2006).

WASTE MANAGEMENT INFRASTRUCTURE

10.4.5 There are over 50 waste management sites within West Sussex, the majority of them located near nearby centres that produce the majority of waste. As of 2010/11 in West Sussex 48% of all waste was being recycled, 33% being disposed to landfill and 20% being managed in other ways (including out of county treatment).

10.4.6 It is generally recognised that there is a shortage of strategic waste management facilities in the UK and an increase in waste management infrastructure is required to manage waste in the UK.

10.4.7 West Sussex aims to be a Zero Waste to Landfill county by 2031, which is expected to put pressure on the existing capacity of waste treatment facilities and present a need in future years for more waste management facilities to be created in the area.

10.5 REGULATORY AND POLICY FRAMEWORK

STATUTORY REQUIREMENTS

10.5.1 The EU Waste Framework Directive (2008/98/EC) provides an overarching legislative framework for the collection, transportation, recovery and disposal of waste. It outlines the Waste Hierarchy and the five steps for dealing with waste: prevention; preparing for re-use; recycling; other recovery, and; disposal. The Directive explicitly set a target for the recycling and reuse of 70% for construction, demolition and excavation wastes by 2020. This requirement has been implemented in England through The Waste (England and Wales) Regulations 2011.

10.5.2 In addition, the following legislative instruments in the UK govern the storage, collection, treatment and disposal of waste:

- The Control of Pollution Act 1974;
- The Control of Pollution (Amendment) Act 1989;
- Environmental Protection Act 1990 (EPA);
- The Environment Act 1995;
- The Finance Act 1996;
- Waste Minimisation Act 1998;
- The Waste and Emissions Trading Act 2003;
- The Clean Neighbourhoods and Environment Act 2005; and
- The Waste (England and Wales) (Amendment) Regulations 2012 and 2014.

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS (NPSNN)

- 10.5.3 The NPSNN requires that if a project is categorised as a NSIP evidence of appropriate mitigation measures (incorporating engineering plans on configuration and layout, and use of materials) during both design and construction needs to be presented together with the arrangements for managing any wastes that are produced.
- 10.5.4 Some of the scheme options proposed are likely to be considered an NSIP and will therefore be required to be compliant with the NPSNN.

WASTE MANAGEMENT PLAN FOR ENGLAND (2013)

- 10.5.5 The Waste Management Plan for England is a high level document which is non-site specific and provides an analysis of the current waste management situation in England. It provides planning framework to enable local authorities to put forward strategies that identify sites and areas suitable for new or enhanced waste management facilities to meet growing demand, through local waste management plans.

NATIONAL PLANNING POLICY FOR WASTE (OCTOBER 2014)

- 10.5.6 This document sets out detailed waste planning policies and states that all local authorities should have regard to its policies when discharging their responsibilities. The document provides guidance to local authorities on the following:
- Using a proportionate evidence base when preparing waste plans;
 - Identifying the need for waste management facilities;
 - Identifying suitable sites and areas for facilities; and
 - How to determine waste planning applications.

WEST SUSSEX WASTE LOCAL PLAN (2014)

- 10.5.7 This Local Plan contains WSCC's strategic vision for the management of waste until 2031. The Local Plan contains a number of waste related policies that the proposed Arundel works would need to comply with in order to contribute to the County's strategic goals.
- 10.5.8 Policy W23: Waste Management within Development states that 'proposals for development will be permitted provided that the waste generated during construction, demolition and excavation is minimised and that opportunities for re-using and recycling of waste are maximised'.
- 10.5.9 The chosen option should be in line with the strategic goals of this document in order to be compliant with county policy.

DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

- 10.5.10 To limit potential impacts upon resources and demonstrate that decisions made during detailed design, construction and operation represent long term value for money, a number of measures for materials resource efficiency and waste have been considered.

MITIGATION INCLUDED IN DESIGN

- 10.5.11 A number of standard mitigation measures should be incorporated within the design of the preferred option to limit material and waste impacts of the scheme works and aim to reduce the requirement of additional imported materials. Currently there is not sufficient detail on the scheme options to determine which mitigation would be appropriate for each option within this ESR. Details of mitigation requirements will be outlined in PCF Stage 2, once the number of options has been reduced, and more information is available on the option designs. The details will be further refined for the preferred option in PCF Stage 3.
- 10.5.12 The proposed scheme works should aim to minimise export and import of fill materials. An example of how this could be achieved would be by balancing earthworks cut and fill volumes.
- 10.5.13 Topsoil stripped as a result of the works should be reused wherever possible in order to establish landscaping features such as embankments and verges as well as to provide a basis for landscape planting.
- 10.5.14 Where existing surfaces are to be replaced, this material should be re-used as either a sub-base or inclusion within new scheme construction.

MITIGATION INCLUDED IN CONSTRUCTION

- 10.5.15 Mitigation during construction should be managed through the implementation of an Outline Site Waste Management Plan (SWMP) for the preferred option at the detailed design stage.
- 10.5.16 The SWMP will aim to ensure that the waste produced during the construction phase, in addition to other phases of the scheme is dealt with in accordance with the Duty of Care Provisions in the Environmental Protection Act 1990.

DETAILED ASSESSMENT OF MATERIALS

- 10.5.17 A Detailed Assessment should be undertaken, once the preferred option has been selected, to identify how the use of materials conforms to high level strategy targets outlined in the following policy documents:
- The EU Waste Framework Directive 2008;
 - The Waste (England and Wales) (Amendment) Regulations 2012;
 - National Planning Policy Framework 2012;
 - Waste Prevention Programme for England 2013; and
 - West Sussex Waste Local Plan (2014).

10.6 OVERALL ASSESSMENT

- 10.6.1 No information on the materials or waste generation associated with the scheme options is available at this early stage. However, in general it is assumed that options with a larger development footprint, and larger scale ground works will produce a higher level of waste and require increased amounts of materials to complete.

OPTION 0A

- 10.6.2 This option consists of improvements to the Crossbush junction only and is considered the 'do minimum' option. However, it still requires large scale improvements of the

Crossbush junction that will require the use of primary material resources and will produce groundwork related spoil that will need to be disposed of as waste.

- 10.6.3 This option should be considered the option with the least material requirements for large scale improvement of the A27 and is predicted to have a slight adverse impact on materials.

OPTION 0B

- 10.6.4 This option incorporates the ground works associated with Option 0A as well as widening of the existing A27 to a dual carriage way, which will require the use of primary and secondary materials and is likely to produce spoil waste from the groundworks.

- 10.6.5 The option is considered likely to have a moderate adverse impact on materials.

OPTION 0BA

- 10.6.6 The material requirements of option 0BA is expected to be greater than that of Option 0B as a result of the inclusion of an offline section of road. It is also expected to produce surplus material through clearance and excavation relating to highway construction. The alignment of Option 0BA runs through a small section of woodland that will increase option related waste generation.

- 10.6.7 This option is considered to have a moderate adverse impact on materials.

OPTION 1

- 10.6.8 This option is expected to require materials for the offline road construction and extensive widening of the existing road. Widening of the existing A27 is also expected to produce construction waste that will need to be disposed of or reused elsewhere. The offline section of the scheme will increase the material requirements of the option considerably when compared to the online improvement options. The construction of the offline section of road will also require the disposal or reuse of top soil and other spoil associated with the groundworks.

- 10.6.9 This assessment indicates that this improvement option will have moderate adverse impact on materials.

OPTION 2

- 10.6.10 Although the shortest of the solely offline improvement options, Option 2 would still require a large amount of materials to complete as well as be likely to produce a large amount of surplus material that would need to be deposited as waste or be reused. Option 2 also passes through a large area of woodland which would need to be cleared and the vegetative material disposed of or recycled.

- 10.6.11 This option is expected to have major adverse impacts on materials.

OPTION 3

- 10.6.12 A large amount of primary and secondary materials are expected to be used as a result of this option as it requires the construction of a large section of a major highway and its supporting infrastructure. The scale of the works would also result in large scale ground works, excavation and site clearance which are likely to produce large amounts of topsoil, spoil and vegetation waste. As the alignment runs through a section of woodland, timber

waste is expected to be produced and has the potential to be recycled.

10.6.13 This option is expected to have major adverse impacts on materials.

OPTION 4

10.6.14 Offline highway construction and large scale junction improvements at either end of the route's extent would involve large scale use of primary and secondary materials. Clearance and groundworks associated with the construction of this option will produce large amounts of excess material that will need to be disposed of as waste, although waste levels would be reduced when compared to Options 2 and 3, as result of the route avoiding large areas of woodland.

10.6.15 This option is expected to have major adverse impacts on materials.

OPTION 5

10.6.16 As with all the offline options, highways construction and junction improvements will require large scale use of primary resources and will result in the production of significant amounts of spoil and other material that will need to be disposed of as waste, however, this amount is expected to be reduced when compared to option 3 which will require the clearance of woodland.

10.6.17 This option is expected to have a major adverse impact on materials.

OPTION 5A

10.6.18 Option 5A is expected to have the same impact on materials and waste as Option 5.

OPTION 5B

10.6.19 This option is expected to have the same impact on materials and waste as option 5.

10.7 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

10.7.1 No detailed information on materials use or waste quantities generated is available at this stage of design. This assessment outlines high level impacts associated with materials use and waste generated by the scheme options, with these being likely to change as the scheme options are reduced and scheme designs refined. This assessment will be updated at PCF Stage 2 and 3 when more detailed information on materials and waste becomes available.

11 NOISE AND VIBRATION

11.1 INTRODUCTION

11.1.1 This chapter provides an assessment of the likely noise and vibration impacts arising from the construction and operation of the scheme options on nearby sensitive receptors. Information available at PCF Stage 1 is limited. Therefore, the assessment should be considered as preliminary and its primary objective is to support the optioneering process.

11.1.2 The scheme options have the potential to affect the noise and vibration levels experienced by nearby noise sensitive receptors due to changes in the road alignment on both the on-line and off-line options.

11.1.3 A glossary of acoustics terminology is presented in Appendix E.

11.2 ASSESSMENT METHODOLOGY

COLLECTION OF BASELINE INFORMATION

11.2.1 Noise Important Areas (NIAs) within close proximity to the site have been identified using the Highways England database. Residential areas have been identified using Google Earth and observations on site.

11.2.2 A preliminary noise survey was undertaken on 19th January 2016 to establish the current noise climate within close proximity to road links potentially affected by the scheme.

11.2.3 The survey methodology followed the shortened measurement procedure described in Calculation of Road Traffic Noise (CRTN) over three consecutive hours on a typical weekday. Noise descriptors L_{A10} , L_{A90} , L_{Aeq} , L_{Amin} , L_{Amax} were recorded.

11.2.4 The weather conditions during the survey were conducive to environmental noise monitoring, dry with low wind speeds. This allows repeatability of the survey and provides a representative assessment of the baseline conditions.

11.2.5 Table 11-1 describes the noise survey locations which are also illustrated in Figure 11.1.

Table 11-1: Measurement Locations

MEASUREMENT LOCATION	INDICATIVE ADDRESS	DISTANCE FROM THE CARRIAGEWAY (M)
ML1	Ford Road, Arundel BN18	1.5
ML2	Chichester Road (A27), Arundel BN18 0UX	8
ML3	Arundel Bypass (A27), Arundel BN18 9JU	10
ML4	London Road (A284), Arundel BN18 9JL	10

11.2.6 Table 11-2 describes the equipment used in the survey. Class 1 Sound Level Meters (SLMs) were used to undertake the measurements in free field conditions at a height of 1.2m above the ground level. Calibration certificates of the noise equipment used in the survey are presented in Appendix F.

Table 11-2: Noise Survey Equipment

MEASUREMENTS	SOUND LEVEL METER	PRE-AMPLIFIER	MICROPHONE	CALIBRATOR
ML1, 2	Rion NL-52 Sn 00632043	Rion NH-25 Sn 32071	Rion UC-59 Sn 05210	Rion NC-74 Sn 34536109
ML3, 4	Rion NL-52 Sn 01021290	Rion NH-25 Sn 21332	Rion UC-59 Sn 04346	Rion NC-74 Sn 34536109

ASSESSMENT OF IMPACTS

11.2.7 The likely noise and vibration impacts arising from the construction phase of the scheme options will be assessed in accordance with BS5228 -1&2 (2009+A1 2014). The significance of impacts during the construction phase will be assessed based on the 'ABC' method described in BS5228. This method bases the construction noise impact assessment upon the baseline ambient noise levels. Categories of threshold values are assigned in accordance with Table 11-3. This method presents the threshold of significant effects at dwellings due to construction noise.

Table 11-3: Assessment Category and Threshold Value

EVALUATION PERIOD	ASSESSMENT CATEGORY (DB LAEQ)		
	A	B	C
Night-time (23:00-07:00)	45	50	55
Evening and Weekends*	55	60	65
Daytime (07:00-19:00)	65	70	75
* 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays.			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.			
Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as Category A values.			
Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than Category A values.			
The Category (A, B or C) is to be determined separately for each time period and the lowest noise category is then used throughout the 24-hour cycle, e.g. a site which is category A by day and category B or C in the evening and night will be treated as category A for day, evening and night.			

11.2.8 Where the construction noise level exceeds the thresholds for the appropriate category, then the significance of the impact will be determined as follows:

- negligible (<1dB);
- low (1-3dB);
- medium (3-5dB); and
- high (5-10dB).

11.2.9 In the absence of a detailed list of plant used during construction, typical noise levels for construction plant items presented in BS5228 will be used to complete the assessment. Plant items associated with the activities of site clearance, drainage & piling and general road construction will be used in the calculations as presented in Table 11-4.

Table 11-4: Typical Construction Noise Levels at 10m

CONSTRUCTION ACTIVITY	CALCULATED DB L_{Aeq} AT 10M
Site Preparation	90
Piling and Drainage	88
Road Construction	87

11.2.10 Indicative values in Table 11.4 have been used in this assessment to identify areas potentially subject to a significant noise impact. An assessment of the likely vibration impact will be undertaken at a later stage once information about the construction methodology is available.

11.2.11 For the operational phase, road traffic flow information required to quantify the likely impacts arising from each of the scheme options is not yet available. Therefore, at this stage a qualitative assessment has been produced based on a description of the likely road traffic flow changes presented in Chapter 3 earlier in the ESR. An indication of the significance of impacts has been provided based on DMRB guidance, introduced later on in this chapter.

11.2.12 A computer noise model will be prepared in due course once the quantitative information is available for both the construction and operational phases.

11.3 STUDY AREA

11.3.1 The study area for the construction assessment has been limited to noise sensitive receptors within 300m from the proposed works.

11.3.2 The study area for the operational phase has been defined in accordance with the methodology in DMRB. The following steps have been taken into account to define the study area:

- The start and end points of the physical works associated with the junction options were identified;
- The existing routes that are being by passed or improved, and any proposed new routes, between the start and end points were identified;
- A one kilometre boundary from the carriageway edge of the routes defined above was defined; and
- A 600m boundary from the carriageway edge around each of the routes identified in (2) and also 600m from any other affected route within the boundary defined in (3) were identified. An affected route is where there is a possibility of a change of 1dB(A) in the short term and 3 dB(A) in the long term.

11.4 BASELINE CONDITIONS

NOISE CONSTRAINTS

11.4.1 Surroundings of the site include a mixture of urban and semi-rural areas with the majority of noise-sensitive receptors concentrated in and around the town of Arundel.

- 11.4.2 There are twelve NIAs at, or within, close proximity to the site as shown in Figure 11.1. Table 11-5 presents a list of the NIAs and the associated design options which have the potential to adversely affect them.

Table 11-5: Noise Important Areas

NIA	DESIGN OPTION
12488	0A, 0B, 0BA and 1
5487	0A, 0B, 0BA and 1
5488	0A, 0B, 0BA and 1
12489	0A, 0B, 0BA and 1
5486	0A, 0B, 0BA and 1
5484	0B and 0BA
5485	0A, 0B, 0BA and 1
6157	0B and 0BA
6158	0B
5490	0B and 5B
5491	0B
12485	0B

- 11.4.3 In addition to the above, the A27 runs along-side and through the South Downs National Park (SDNP). Some of the scheme options currently cross Binsted Wood and Tortington Common. Arundel Park SSSI is immediately north of Arundel.

EXISTING NOISE LEVELS

- 11.4.4 A summary of the baseline noise survey results is presented in Table 11-6. It should be noted that the results presented do not include a distance correction. A detailed set of measurements for each location is presented in Appendix G.

Table 11-6: Noise Survey Results

MEASUREMENT LOCATION	DATE AND START TIME	L _{A10, 3H} DB	L _{A10, 18H} DB	L _{AEQ, 3H} DB	L _{A90, 3H} DB
ML1	19/01/2016 10:05	74	73	70	43
ML2	19/01/2016 13:55	75	74	73	43
ML3	19/01/2016 11:22	67	66	65	59
ML4	19/01/2016 14:30	73	72	68	48

11.4.5 L_{A10, 18h} was calculated following the shortened measurement procedure described in the CRTN from the relation:

$$L_{A10, 18h} = L_{A10, 3h} - 1\text{dB (A)}$$

11.4.6 Observations on site concluded that the existing noise climate is dominated by road traffic. It can be seen from the results in Table 11.6 that the existing noise is generally above L_{A10, 18h} 68 dB at locations within close proximity to the road network. It should be also noted that some residential properties are within close proximity to the main roads as it is the case for the first row of dwellings at Ford Road, representative of ML1, and those properties lying within the NIAs along the A27, representative of ML2 and ML3.

11.4.7 The noise survey data presented in this report is suitable to validate a preliminary noise model which will be prepared in the next PCF Stage when the scheme options are refined and traffic data is produced.

11.5 REGULATORY AND POLICY FRAMEWORK

ENVIRONMENTAL NOISE DIRECTIVE, 2002

11.5.1 EU Directive 2002/49/EC relates to the assessment and management of environmental noise, and it is normally referred to as the Environmental Noise Directive (END). It promotes the implementation of three steps:

- Undertake strategic noise mapping to determine exposure to environmental noise;
- Ensure information on environmental noise is made available to the public; and
- Establish Action Plans based on the strategic noise mapping results, to reduce environmental noise where necessary, and to preserve environmental noise quality where it is good.

11.5.2 END has been transposed into UK law as the Environmental Noise (England) regulations 2006 (as amended). As part of this process, noise mapping has been undertaken and NIAs have been identified at locations where the 1% of the population that are affected to the highest noise levels is located, in order to identify the areas which require potential action.

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS, 2014

- 11.5.3 The NPSNN provides advice on the content of a noise assessment for EIA where a development is likely to result in significant noise impacts. It also requires consideration of the potential for noise impacts wider than at the proposed development, that are directly associated with the development, such as changes in the road traffic movements elsewhere on the national networks, where appropriate.
- 11.5.4 The applicant should consult Natural England with regards to the assessment of noise on designated nature conservation sites, protected landscapes, protected species or other wildlife, where applicable.

NOISE INSULATION REGULATIONS 1975, AS AMENDED 1988

- 11.5.5 The Noise Insulation Regulations (NIR) 1975, amended 1988, provide the framework to determine the entitlement to noise insulation treatment at eligible buildings (i.e. dwellings and other building used for residential purposes within 300m of the nearest point on the new or altered highway). The following three conditions should be met:
- The combined expected maximum noise traffic level, i.e. the relevant noise level from the new or altered highway together with any other traffic in the vicinity must not be less than the specified noise level, LA10,18h 68 dB;
 - The relevant noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. the total traffic existing before the works to construct or improve the highway were begun; and
 - The contribution to the increase in the relevant noise level from the new or altered highway must be at least 1.0 dB(A).
- 11.5.6 The noise should be assessed at a reception point located 1m in front of the most exposed part of an external window or door of an eligible room. Traffic flows used in the calculations should be the maximum expected in a period of 15 years after opening to traffic. The predictions will be normally undertaken using the Annual Average Weekly Traffic (AAWT).

BS7445, 2003

- 11.5.7 BS 7445:2003 'Description and Measurement of Environmental Noise' defines and prescribes best practice during recording and reporting of environmental noise. It advises that the information to be reported should include measurement technique (including type of instrumentation, measurement procedure and position of measurements), prevailing conditions during the measurements and any relevant qualitative data such as the nature of the sound source.

BS5228:2009+A1, 2014

- 11.5.8 BS5228 'Code of practice for noise and vibration control on construction and open sites', gives recommendations on noise control relating to construction activities. The standard provides advice on prediction methods, noise measurements and assessment for the associated impact.

DESIGN MANUAL FOR ROADS AND BRIDGES, VOLUME 11, SECTION 3, 2011

- 11.5.9 Part 7, Noise and Vibration (HD 213/11) advises on the appropriate level of noise and

vibration assessment for road schemes.

11.5.10 The procedure to assess impact uses three levels: a) scoping, b) simple and c) detailed. Selecting the appropriate level of assessment depends on the following threshold criteria:

- Permanent change in magnitude of 1 dB(A) in the short term (i.e. on opening);
- Permanent change in magnitude of 3 dB(A) in the long term (i.e. between opening and future assessment years); and
- The predicted noise level during night-time L_{night} , outside is greater than 55dB in any scenario. The night-time noise level will be calculated in line with the methodology prepared by TRL, introduced later in the chapter.

11.5.11 The assessment is based upon the criteria for short-term and long-term noise impacts outlined in Tables 3.1 and 3.2 in of Section 3 Part 7 Noise and Vibration. Based on these tables, a change in road traffic noise of 1dB(A) in the short-term, when the scheme is opened, is the smallest considered perceptible. In the long-term, a 3 dB(A) change is considered perceptible.

CALCULATION OF ROAD TRAFFIC NOISE, 1988

11.5.12 This memorandum describes the procedures for calculating noise from road traffic. It provides a general method of calculation for predicting noise levels at a distance from a highway, taking into account different traffic parameters, intervening ground cover, road configuration and site layout. The procedures and requirements to be met during site measurements are detailed, together with details of a simplified measurement procedure which is acceptable in certain circumstances.

11.6 DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

11.6.1 A mitigation strategy will be developed at a later stage in the design process, after the quantitative assessment is undertaken.

11.6.2 During the construction phase, it is recommended that the Contractor should apply Best Practicable Means (BPM) to minimise any residual noise impact. General methods of noise control include:

- The appropriate selection of plant, construction methods and programming: Only plant conforming with or better than relevant national or international standards, directives or recommendations on noise or vibration emissions will be used. Construction plant will be maintained in good condition with regards to minimising noise output and workers exposed to harmful noise and vibration;
- Construction plant will be operated and maintained appropriately, having regard to the manufacturer's written recommendations or using other appropriate operation and maintenance programmes which reduce noise and vibration emissions. All vehicles and plant will be switched off when not in use;
- Design and use of site hoardings and screens, where necessary, to provide acoustic screening at the earliest opportunity. Where practicable, gates will not be located opposite buildings containing noise sensitive receptors;
- Choice of routes and programming for the transport of construction materials, spoil and personnel to reduce the risk of increased noise and vibration impacts due to the construction of the junction;

- Vehicle and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers, to be maintained in good working order and operated in such a manner as to minimise noise emissions. Plant items that comply with the relevant EU/UK noise limits applicable to that equipment will be used;
- The positioning of construction plant and activities to minimise noise at sensitive locations;
- Equipment that breaks concrete by munching or similar, rather than by percussion, will be used as far as is practicable;
- The use of mufflers on pneumatic tools;
- Where practicable, rotary drills actuated by hydraulic or electrical power should be used for excavating hard materials;
- The use of non-reciprocating construction plant where ever practicable; and
- The use, where necessary, of effective sound reducing enclosures.

- 11.6.3 In addition to the above, BS5228 advises that good relations with people living and working in the vicinity of the site are important. It suggests that good relations can be developed by keeping people informed of progress. The formation of liaison committees with members of the public should be considered where possible.
- 11.6.4 It is anticipated that a combination of BPM and temporary noise barriers has the potential to achieve a noise attenuation of between 10 – 15 dB(A) at the closest receptors.
- 11.6.5 Mitigation measures will be considered as appropriate to minimise any impact arising from the operation of the scheme. Noise barriers, low noise road surface will be considered, however, it should be noted that constraints related to ecology and landscape may outweigh the benefit of the noise barrier. Emphasis should be given to protect the properties within the NIAs identified in this report.
- 11.6.6 Implementation of a noise barrier has the potential to achieve a noise attenuation in the order of 10 dB(A). On the other hand, implementation of a low noise surface has the potential to achieve a noise attenuation between 1 – 3.5 dB(A), depending on the traffic speed.

11.7 OVERALL ASSESSMENT

- 11.7.1 For the construction phase, it is likely that the nearest noise sensitive receptors will fall into the Assessment Categories A and B (see Table 11-3 and Figure 11-1). Taking into consideration the typical construction noise levels presented in Table 11-4, it is likely that dwellings within close proximity to the road works (10 – 15m) would be likely to experience a significant noise impact arising from construction (i.e. medium or high according to paragraph 11.2.8). Therefore, it is recommended that the measures introduced in the previous section are carefully considered in the PCF Stage 3 Environmental Assessment and CEMP stages.
- 11.7.2 For the operational phase, Table 11-7 below presents a summary of the qualitative assessment. An indicative alignment of the design options have been overlaid in Figure 11.1, Appendix A. Without appropriate mitigation, options 0A, 0B, 0BA and 1 are likely to result in long-term increase in noise within NIAs. Mitigation to address potential increases in noise within NIAs will require further consideration at PCF Stage 2.

Table 11-7: Qualitative Noise Impact Assessment

DESIGN OPTION	QUALITATIVE NOISE IMPACT ASSESSMENT	DESCRIPTION
0A	Minor adverse (short-term) and negligible (long-term)	Sensitive receptors along the A27 corridor, including those within NIAs have the potential to be adversely affected in the short term. Negligible impacts are anticipated in the long-term.
0B	Minor adverse (short-term) and Minor (long-term)	Sensitive receptors along the A27 corridor, including those within NIAs have the potential to be adversely affected due to increase in traffic flows.
0BA	Minor adverse (short-term) and Minor (long-term)	Sensitive receptors along the A27 corridor, including those within NIAs have the potential to be adversely affected due to increase in traffic flows.
1	Minor adverse (short-term) and Minor (long-term)	Sensitive receptors along the A27 corridor, including those within NIAs have the potential to be adversely affected due to increase in traffic flows. Properties in the Arundel Station area are likely to be less affected.
2	Minor beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, dwellings in the southern part of town and closer to the off-line route would be adversely affected. A lower number of NIAs would be affected compared to previous options.
3	Minor beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, a limited number of properties in the southern part of town and closer to the off-line route would be adversely affected. NIAs are likely to be less affected.
4	Moderate beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, a limited number of properties and rural areas including Binsted Wood and closer to the off-line route would be adversely affected. NIAs are likely to be less affected.
5	Moderate beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, a limited number of properties and rural areas including Binsted Wood and closer to the off-line route would be adversely affected. NIAs are likely to be less affected.
5A	Moderate beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, a limited number of properties and rural areas including Binsted Wood and closer to the off-line route would be adversely affected. NIAs are likely to be less affected.
5B	Moderate beneficial (short-term) and negligible (long-term)	The majority of the receptors around Arundel Town may perceive a reduction in noise levels near the existing A27 link. However, noise sensitive receptors in the villages of Walberton and Tortington, dwellings to the south of Binsted, and a limited number of properties and rural areas closer to the off-line route would be adversely affected. NIAs along the A27 in the town area would be less affected. However, those NIAs to the west of the site (e.g. 6158 and 5490) are likely to be adversely affected.

11.8

INDICATION OF ANY DIFFICULTIES ENCOUNTERED

11.8.1 The assessment presented in this chapter will have to be updated once quantitative road traffic data is available and the selection of scheme options is developed. Therefore, some of the impacts described in this chapter may be different once the modelling is finalised.

12 PEOPLE AND COMMUNITIES

12.1 INTRODUCTION

12.1.1 This assessment follows the updated DMRB interim guidance contained within IAN 125/15, combining published guidance in DMRB Volume 11, Section 3, Parts 6 (Land Use), 8 (Pedestrians, Cyclists, Equestrians and Community Effects) and 9 (Vehicle Travellers) into one assessment of People and Communities.

12.1.2 The assessment considers any impacts that the proposed scheme may have on:

- Effects on All Travellers: Motorised Travellers (MT) (drivers and passengers of both public and private vehicles) and Non- Motorised Users (NMU) (pedestrians, cyclists and equestrians), including amenity and journey length;
- Effects on Communities: including development land, agricultural land, private and community land, community severance, tourism and recreation, and housing; and
- Effects on People: including the local economy, employment, health and social profiles.

12.1.3 The ESR provides a high level assessment of the potential for the scheme options to affect existing travel patterns, journey lengths and community effects within the study area. Road safety has also been considered, together with effects on severance at the local level.

12.2 ASSESSMENT METHODOLOGY

EFFECTS ON ALL TRAVELLERS

MOTORISED TRAVELLERS: VIEW FROM THE ROAD

12.2.1 The DMRB Volume 11, Section 3, Part 9 describes 'Views from the Road' as: '...the extent to which travellers, including drivers are exposed to the different types of scenery through which a route passes.' Considerations should include:

- The types of scenery or the landscape character as described and assessed for the baseline studies;
- The extent to which travellers may be able to view the scene;
- The quality of the landscape as assessed for the baseline studies; and
- Features of particular interest or prominence in the view.

12.2.2 Views from the road will be categorised by the following criteria in Table 12-1.

Table 12-1: DMRB Criteria for Views from the Road

DMRB "VIEW" CATEGORY	DESCRIPTION
No View	Road in deep cutting or contained by earth mounds, environmental barriers or adjacent structures.
Restricted View	Frequent cuttings or structures blocking the view
Intermittent View	Road generally at ground level but with shallow cuttings or barriers at intervals
Open View	View extending over many miles, or only restricted by existing landscape features.

MOTORISED TRAVELLERS: DRIVER STRESS

12.2.3 Driver Stress is defined in Volume 11 of the DMRB as the adverse mental and psychological effects experienced by a driver traversing a road network. Stress can induce in drivers feelings of discomfort, annoyance, frustration, or fear culminating in physical or emotional tension that detracts from the value and safety of the journey. Volume 11 of the DMRB indicates that with increased driver stress, a drop in driving standards occurs, which may be expressed as an increase in aggression towards other road users, or a diminished response to visual and other stimuli.

12.2.4 The level of stress experienced by a driver may be affected by a number of factors including: road layout and geometry, surface riding characteristics, junction frequency and speed and flow per lane. There are three main components of driver stress:

- Driver frustration – Caused by an inability to drive at a speed consistent with the standard of the road, which increases as speed falls in relation to expectations;
- Driver fear – The main factors are the presence of other vehicles, inadequate sight distances and the likelihood of pedestrians, particularly children, stepping into the road. Fear is highest when speeds, flows and the proportion of heavy vehicles are all high, becoming more important in adverse weather conditions; and
- Driver uncertainty – caused primarily by signing that is inadequate for the individual's purposes.

12.2.5 The measurable aspect of Driver Stress is associated with frustration due to delays. However, no detailed modelling of the performance of the A27 has been undertaken at this stage of assessment. The available research evidence does not permit the use of finely graded assessments of other aspects of driver stress (including Driver Fear and Driver Uncertainty). As a consequence the level of Driver Stress within this assessment has been determined through a qualitative assessment of the above factors, under a three point descriptive scale, as recommended under DMRB guidance, as Low, Moderate or High.

NON-MOTORISED USERS

12.2.6 The proposed methodology will be based on the procedures set out in the DMRB Volume 11, Section 3, Parts 8 and 9 and the application of DMRB Volume 5, Section 2, Part 5, HD42/05 and will consider:

- The route option's impact on the journeys that NMU make in its locality;
- The impact on existing usage of the community facilities and routes by pedestrians and others;
- Changes in safety and amenity value of routes which may be affected by the proposed route; and

→ The effects of the scheme options on community severance.

12.2.7 The assessment will involve a desk study to identify likely NMU activity and how local community facilities are likely to be impacted by the construction and operation of the scheme options in both adverse and beneficial senses.

12.2.8 The level of new severance will be taken into account using criteria set out by DMRB Volume 11, Section 3, Part 8 which categorises the level of severance using a three point scale as follows:

- Slight - In general the current journey pattern is likely to be maintained, but there will probably be some hindrance of movement; and
- Moderate – Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be longer and less attractive. Severe – People are likely to be deterred from making trips to an extent sufficient to induce a re-organisation of their habits. This would lead to a change in the location of centres of activity or in some cases to a permanent loss to a particular community. Alternatively, considerable hindrance will be cause to people trying to make their existing journeys.

EFFECTS ON COMMUNITIES AND EFFECTS ON PEOPLE

12.2.9 A qualitative assessment based on professional judgement will be carried out in the absence of specific guidance on both the potential effects on communities and on people. Desk based research will be carried out and will include a review of publicly available data.

12.3 STUDY AREA

EFFECTS ON ALL TRAVELLERS

12.3.1 The study areas for the assessment of the effect on all travellers are as follows:

- Motorised Travellers - The study area for both views from the road and driver stress is from the A27 to the west of Arundel to the Crossbush Junction, as shown by the study area in Figure 1-1; and
- Non-Motorised Users - The study area for the assessment of impact on NMU includes those PRoWs and NMU routes directly affected by the scheme options and any feeder PRoWs (Figure 12.1).

EFFECTS ON COMMUNITIES

12.3.2 The study areas for the assessment of effect on communities are as follows:

- Community Severance - The study area for 'community severance' will be extended to include communities that may potentially be directly affected by the proposed scheme, for example, through severance;
- Tourism and Recreation - The study area for tourism and recreation facilities includes any facilities accessed from the A27 (west of Arundel to the Crossbush Junction) and those within the land corridor required for each route option;
- Housing - Housing will be reviewed according to the relevant ward boundaries referred to by the Arun Local Plan, in this case Arundel and Walburton;
- Private Assets and Demolition of Private Property - The study area for 'private assets' consists of the land parcels required to accommodate the proposed development.

Private Property is land outside the existing highways boundary that does not accommodate public open space or any other community facility or asset. It can be residential or commercial/industrial land;

- Community Land - Community land is any area of public open space and other facilities such as schools, hospitals, libraries and recreation facilities relied upon for community health and well-being. The study area for 'community land' consists of the land parcels required to accommodate the proposed development;
- Development Land - Development land is land designated within the development plan for particular development purposes, or for which planning permission has been granted or is pending. Committed Developments and Proposed Growth is discussed in Chapter 14 (Consideration of Cumulative Effects) of this ESR. The study area for 'development land' consists of the land parcels required to accommodate the proposed development; and
- Agricultural Land - The study area for 'agricultural land' consists of the agricultural land parcels required to accommodate the proposed development.

EFFECTS ON PEOPLE

12.3.3 The approach and study areas for the assessment of effect on people are as follows:

- Local Economy - Publicly available data has been gathered for the relevant Lower Super Output Areas (Arun 001A, B, C and D) maintained by the Office of National Statistics (ONS), by relevant wards (Arundel and Walburton) and the district of Arun, according to which data sets are available;
- Social Profile - Publicly available data has been gathered for the district of Arun, according to the data sets within Arun District Council's Equalities Impact Assessment; and
- Health Profile - Publicly available data has been gathered for the district of Arun, according to the data sets within the published Public Health England Health Profile and available ONS data sets (2011 census).

12.4 BASELINE CONDITIONS

EFFECTS ON ALL TRAVELLERS

MOTORISED TRAVELLERS: VIEWS FROM THE ROAD

12.4.1 The Study area for the scheme is shown on Figure 1-1. From west to east of the existing A27, the current views from the road are as follows:

- On entering Arundel from the west, on Chichester Road, the road is level with the surrounding land. There are intermittent views on both sides of agricultural land, screened in part by roadside vegetation;
- On the approach to Arundel, vegetation becomes denser, providing no view beyond the immediate border, until passing the cricket ground, where intermittent views of fields are visible on the north side of the road;
- Vegetation again closes in, bordering the road on the approach to Chichester Road roundabout to provide no view beyond;
- Views along the Arundel Bypass are again intermittent, of the surrounding agricultural land; and

- Following the Crossbush roundabout, the Causeway is largely surrounded by flat topography with intermittent views of agricultural land with some screening provided by vegetation and existing buildings.

12.4.2 In general, the views from the road for MT on the surrounding road network provide a positive experience.

MOTORISED TRAVELLERS: DRIVER STRESS

12.4.3 The West Sussex Transport Plan 2011 – 2026 describes the A27 at Arundel as a bottleneck, where there are high accident rates and diversions onto unsuitable routes are required at times of delay. This increases the levels of driver frustration.

12.4.4 Due to the presence of connecting footpaths and pavements on stretches of the A27 through Arundel, and the proximity of houses and community facilities, there are likely to be pedestrians crossing or walking alongside the road. This increases the level of fear felt by MT.

12.4.5 It is not possible to assess route uncertainty, however due to the level of driver frustration (defined in para.12.2.3) due to delays experienced by MTs, the level of Driver Stress experienced is High.

NON-MOTORISED USERS: AMENITY AND JOURNEY LENGTH

12.4.6 Impacts on NMU are described below. The position of scheme options relative to PRoW are shown on Figure 12.1.

OPTIONS 0A, 0B AND 0BA

12.4.7 There are two footpaths which are adjacent to the A27 east of the Crossbush junction (Footpath 2205, which begins from the A284 at Brook Law and traverses east and then south, and Footpath 2202 which traverses south towards the A27 from the unclassified road running through Crossbush), but these are separated from the A27 by vegetation and there are no crossing points.

12.4.8 East of the Crossbush junction, the road is dualled with no footpaths and therefore not suitable for pedestrian use. West of the junction there are footways within the verge and pavements for pedestrian use.

OPTION 1

12.4.9 In addition to Footpaths 2205 and 2202 as above, the following footpaths intersect the existing A27 along the section considered within this assessment:

- Footpath 2207, which traverses north from Lyminster to join with the A27 east of Arundel Train Station. This path will be crossed by the new alignment;
- Footpath 206, which crosses the A27 east of the Chichester Road roundabout;
- Footpath 348, which crosses the A27 east of the cricket ground;
- Footpath 346, which joins with the A27 west of Arundel Lodge; and
- Footpath 3067, which is shown to join with Chichester Road just west of the point where it becomes a dual carriageway, but appears to continue west on an undesignated track as crossing the road here is not possible.

OPTION 2

12.4.10 The following PRoW are considered in the assessment of Option 2:

- Footpath 2207 would be crossed by the route;
- Footpath 206 would be crossed by the route, on the western bank of the River Arun;
- Footpaths 347 and 347/1 join with the unclassified road, north west of Hunger Down House;
- Footpath 342 crosses with the unclassified road, north west of Hunger Down House; and
- Footpath 3067, which is shown to join with Chichester Road just west of the point where it becomes a dual carriageway, but appears to continue west on an undesignated track as crossing the road here is not possible.

OPTION 3

12.4.11 The following PRoW are considered in the assessment of Option 3:

- Footpath 2207 would be crossed by the route;
- Footpath 206 would be crossed by the route, on the western bank of the River Arun, south of the Priory remains;
- Footpath 3403 would be crossed north east of Tortington;
- Footpath 3404 would be crossed north east of Tortington;
- Footpath 342 would be crossed by the route;
- Footpath 347 would be crossed twice: east of Binsted Lane and south of Chichester Road; and
- Bridleway 338 would be crossed south west of Scotland Barn.

OPTION 4

12.4.12 The following PRoW are considered in the assessment of Option 4:

- Footpath 2207 would be crossed by the route;
- Footpath 206 would be crossed by the route, on the western bank of the River Arun, south of the Priory remains;
- Footpath 3403 would be crossed north east of Tortington;
- Footpath 354 would be crossed north west of Fairmeads Farm;
- Footpath 342 would be crossed, east of Binsted;
- Footpath 341 would be crossed, north east of Binsted;
- Bridleway 338 (Old Scotland Lane) would be crossed north of Church Farm; and
- Bridleway 336 would be crossed by the route.

OPTION 5

12.4.13 The following PRoW are considered in the assessment of Option 5:

- Footpath 2207 would be crossed by the route;
- Footpath 206 would be crossed by the route, on the western bank of the River Arun, north of the Priory remains;

- Footpath 207 would be crossed;
- Footpath 3402 would be crossed;
- Footpath 342 would be crossed, east of Binsted;
- Footpath 341 would be crossed, north east of Binsted;
- Bridleway 338 (Old Scotland Lane) would be crossed north of Church Farm; and
- Bridleway 336 would be crossed by the route.

OPTION 5A

12.4.14 All of the PRoW described above under Option 5 are also considered in the assessment of Option 5A, except for Footpath 207 which is not relevant to Option 5A. In addition, Footpath 3403 would be crossed north east of Tortington under Option 5A (and not option 5).

OPTION 5B

12.4.15 The following PRoW are considered in the assessment of Option 5b:

- Bridleway 392 would be crossed by the route north-west of Walberton;
- Footpath 350 would be crossed by the route east of Walberton;
- Footpath 354 would be crossed by the route north of Fairmeads farm;
- Footpath 3403 would be crossed by the route north of Tortington;
- Footpath 206 would be crossed by the route, on the western bank of the River Arun, and;
- Footpath 2207 would be crossed by the route north Broomhurst Farm.

12.4.16 There are no National Cycle routes which will be affected by any of the scheme options.

12.4.17 The majority of PRoW outside of the built up areas of Arundel are set within agricultural land and are likely to be used primarily for recreational purposes.

EFFECTS ON COMMUNITIES

COMMUNITY SEVERANCE

12.4.18 Community severance is defined as the separation of residents from facilities and services that they use within their community, in this case as a result of the proposed scheme.

12.4.19 The proposed scheme options are located on the outskirts of Arundel. The nearest communities are Crossbush (400m east of Crossbush junction), Lyminster (1 km south of Crossbush junction), Tortington (250m south of Option 2 and 5, 300m north of Option 3), Binsted (500m south of Option 5 and 5a, 450m north of Option 5b), Walberton (300m south of Option 5b).

12.4.20 Communities to the north of Arundel and the scheme options, including Slindon Common, Offham and Warning camp, are considered unlikely to be affected by severance. This is due to the scheme options not impacting on their access to facilities and services within the larger communities of Arundel, Eastergate and Littlehampton.

12.4.21 The majority of journeys between these communities to access facilities are likely to be made by vehicle. This is due to distance and the type of facilities and services being accessed.

12.4.22 The following paragraphs provide a summary of the facilities available to residents within these communities and the journeys that are likely to be taken between communities to access certain facilities.

ARUNDEL

12.4.23 Arundel has a population of 4,298. According to the Arun Settlement Sustainability Study, Arundel has the following facilities within a ten minute walk for residents:

- Community hall;
- Two food stores;
- GP surgery;
- Pharmacy;
- Community Hospital;
- Places of worship – a cathedral and three churches;
- Post Office; and
- Two primary schools.

12.4.24 Likely journeys to take place to and from Arundel include:

- Journeys to and from Littlehampton to access secondary schools, further community facilities and employment premises via the A284. These journeys are not likely to be undertaken on foot due to the distance;
- Journeys from Tortington to access community facilities within Arundel via Ford Road. PRow routes from Tortington to the centre of Arundel are approximately 2km in length; and
- Journeys from Arundel to Eastergate to access secondary schools, shops and the GP surgery via the A27 and Fontwell Avenue.

CROSSBUSH

12.4.25 There are no community facilities within Crossbush and therefore residents are likely to access these within either Arundel via the A27 or Littlehampton via the A284. The sections of the A27 between Crossbush and Arundel have pavements and are therefore suitable for pedestrians. Footpath 2207 also provides a direct pedestrian link between Lyminster, north of Littlehampton, and Crossbush.

TORTINGTON

12.4.26 There are no community facilities within Tortington and therefore residents are likely to access these primarily within Arundel where available via Ford Road or Littlehampton via Grevatts Lane. Ford Road is a single carriageway road at national speed limit with no pavements, and therefore not suitable as a pedestrian access route. Paths 3403 and either 342 or 207 and 206 provide pedestrian access north to Arundel, in combination with the local road network.

WALBURTON

12.4.27 Walburton contains a primary school and a GP surgery. For other facilities, residents are likely to travel to Arundel via the A27 or Eastergate via the A27 and Fontwell Avenue. Footpaths 350 and 342 provide a direct pedestrian link from Walburton to Arundel.

EASTERGATE

12.4.28 Eastergate has a population of 568. Within Eastergate there are two secondary schools, three primary schools, four food stores, a pharmacy and a GP surgery. Access to further community facilities and journeys to employment premises are likely to head west on the Oving Road to Chichester.

LITTLEHAMPTON

12.4.29 Littlehampton has a population of 24,478. Littlehampton has the majority of community facilities required within the settlement itself with numerous GP surgeries, primary and secondary schools, food stores and places of worship.

TOURISM AND RECREATION

12.4.30 There are a number of tourist and recreational facilities located within Arundel, which can be accessed either directly from the A27 or its feeder roads (Figure 12-2). The following are located north of the A27:

- Arundel Castle;
- Arundel Museum;
- Arundel Cathedral;
- Arundel Castle Cricket Ground;
- Arundel Wetland Centre;
- Arundel Lido;
- Arundel Farm Riding Centre;
- Arundel Ghost Experience; and
- Arundel Cricket Club.

12.4.31 There are also a number of service led business such as hotels and restaurants which are located on the existing A27:

- Maynards Caravan Park;
- Premier Inn Arundel and Crossbush Beefeater;
- Facilities at the Arundel Service Station;
- The Arundel Park Hotel; and
- The White Swan.

12.4.32 South of the A27 the following facilities are located in the study area:

- Billycan camping, Manor Farm Arundel;
- Hanger Down House Bed and Breakfast;
- Brooklands Country Guest House;
- Avisford Park Golf Club and Hilton Hotel; and
- Bonnies Boutique Bed and Breakfast.

HOUSING

12.4.33 The following areas have been identified as strategic locations for growth in the district of Arun under the Local Plan.

- The coastal towns of Littlehampton and Bognor Regis;
- The villages of Barnham, Eastergate and Westergate; and
- Areas in and around Angmering.

12.4.34 Under Policy H SP1 of the Local Plan, the parishes of Arundel and Walburton have been set a housing allocation of 50 housing units each to be provided before 2031. Under Policy SP8 of the Draft Local Plan the same allocations have also been included, to be provided before 2028.

COMMUNITY LAND

12.4.35 There is a narrow strip of land north of Tortington, known as Broad Green Waste, which is registered as Common Land under the CRoW2000. Options 3 and 4 cross this piece of land. No other community land is found within the study area.

DEVELOPMENT LAND

12.4.36 Within the emerging Arun Local Plan, the Policy Maps show that the Arundel Bypass corridor has been safeguarded. The land south of Arundel through which the routes traverse is allocated as a Gap Between Settlements. The only other land development allocation under the Plan within the Study Area is an aspiration to develop a cycle path which follows the River Arun on its western bank from Arundel to Littlehampton. The proposed cycle path route will be crossed by all scheme options. Any interaction between the scheme and proposed cycle routes will be designed in line with IAN 195/16 Cycle Traffic and the Strategic Road Network.

DEMOLITION OF PRIVATE PROPERTY

12.4.37 Option 5b is likely to directly impact on several properties to the north of Walburton, including residential properties and the Hilton hotel and golf club.

AGRICULTURAL LAND

12.4.38 Agricultural land has been classified by the Ministry for Agriculture, Fisheries and Food (MAFF), now the Defra, by grade land according to the extent to which chemical and physical characteristics impose long term limitations on agricultural use for food production. In accordance with DMRB guidance, only land potentially falling within ALC grades 1, 2 and 3a, are considered to be “Best and Most Versatile” (BMV). BMV land is best suited to adapting to the changing needs of agriculture and maintaining the competitiveness of UK agriculture against international competitors.

12.4.39 The ALC maps, upon which the assessment is based, were created from surveys undertaken by Defra between 1989 and 1999, and should be treated with some caution in the absence of detailed site investigation survey results. Grades 3a and 3b are not distinguished between on these maps.

12.4.40 The ALC map indicates that the land to be considered for the scheme options is a mixture of grade 3 (moderate) and 4 (poor). Without further investigation it is not possible to identify what quantities of each are present.

DEPRIVATION

12.4.41 The Indices of Multiple Deprivation²¹ use a combination of information relating to income, employment, education, health, skills and training, barriers to housing and services and crime to create an overall score of deprivation. As a lower score indicates greater

²¹ Department for Communities and Local Government (2015)

deprivation the most deprived area is indicated by a rank of 1. The scores of the relevant Lower-layer Super Output Areas (LSOAs) which are affected by the scheme options are detailed in Table 12-2. The scores for all LSOA in the district provide an average for which the district is given a rank.

Table 12-2: Indices of Multiple Deprivation Scores for relevant LSOAs in Arun

LSOA	INDEX OF MULTIPLE DEPRIVATION 2015
Arun 001A	15.577
Arun 001B	6.839
Arun 001C	16.61
Arun 001D	15.067

12.4.42 In 2015, the district of Arun had a rank of 141 out of 326 local authorities in England for its average IMD score. This was an increase in ranking from 2007²², when Arun was ranked at 186, suggesting that the level of deprivation in Arun has increased during this period.

EMPLOYMENT

12.4.43 Employment statistics²³ for the district of Arun show that the numbers of economically active employed and economically active unemployed residents is lower than the regional and national average, as shown in Table 12-3. The number of economically inactive residents is lower than the national average, but higher than the regional average.

Table 12-3: Employment Statistics for Arun, South East and England

	ARUN	SOUTH EAST	ENGLAND
Residents aged 16-74	106,071	6,274,341	38,881,374
Economically Active	65,185 (61.5%)	4,095,333 (65.2%)	24,142,464 (62.1%)
Economically active - Unemployed	3,538 (3.3%)	216,231 (3.4%)	1,702,847 (4.4%)
Economically Inactive	37,348 (35.2%)	1,962,777 (31.4%)	13,036,063 (37.5%)

12.4.44 The key industries of the district are wholesale and retail trade and repair of motor vehicles (17.1% of employed residents), human health and social work (14.4%), manufacturing (8.7%), construction (8.6%) and education (8.3%).²⁴

12.4.45 The Arun Local Plan lists the following sites for commercial growth and employment land allocation under the Proposals Map:

²² Department for Communities and Local Government (2007)

²³ Office for National Statistics (2011)

²⁴ Office for National Statistics (2011)

- Arunside Industrial Estate, Littlehampton 2.3 ha;
- Roundstone Area, Angmering (Part of SITE4) 3.3 ha; and
- Land North of Oldlands Farm, North Bersted 11.2 ha.

12.4.46 Additionally, under the emerging Local Plan, Littlehampton is listed as an area for strategic growth and employment.

SOCIAL PROFILE

12.4.47 According to the Arun District Council Equalities Impact Assessment, written as part of the supporting evidence for the Draft Local Plan in 2012, the following conclusions were drawn about the social profile of residents within the district:

- Arun has one of the UK's highest populations of elderly people, with in excess of 30% of residents being over the age of 60, compared to almost 20% nationally;
- The higher proportion of older people will affect figures for the number of people with disabilities. Arun also has high levels of benefit claimants who are sick and disabled, especially in deprived wards where concentrations are the highest in West Sussex; and
- The 2010 mid-year population estimates show that the population at Arun was 150,561. Of this, 52.2% were female, which compared with 50.7% for England.

HEALTH PROFILE

12.4.48 The state of health of all residents in Arun, the South East and England as recorded within the 2011 census²⁵ is shown in Table 12-4. Arun has a lower number of people than both the South East and England listed as in good health when considering both very good and good health.

²⁵ Office for National Statistics (2011)

Table 12-4: Health of people in Arun, the South East and England in 2011

	ARUN	SOUTH EAST	ENGLAND
Very Good Health	62,774 (42%)	4,232,707 (49%)	25,005,712 (47.2%)
Good Health	54,975 (36.8%)	2,989,920 (34.6%)	18,141,457 (34.2%)
Fair Health	23,299 (15.6%)	1,037,592 (12%)	6,054,092 (13.1%)
Bad Health	6,608 (4.4%)	291,456 (3.4%)	2,250,446 (4.2%)
Very Bad Health	1,862 (1.2%)	83,075 (1%)	660,749 (1.2%)

12.4.49 Table 12-5 outlines the numbers of people within Arun, the South East and England who consider their day-to-day activities to be limited by their health²⁶.

Table 12-5: Day to day Activity Limits in Arun, the South East and England in 2011

	ARUN	SOUTH EAST	ENGLAND
Day-to-Day Activities Limited a Lot	13,984 (9.4%)	593,643 (6.9%)	4,405,394 (8.3%)
Day-to-Day Activities Limited a Little	17,505 (11.7%)	762,561 (8.8%)	4,947,192 (9.3%)
Day-to-Day Activities Not Limited	118,029 (78.9%)	7,278,546 (84.3%)	43,659,870 (82.4%)

12.4.50 The Public Health England Health Profile²⁷ for Arun in 2015 summarises that:

- The health of people in Arun is varied compared with the England average. Deprivation is lower than average, however about 15% (3,600) children live in poverty. Life expectancy for women is higher than the England average;
- Life expectancy is 10.1 years lower for men and 10.0 years lower for women in the most deprived areas of Arun than in the least deprived areas;
- In Year 6, 18.7% (233) of children are classified as obese. The rate of alcohol-specific hospital stays among those under 18 was 34.6*. This represents 10 stays per year. Levels of GCSE attainment are worse than the England average. Levels of breastfeeding are better than the England average; and
- In 2012, 21.4% of adults are classified as obese. The rate of alcohol related harm hospital stays was 596*, better than the average for England. This represents 963 stays per year. The rate of self-harm hospital stays was 280.8*, worse than the average for England. This represents 381 stays per year. The rate of smoking related deaths was 276*. This represents 350 deaths per year. The rate of hip fractures is worse than average. Rates of sexually transmitted infections and TB are better than

²⁶ Office for National Statistics (2011)

²⁷ Public Health England (2015)

average. Rates of statutory homelessness, long term unemployment, drug misuse and early deaths from cardiovascular diseases are better than average.

12.4.51 The priorities in Arun for addressing healthcare detailed within this publication include tackling health inequalities, reducing alcohol related harm, tackling social isolation, and child and family health.

12.4.52 There are no AQMAs within the district of Arun.

12.5 REGULATORY AND POLICY FRAMEWORK

NATIONAL

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS (NPSNN)

12.5.1 Depending on the scheme option chosen, it may be categorised as an NSIP and require a Development Consent Order. The NPSNN identifies the government's objectives for the National Networks, and those relevant to MT and NMU include:

- Support and improve journey quality, reliability and safety;
- Support the delivery of environmental goals and the move to a low carbon economy; and
- Join up our communities and link effectively to each other.

NATIONAL PLANNING POLICY FRAMEWORK

12.5.2 The NPPF sets out a number of 'Core Planning Principles', which are necessary to deliver sustainable development. One of the principles, most relevant to this chapter, emphasises the need to manage patterns of growth to make the fullest possible use of public transport, walking and cycling.

12.5.3 Section 4 of the NPPF sets out how transport should be considered within the context of planning decisions and sustainable development. The framework states that encouragement should be given to solutions that seek to reduce congestion and serve to facilitate the use of sustainable transport.

12.5.4 The NPPF also encourages development that exploits opportunities for sustainable transport. Particularly by giving priority to pedestrian and cycle movements, and providing access to high quality public transport facilities. In addition, the NPPF encourages development that minimises conflict between vehicular traffic, cyclists and pedestrians.

12.5.5 The NPPF states that local authorities should "develop strategies for the provision of viable infrastructure necessary to support sustainable development".

THE COUNTRYSIDE AND RIGHTS OF WAY ACT 2000 (CROW ACT)

12.5.6 The CRoW Act regulates all PRoW and ensures access to them. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every 10 years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements.

LOCAL

EMERGING ARUN LOCAL PLAN 2011 - 2031 (OCTOBER 2014)

12.5.7 The Plan will replace the Arun District Local Plan 2003 when formally adopted, and sets out the vision for Arun for 2013 and beyond. The following policies in Table 12-6 are relevant to the People and Communities assessment.

Table 12-6: Relevant Policies from the Emerging Arun Local Plan

POLICY REFERENCE	POLICY DETAILS
Policy LAN DM2	Any development including the A27 Arundel bypass will be of a high design standard that reflects the quality of the landscape and the setting of Arundel.
Policy EMP SP1	The Council, with partners, will promote the sustainable growth of the District's economy by supporting the provision of a flexible supply of land to meet the varying needs of different economic sectors.
Policy TOU SP1	Sustainable tourism growth for Arun requires the protection of features that make the District attractive to visitors.
Policy SO DM1	Unless designated by this Plan or a Neighbourhood Development Plan, the use of Grades 1, 2 and 3a of the ALC for any form of development not associated with agriculture, horticulture or forestry will not be permitted unless need for the development outweighs the need to protect such land in the long term.
Policy H SP1	Efficient and well-connected permeable road and Public Right of Way layouts that provides a choice of safe and convenient routes for car users and non-motorised mode users (NMU). New and diverted routes must be designed to a standard agreed with the County Council to ensure on-going responsibilities. Routes should be designed to ensure users feel safe and comfortable, such as wide green corridors... Development proposals must facilitate the needs of pedestrians, cyclists and vehicular users in the overall design concept.
Policy D SP1	All development proposals should be of good quality and demonstrate a high standard of design.
Policy HWB SP1	All development shall be designed to maximise the impact it can make to promoting healthy communities and reducing health inequalities. In particular regard shall be had to...providing or contributing to the necessary infrastructure to encourage physical exercise and health, including accessible open space,...and safe, well promoted, walking and cycling routes
Policy OSR DM1	Protection of open space, outdoor sport and recreation facilities.
Policy DM 21	New development must ensure ease of movement, prioritising safe pedestrian and cycle access to the green infrastructure network and access to public transport and community transport services where a need has been identified. Access to alternative modes of transport including public transport services, the public right of way and cycle networks, must be available and accessible to all members of the community.
Policy T SP2	Littlehampton to Arundel Green Link - A new strategic Green Link is proposed between Littlehampton and Arundel, along the River Arun.
Policy T SP3	To ensure that improvements necessary to enhance the strategic and supporting road network within the District can be carried out; the lines of major road schemes...will be protected from development as follows... Safeguard the line of the following route, of the A27: m. Pink/Blue Route A27 Arundel By-pass.

ARUN DISTRICT LOCAL PLAN 2003

12.5.8 The Arun District Local Plan 2003 was adopted on the 17th April 2003. It forms a statement of Arun District Council's planning policies, which are to be used as a basis for decision making in planning applications.

12.5.9 The key aim of the plan is to apply the principles of sustainable development in assessing development proposals, striking the balance between the need for development and the protection of scarce resources. The policies in Table 12-7 are relevant to this assessment.

Table 12-7: Relevant Policies from the Arun District Local Plan 2003

POLICY REFERENCE	POLICY DETAILS
POLICY GEN14 Public Transport	Where appropriate, new development will be required to make provision for public transport facilities. Where new development can only take place with improvements to public transport services, or such improvements would be likely to influence desirable travel patterns, the Local Planning Authority will seek contributions towards the cost of improvements.
POLICY GEN15 Cycling and Walking	The Council will continue to work with WSCC and others to encourage and support the development of safe cycle and footpath networks. Where appropriate, new development will be required to provide safe and attractive facilities for cyclists and pedestrians, both within the site and in the form of links to the surrounding area. The proposed River Arun cycle routes will be protected from development which would preclude their use as a safe cycle route.
POLICY GEN16 Public Rights of Way	The Council will protect the rights of way network and will support and encourage improvements and enhancements. Development will not be permitted which would have an adverse impact on the use of a right of way. The rural characteristics of rights of way outside of the built up area boundaries should be retained.
POLICY DEV15 Safeguarding the Main Road Network	The lines of the following major road schemes will be protected from development: (i) A27 Arundel Bypass

SOUTH DOWNS NATIONAL PARK AUTHORITY

12.5.10 The SDNPA is currently preparing its Local Plan, which is presently covered by the saved policies of 11 inherited Local Plans and one adopted Core strategy. When adopted, the SDNPA Local Plan will replace all existing planning policies across the National Park.

WEST SUSSEX LOCAL TRANSPORT PLAN 2011 - 2026

12.5.11 The West Sussex Local Transport Plan sets out the Council's plan to improve the transport network. One of the highest priorities within the plan is: "Improvements to the A27 trunk road and complementary public transport improvements to the current bottlenecks at Chichester, Arundel and Worthing (not currently programmed) to increase capacity, improve reliability and safety and increase the competitiveness of local businesses and attract investment."

12.6 DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

EFFECTS ON ALL TRAVELLERS

MOTORISED TRAVELLERS

12.6.1 The preferred design solution should improve the experience of MT using the route and connecting roads. The following mitigation and enhancement measures will contribute to an improved experience for MT:

- Where overriding landscape or design constraints do not restrict this, the view from the road for MT should not be further obstructed by new structure(s), and open views of the surrounding countryside should be retained; The delays currently experienced by MT using the Arundel Bypass, and connecting roads are expected to lead to frustration, and should be reduced. The best performing options will result in a reduction in Driver Stress associated with delays;
- Signage and layout should be clear to understand and avoid creating Route Uncertainty. Any diversions or closures undertaken during construction should be clearly advertised, and any diversionary routes should not lead to Uncertainty; and
- Best practise landscape management techniques, as outlined in the DMRB, Volume 10, will be embedded in the design to ensure safety whilst respecting the environment. Embedded design safety measures will reduce fear of accidents with other MTs and NMUs.

12.6.2 These issues should be addressed at the subsequent phase of design.

NON-MOTORISED USERS

12.6.3 The preferred design solution should accommodate NMUs and either retain or improve the existing access arrangements. For example, the existing footpaths should be retained and where crossed by the route, provided with proper means of access to prevent severance. Any diversionary works or closure of NMU routes should be undertaken following proper consultation with affected groups or individuals, and the required consent orders obtained.

12.6.4 Use of best practice design with regards to the safety of NMU, including lighting, will improve the amenity of users of the footpaths in the surrounding areas. Additionally, landscaping that can provide screening of the road where possible and reduce noise levels for the wider network of PRow will also improve amenity for users.

12.6.5 Existing types of access to PRow should be retained, for example, by not introducing new barriers such as stiles, which may restrict certain users.

EFFECTS ON COMMUNITIES

COMMUNITY SEVERANCE

12.6.6 Existing footpaths should be retained and where crossed by the route, provided with proper means of access to prevent severance. PRow and bridleways should be diverted and remain open throughout the construction period where possible. The extend of diversions or closures are not known at this stage of design. Existing roads should be incorporated into the scheme, allowing for crossing points within the design.

TOURISM AND RECREATION

12.6.7 Use of best practice construction methods during construction will reduce disruption to users of facilities within the vicinity of the scheme. This will include maintaining MT and NMUs access to tourism and recreational facilities throughout the construction period. PRoWs and bridleways should be diverted and remain open throughout the construction period where possible.

HOUSING

12.6.8 The preferred design solution should be designed with future development in mind.

COMMUNITY LAND

12.6.9 Land registered as Common Land will need to be de-registered and may require replacement land to be provided in exchange for the land lost.

DEVELOPMENT LAND

12.6.10 Consideration should be given within the design to accommodate the proposed cycle route should it be developed within the future in accordance with IAN 195/16.

AGRICULTURAL LAND

12.6.11 If a significant area of BMV agricultural land will be required to enable development of a scheme option, there may be a need to undertake an Agricultural Impact Assessment. This should consider the impact of the preferred option on the existing agricultural business affected by the loss, and the future viability of any land which is severed by development. The Agricultural Impact Assessment will be undertaken in conjunction with a consultation with Defra and the affected land owners.

12.6.12 Although agricultural land required within the footprint of the route will be lost permanently, the following measures can be implemented during construction:

- Agricultural land take – Ensure the scheme involves the permanent land take of the minimum amount of land necessary. Wherever possible, land required in addition for construction, for example for site compounds, would be returned to agricultural use;
- Severance during construction to be minimised through careful siting of construction compounds and lay down areas, and careful planning of construction activities through consultation with landowners;
- Crop Loss and timing impacts – crop loss can be reduced by giving advanced warning to enable farmers to plan ahead;
- Consideration of field drainage impacts during the design phase; and
- Noise and dust to be kept to a minimum and within acceptable working limits, using best practice methods.

EFFECTS ON PEOPLE

ECONOMY

12.6.13 Where possible, the workforce and scheme supply chain should be sourced locally.

SOCIAL PROFILE

12.6.14 The design should take account of vulnerable groups such as the disabled, children and elderly people.

HEALTH PROFILE

12.6.15 Best practice construction methods should be used to minimise noise and emissions to air during construction.

12.6.16 PRow should remain open where possible and diverted if necessary, instead of closures, to allow active travel and recreational use by residents.

12.7 OVERALL ASSESSMENT

12.7.1 Table 12-8 presents a summary of the impacts by scheme option.

Table 12-8 Summary of impacts on people and communities, by option

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
Option 0A	<p>Online improvements at the Crossbush junction will not have an impact on the views from the road experienced by MTs. Driver stress may be temporarily adversely impacted by works, but will be reduced in during operation due to improved traffic flows. The scheme would be expected to provide a benefit to MTs in the short term. However, this would likely be reduced in the long term, as the improvements are unlikely to be able meet expected increases in demand up to 2041. NMU amenity may be temporarily affected on Footpaths 2202 and 2205 by works. It will not affect journey length for MTs or NMU. It does not affect any existing NMU routes.</p>	<p>This option does not have the potential to sever existing communities. It will not directly affect any tourism or recreational facilities nor adversely affect future housing development. It does not require the demolition of any existing housing. Community and private assets will not be impacted upon.</p>	<p>This option will have a slight beneficial effect on commuter journeys and access into Arundel. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun.</p> <p>It will have a slight beneficial effect on the flow of traffic on the A27 and therefore will be likely to have a slight beneficial effect on air quality and therefore amenity. It will not disproportionately affect any vulnerable groups.</p>
Option 0B	<p>Online improvements at the Crossbush junction will not have an impact on the views from the road experienced by MT. Where further land is required, vegetation which currently screens the view may need to be removed. Driver</p>	<p>This option will not sever existing communities; directly affect any tourism or recreational facilities; or adversely affect future housing development. It does not require the demolition of any existing housing. Journey length and community and</p>	<p>This option will have a slight beneficial effect on commuter journeys and access into Arundel. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It will have a</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
	<p>stress may be temporarily adversely impacted by works, but will be reduced in the locality during operation due to improved traffic flows. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041. NMU amenity may be temporarily affected on Footpaths 2202 and 2205 by works. It will not affect journey length for MT or NMU and does not affect any existing NMU routes.</p>	<p>private assets will not be impacted upon.</p>	<p>slight beneficial effect on the flow of traffic on the A27 and therefore will be likely to have a slight beneficial effect on air quality and therefore amenity. It will not disproportionately affect any vulnerable groups.</p>
<p>Option 0BA</p>	<p>Online improvements at the Crossbush junction will not have an impact on the views from the road experienced by MTs. Offline improvements will pass through agricultural land, similar to that surrounding the existing route alignment and therefore views from the road are not likely to be significantly affected.</p> <p>Driver stress may be temporarily adversely impacted by works, but will be reduced in the locality during operation as traffic flow will be improved. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041.</p> <p>NMU amenity may be temporarily adversely affected where PRow routes</p>	<p>This option will not sever existing communities. It will not directly affect any tourism or recreational facilities. It will not adversely affect future housing development and does not require the demolition of any existing housing.</p> <p>There will be a small loss of agricultural land required to accommodate the works, as the new route alignment crosses through 8 fields west of the Crossbush junction. The majority of these fields will be bisected, which may impact on their viability. Should any further land be required to accommodate the works, private property may be affected. There will be no impact upon community land or development land.</p>	<p>This option will have a slight beneficial effect on commuter journeys and access into Arundel. It is not likely to have any direct impacts on the areas of strategic growth and employment land allocations within Arun.</p> <p>It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings and therefore an adverse effect on the local economy. It will be likely to have a slight beneficial effect on the flow of traffic on the A27 and therefore will have a slight beneficial effect on air quality and therefore amenity. It will not disproportionately affect any vulnerable groups.</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
	and roadside paths interact with the road. Journey length will be marginally decreased for MT on the A27.		
Option 1	<p>Online improvements at the Crossbush junction will not have an impact on the views from the road experienced by MTs. Offline improvements will run through agricultural land, similar to that surrounding the existing route alignment and therefore views from the road are not anticipated to be significantly affected. Driver stress may be temporarily adversely impacted by works, but will be reduced in the locality during operation as traffic flow will be improved. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041.</p> <p>NMU amenity may be temporarily adversely affected by improvements works where PRow routes and roadside paths interact with the road. Amenity for users of Footpath 2207 will be reduced as they will have to cross the new alignment of the A27 before reaching the existing route, as opposed to crossing agricultural land. Providing the footpath is accommodated within the design and access remains at the same location, journey length for NMU will not be increased. Journey length will</p>	<p>Providing Footpath 2207 is accommodated within the design, and access remains at the same location, no new severance will be created. This option will not directly affect any tourism or recreational facilities. It will not adversely affect future housing development and does not require the demolition of any existing housing. There will be a small loss of agricultural land required to accommodate the works, as the new route alignment crosses through nine fields west of the Crossbush junction. The majority of these fields will be bisected, which may impact on their viability. Should any further land be required to accommodate the works, private property may be affected. There will be no impact upon community land or development land.</p>	<p>This option will have a slight beneficial effect on commuter journeys and access into Arundel. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. This route requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings, and therefore an adverse effect on the local economy.</p> <p>This option will have a slight beneficial effect on the flow of traffic on the A27 and therefore will be likely to have a slight beneficial effect on air quality and therefore amenity. Providing PRow are diverted and remain open, there should not be an adverse effect on health from limits to active travel and recreational use. This option will not disproportionately affect any vulnerable groups.</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
	be marginally decreased for MT using the A27. Footpath 2207 will be crossed and may have to be temporarily diverted during construction.		
Option 2	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact. At the western end of the option, the route will remain surrounded by woodland and views will remain as restricted or no view. It would reduce congestion and increase traffic flow, resulting in a beneficial impact by directing on going traffic away from Arundel. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041. All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey length for MT will be increased. Six footpaths will be crossed by this option and there is potential for PRoW to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 342, 2207, 3403 and 206 and there is potential for community severance for NMU. Access between communities by vehicle will not be affected and there will be no effect on community severance for MT, providing existing roads remain as a means of access to Arundel.</p> <p>It will not permanently affect any tourism or recreational facilities. Recreational facilities located at the proposed junction with the A27 at the western end of the route option may experience some temporary disruption during construction. It will not adversely affect future housing development and does not require the demolition of any existing housing. There will be a loss of agricultural land required to accommodate the works, which is likely to be more than 20ha. Some of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land or community land. There is potential for this route to impact upon the proposed cycleway.</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings.</p> <p>Commercial businesses located at the proposed junction with the A27 at the western end of the route option may experience some temporary disruption during construction. It will have a beneficial effect on the flow of traffic on the A27 and therefore will have a beneficial effect on air quality. Noise levels for residents at the south of Arundel and in Tortington may increase, causing an adverse effect. Providing PRoW are diverted and remain open, there should not be an adverse effect on health from limitations put on active travel and recreational use. It will not</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
			disproportionately affect any vulnerable groups.
Option 3	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact. At the western end of the option, the route will remain surrounded by woodland and views will remain as restricted or no view. It would reduce congestion and increase traffic flow, resulting in a beneficial impact by directing on going traffic away from Arundel. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041.</p> <p>All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey length for MTs will be marginally increased. Six footpaths will be crossed by this option and there is potential for PRoW to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 342, 2207, 3403 and 206 and there is potential for community severance for NMU. Access between communities by vehicle will not be affected and there will be no effect on community severance for MTs, providing existing roads remain as a means of access to Arundel. It will have a permanent adverse effect on Billycan Camping as the route runs through its footprint. It is not anticipated that any other facilities will be directly affected. It will not adversely affect future housing development and does not require the demolition of any existing housing. There will be a loss of agricultural land which is likely to be more than 20ha. The majority of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land. This route will traverse through an area of designated Common Land, which will need to be deregistered. There is potential for this route to impact upon the proposed cycleway.</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings. It will have a permanent adverse effect on Billycan Camping as the route runs through its footprint, and may mean that it is no longer a viable commercial business. It will have a beneficial effect on the flow of traffic on the A27 and therefore it is likely it will have a beneficial effect on air quality (and therefore amenity) for residents of Arundel, but may have an adverse effect on amenity for residents of Tortington. Noise levels for residents of Tortington may increase, causing an adverse effect on local amenity. It will not disproportionately affect any vulnerable groups.</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
Option 4	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact. At the western end of the option, the route will remain surrounded by woodland and views will remain as restricted or no view. This option would reduce congestion and increase traffic flow, resulting in a beneficial impact by directing on going traffic away from Arundel.</p> <p>All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey lengths for MT are likely to be marginally increased. Eight footpaths will be crossed by this option and there is potential for PRow to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 342, 2207, 3403 and 206 and there is potential for community severance for NMU. Access between communities by vehicle will not be affected and there will be no effect on community severance for MT, providing existing roads remain as a means of access to Arundel. This option will have a permanent adverse effect on Billycan Camping as the route runs through its footprint. It is not anticipated that any other facilities will be directly affected. It will not adversely affect future housing development and does not require the demolition of any existing housing.</p> <p>There will be a loss of agricultural land required to accommodate the works, which is likely to be more than 20ha. The majority of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land. This route has the potential to affect an area of designated Common Land, which will need to be deregistered. There is also potential for this route to impact upon the proposed cycleway.</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. This route requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings. This option will have a permanent adverse effect on Billycan Camping as the route runs through its footprint, and may mean that it is no longer a viable commercial business. This option will have a beneficial effect on the flow of traffic on the A27 and therefore it is likely it will have a beneficial effect on air quality, and therefore amenity, for residents of Arundel, but may have an adverse effect for residents of Tortington. Noise levels for residents of Tortington may increase, causing an adverse effect on local amenity. It will not disproportionately affect any vulnerable groups.</p>
Option 5	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact.</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 342, 2207 and</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
	<p>At the western end of the option, the route will remain surrounded by woodland and views will remain as restricted or no view. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041. All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey lengths for MTs are likely to be marginally increased. 8 footpaths will be crossed and there is potential for PRoW to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>206 and there is potential for community severance for NMU. Access between communities by vehicle will not be affected and there will be no effect on community severance for MTs, providing existing roads remain as a means of access to Arundel. It is not anticipated that any tourism or recreational facilities will be directly affected. It will not adversely affect future housing development and does not require the demolition of any existing housing. There will be a loss of agricultural land required to accommodate the works, which is likely to be more than 20ha. The majority of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land or community land. There is potential for this route to impact upon the proposed cycleway.</p>	<p>will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings, with an adverse effect on the local economy. It will have a beneficial effect on the flow of traffic on the A27 and therefore it is likely it will have a beneficial effect on air quality, and therefore amenity, for residents of Arundel, but may have an adverse effect for residents of Tortington. Noise levels for residents of south Arundel and Tortington may increase, causing an adverse effect on local amenity. It will not disproportionately affect any vulnerable groups.</p>
Option 5A	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact. At the western end of the option, the route will remain surrounded by woodland and views will remain as restricted or no view. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041.</p> <p>All footpaths crossed by the option will see</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 342, 2207 and 206 and there is potential for community severance for NMU. Access between communities by vehicle will not be affected and there will be no effect on community severance for MT, providing existing roads remain as a means of access to Arundel. It will have a permanent adverse effect on Billycan Camping as the route runs through its footprint. It is not anticipated that any other facilities will be</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings. It will have a permanent adverse effect on Billycan Camping as</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
	<p>a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey length for MT will be marginally increased. Eight footpaths will be crossed by this option and there is potential for PRoW to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>directly affected. It will not adversely affect future housing development and does not require the demolition of any existing housing. There will be a loss of agricultural land, which is likely to be more than 20ha. The majority of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land or community land. There is potential for this route to impact upon the proposed cycleway.</p>	<p>the route runs through its footprint, and may mean that it is no longer a viable commercial business. It will have a beneficial effect on the flow of traffic on the A27 and therefore it is likely it will have a beneficial effect on air quality, and therefore amenity for residents of Arundel, but may have an adverse effect for residents of Tortington. Noise levels for residents of Tortington may increase, causing an adverse effect on local amenity. It will not disproportionately affect any vulnerable groups.</p>
Option 5B	<p>This option would traverse through open agricultural land and it is likely that views from the road would be more open, resulting in a beneficial impact. The scheme would be expected to provide a long term benefit to MTs, meeting expected increases in demand up to 2041.</p> <p>All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels. Journey length for MT will be marginally increased. Six footpaths will be crossed by this option and there is potential for PRoW to increase in length if diversions are put in place, increasing NMU journeys.</p>	<p>Although it is likely that journeys between communities will be made by road, several of the affected footpaths provide direct links between communities, including Footpaths 350, 2207 and 206 and there is potential for community severance for NMUs. Access between communities by vehicle will not be affected and there will be no effect on community severance for MT, providing existing roads remain as a means of access to Arundel. It will have a permanent adverse effect on Billycan Camping and the Hilton hotel and golf course, as the route runs through their footprint boundaries. It is not anticipated that any other facilities will be directly affected. It will not adversely affect future housing development, although the route is likely to require the demolition of several existing properties. There will be a loss of agricultural land, which is likely to be more than 20ha. The majority</p>	<p>This option will have a beneficial effect on commuter journeys and access into Arundel, as traffic is diverted away from the existing A27. It is not likely that there will be any direct impacts on the areas of strategic growth and employment land allocations within Arun. It requires permanent use of agricultural land and may have an adverse effect on the commercial viability of any affected farm holdings. It will have a permanent adverse effect on Billycan Camping and the Hilton Hotel and golf course, as the route runs through its footprint and may mean that they are no longer a viable commercial business. It will have a beneficial effect on the flow of traffic on the A27 and therefore it is likely it will</p>

OPTION	ALL TRAVELLERS	COMMUNITIES	PEOPLE
		<p>of these fields will be bisected, which may impact on their viability. There will be no impact upon other private land or community land. There is potential for this route to impact upon the proposed cycleway.</p>	<p>have a beneficial effect on air quality, and therefore amenity, for residents of Arundel, but is likely have an adverse effect for residents of Tortington, Binsted and Walberton. Noise levels for residents of Tortington, Binsted and Walberton may increase, causing an adverse effect on local amenity. It will not disproportionately affect any vulnerable groups.</p>

12.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

12.8.1 A site visit has not been carried out at this stage of assessment, and therefore the assessment is based on publicly available data.

13 ROAD DRAINAGE AND THE WATER ENVIRONMENT

13.1 INTRODUCTION

- 13.1.1 This chapter provides preliminary assessment of potential effects on road drainage and the surrounding water environment caused by the construction and operation of the proposed scheme options. It also describes the existing baseline information. The assessment has been undertaken in accordance with the methodology promoted within DMRB Volume 11, Section 3, Part 10 (HD 45/09).
- 13.1.2 This chapter includes an assessment of the potential impacts to groundwater bodies associated with the generation of surface-borne pollutants, such as polluted surface water runoff. This chapter will not cover hydrogeological impacts associated with the disturbance of contaminated land or the movement of groundwater flow. Potential impacts to groundwater resources and quality associated with these aspects has been addressed in Section 9 Geology and Soils.
- 13.1.3 This chapter includes an assessment of the potential impacts on ecological, chemical and hydro-morphological quality elements of surface water features. However, a detailed assessment of potential effects on ecological receptors, including aquatic ecology, has been addressed in Section 8 Nature Conservation.
- 13.1.4 Once the preferred option has been selected, the ESR for that option will be supported by a Flood Risk Assessment (FRA) that will provide a detailed assessment of potential impacts of flood risk on the Scheme and to people and property elsewhere as a result of the Scheme.

13.2 ASSESSMENT METHODOLOGY

- 13.2.1 This chapter provides a high-level qualitative assessment of the potential impacts of the junction options on the water environment. The assessment is based on the limited layout information that is available for each of the scheme options. The DMRB promotes the following approach:
- Estimation of the importance of the attribute;
 - Estimation of the magnitude of the impact; and
 - Assessment of the significance of the impact based on the importance of the attribute and the magnitude of the impact.
- 13.2.2 The value and sensitivity of a potential receptor is considered in terms of indicators such as quality, scale, rarity and substitutability. The criteria in Table A4.3 of HD 45/09 have been used to estimate the importance of water environment attributes in the study area.
- 13.2.3 Assessing the magnitude of a potential impact is undertaken using the criteria provided in Table A4.4 of HD 45/09. Not all effects are adverse and there is the potential for beneficial effects.
- 13.2.4 The overall significance of potential impacts considers both the magnitude of the impact against the value of the receptor. The overall significance of an effect is also assessed with regards to the likelihood of the effect, the potential use of mitigation, and any legal obligations.

13.2.5 Following the impact assessment process, mitigation measures are outlined to minimise any significant adverse effects upon the water environment. Any residual effects following these measures will be detailed.

13.3 STUDY AREA

13.3.1 The study area consists of the area of the proposed scheme options and a buffer zone that extends approximately 1km from the proposed Scheme Options. Features that may be affected by pollutants transported downstream of the works could be greater than 1km from the proposed scheme options and these features will also be included within the assessment as appropriate. Similarly, the potential impacts on flood risk could be experienced by receptors greater than 1km from the proposed scheme options and this will be taken into consideration.

13.4 BASELINE CONDITIONS

13.4.1 Baseline information described in this section has been obtained from the following sources:

- EA mapping available online;
- MAGIC geographical information portal;
- Ordnance Survey mapping; and
- Groundsure Report dated April 2015.

SURFACE WATER

THE RIVER ARUN

13.4.2 The River Arun flows through the centre of Arundel, flowing in a southerly direction to discharge to the sea approximately 6.5km downstream of Arundel at Littlehampton. The River Arun is designated as a 'main river' and is therefore under the jurisdiction of the EA. The quality of the River Arun in the area of the proposed scheme options has been assessed against objectives of the WFD and the results show that its current ecological quality is assessed to be poor.

13.4.3 The River Arun forms an important focal point for the town. The river also has high recreational value for boating and walks along the riverbank within the vicinity of the scheme options.

13.4.4 The works proposed for Option 0A are, at their closest points, located approximately 60m to the west and 100m to the south of the River Arun. Options 0B and 1 cross the River Arun along the existing alignment of the A27. Options 2, 3 and 5 would require a new crossing over the River Arun to be constructed.

OTHER SURFACE WATER FEATURES

13.4.5 There are a large number of ordinary watercourses and land drains that are located to the south of the existing A27 that flow south through Fowler's Copse, Binsted Wood and Tortington Common before confluencing and outfalling to the River Arun south of Ford Station. The majority of these watercourses are designated as ordinary watercourses and are therefore under the jurisdiction of WSCC as Lead Local Flood Authority (LLFA). However, the key carrier drains that convey flow from the west and south of Binsted Wood to the River Arun are designated as a main river and are therefore under the jurisdiction of the EA.

13.4.6 A large number of drains are also located between Ford Road and the Arun Valley Railway

(on either side of the River Arun) providing a land drainage function to the low lying agricultural lands within this area and conveying water to the River Arun. All of these watercourses are designated as ordinary watercourses and are therefore under the jurisdiction of WSCC as LLFA.

- 13.4.7 An existing system of ponds is located in the Avisford Park Golf Club to the east and west of Yapton Lane. It is considered likely that purpose of these ponds is for aesthetical value but little is currently known regarding their ecological value or sensitivity. This will be investigated further at PCF Stage 3.
- 13.4.8 Water quality within these surface water features is not monitored against the objectives of the WFD and there are no known ecological designations.

SURFACE WATER ABSTRACTIONS & DISCHARGE POINTS

- 13.4.9 The EA's Water Abstraction Licences map and Groundsure report identify several licensed surface water abstractions within 1km of the proposed scheme options. Water abstracted from these abstractions is reported to be used for agricultural, aquaculture, irrigation or industrial purposes.
- 13.4.10 The Groundsure report identifies forty-seven active discharge points to surface water features within 1km of the proposed scheme options.

GROUNDWATER

- 13.4.11 Review of the EA's Groundwater map indicates that the Inner Zone (Zone 1) of a designated groundwater Source Protection Zone (SPZ) is located approximately 250m to the north of the existing A27 and the scheme options 0B and 1. A second groundwater SPZ is located to the west of the scheme options, with Zone 3 of the groundwater SPZ identified approximately 200m to the north-west of the junction of proposed Option 5B and the existing A27. None of the scheme options pass through the SPZ. SPZs are mapped in Figure 13.1 in Appendix A.
- 13.4.12 British Geological Survey (BGS) data indicates that bedrock geology within the majority of the Scheme area comprises Lambeth Group (clay, silt and sand) and London Clay Formation. The Lambeth Group is classified as Secondary A Aquifer, described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The London Clay is considered to be unproductive strata. Further detail of the geology underlying the study area is provided in Section 9 'Geology and Soils'.
- 13.4.13 BGS data indicates that bedrock geology immediately to the north of the A27 (and therefore immediately north of Options 0B and 1) and to the east of Arundel (and therefore partially beneath Options 0B, 1, 2 and 5) comprises Spetisbury Chalk Member. This geology is classified as Principal Aquifer, described as layers of rock or drift deposits that have high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage and may support water supply and/or river base flow on a strategic scale.
- 13.4.14 Superficial deposits of clay, silt, sand and gravel are located throughout the study area and are classified predominantly as Secondary A Aquifers.
- 13.4.15 Groundwater quality is monitored against objectives of the WFD within the Principal Aquifer to the north of the existing A27 alignment. The results indicate that the current quantitative and chemical quality are assessed to be poor.
- 13.4.16 The EA's Water Abstraction Licences map and Groundsure report identify several licensed groundwater abstractions within 1km of the scheme options. Water abstracted from these abstractions is reported to be used for agricultural, aquaculture and irrigation.

13.4.17 The Groundsure report identifies six active discharge points to groundwater within 1km of the proposed scheme options.

FLOOD RISK

13.4.18 The most significant flood risk is associated with fluvial and/or tidal flooding from the River Arun. Within the vicinity of the scheme options, this predominantly affects land between Ford Road in the west and the Arun Valley Railway in the east which is indicated to be located within the high risk Flood Zone 3. All scheme options are identified to be at risk from this source of flooding, as illustrated on the Flood Zones map provided in Figure 13.1, Appendix A. Flood Zone 3 is described as land having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of tidal flooding. It is not yet known if the source of this flooding is fluvial, tidal or a combination of the two, but consultation undertaken with the EA has suggested that this is likely to be predominantly tidal. This will need to be confirmed through further consultation with the EA and review of hydraulic modelling data.

13.4.19 Review of the EA's Flood Map for Planning identifies flood defences located adjacent to the east and west banks of the River Arun within the scheme area, although the standard of protection provided by these defences is currently unknown. The fluvial and/or tidal floodplain within the vicinity of the scheme options will therefore provide floodwater storage to assist in the reduction of flood risks to the town of Arundel to the north of this area.

13.4.20 Review of the EA's Flood Map for Planning also indicates fluvial and/or tidal flood risk associated with the main rivers that convey flow from the west and south of Binsted Wood to the River Arun. Options 4, 5, 5A and 5B are indicated to pass through this area of risk and therefore are at risk of flooding from this source. Land within this area is predominantly agricultural, although review of OS mapping indicates that individual properties are located in close proximity to the mapped extents.

13.4.21 Fluvial and tidal flooding associated with the large number of drains that flow through Fowler's Copse, Binsted Wood and Tortington Common are not illustrated on the EA's Flood Map for Planning, most likely due to the small size of the catchments served by these watercourses. However, review of the EA's Risk of Flooding from Surface Water map illustrates likely flood risk associated with these watercourses and indicates that flow largely stays within the watercourse channel until the confluence of these watercourses to the south of Binsted Wood.

VALUE (SENSITIVITY) OF RESOURCE

13.4.22 At this stage, the water environment receptors that are most likely to be affected by the scheme options include:

- The River Arun: A main river under the jurisdiction of the EA. Current WFD classification is 'poor'. However, the river flows through a popular urban area and is used for boating. Value of this resource is considered to be High at this stage of the assessment;
- Other surface water features within vicinity of scheme options: No known designations, although the location of features within the woodland most likely provides local importance to the overall value of these areas. Support local abstractions for non-potable uses. Value of these resources is considered to be Medium at this stage of the assessment;
- Ponds located in the Avisford Park Golf Club: No known designations and ecological value not known at this stage, although likely to be for aesthetical purposes. Value of these resources is assumed to be Low at this stage of the assessment;
- Groundwater: Majority of Schemes underlain by Secondary A Aquifer with current WFD classification of 'poor'. Supports local abstractions for non-potable uses. Value of this resource is considered to be Medium. Principal Aquifer to north of A27 supports designated SPZ and therefore considered to be Very High;

- Floodplain associated with the River Arun: Flood risk will be reduced through the provision of existing flood defences, although the standard of protection is unknown. The identified flood defences and associated fluvial and/or tidal floodplain provide protection to the town of Arundel. Value of this resource is therefore considered to be Very High; and
- Floodplain associated with other surface water features within vicinity of scheme options: Flood risk predominantly within rural areas with few properties identified to be located in close proximity to mapped extents. Value of this resource is therefore considered to be Low.

13.5 REGULATORY AND POLICY FRAMEWORK

EUROPEAN POLICY

WATER FRAMEWORK DIRECTIVE (2000/60/EC)

- 13.5.1 The overall objective of the WFD is to bring about the effective co-ordination of water environment policy and regulation across Europe. The main aims of the legislation are to ensure that all surface water and groundwater reach 'good' status (in terms of ecological and chemical quality and water quantity, as appropriate), promote sustainable water use, reduce pollution and contribute to the mitigation of flood and drought.
- 13.5.2 The WFD contains provisions for controlling discharges of dangerous substances to surface waters and groundwater and includes a 'List of Priority Substances'. Various substances are listed as either List I or List II substances, with List I substances considered the most harmful to human health and the aquatic environment. The purpose of the directive is to eliminate pollution from List I substances and reduce pollution from List II substances.

GROUNDWATER DIRECTIVE (2006/118/EC)

- 13.5.3 This Groundwater Directive aims to set groundwater quality standards and introduce measures to prevent or limit pollution of groundwater. The directive has been developed in response to the requirements of Article 17 of the WFD, specifically the assessment of chemical status of groundwater and objectives to achieve 'good' status.

NATIONAL POLICY

NATIONAL PLANNING POLICY FRAMEWORK

- 13.5.4 Planning Practice Guidance 'Flood Risk and Coastal Change' has been published alongside the NPPF to set out how certain policies, including those relating to flood risk, should be implemented. They identify how new developments must take into account flood risks, including making allowance for climate change impacts.
- 13.5.5 The NPPF requires that inappropriate developments in areas of flood risk should be avoided by directing development away from high risk areas. When development is necessary, projects should be made safe from flooding without increasing flood risk elsewhere. The sequential test is used as the principal step to identify preferred locations. If development is deemed necessary in a flood zone, an exception test can be conducted through an appraisal of risk, and appropriate reduction and management measures can be implemented.
- 13.5.6 All applications in the following areas should be accompanied by a FRA – all projects in Flood Zones 2 and 3 (medium and high probability of river and tidal flooding); projects of 1ha or greater in Flood Zone 1 (low probability of river and tidal flooding); projects which may be at significant risk from other sources of flooding (local watercourses, surface water, groundwater or reservoirs); or where the EA has notified the local planning authority that there are critical drainage problems.

NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS (NPSNN)

- 13.5.7 The NPSNN recognises that infrastructure development can have adverse effects on the water environment. It states that the Government's planning policies make clear that the planning system should contribute to and enhance the natural and local environment by, amongst other things, preventing both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution.
- 13.5.8 It also states that for those projects that are improvements to the existing infrastructure, such as road widening, opportunities should be taken, where feasible, to improve upon the quality of existing discharges where these are identified and shown to contribute towards Water Framework Directive commitments.
- 13.5.9 The NPSNN advises applicants for projects that may be affected by or may add to flood risk to seek sufficiently early pre-application discussions with the EA, and where relevant other flood risk management bodies.

ENVIRONMENT AGENCY GROUNDWATER PROTECTION: POLICY AND PRACTICE (GP3)

- 13.5.10 The EA is the statutory body responsible for the protection and management of groundwater resources in England. This document sets out the framework for EA regulation. Part 4 of the document, Legislation and Policies, is of key importance to development proposals and sets out the key groundwater legislation and how this is interpreted by the EA as well as the EA's policy on activities that pose a risk to groundwater and how the EA will respond to activities and proposals.

ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2010

- 13.5.11 The Environmental Permitting (England and Wales) Regulations 2010 replaced the Water Resources Act 1991 as the key legislation for water pollution in the UK. Under the Environmental Permitting Regulations it is an offence to cause or knowingly permit a water discharge activity, including the discharge of polluting materials to freshwater, coastal waters, relevant territorial waters or groundwater, unless complying with an exemption or an environmental permit. The EA sets conditions which may control volumes and concentrations of particular substances or impose broader controls on the nature of the effluent, taking into account any relevant water quality standards from EC Directives.

LOCAL POLICY

ARUN DISTRICT LOCAL PLAN 2003

- 13.5.12 The Local Plan sets out planning policies that will be considered in the approval of applications within the District. The following policies are relevant to the water environment:
- Policy GEN9 Foul and Surface Water Drainage: planning permission for development which will materially increase foul and/or surface water discharges will be refused unless either adequate drainage capacity exists or appropriate drainage capacity can be provided as part of the development. Consideration should also be given to the use of Sustainable Urban Drainage Systems;
 - Policy GEN10 Tidal Flooding and Coastal Defence: planning permission will be refused for development which would be at unacceptable risk of tidal flooding and/or where proposals are detrimental to the integrity of tidal defences or the ability to maintain or improve them;

- Policy GEN11 Inland Flooding: permission for development which would be at risk from flooding and/or materially decrease the capacity of a floodplain to store or pass flows of floodwater will be refused unless compensatory flood storage/waterway areas can be provided as part of the development and the function and effectiveness of existing watercourses, or their replacement, are not adversely affected;
- Policy GEN23 The Water Environment: development will not be permitted if it would have a direct or indirect unacceptable adverse impact on the water environment. Where appropriate, the Council will support initiatives which seek to restore or enhance the water environment;
- Policy GEN25 Water Resources: development will only be permitted where adequate water resources are available or will be provided in time to serve the development, and that provision is not considered detrimental to existing abstractions, river flows, water quality, fisheries, amenity and nature conservation; and
- Policy GEN26 Water Quality: development will only be permitted where it would not lead to deterioration in the quality or potential yield of surface water and groundwater resources.

13.6 DESIGN, MITIGATION AND ENHANCEMENT MEASURES, INCLUDING MONITORING REQUIREMENTS

CONSTRUCTION

- 13.6.1 At the construction stage it is possible that mobilised suspended solids or spillage of fuels, lubricants and hydraulic fluids from construction plant could migrate to identified water features either directly or via the highway drainage system. The construction works could also have a detrimental effect on the quality of surface water features associated with construction works within the watercourse channels, for example through earthworks in the channel that could increase sedimentation.
- 13.6.2 To mitigate these risks as far as practicable, it is recommended that a CEMP is prepared and adopted during the construction stage to limit the risk of pollutants entering surface water features or discharging to ground. The CEMP will detail the procedures and methods that must be followed to minimise the potential environmental effects of construction activities. The CEMP will also describe the procedures to be followed in the event of an environmental emergency such as a fuel or chemical spillage.

OPERATION

- 13.6.3 It will be important to ensure that the proposed scheme options do not significantly increase the risk of flooding to people and property elsewhere, most notably through the reduction of floodplain storage, impacts to existing flood defences, obstruction to flow conveyance, or an increase in the rate and volume of surface water runoff. The design of the scheme options should therefore strive to achieve the following key principles:
- No net loss of fluvial floodplain storage, most notably associated with the River Arun between Ford Road and the Arun Valley Railway. Impacts could be mitigated through limiting works within the identified fluvial floodplain, the provision of like-for-like floodplain compensation, or by limiting lost fluvial storage through the design of proposed structures;
 - No notable impact on flood flow conveyance, most notably associated with the River Arun but also the main rivers to the west and south of Binsted Wood. Impacts could be mitigated through avoiding the construction of structures that would impede the flow of water up to and including the 1 in 100 annual probability fluvial flood event and taking tidal effects into account;

- Provision of clear span bridges wherever possible, noting that this will be of key importance for the proposed crossings of the River Arun and, ideally, the main rivers to the west and south of Binsted Wood, and maintaining sufficient flow capacity for the 1 in 100 annual probability fluvial flood event and taking tidal effects into account;
- Provision of appropriately sized culverts for all crossings of other ordinary watercourses and drains, at minimum maintaining the capacity of the channel and, wherever possible and in accordance with DMRB, providing sufficient capacity to cater for the 1 in 100 annual probability fluvial flood event. Consideration will also need to be given to maintaining connectivity for aquatic ecology;
- Ensuring no reduction in the standard of protection served by existing flood defences, or impact to the ability to maintain these defences;
- Providing a robust surface water drainage system that ensures discharge from the proposed Scheme does not increase flood risk elsewhere up to and including the 1 in 100 annual probability rainfall event. The need to provide attenuation and restrict the rate and volume of discharge will need to be agreed with WSCC as LLFA, and with the EA if discharge to the River Arun is proposed;
- Consideration of the potential effects of climate change over the lifetime of the Scheme and in accordance with EA guidance, noting that tide levels are likely to rise by c.1.2m, river flows are likely to increase by c.35-105% and rainfall intensity is likely to increase by c.20-40% in accordance with updated EA recommendations published in March 2016; and
- During preliminary consultation undertaken by the project team, the EA advised that the existing flood defences on the River Arun are unlikely to provide appropriate flood defence viable defence to maintain, within the next 50 years. The EA suggested that improvement works to the tidal flood defences may be undertaken as part of the Scheme and could provide benefit to the area and the Scheme itself. In addition, the EA also suggested that salt marsh habitat could be established behind any new tidal flood defences. Further consideration will be given to the potential for the proposed Scheme to provide flood management and ecological enhancement in consultation with the EA and Natural England.

13.6.4 It will also be important to ensure that the proposed scheme options do not have an adverse effect on water quality, which in turn could have an adverse effect on local surface water and groundwater abstractions. Consideration will need to be given to the treatment of runoff prior to discharge and the measures that will be required in the event of spillage. Multi-stage proposals that maximise passive treatment through the use of SUDS are recommended. The Scheme may also offer opportunities to provide betterment, most notably for Options 0A, 0B and 1 that utilise the existing road alignment.

13.7 OVERALL ASSESSMENT

13.7.1 The scheme options have the potential to impact the water environment during construction and operation. A high level assessment of the potential effects is provided below. This takes into consideration mitigation measures that are good practice and have little impact to scheme design, such as the implementation of a CEMP or appropriate crossing of a minor land drain. It does not take into consideration measures that will have a notable impact on the design of the scheme, such as the provision of a clear-span bridge structure. A more detailed assessment of potential effects that considers all mitigation measures will be undertaken as part of the EIA when details of the design and proposed mitigation measures are known.

13.7.2 Potential effects to surface water features, groundwater features and flood risk during construction could arise from:

- Increased pollution risks from mobilised suspended solids, spillage of fuels or other harmful substances that may migrate to surface water and groundwater receptors;

- Impacts to the hydromorphological and ecological quality of watercourses associated with works within or in close proximity to watercourses; and
- Increased flood risks associated with temporary works within areas identified to be at risk of fluvial and/or tidal flooding.

13.7.3 Potential effects to surface water features, groundwater features and flood risk during operation could arise from:

- Polluted surface water runoff containing silts and hydrocarbons that may migrate or be discharged to surface water features or groundwater resources;
- Increased flood risk to people and property elsewhere as a result of construction within areas identified to be at flood risk, thus impacting flood flow conveyance and reducing floodplain storage, and impact to existing flood defences;
- Increased flood risk to the Scheme as a result of construction within areas identified to be at flood risk;
- Permanent impact to the hydromorphological and ecological quality of watercourses associated with works within or in close proximity to watercourses; and
- Increased rates and volumes of surface water runoff from an increase in impermeable area and/or changes to the existing drainage regime leading to a potential increase in flood risk.

OPTION 0 (INCLUDING 0A, 0B AND 0BA) AND OPTION 1

13.7.4 These Options largely follow the alignment of the existing A27 and therefore the risk to the quality of the water environment is likely to be comparatively minimal during construction and operation, assuming that appropriate pollution control measures as outlined within a CEMP are implemented during construction and a robust surface water drainage system is installed during operation. These Options may also offer an opportunity for betterment during the operational phase if the existing drainage systems are upgraded. The greatest risks to water quality during construction will be associated with works within the channel of the River Arun, if improvements to the existing bridge are required. At this time, the magnitude of the potential risk to the quality of the water environment is considered likely to be negligible to minor adverse.

13.7.5 The greatest flood risks during construction and operation are likely to be associated with temporary and permanent works within the floodplain and channel of the River Arun. Unless significant works to the existing bridge are required this is unlikely to pose significant risk to adjacent urban areas. However, any reduction in the capacity of the watercourse or fluvial floodplain could easily increase flood risk to the town.

13.7.6 Option 0BA and Option 1 require the construction of new carriageway within currently undeveloped land to the east of Arundel as the schemes cross the Arun Valley Railway. The greatest risks are likely to be associated with loss of fluvial floodplain storage and impacts to fluvial flood flow conveyance, which may adversely impact adjacent property and infrastructure. However, it is noted that few properties are located within close proximity to this area of floodplain storage. Prior to the consideration of mitigation and further assessment of the fluvial/tidal relationship, the magnitude of any effects are considered to be minor to moderate adverse.

13.7.7 The construction of Option 0BA and Option 1 within currently undeveloped land in the vicinity of the Arun Valley Railway will require the crossing of a number of land drains. Assuming that the capacity of these drains can be maintained, the impact magnitude is likely to be negligible.

13.7.8 The works are unlikely to pose significant impact to the hydromorphological and ecological

quality of affected watercourses. The crossing of the existing land drains in the vicinity of the Arun Valley Railway may remove ecological habitat and impact connectivity, although the existing A27 and Arun Valley Railway will already provide a barrier to the movement of aquatic species and therefore the impacts are likely to be negligible.

OPTION 2

13.7.9 Option 2 will have little effect on watercourses to the east of Arundel (i.e. those located within Fowler's Copse, Binsted Wood and Tortington Common), but will cross a number of land drains between Ford Road and the Arun Valley Railway.

13.7.10 It is likely that risks to the quality of the water environment can be largely mitigated during construction through the implementation of a CEMP and during operation through the implementation of a robust surface water drainage system. However, Option 2 will also require a new bridge across the River Arun and risks to water quality will be difficult to mitigate entirely. The works may also remove ecological habitat and affect connectivity for aquatic species, although risks to the overall ecological quality of the watercourse can be largely mitigated through the provision of a clear span structure. The magnitude of this impact is likely to be moderate to minor adverse, although impacts during construction are likely to be temporary. Further assessment to aquatic and terrestrial habitats and species is provided within Section 8 Nature Conservation.

13.7.11 The greatest flood risks during construction and operation will be associated with temporary and permanent works within the floodplain and channel of the River Arun. Any reduction in the fluvial capacity of the watercourse or floodplain, (or impacts to existing flood defences, could increase flood risk to urban areas of Arundel and to Priory Farm to the south of the Scheme alignment. Without the inclusion of robust mitigation, the magnitude of the impact could be major adverse. By maintaining the capacity of the fluvial watercourse by providing a clear span structure, and by maintaining the capacity of the fluvial floodplain by allowing flood flow conveyance and providing compensatory storage, the impacts could be reduced. The magnitude of the impact will be heavily dependent on the fluvial/tidal characteristics of flooding in this area and will need to be informed via detailed hydraulic analysis. Consultation with the EA has also suggested that tidal flood defence benefit could be provided through the design of the scheme and associated embankments.

13.7.12 It is considered likely that the capacity of the land drains between Ford Road and the Arun Valley Railway can be maintained and hence the impact magnitude for these receptors is likely to be negligible. The works within this area may, however, cause impact to the hydromorphological and ecological quality of these drains by removing ecological habitat and severing connectivity. At this stage the magnitude of the impact is considered likely to be minor adverse.

OPTION 3

13.7.13 Option 3 will cross a number of ordinary watercourses and land drains within Fowler's Copse, Binsted Wood and Tortington Common, and a number of land drains between Ford Road and the Arun Valley Railway.

13.7.14 As per Option 2, it is likely that risks to the quality of the water environment can be largely mitigated during construction through the implementation of a CEMP and during operation through the implementation of a robust surface water drainage system. However, Option 3 will also require a new bridge across the River Arun and risks to water quality will be difficult to mitigate entirely. The magnitude of this impact is likely to be moderate to minor adverse, although impacts are likely to be temporary.

13.7.15 The greatest flood risks during construction and operation will be associated with temporary

and permanent works within the floodplain and channel of the River Arun. Any reduction in the fluvial capacity of the watercourse or floodplain, or impacts to existing flood defences, could increase flood risk to urban areas of Arundel and to Priory Farm to the north of the Scheme alignment. The magnitude of the impact (pre and post mitigation) is considered to be the same as that assessed for Option 2.

13.7.16 It is considered likely that the capacity of the land drains within Fowler's Copse, Binsted Wood and Tortington Common, and between Ford Road and the Arun Valley Railway, can be maintained and hence the impact magnitude is likely to be negligible. Option 3 will also cross a number of important ordinary watercourses within Fowler's Copse, Binsted Wood and Tortington Common and, unless a culvert/bridge of sufficient capacity is provided, this could cause localised increase in flood risk. Appropriate mitigation measures may therefore be required to maintain the capacity of the watercourses. Review of OS mapping indicates that there are no receptors within the immediate vicinity of the Scheme that are likely to be adversely affected by this risk hence impact magnitude is likely to be negligible to minor adverse.

13.7.17 The works within Fowler's Copse, Binsted Wood and Tortington Common, and between Ford Road and the Arun Valley Railway, may cause impact to the hydromorphological and ecological quality of the watercourses and drains within this area by removing ecological habitat and severing connectivity. At this stage and prior to implementing appropriate mitigation, the magnitude of the impact is considered likely to be moderate adverse.

OPTION 4

13.7.18 Option 4 will have no impact on the ordinary watercourses and land drains located within Fowler's Copse, Binsted Wood and Tortington Common. However, the Scheme will cross the main river that conveys flow from the south of Binsted Wood to the River Arun, and it will also cross a number of land drains between Ford Road and the Arun Valley Railway.

13.7.19 As per Option 2 and 3, it is likely that risks to the quality of the water environment can be largely mitigated during construction through the implementation of a CEMP and during operation through the implementation of a robust surface water drainage system. However, Option 4 will require a new crossing across the main river to the south of Binsted Wood and this will require works within or in close proximity to the river channel that will be difficult to mitigate entirely. As per Option 3, Option 4 will also require a new bridge across the River Arun. The magnitude of this impact on the quality of surface water features during construction is therefore likely to be moderate to minor adverse, although impacts are likely to be temporary.

13.7.20 As per Options 2 and 3, the greatest flood risks during construction and operation will be associated with temporary and permanent works within the floodplain and channel of the River Arun. The magnitude of the impact (pre and post mitigation) is considered to be the same as that assessed for Option 2. However, Option 4 will also require works within the fluvial floodplain of the main river to the south of Binsted Wood. Unless a culvert/bridge of sufficient capacity is provided to maintain the fluvial capacity of the channel and floodplain, or appropriate flood compensation is provided, this could cause localised increase in flood risk. Review of OS mapping indicates a number of properties that are located in the vicinity of the Scheme along Binsted Lane that are likely to be adversely affected by this risk hence impact magnitude is considered to be moderate adverse.

13.7.21 The proposed crossing of the main river to the south of Binsted Wood may cause impact to the hydromorphological and ecological quality of the watercourse by removing ecological habitat and severing connectivity. Similarly, and as per Options 2 and 3, the works could also

have a similar impact to the land drains between Ford Road and the Arun Valley Railway. At this stage and prior to implementing appropriate mitigation, the magnitude of the impact is considered likely to be minor to moderate adverse.

OPTION 5 AND 5A

13.7.22 All potential effects associated with Option 5 and 5A are considered to be the same as those considered for Option 4.

OPTION 5B

13.7.23 Option 5B will cross the two main rivers located to the west and to the south of Binsted Wood, as well as the River Arun to the east. As per Option 4, will also cross a number of land drains located between Ford Road and the Arun Valley Railway. In addition, Option 5B is proposed to be located in close proximity to the existing system of ponds located in the Avisford Park Golf Club to the east and west of Yapton Lane.

13.7.24 As per Option 2, 3 and 4, it is likely that risks to the quality of the water environment can be largely mitigated during construction through the implementation of a CEMP and during operation through the implementation of a robust surface water drainage system. However, risks associated with the new watercourse crossings will be difficult to mitigate entirely and may require the full or partial loss water features located within the golf course. The magnitude of potential impact to the watercourses is likely to be moderate to minor adverse, although impacts are likely to be temporary. The magnitude of potential impact to the ponds within the golf course is likely to be major adverse, although their ecological value is likely to be low.

13.7.25 As per Options 2, 3 and 4, the greatest flood risk during construction and operation will be associated with temporary and permanent works within the floodplain and channel of the River Arun, and with the required crossings over the main rivers located to the south and west of Binsted Wood. Unless a culvert/bridge of sufficient capacity is provided to maintain the fluvial capacity of the channel and floodplain, or appropriate flood compensation is provided, this could cause localised increase in flood risk. Review of OS mapping indicates a number of properties that are located in the vicinity of the Scheme in Walberton and along Binsted Lane that are likely to be adversely affected by this risk hence impact magnitude is considered to be moderate adverse.

SIGNIFICANT EFFECTS

13.7.26 A summary of likely significance is provided within Table 13-1. This assessment is indicative only at this stage to provide an indication of possible effects of the scheme on the water environment. A detailed assessment must be undertaken that takes into consideration proposed design and mitigation measures, and that is informed by a more detailed assessment of baseline conditions. As the options are refined through the design process, mitigation measures will be developed to reduce the significance of identified impacts in line with the NPSNN.

Table 13-1 Summary of impact significance

OPTION	RECEPTOR	IMPACT	SIGNIFICANCE
Options 0A, 0B, 0BA, and 1	River Arun	Risks to ecological, chemical and hydromorphological quality	Slight adverse
	Other surface water features	Risks to ecological, chemical and hydromorphological quality	Neutral
	Groundwater	Risks to water quality	Neutral

OPTION	RECEPTOR	IMPACT	SIGNIFICANCE
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure associated with works within centre of Arundel	Neutral
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure associated with works to east of Arundel	Slight adverse
Option 2	River Arun	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Other surface water features	Risks to ecological, chemical and hydromorphological quality	Neutral to slight adverse
	Groundwater	Risks to water quality	Neutral
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure	Very large adverse
	Floodplain associated with other surface water features	Increased flood risk to urban areas and infrastructure	Neutral
Option 3	River Arun	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Other surface water features	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Groundwater	Risks to water quality	Neutral
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure	Very large adverse
	Floodplain associated with other surface water features	Increased flood risk to urban areas and infrastructure	Neutral
Option 4, 5, 5A	River Arun	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Other surface water features	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Groundwater	Risks to water quality	Neutral
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure	Very large adverse
	Floodplain associated with other surface water features	Increased flood risk to urban areas and infrastructure	Slight adverse
Option 5b	River Arun	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Other surface water features	Risks to ecological, chemical and hydromorphological quality	Moderate adverse
	Ponds within Avisford Park Golf Club	Full or partial loss of ponds	Slight adverse
	Groundwater	Risks to water quality	Neutral
	Floodplain associated with the River Arun	Increased flood risk to urban areas and infrastructure	Very large adverse
	Floodplain associated with other surface water features	Increased flood risk to urban areas and infrastructure	Slight adverse

OPTION	RECEPTOR	IMPACT	SIGNIFICANCE
	features		

13.8 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

- 13.8.1 The assessment of potential impacts is currently based on indicative scheme layout drawings and decisions regarding the proposed design and mitigation have not yet been made. This is of particular importance when considering impacts associated with the quality of surface water runoff and the potential effects of the scheme on flood risk. It is proposed that the Highways Agency Water Risk Assessment Tool (HAWRAT) method of assessing potential risks to water quality will be applied during subsequent stages of assessment.
- 13.8.2 Information regarding baseline flood risk has been obtained from desk based sources and has not yet been informed by review of hydraulic modelling data. Further analysis must be undertaken to fully understand the potential risks to the scheme and potential impacts to people and property elsewhere. A quantitative assessment of flood risks, particularly those associated with works in the mapped fluvial and tidal floodplains, will be required to inform the detailed assessment.
- 13.8.3 Further information regarding the significance of the watercourses within close proximity of the scheme options will need to be obtained via site survey, in particular, information regarding the ecological importance of these watercourses in regard to aquatic ecology.

14 ASSESSMENT OF CUMULATIVE EFFECTS

14.1 INTRODUCTION

14.1.1 Cumulative effects “result from multiple actions on receptors and resources and over time and are generally additive or interactive (synergistic) in nature. Cumulative impacts can also be considered as impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project” (Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interaction, European Commission, May 1999, cited in DMRB 11.2.5; HD 205/08) . Cumulative effects are broadly effects that result from the accumulation of a number of individual effects that may also have synergistic aspects.

14.2 STUDY AREA

14.2.1 The spatial scope of the cumulative effects study is taken to be the potential physical extent of the alternative options considered, and a 500m study area surrounding this area. At this early stage in the design process, the cumulative effects assessment focuses exclusively on potential cumulative impacts associated with the nine alternative options, rather than examining cumulative impacts with different projects.

14.3 ASSESSMENT METHODOLOGY

LEGISLATION AND GUIDANCE

14.3.1 The improvement options which are being considered within this assessment may eventually require the applicant to carry out a full Environmental Impact Assessment (EIA); however, applicable guidance used for this assessment included the European Union (EU) (1999) European Directorate XI: Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions.

14.3.2 The EIA Regulations require projects, as part of the environmental assessment process, to identify the potential for, and assess where present, the beneficial or adverse impact of cumulative effects in the wider environmental context.

14.3.3 DMRB 11.2.5 (HD 205/08) and Part 6 (HD 48/08) have also been referred to as guidance to assess the cumulative effects of the improvement options.

SCOPE OF ASSESSMENT

14.3.4 This assessment focuses on cumulative impacts from a single project. These are impacts that arise from the combined action of a number of different impacts upon a single resource / receptor.

14.3.5 This assessment identifies the specific receptors that would experience a number of different impacts from the construction and operational stage of the different improvement options. The significance of potential cumulative impacts has been described, but is not assigned an overall significance level at this stage of the assessment. A detailed assessment would require other topics to be at a more advanced stage, and establish significance based on quantitative data.

14.3.6 The assessment of cumulative impacts from different projects together with this scheme is given initial consideration, using details of planned infrastructure projects published in the

Local Plan and on the Highways England website.

14.4 OVERALL ASSESSMENT

OPTIONS 0A, 0B, 0BA, AND 1 - PREDOMINANTLY ONLINE IMPROVEMENT OPTIONS

14.4.1 Scheme options 0A, 0B, 0BA and 1 are predominantly on-line improvements involving junction upgrades and widening to the existing A27 alignment through Arundel or minimal lengths of off-line sections of the road. These options will require less construction works than the other predominantly off-line improvement options and propose the introduction of no additional large structures.

EFFECTS ON PEOPLE AND LOCAL COMMUNITIES

14.4.2 Sensitive receptors along the A27 corridor, such as residences close to the above options, are likely to experience disturbance impacts associated with several environmental disciplines. There is likely to be some nuisance caused by dust, noise, vibration, traffic and adverse visual impacts, during the construction phase. Disturbance from construction traffic and noise potentially extends to communities and travellers along connecting transport routes.

14.4.3 During construction, the disturbance associated with these options is likely to take place over a shorter period than the offline options, as the activities will take less time to complete. Options 0A, 0B, and 0BA, which require smaller scale construction works, are generally expected to have lower disturbing effects on People and Communities than Option 1 and the proposed offline options.

14.4.4 During operation, these options will improve the flow of traffic along the A27 Arundel. However, due to the proximity to residential properties, these options are likely to result in higher disturbance levels and therefore adverse cumulative effects on people and communities.

EFFECTS ON PROTECTED SPECIES AND HABITATS

14.4.5 There is some potential for protected species and habitats to be subject to the same disturbance effects as local residences. They may be subject to adverse impacts associated with dust, noise, vibration and traffic during construction.

OPTIONS 2, 3, 4, 5, 5A AND 5B – OFFLINE BYPASS OPTIONS

14.4.6 These options involve larger scale construction works (with a larger footprint, and size of structures). They involve creating a new route for the A27 which bypasses Arundel to the south.

EFFECTS ON PEOPLE AND COMMUNITIES

14.4.7 Sensitive receptors, such as residential properties in close proximity to the proposed bypass options are likely to experience disturbance from a number of aspects. There is likely to be some nuisance from dust, noise, traffic during the construction phase. Disturbance from construction traffic and noise will potentially extend to communities and travellers along connecting transport routes.

14.4.8 During construction, the disturbance associated with the offline option is likely to take place over a longer period than the online options discussed above. However, these options are

generally further away from sensitive receptors, and therefore construction works are likely to result in lower disturbing effects overall.

- 14.4.9 During operation, the off-line options will improve traffic flows and reduce effects on residences and communities related to air quality and noise.

EFFECTS ON PROTECTED SPECIES AND HABITATS

- 14.4.10 There is some potential for protected species and habitats to be subject to the same disturbance effects as local residences. They may be subject to adverse impacts associated with dust, noise, vibration and traffic during construction. Offline options would be located partly within Binsted Wood Complex LWS and other statutory designations. Therefore, these options are more likely than the online options to result in higher disturbance effects on protected species.

14.5 INTER-PROJECT EFFECTS

- 14.5.1 The scheme options will be considered in conjunction with other infrastructure projects planned in the Arun District and wider study area at a later stage of assessment. WSCC has identified a number of road schemes which aim to improve the existing transport network, and these are listed in Table 14.1.
- 14.5.2 The proposed infrastructure schemes listed in Table 14.1 are likely to change flows of traffic and may give rise to cumulative environmental impacts, particularly from noise and air quality effects on people and the environment. These impacts are not considered on a scheme by scheme basis at this stage of assessment, as the traffic model, which would enable a quantitative consideration of cumulative effects such as air quality and noise, has not been finalised.
- 14.5.3 There is the potential for cumulative effects on built heritage, townscape and visual receptors, resulting from the combination of, or interaction between, the A27 Arundel improvements and the cumulative schemes in close proximity to the site. The cumulative impacts associated with these schemes will be considered in more detail at later stages of design.
- 14.5.4 In addition to the projects within Arun District there is also the potential for cumulative effects arising from a wider area. In particular, any landscape effects arising on the SDNP as a result of this scheme could have a cumulative effect with other schemes affecting the SDNP.
- 14.5.5 The planned infrastructure schemes which are considered to have the potential for cumulative effects together with this scheme are outlined in Table 14-1 and are taken from the Arun Local Plan 2011 – 2031 (Publication Version) or the Highways England website.

Table 14-1 Planned infrastructure schemes for consideration of cumulative effects

SCHEME	DESCRIPTION
A27 Improvements – Worthing and Lancing	The proposed improvements to the A27 at Worthing and Lancing are improvements to the capacity of the road and junctions along the stretch of single carriageway in Worthing and narrow lane dual carriageway in Lancing. The extent and scale of the improvements, including the option of full dualling are to be agreed in consultation with West Sussex County Council and the public.
M3 Junction 9	This scheme aims to allow free movement between the A34 and the M3 to reduce existing traffic congestion and delays, and improve safety at the junctions. Scheme options are currently being investigated, and the public will be consulted in 2017.
A27 Chichester Improvements	The Chichester Bypass is a 5.5km long dual carriageway located south of Chichester, with at-grade roundabouts at Portfield, Bognor Road (A259), Whyke (B2145), Stockbridge Road (A286) and Fishbourne Road (A259), and a traffic signal controlled junction with Oving Road (B2144). Congestion and extensive queuing occurs daily at most of the junctions along the bypass, especially during the seasonal peaks. The proposed improvements to the A27 at this location will reduce congestion, improve road safety, and improve capacity. The extent and scale of the improvements are to be agreed in consultation with West Sussex County Council and the public.
A259 Felpham Way and Northern Relief Road	This scheme would enable the delivery of the LEC airfield site, which makes up part of the Enterprise Bognor Regis Strategic Employment Land Allocation (Policy EMP SP2). It would also play a key role in connecting the site with the main road network. The exact route that the link road will take is yet to be determined. The delivery of the Enterprise Bognor Regis is a priority for the Council and has also been identified within the Coast to Capital Local Enterprise Partnership Strategic Economic Plan as an opportunity area for the creation of employment growth. Given the significant economic improvements that the link road would bring, there is a strong case for funding the route and it has been identified as a "pipeline scheme" by the Strategic Economic Plan. A potential source of funding will be through Tax Incremental Finance (TIF), subject to Enterprise Zone status being secured for the Enterprise Bognor Regis site.
A259 Roundstone Bypass Improvement and the A259 Fitzalan Link	Body Shop roundabout improvement - These schemes, which propose the dualling of the A259 between Station Road and the A280 roundabout; and between the Fitzalan Link and Body Shop roundabout were identified through the A259 Route Improvement Study (2013). It has recently been announced that funding has been made available from the Coast to Capital Regional Growth Fund for the delivery of these schemes.
A259 Bognor Regis	Chichester Improvements (Stage 2) - Further work is required in the form of design, consultation and approval for this scheme and there is no current commitment to deliver the scheme.
A284 Lyminster Bypass	The proposed Lyminster Bypass will connect to the committed southern section which will run between Toddington Nurseries and the A259 and the Fitzalan Link. The bypass will improve north-south access from the A27 to Littlehampton by reducing the delays associated with the existing A284 Lyminster Road and the Wick level crossing. This scheme is expected to make the A284 Lyminster Road quieter and encourage walking and cycling on the route. The route will be funded through a mixture of planning obligations, the Regional Growth Fund and potential contributions from Network Rail.
A29 realignment through the Barnham/Eastergate /Westergate strategic site allocation	The potential to realign the A29 has long been documented by West Sussex County Council as a scheme to reduce congestion and to provide better north-south links between the A27 and the A259. The Council has worked with WSCC to develop an evidence base to support a realigned A29 route which includes bridging the railway line. The indicative scheme will also run through the strategic housing allocation, acting as an access route for the proposed development, as detailed in policy H SP1. This strategic priority ties in with the aim of the West Sussex Local Transport Plan (2011 - 2026) to "develop opportunities through new development that will improve the access along the A29, including the potential to bridge the railway level crossing at Woodgate". The delivery of this route will be through planning obligations from the strategic allocation and funding has recently been announced for the scheme as part of the Coast to Capital Regional Growth Fund.
A29 realignment (southern tie-in) and	Evidence indicates that the A29 realignment would have wider benefits if it included both of the tie-in routes. As a comprehensive route, including tie-ins, the realignment

SCHEME	DESCRIPTION
the A29 realignment (northern tie-in)	would become more attractive to users and transfer more traffic away from the existing A29 and surrounding villages. Furthermore, the northern tie-in route would reduce traffic approaching the A29/B2233 War Memorial Junction and would resolve existing congestion problems. As indicative routes, these schemes are subject to further design, consultation and approval. Given the strategic importance of the realignment, as identified by the Local Enterprise Partnership Coast to Capital Strategic Economic Plan, there will be a strong argument to support funding for the route as part of a combination of funding sources.

14.5.6 In addition to the infrastructure schemes which are listed, Arun Council and other nearby local authorities have planned or committed housing and employment growth which are being taken forward as part of the development planning process. The traffic model associated with this scheme will consider the traffic growth associated with this proposed housing and employment growth. The list of developments which are being considered within the traffic model have been discussed and agreed with the local authorities. These will be reflected in the traffic forecast model which is being developed, and which will be reported in the Traffic Forecasting Report towards the end of PCF Stage 1. The impacts associated with those developments will be considered as part of the noise and air quality assessments, but will be reported within the cumulative effects assessment when they can be quantified, during PCF Stage 2.

14.5.7 Cumulative effects associated with noise, air quality and traffic are likely to increase due to Arun District’s planned housing schemes. The growing District’s housing requirements are likely to result in more cars using the local transport network and increased pressure on the District’s transport infrastructure. According to the Arun Local Plan:

“the Council considers that 580 homes on average per year represents a reasonable target for housing provision which meets the District’s full objectively assessed housing needs.”

14.6 INDICATION OF ANY DIFFICULTIES ENCOUNTERED

14.6.1 This assessment does not feature a full assessment of the cumulative impacts from different projects together with the scheme being assessed, as described in DMRB 11.2.5 (HD 205/08) and Part 6 (HD 48/08). However, the main expected cumulative impacts from different projects with the A27 Arundel improvements are considered likely to be from changes to the flows of traffic, and the associated environmental impacts on noise and air quality. The traffic modelling which would enable such an assessment is not available at this stage, and therefore the assessment of these effects will be undertaken at a later stage and will be supported by the Transport Assessment.

15 OUTLINE ENVIRONMENTAL MANAGEMENT PLAN

15.1.1 Table 15-1 provides a summary of the environmental mitigation and management measures that will be required, based on the current level of understanding of the impacts of the overall scheme. At this stage generic measures are provided that are likely to be required for all of the design options currently being proposed. The specific detail of mitigation required will need to be revisited once an option has been selected and the impacts can be better understood.

Table 15-1 Outline Environmental Management Plan

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
Air Quality	Local residents Ecological receptors within SDNP and Ancient Woodland AQMA in Storrington	Nuisance caused by dust deposition during construction Impact on human health from NO _x and PM ₁₀ emissions due to construction traffic causing congestion	Best Practice Measures in a CEMP Traffic Management Plan	Prior to Construction
Cultural Heritage	Unknown buried remains	Physical disturbance caused during the excavation of new roads, service trenches, topsoil stripping, landscaping features and drainage ponds	Archaeological Investigations to establish nature, extent and survival of any previously unrecorded buried archaeological remains	As part of an update to the ESR
	Heritage Assets including Scheduled Monuments, Listed Buildings, Registered Park and Garden, Conservation Area, Non-designated historical landscapes and ANAs.	Impact on historic setting Direct impact on historic buildings due to demolition	High quality design Undertake Setting Assessment including Historical Landscape Assessment Building Investigation for historic buildings subject to direct impacts	Prior to submission of application for Development Consent. I
Landscape	Residential properties within the visual envelope of the road Recreational receptors including visitors to Arundel Castle, the historic town and bridge over the River Arun. Users of PRoWs in close proximity to the site SDNP and nationally designated LCAs in close proximity to the site	Deteriorated visual amenity due to loss of grass verge, scrub, and trees within the highway boundary, loss of woodland and fields (for some options) and new structures and traffic being introduced to viewpoints. Damage to landscape character due to addition of uncharacteristic noticeable features and elements	During construction all existing tree, scrub, shrub and hedgerow planting within the highway estate would be retained wherever possible and protected in accordance with BS5837:2012. Loss of tree, scrub and shrub cover should be substituted elsewhere within the highway boundary in the vicinity of the scheme. Construction working methods around tree roots should take account of arboricultural advice for the protection of all retained	Prior to submission of application for Development Consent. I

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
			trees.	
Ecology and Nature Conservation	Designated Sites (SAC, SPA, Ramsar, SSSI, LWS)	Habitat loss, fragmentation, degradation or disturbance	Assessment of Impacts on European Sites, undertake species surveys including bats survey	As part of an update to the ESR
	Valued habitats including Ancient Woodland	Temporary disturbance or permanent loss of these habitats	Option selection, design of structures, layouts, management plan and aftercare plan	As part of an update to the ESR
	Protected species	Loss of habitat, disturbance and direct harm	Undertake Phase II species surveys e.g. dormouse, otter, water vole, badger and bats, to determine exact management measures required.	As part of an update to the ESR at later stage in design process to reduce likelihood of surveys going out-of-date
Geology and Soils	Geology and soils, construction workers and water resources	Contamination, accidental spillage	Best Practice measures in a CEMP	Prior to Construction
	Buildings (buried concrete structures)	Damage to the structure due to chemical attack and degradation	Ground Investigation	During the development of the design
Materials	Waste management infrastructure and sources of material resources	Use of finite resources and the production of waste with limited management infrastructure capacity	Outline SWMP and detailed assessment of materials once the design option has been selected	Prior to Construction
Noise and Vibration	Residential receptors (including NIAs) recreational users of footpaths and outdoor space, sensitive habitat and species.	Disturbance from construction phase or due to bringing road traffic noise closer to receptor	BPM to minimise construction noise If required noise mitigation for the operation phase could include low noise surfacing, noise barriers or secondary glazing The formation of liaison committees with members of the public should be considered where possible	Prior to submission for planning permission/DC O approval
People and Communities	Motorised users of the road NMU of road and off-road routes	Reduced views from the road Change in levels of driver stress Reduction in NMU amenity and journey length	Consideration of landscape screening of the road wherever possible Use of Best Practice construction methods to reduce disruption to users of facilities within vicinity	Prior to submission for planning permission/DC O approval
	Users of community facilities Registered Common	Community severance Loss of private assets	Deregistration of Common Land if required Agricultural Land Assessment to	

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
	Land Owners and users of private property Agricultural Land classified as BMV	Loss of BMV Agricultural Land	determine in detail the quality of the agricultural land.	
Road Drainage and the Water Environment	Floodplain	Increased flood risk	Prepare a FRA once option is decided upon	As part of an update to the ESR Prior to Construction
	Surface and Groundwater Quality (including River Arun)	Deterioration in quality and quantity	Best Practice Measures in a CEMP	

16 CONCLUSIONS

16.1 KEY CONSTRAINTS ASSOCIATED WITH THE SCHEME

- 16.1.1 There are several environmental constraints, as shown in Figure 16.1, associated with the scheme. Some options are located within the SDNP, and the others are in close proximity to its boundary. Binsted Wood Complex LWS, which has large areas of Ancient Woodland is immediately adjacent to the scheme options, and although Ancient Woodland has no statutory protection, section 118 of the NPPF states 'planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including Ancient Woodland... unless the need for, and benefits of, the development in that location clearly outweigh the loss'. Ancient Woodland cannot be compensated through recreation in the same way as other habitats.
- 16.1.2 Arundel Park SSSI is within 2km of the scheme, and there are several non-statutory designated sites of county importance within 2km of the scheme. There are various heritage assets (Scheduled Monuments, Listed Buildings, Arundel Conservation Area, including Arundel Castle) nearby for which setting is likely to be a key constraint. All options are in close proximity to the River Arun and are partly located within Flood Zone 3, which indicates a high risk of flooding. There are likely to be protected species present, which may be affected by all of the options, and surveys will be required to determine the potential severity of these effects.
- 16.1.3 In view of the early design stage, specific mitigation measures in respect of each individual option have not been detailed at this stage. Therefore, only a high level consideration of generic and typical mitigation measures has been undertaken as part of this assessment.

16.2 SUMMARY OF POTENTIAL EFFECTS ASSOCIATED WITH EACH OPTION

SCHEME OPTION 0A

- 16.2.1 Air quality - This option is likely to have a slight adverse effect on air quality during the construction phase due to the proximity of residential properties and the community hospital to the works, and also during the operational phase, with congestion improvements being countered by the single carriageway giving less capacity than demand at peak period. Therefore, traffic growth in future years is likely to negate if not worsen any air quality benefits from the junction improvements.
- 16.2.2 Cultural heritage – The effect on the cultural heritage resource from this option is considered likely to be neutral, as it is unlikely to adversely impact the setting of heritage assets, due to the minimal scale of works required, and there will be no physical impact on known heritage assets.
- 16.2.3 Landscape - This option will have moderate adverse effect on the landscape and a slight adverse effect on the visual amenity of the surrounding area. These effects will arise due to the increase in built form, loss of mature trees and shrubs within the existing highway boundary and increase in traffic on the A27.
- 16.2.4 Nature conservation – A neutral effect on nature conservation is expected. Effects may still arise as a result of impacts on hedgerows and protected species, including badger and reptiles. However, it is unlikely these would be significant. No impacts on statutory or non-statutory designated sites are predicted.
- 16.2.5 Geology and soils – This option is likely to have a slight adverse effect on soils due to the

minimal land take and earthworks.

- 16.2.6 Materials – This option is considered to have a slight adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.
- 16.2.7 Noise and vibration – During construction, this option may have a minor adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors over the longer term.
- 16.2.8 People and Communities – This option will have a slight beneficial effect on People and Communities. In particular, the option will realise benefits for Motorised Travellers using the A27, as the option would be likely to meet forecast demand in the short term. During construction, there is potential for significant disruption for MT users and neighbouring communities, including residents of Arundel, as the works will be predominantly online.
- 16.2.9 Road drainage and the water environment - This option may have a slight adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, and a slight adverse effect on flood risk to urban areas and infrastructure associated with works to the east of Arundel.

SCHEME OPTION 0B

- 16.2.10 Air quality - This option is likely to have a slight adverse effect on air quality during construction due to dust emissions in and around Arundel. It is likely to have a neutral effect on air quality during operation, with a reduction in congestion on the A27 being counteracted by the increase in flows along Ford Road and increases in traffic growth in future years.
- 16.2.11 Cultural heritage – This option is likely to have between a slight and large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question), and a moderate or large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.
- 16.2.12 Landscape - This option could be expected to have moderate adverse effect on the landscape, and a slight adverse effect on the visual amenity of the surrounding area. These effects would arise due to the increase in built form, loss of mature trees and shrubs within the existing highway boundary and increase in traffic on the A27.
- 16.2.13 Nature conservation – A large adverse effect on nature conservation is expected. This option is likely to have a significant adverse impact on ecology at the County level due to the widening of the existing A27 carriageway to a dual carriageway. Widening is likely to result in the permanent loss of a narrow belt of Ancient Woodland habitat along the northern edge of Binsted Wood Complex LWS and southern edge of Rewell Wood Complex LWS, totalling approximately 3.4ha. This loss of Ancient Woodland would need to be compensated. Significant impacts on hedgerows, grassland and waterbodies habitats and possible impacts on some protected species, including badger and reptiles are predicted.
- 16.2.14 Geology and soils – This option is likely to have a slight adverse effect on soils due to the minimal land take and earthworks.
- 16.2.15 Materials – This option is considered to have a moderate adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.
- 16.2.16 Noise and vibration – During construction, this option may have a adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a minor adverse effect on noise sensitive receptors along the A27 and in the NIAs over the longer term due to the increase in traffic flows. This is a worst case outcome

and also excludes any mitigation which would be required to prevent increases in noise within NIAs.

16.2.17 People and Communities – This option will have a neutral effect on People and Communities. The option will realise benefits for Motorised Travellers using the A27, as the option would be likely meet forecast demand in the long term. During construction, there is potential for significant disruption for MT and neighbouring communities, including residents of Arundel, as the works will be predominantly online. During operation, the option will adversely affect people and communities in Arundel, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.

16.2.18 Road drainage and the water environment - This option may have a slight adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, and a slight adverse effect on flood risk to urban areas and infrastructure associated with works to east of Arundel.

SCHEME OPTION 0BA

16.2.19 Air quality - This option is likely to have a slight adverse effect on air quality during construction due to dust emissions in and around Arundel. It is likely to have a neutral effect on air quality during operation with a reduction in congestion on the A27 being counteracted by the increase in flows along Ford Road and increases in traffic growth in future years.

16.2.20 Cultural heritage – This option is likely to have between a slight and large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a moderate or large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

16.2.21 Landscape - This option will have moderate adverse effect on the landscape and a slight adverse effect on the visual amenity of the surrounding area. These effects will arise due to the increase in built form, loss of mature trees and shrubs within the existing highway boundary and increase in traffic on the A27.

16.2.22 Nature conservation – A large adverse effect on nature conservation is expected. This option is likely to have a significant adverse impact on ecology at the County level due to the widening of the existing A27 carriageway to a dual carriageway. Widening is likely to result in the permanent loss of a narrow belt of Ancient Woodland habitat along the northern edge of Binsted Wood Complex LWS and southern edge of Rewell Wood Complex LWS. The option also involves loss of Ancient Woodland and an Veteran Tree north west of Crossbrush Junction. The total loss of Ancient Woodland for this option is 4.4ha, the loss of which would need to be compensated. Significant impacts on hedgerows, grassland and waterbodies habitats and possible impacts on some protected species, including badger and reptiles are predicted.

16.2.23 Geology and soils – This option is likely to have a slight adverse effect on soils due to the minimal land take and earthworks.

16.2.24 Materials – This option is likely to have a moderate adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.

16.2.25 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a minor adverse effect on noise sensitive receptors along the A27 and in the NIAs over the longer term due to the increase in traffic flows. This is a worst case outcome and also excludes any mitigation which would be required to prevent increases in

noise within NIAs.

16.2.26 People and Communities – This option will have a slight beneficial effect on People and Communities. In particular, the option will realise benefits for Motorised Travellers using the A27, as the option would be likely meet forecast demand in the long term. During construction, there is potential for significant disruption for MT and neighbouring communities, including residents of Arundel, as the works will be predominantly online. During operation, the option will adversely affect people and communities located south of Arundel, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.

16.2.27 Road drainage and the water environment - This option may have a slight adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, and a slight adverse effect on flood risk to urban areas and infrastructure associated with works in the floodplain and loss of floodplain storage.

SCHEME OPTION 1

16.2.28 Air quality - This option is likely to have a slight adverse effect on air quality during construction due to dust emissions around the Ford Road junction. It is likely to have a neutral effect on air quality during operation, with benefits from reductions in congestion being counteracted by the increase in flows along Ford Road and increases in traffic growth in future years.

16.2.29 Cultural heritage - This option is likely to have between a slight and large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question) and a moderate or large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

16.2.30 Landscape - This option will have moderate adverse effect on the landscape, and a slight adverse effect on the visual amenity of the surrounding area. These effects will arise due to the increase in built form, loss of mature trees and shrubs within the existing highway boundary and increase in traffic on the A27.

16.2.31 Nature conservation – Similar to Options 0B and 0BA, a large adverse effect on nature conservation is expected. This option is likely to have a significant adverse impact on ecology at the County level due to the widening of the existing A27 carriageway to a dual carriageway. Widening is likely to result in the permanent loss of a narrow belt of Ancient Woodland habitat along the northern edge of Binsted Wood Complex LWS and southern edge of Rewell Wood Complex LWS, totalling approximately 5.2ha. This Ancient Woodland Loss would need to be compensated. Significant impacts on hedgerows, grassland and waterbodies habitats and possible impacts on some protected species, including badger and reptiles are predicted.

16.2.32 Geology and soils – This option is likely to have a slight adverse effect on soils due to the minimal land take and earthworks.

16.2.33 Materials – This option is likely to have a moderate adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.

16.2.34 Noise and vibration – During construction, this option may have a large adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a minor adverse effect on noise sensitive receptors along the A27 and in the NIAs over the longer term due to the increase in traffic flows. Properties in the Arundel Station area are likely to be less affected. This is a worst case outcome and also excludes any mitigation which would be required to prevent increases in noise within NIAs.

16.2.35 People and Communities – This option will have a neutral effect on People and Communities.

The option will realise benefits for Motorised Travellers using the A27, as the option would be likely to meet forecast demand in the long term. During construction, there is potential for significant disruption for users, including residents of Arundel. During construction and operation, this option will adversely affect people and communities, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.

16.2.36 Road drainage and the water environment - This option may have a slight adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, and a slight adverse effect on flood risk to urban areas and infrastructure associated with works in the floodplain and loss of floodplain storage.

SCHEME OPTION 2

16.2.37 Air quality - This option is likely to have a slight adverse effect on air quality during construction due to the size of the scheme, which gives this option an impact from dust emissions of up to large magnitude, with a medium risk of impacts at several locations where the new road passes close to residential properties. During operation the removal of traffic from the Ford Road junction and rerouting of local traffic will result in an overall slight positive impact on air quality during operation, although, there is a likely worsening in air quality at a small number of locations, including Hazel Grove at the western edge of Arundel.

16.2.38 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a moderate to very large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

16.2.39 Landscape - This option will have large adverse effect on the landscape and a large adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to have adverse impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated.

16.2.40 Nature conservation – A large adverse effect on nature conservation is expected. It is likely to result in the permanent loss of land within the north-east corner of Binsted Wood Complex LWS, which is also designated Ancient Woodland. In addition, the widening of Tortington Lane would also likely result in the permanent loss of habitat towards the western edge of Binsted Wood Complex LWS. Collectively approximately up to 14ha of Ancient Woodland would be lost. This impact would be likely to compromise the ecological integrity of the LWS. Ancient Woodland loss would need to be compensated. Significant impacts on hedgerows, grassland and waterbodies habitats and possible impacts on some protected species, including badger and reptiles are also predicted.

16.2.41 Geology and soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soil are expected to be slight to moderate adverse.

16.2.42 Materials – This option is expected to have major adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.

16.2.43 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and in the NIAs over the longer term due to the increase in traffic flows. There is potential for a moderate short term benefit. Properties in the southern part of the town and

closer to the off-line route would be adversely affected.

- 16.2.44 People and Communities – This option will have a slight beneficial effect on People and Communities. It will realise significant benefits for Motorised Travellers using the A27, as the option would be likely meet forecast demand in the long term. However, this option is offline and will involve land take from agricultural land south of Arundel, and from land with recreational and amenity value in Binsted Wood. During construction and operation, this option will adversely affect people and communities located south of Arundel, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.
- 16.2.45 Road drainage and the water environment - This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, and a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

SCHEME OPTION 3

- 16.2.46 Air quality - During construction this offline option is likely to have a moderate adverse effect on air quality, due to the size of the scheme, which gives this option an impact from dust emissions of large magnitude. Once operational, this offline option will have a moderate positive effect on air quality as the alignment removes traffic congestion around the Crossbush junction and along the existing A27, as well as rerouting of local traffic which would benefit roadside properties.
- 16.2.47 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a moderate to very large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.
- 16.2.48 Landscape - This option will have moderate adverse effect on the landscape, and a major adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to adverse impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated.
- 16.2.49 Nature conservation – This offline option is likely to have large adverse effects on nature conservation. Option 3 is an off-line route from the existing A27 alignment which continues in a south east direction through the centre of Binsted Wood Complex LWS, which is also designated as Ancient Woodland. Up to 24ha of this area would be lost, compensation for this loss in habitat would be required. In addition, significant effects on hedgerows, grassland, riparian vegetation and waterbodies habitats, and possible effects on some protected species, including badger and reptiles are predicted.
- 16.2.50 Geology and soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soils are expected to be slight to moderate adverse.
- 16.2.51 Materials – This option is expected to have major adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.
- 16.2.52 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and in the NIAs over the longer term due to the increase in traffic flows. The is potential

for a moderate short term benefit. Properties in the southern part of the Town and closer to the off-line route would be adversely affected.

16.2.53 People and Communities – This option will have a slight beneficial effect on People and Communities. It will realise significant benefits for Motorised Travellers using the A27, as the option would be likely meet forecast demand in the long term. However, this option is offline and will involve land take from agricultural land south of Arundel, and land with recreational and amenity value in Binsted Wood. This option will have a permanent adverse effect on Billycan Camping as the route runs through its footprint, and may result in it ceasing to be a viable commercial business. During construction and operation, this option will adversely affect people and communities located south of Arundel, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.

16.2.54 Road drainage and the water environment - This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun and other surface water features, as well as a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

SCHEME OPTION 4

16.2.55 Air quality - During construction this offline option is likely to have a moderate adverse effect on air quality, due to the size of the scheme, which gives this option an impact from dust emissions of large magnitude. Once operational, this offline option will have a moderate positive effect on air quality as the alignment removes traffic congestion around the Crossbush junction and along the existing A27, as well as rerouting of local traffic which would benefit roadside properties.

16.2.56 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a moderate to very large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

16.2.57 Landscape - This option will have moderate adverse effect on the landscape, and a large adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to have an adverse impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated.

16.2.58 Nature conservation – This offline option is likely to have large adverse effects on nature conservation. Option 4 is located partly within Binsted Wood Complex LWS which is also designated as Ancient Woodland. Option 4 is an off-line route from the existing A27 alignment which commences further west and circumnavigates the majority of Binsted Wood Complex LWS. This option would likely result in the permanent loss of approximately 6.6ha of Ancient Woodland mostly within the north-west corner of Binsted Wood Complex LWS. This magnitude of habitat loss would be likely to affect the integrity of this LWS. This loss of Ancient Woodland would need to be compensated. In addition, significant effects on hedgerows, grassland, riparian vegetation and waterbodies habitats, and possible effects on some protected species, including badger and reptiles are predicted.

16.2.59 Geology and soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soils are expected to be slight to moderate adverse.

16.2.60 Materials – This option is expected to have a major adverse effect on materials due to the use

of raw materials and waste likely to be generated by the construction works.

- 16.2.61 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and in the NIAs over the longer term due to the increase in traffic flows. There may be a moderate benefit in the short term. Properties closer to the off-line route would be adversely affected.
- 16.2.62 People and Communities – This option will have a mixed effect on People and Communities. It will realise significant benefits for Motorised Travellers using the A27, as the option would be likely meet forecast demand in the long term. However, this option is offline and it will involve significant land take from agricultural land, which is an irreplaceable resource. It will also potentially result in adverse effects on farm businesses located in this area. This option will have a permanent adverse effect on Billycan Camping as the route runs through its footprint, and may result in it ceasing to be a viable commercial business. During construction and operation, this option will adversely affect people and communities located south of Arundel, and east of Binsted, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.
- 16.2.63 Road drainage and the water environment – This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, a moderate adverse effect on the quality of surface water features, as well as a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

SCHEME OPTION 5

- 16.2.64 Air quality - During construction this offline option is likely to have a moderate adverse effect on air quality, due to the size of the scheme, which gives this option an impact from dust emissions of large magnitude. Once operational, this offline option will have a moderate beneficial effect on air quality as the alignment removes traffic congestion around the Crossbush junction and along the existing A27, as well as rerouting of local traffic which would benefit roadside properties.
- 16.2.65 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a slight to moderate adverse effect on earthworks and below-ground heritage assets within 200m of the study area.
- 16.2.66 Landscape - This option will have moderate adverse effect on the landscape, and a moderate to large adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to adverse impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated. All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels.
- 16.2.67 Nature conservation – this option is considered to have up to a moderate adverse effect on nature conservation. Option 5 is located partly within Binsted Wood Complex LWS which is also designated Ancient Woodland. Option 5 is an off-line route from the existing A27 alignment which commences further west and circumnavigates the majority of Binsted Wood Complex LWS. This option would likely result in the permanent loss of approximately 6ha of Ancient Woodland towards the north-west corner of Binsted Wood Complex LWS. This magnitude of habitat loss would be likely to affect the integrity of this LWS. Compensation for

this Ancient Woodland loss would be required. In addition, significant effects on hedgerows, grassland, riparian vegetation and waterbodies habitats, and possible effects on some protected species, including badger and reptiles are predicted.

16.2.68 Geology and soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soils are expected to be slight to moderate adverse.

16.2.69 Materials – This option is expected to have a major adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.

16.2.70 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and in the NIAs over the longer term due to the increase in traffic flows. There may be a moderate benefit in the short term. Properties closer to the off-line route would be adversely affected.

16.2.71 People and Communities – This option will have a mixed effect on People and Communities. It will realise significant benefits for MT using the A27, as the option would be likely meet forecast demand in the long term. However, this is an offline option that will involve significant land take from agricultural land, which is an irreplaceable resource. It will also potentially result in adverse effects on farm businesses located in this area. During construction and operation, this option will also adversely affect people and communities located south of Arundel, and east of Binsted, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.

16.2.72 Road drainage and the water environment - This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, a moderate adverse effect on the quality of surface water features, as well as a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

SCHEME OPTION 5A

16.2.73 Air quality - During construction this offline option is likely to have a moderate adverse effect on air quality, due to the size of the scheme, which gives this option an impact from dust emission of large magnitude. Once operational, this offline option will have a moderate beneficial effect on air quality as the alignment removes traffic congestion around the Crossbush junction and along the existing A27, as well as rerouting of local traffic which would benefit roadside properties.

16.2.74 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question – the effect on a scheduled monument is considered very large), and a moderate to very large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

16.2.75 Landscape - This option will have moderate adverse effect on the landscape, and a major adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to adverse impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated. All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels.

- 16.2.76 Nature conservation – this option is considered to have up to a moderate adverse effect on nature conservation. Option 5A is located partly within Binsted Wood Complex LWS which is also designated Ancient Woodland. Option 5A is an off-line route which circumnavigate the majority of Binsted Wood Complex LWS (similar to Options 4 and 5). This would likely result in the permanent loss of up to 6ha of Ancient Woodland habitat towards the north-west corner of Binsted Wood Complex LWS. This loss of Ancient Woodland would need to be compensated. Overall, up to a moderate adverse impact from Option 5A is anticipated on the ecological integrity of this LWS. In addition, significant effects on hedgerows, grassland, riparian vegetation and waterbodies habitats, and possible effects on some protected species, including badger and reptiles are predicted.
- 16.2.77 Geology and soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soils are expected to be slight to moderate adverse.
- 16.2.78 Materials – This option is expected to have a major adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.
- 16.2.79 Noise and vibration – During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and in the NIAs over the longer term due to the increase in traffic flows. There may be a moderate benefit in the short term. Properties closer to the off-line route would be adversely affected.
- 16.2.80 People and Communities – This option will have a mixed effect on People and Communities. It will realise significant benefits for MTs using the A27, as the option would be likely meet forecast demand in the long term. However, this offline option will involve significant land take from agricultural land, which is an irreplaceable resource. It will also potentially result in adverse effects on farm businesses located in this area. This option will have a permanent adverse effect on Billycan Camping as the route runs through its footprint, and may result in it ceasing to be a viable commercial business. During construction and operation, this option will also adversely affect people and communities located south of Arundel, and east of Binsted, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing.
- 16.2.81 Road drainage and the water environment - This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, a moderate adverse effect on the quality of surface water features, as well as a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

SCHEME OPTION 5B

- 16.2.82 Air Quality - During construction this offline option is likely to have a moderate adverse effect on air quality, due to the size of the scheme, which gives this option an impact from dust emission of large magnitude. Once operational, this offline option will have a moderate beneficial effect on air quality as the alignment removes traffic congestion around the Crossbush junction and along the existing A27, as well as rerouting of local traffic which would benefit roadside properties. Residential properties on Yapton Lane to the north of Walberton are likely to experience a worsening in air quality due to the scheme.
- 16.2.83 Cultural heritage - This option is likely to have between a slight and very large adverse effect on the setting of nearby designated heritage assets (depending on the sensitivity of the asset in question), and a moderate to very large adverse effect on earthworks and below-ground heritage assets within 200m of the study area.

- 16.2.84 Landscape - This option will have moderate adverse effect on the landscape and a moderate to large adverse effect on the visual amenity of the surrounding area. These effects will arise due to the noticeable damage to existing character and distinctive features, and the addition of uncharacteristic noticeable features and elements. It is likely to adversely impact on sensitive visual receptors due to perceptible damage to views from highly sensitive receptors that could not be mitigated. All footpaths crossed by the option will see a localised permanent reduction in amenity due to the visual intrusion and increased noise levels.
- 16.2.85 Nature Conservation - This option is considered to have up to a moderate adverse effect on nature conservation. The option crosses a small stream which drains Binsted Wood Complex LWS. Although Option 5B is downstream of Binsted Wood Complex LWS potential adverse hydrological impacts on the LWS cannot be ruled out without detailed design information. These aquatic impacts may be adverse and significant at up to the County level. In addition, significant effects on hedgerows, grassland, riparian vegetation and waterbodies habitats, and possible effects on some protected species, including badger and reptiles are predicted.
- 16.2.86 Geology and Soils – This offline option entails land take during construction, major earthworks and major ground disturbance. Therefore, throughout construction and operation, effects on soils are expected to be slight to moderate adverse.
- 16.2.87 Materials - This option is expected to have a major adverse effect on materials due to the use of raw materials and waste likely to be generated by the construction works.
- 16.2.88 Noise and Vibration - During construction, this option may have a significant adverse effect on noise sensitive receptors in close proximity to the construction works. During operation, this option is likely to have a negligible effect on noise sensitive receptors in Arundel, along the A27 and the NIAs within the town area. There may be moderate short term benefits. Noise sensitive receptors in the villages of Walberton, Tortington, Binsted, and two NIAs to the west of the option, are likely to be adversely affected during operation.
- 16.2.89 People and Communities - This option will have mixed effects on People and Communities. It will realise significant benefits for MTs using the A27, as the option would be likely to meet forecast demand in the long term. However, this offline option will involve significant land take from agricultural land, which is an irreplaceable resource, it will also potentially result in adverse effects on farm businesses located in this area. This option will have a permanent adverse effect on Billycan Camping and the Hilton hotel and golf course, as the route runs through their boundaries, and may result in them ceasing to be a viable commercial business. During construction and operation, this option will also adversely affect people and communities located south of Arundel, including Walberton, Tortington and Binsted, who will be subject to increased noise effects, resulting in adverse effects on health and wellbeing. Overall the effects are expected to be adverse.
- 16.2.90 Road Drainage and the Water Environment - This option is expected to have a moderate adverse effect on the ecological, chemical and hydromorphological quality of the River Arun, a minor to moderate adverse effect on the quality of surface water features, as well as a very large adverse effect on flood risk to urban areas and infrastructure due to works in the floodplain and loss of floodplain storage.

ALL OPTIONS

- 16.2.91 Table 16-1 summarises the potential impacts associated with each option during the operational phase, using the 7 point scale from WebTAG, where large adverse is -3, large beneficial is 3, and neutral is 0 assuming normal mitigation measures. Where there are several different impacts arising from a DMRB topic or the impacts affect different receptors to a differing degree, the score in Table 16.1 presents the worst case impact relating to that topic.

Table 16-1 Quantitative Summary of the Potential Effects of each Improvement Option

DMRB Topic	IMPROVEMENT OPTIONS									
	0A	0B	0BA	1	2	3	4	5	5A	5B
Air Quality	-1	0	0	0	1	2	2	2	2	2
Cultural Heritage	0	-2	-2	-2	-3	-3	-3	-3	-3	-2
Landscape	-2	-2	-2	-2	-3	-3	-3	-2	-2	-2
Nature Conservation	0	-3	-3	-3	-3	-3	-3	-3	-3	-2
Geology and Soils	-1	-1	-1	-1	-2	-2	-2	-2	-2	-2
Materials	-1	-2	-2	-2	-3	-3	-3	-3	-3	-3
Noise and Vibration	0	-1	-1	-1	0	0	0	0	0	0
People and Communities	1	0	1	0	1	0	0	0	0	-2
Road Drainage and Water Environment	-1	-1	-1	-1	-3	-3	-3	-3	-3	-3

16.2.92 The scheme options which are considered within this ESR consist of Options 0A, 0B, 0BA which would be exclusively online, and Options 1, 2, 3, 4, 5, 5A and 5B which are either predominantly offline or entirely offline. The significance and type of environmental effects which are described within this assessment broadly depend on this distinction, as described below.

ONLINE OPTIONS

16.2.93 The entirely online options which are under consideration broadly have less significant environmental effects, particularly due to the limited land take from environmentally sensitive areas. These options would also result in less significant effects due to decreased materials consumption. However, it is also considered that relative to the offline options, the online options would result in a fewer benefits and may not address existing issues considered under the topic of People and Communities, particularly due to the likely future increases in congestion on the existing A27 alignment. This future congestion will both affect the experience of Motorised Travellers, and result in an increase in adverse noise and air quality effects to communities located in close proximity to the A27 route, particularly in Arundel.

OFFLINE OPTIONS

16.2.94 The offline options are generally considered to result in improved air quality and a decrease in noise effects for sensitive residential areas such as Arundel, and are likely to deliver more significant benefits to People and Communities through improved accessibility for Motorised Travellers. The offline options, however, are affected by the presence of several highly sensitive environmental constraints, and the extent to which these would constrain the development of each option generally depends on the direct, or indirect, effects on these features.

16.2.95 The main constraints which would affect development of the offline options are as follows:

- The landscape and visual significance of the Arun River valley south of Arundel, the setting of the South Downs National Park, which is located immediately to the north of the scheme, and sensitive views from the South Downs;
- The cultural heritage significance of Tortington Priory and Arundel Castle which are Scheduled Monuments, and other listed buildings located in Arundel, and potential effects on the setting of these assets which is considered to extend across the Arun Valley;
- The nature conservation sensitivity of Binsted Park Ancient Woodland, west of Arundel;
- The nature conservation sensitivity of the Arun River valley, which is likely to provide a valuable habitat for sensitive and protected species;

- The sensitivity of the water environment in the Arun River valley, including from potential flood risk; and
- The sensitivity of people living in areas south of Arundel, south of Binsted Park, and west of Binsted to noise.

16.2.96 The extent to which the above key constraints apply to the offline options are described below.

16.2.97 The potential significant effects on landscape and visual assets are considered to reduce for the scheme options which are located further from more sensitive landscape and visual assets. Options 5, 5A and 5B are located further south from Arundel, and any bridge across the Arun Valley will appear more visually distant. As a consequence, Options 5, 5A and 5B are expected to perform better than Options 2 and 3 overall. Option 4 is considered to deliver similar benefits to Options 5, 5A and 5B. However, although it avoids the South Downs National Park Boundary, it is located further out in the open rural landscape south of Binsted Park and has the potential to have increased adverse effects relative to Options 5 and 5a from a landscape and ecological perspective.

16.2.98 The potential significance of effects on cultural heritage assets are considered to be broadly comparable between the offline options. Although Options 4, 5, 5A and 5B are further south of Arundel than Options 1, 2 and 3, and would therefore have a reduced effect on the setting of Arundel Castle, the potential for adverse effects on Tortington Priory and potential below ground assets would be increased.

16.2.99 All of the offline options, except 5B, involve some land take from Binsted Park Ancient Woodland. Ancient Woodland is an irreplaceable natural resource, and the woodland is considered likely to provide a valuable habitat for many sensitive or protected species. It would not be possible to mitigate for its loss. Option 1 involves up to 5.2 ha of land take from Ancient Woodland, as the A27 would need to be widened within existing areas of Ancient Woodland. Options 4, 5 and 5A involve at least 6ha of land take from Ancient Woodland. Options 2 and 3 would have the largest effect due to land take from Ancient Woodland, and would involve up to 14ha, and 24ha of land take from Ancient Woodland respectively. From a nature conservation perspective, the scheme options with less significant effects would avoid any land take from Ancient Woodland, as any loss would have to be compensated at a ratio to be determined with relevant stakeholders.

16.2.100 The potential significant effects on sensitive species and habitats located within the Arun River valley will depend on the presence of those species, which would be subject to further surveys PCF Stage 2 and 3. The relative performance of the offline scheme options should be considered broadly comparable and will largely depend on the specific approach to design and mitigation.

16.2.101 The potential significance of effects on the water environment is considered to be broadly comparable for all of the offline options. The extent to which any offline option is preferred over another offline option will depend on the approach to design. The preferred design would avoid any potential barriers to the Arun River, which could increase flood risk elsewhere, or result in an increased flood risk to the scheme options.

16.2.102 There are potential for significant noise effects to residential properties located south of Arundel, west of Binsted, and south of Binsted Park, these would apply increasingly to the scheme options which are located closer to Binsted, including Options 4, 5, 5A and particularly 5B.

16.3 SCOPING FOR THE NEXT STAGE

- 16.3.1 At this stage of assessment, with several different scheme options still being considered, it is not possible to formally scope out any of the environmental topics from further assessments, as the likely significance of any effect will depend on the option chosen. However, it is possible to give an indication as to the areas that, at this stage, may be scoped out of further assessment at PCF Stage 2, to ensure a more proportionate environmental assessment going forward. We have undertaken this exercise to highlight those topics which are unlikely to result in significant effects.
- 16.3.2 For the mostly on-line options (0A, 0B, 0BA) further consideration should be given to scoping out air quality, geology and soils, noise and vibration, people and communities, and road drainage and the water environment. For the off-line options (2, 3, 4, 5,5A or 5B), further consideration should be given to scoping out air quality, noise and vibration, and parts of people and communities. Option 1 is likely to require a full consideration of all environmental issues, as it is both on and offline.
- 16.3.3 The scheme options which have been assessed at this PCF Stage 1 are exclusively alignments, and therefore much of the assessment set out above is based on assumptions about the likely approach to design, and mitigation. At PCF Stage 2 further assessment will be undertaken, and this will involve consideration of a shorter list of options, and a preliminary design for mitigation. The extent to which mitigation is effective at reducing or mitigating environmental effects will be considered then.

16.4 NEXT STEPS

- 16.4.1 This report will be updated during PCF Stage 2.

17 REFERENCES

17.1 INTRODUCTION AND OVERVIEW / THE PROJECT / ALTERNATIVES CONSIDERED / ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

Government Office for the South East (2002) South Coast Corridor Multi-Modal Study [online] available at: <http://www.socomms.org.uk/reports/South%20Coast%20Corridor%20Multi-Modal%20Study%20Final%20Report.pdf> (Accessed March 2016).

UK Government (2015) A27 Corridor Feasibility Study [online] available at: <https://www.gov.uk/government/publications/a27-corridor-feasibility-study-technical-reports> (Accessed March 2016).

Department for Transport (2014) Road Investment Strategy [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/383145/dft-ris-strategic-vision.pdf (Accessed March 2016).

UK Government (2014) National Policy Statement National Networks (NPSNN) [online] available at: <https://www.gov.uk/government/collections/national-networks-national-policy-statement> (Accessed March 2016).

17.2 AIR QUALITY

Highways Agency (2007) Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Air Quality [online] available at: <http://www.standardsforhighways.co.uk/dmr/vol11/section3/ha20707.pdf> (Accessed March 2016).

Interim Advice Note (IAN) 174/13 (2013) Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA 207/07) [online] available at: <http://www.standardsforhighways.co.uk/ians/pdfs/ian174.pdf> (Accessed March 2016).

Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [online] available at: <http://www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf> (Accessed March 2016).

UK Government (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf (Accessed March 2016).

UK Legislation (2010) The Air Quality Standards Regulations [online] available at: <http://www.legislation.gov.uk/ukxi/2010/1001/introduction/made> (Accessed March 2016).

European Union (2008) Directive on ambient air and cleaner air for Europe, 2008/50/EC [online] available at: http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks, Section 5 Air Quality [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

Department for Communities and Local Government (2012) National Planning Policy Framework,

para. 124 [online] available at:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
(Accessed March 2016).

17.3 CULTURAL HERITAGE

Historic England (2015) The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning: 3 [online] available at: <https://content.historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/gpa3.pdf/> (Accessed March 2016).

Highways England (2007) Design Manual for Roads and Bridges, Cultural Heritage, Volume 11, Section 3, Part 2 [online] available at:
<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/ha20807.pdf> (Accessed March 2016).

West Sussex County Council (2010) Sussex Historic Landscape Characterisation [online] available at: <https://www.westsussex.gov.uk/land-waste-and-housing/landscape-and-environment/sussex-historic-landscape-characterisation/> (Accessed March 2016).

West Sussex County Council (2016) Historic Environment Record [online] available at: <https://www.westsussex.gov.uk/land-waste-and-housing/landscape-and-environment/historic-environment-record/> (Accessed March 2016).

West Sussex County Council (2016) West Sussex Record Office [online] available at: <https://www.westsussex.gov.uk/leisure-recreation-and-community/history-and-heritage/west-sussex-record-office/> (Accessed March 2016).

Historic England (2016) Historic England Archive [online] available at:
<http://archive.historicengland.org.uk/> (Accessed March 2016).

Historic England (2015) The Setting of Heritage Assets, Historic Environment Good Practice Advice in Planning: 3 [online] available at: <https://content.historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/gpa3.pdf/> (Accessed March 2016).

Chartered Institute for Archaeologists (2014) Standard and guidance for historic environment desk-based assessment [online] available at:
http://www.archaeologists.net/sites/default/files/CIfAS&GDBA_2.pdf (Accessed March 2016).

Chartered Institute for Archaeologists (2014) Code of Conduct [online] available at:
<http://www.archaeologists.net/sites/default/files/CodesofConduct.pdf> (Accessed March 2016).

Department for Communities and Local Government (2012) National Planning Policy Framework, op cit 128, 129, 132 [online] available at:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
(Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

UK Legislation (1990) Planning (Listed Buildings and Conservation Areas) [online] available at: <http://www.legislation.gov.uk/ukpga/1990/9/contents> (Accessed March 2016).

UK Legislation (1997) Hedgerow Regulations 1997 [online] available at:
<http://www.legislation.gov.uk/uksi/1997/1160/contents/made> (Accessed March 2016).

Adur & Worthing Councils (1996) Adur District Local Plan [online] available at: <http://www.adur->

www.worthing.gov.uk/adur-ldf/adur-local-plan-1996/ (Accessed March 2016)

17.4 LANDSCAPE

Highways Agency (2010) Interim Advice Note (IAN) 135/10 Landscape and Visual effects Assessment [online] available at: <http://www.standardsforhighways.co.uk/ians/pdfs/ian135.pdf> (Accessed March 2016).

Landscape Institute and Institute of Environmental Management and Assessment (April 2013) Guidelines for Landscape and Visual Impact Assessment 3rd Edition, London: Routledge

Natural England (2014) National Character Areas (NCA) 125. South Downs and NCA 126. South Coast Plain [online] available at: <http://publications.naturalengland.org.uk/search?q=%EF%80%BC%09National+Character+Areas+%28NCA%29+125.+South+Downs+and+NCA+126.+South+Coast+Plain&num=100> (Accessed March 2016).

Land Use Consultants for South Downs National Park (Updated 2011) South Downs Integrated Landscape Character Assessment [online] available at: <https://www.southdowns.gov.uk/wp-content/uploads/2015/03/ILCA-Technical-Document.pdf> (Accessed March 2016).

West Sussex County Council (updated March 2015) Landscape Character Assessment of West Sussex [online] available at: <https://www.westsussex.gov.uk/land-waste-and-housing/landscape-and-environment/landscape-character-assessment-of-west-sussex/> (Accessed March 2016).

International Union for Conservation of Nature (IUCN) (2012) Protected Areas Category V [online] available at: https://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/gpap_category5/ (Accessed March 2016).

Council of Europe (2000) ETS 1X6 [online] available at: <http://conventions.coe.int/Treaty/EN/Treaties/Html/176.htm>. (Accessed March 2016).

Department for Communities and Local Government (2012) National Planning Policy Framework [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

West Sussex County Council (2005) The West Sussex Structure Plan 2001 – 2016 [online] available at: https://www.westsussex.gov.uk/media/3249/adopted_splan_feb05.pdf (Accessed March 2016).

South Downs National Park Authority (2013) The South Downs Partnership Management Plan, Shaping the future of your South Downs National Park, 2014-2019 [online] available at: <https://www.southdowns.gov.uk/wp-content/uploads/2015/01/SDNP-Partnership-Management-Plan-2014-19.pdf> (Accessed March 2016).

Arun District Council (2014) Arun Local Plan 2011 – 2031 Publication Version [online] available at: <http://www.arun.gov.uk/emerging-local-plan> (Accessed March 2016).

17.5 NATURE CONSERVATION

Chartered Institute of Ecology and Environmental Management (2006) Guidelines for Ecological

Impacts Assessment in the United Kingdom CIEEM. Winchester.

DMRB (1993) Design manual for roads and bridges (DMRB) Volume 11 Environmental assessment [online] available at: <http://www.standardsforhighways.co.uk/dmr/vol11/section3.htm> (Accessed January 2016).

LWS have now superseded Sites of Nature Conservation Importance (SNCI) in Sussex.

Defra (2015) Magic [online] available at: <http://magic.defra.gov.uk/> (Accessed January 2016). Natural England (2015) [online] available at: <http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/habsandspeciesimportance.aspx> (Accessed January 2016).

Sussex Biodiversity Partnership (2016) Biodiversity Action Plan [online] available at: <https://www.biodiversitysussex.org.uk/> (Accessed January 2016).

Eaton, M et al (2015) Birds of Conservation Concern 4: the population and status of birds in UK, Channel Islands and Isle of Man. British Birds (108) 708-746.

Joint Nature Conservation Committee (2014) Conservation Designations Spreadsheet [online] available at: <http://jncc.defra.gov.uk/page-3408> (Accessed January 2016).

Defra (2001) The Hedgerows Regulations 1997: a guide to the law and good practice. HMSO, London.

Defra (2012). Biodiversity Offsetting Pilots Technical Paper: the metric for the biodiversity offsetting pilot in England. Defra. London Joint Nature Conservation Committee (2010). Handbook for Phase 1 Habitat Survey - A Technique for Environmental Audit. Joint Nature Conservation Committee, Peterborough.

Stace, C. (2010) New Flora of the British Isles; Third Edition. Cambridge University Press, Cambridge.

Institute of Ecology and Environmental Management (2012) Guidelines for Preliminary Ecological Appraisal; Revised 2nd Edition July 2012.

Ratcliffe, D.A (Ed.) (1977) A Nature Conservation Review. Cambridge University Press, Cambridge.

Spencer, J.W. & Kirby, K.J. (1992) An inventory of Ancient Woodland for England and Wales. Biological Conservation, 67: 77-93.

Spencer, J.W. & Kirby, K.J. (1992) An inventory of Ancient Woodland for England and Wales. Biological Conservation, 67: 77-93.

Defra (2001). The Hedgerows Regulations 1997: a guide to the law and good practice. HMSO, London.

Species of Principal Importance are those listed on Section 41 of the Natural Environment and Rural Communities Act, 2006.

IUCN (2010) The IUCN Red List of Threatened Species *Austropotamobius pallipes* [online] available at: <http://www.iucnredlist.org/details/2430/0> (Accessed January 2016).

PTES (2016) The Peoples Trust for Endangered Species Hazel Dormouse [online] available at: <https://ptes.org/get-informed/facts-figures/hazel-common-dormouse-muscardinus-avellanarius> (Accessed January 2016).

PTES (2016) The Peoples Trust for Endangered Species Hazel Dormouse [online] available at: <https://ptes.org/get-informed/facts-figures/otter/> (Accessed January 2016).

Chanin P (2003) Ecology of the European Otter. Conserving Natura 2000 Rivers Ecology Series No. 10. English Nature, Peterborough.

IUCN (2008) The IUCN Red List of Threatened Species *Arvicola amphibius* [online] available at: <http://www.iucnredlist.org/details/2149/0> (Accessed January 2016).

National Biodiversity Network Gateway (2016) [online] available at: <https://data.nbn.org.uk/> (Accessed January 2016).

Sussex Biodiversity Partnership (2016) Biodiversity Action Plan [online] available at: <https://www.biodiversitysussex.org.uk/> (Accessed January 2016).

HM Government (2011) The natural choice: securing the value of nature. TSO Blackwell.

Highways England (2015) Our plan to protect and increase biodiversity [online] available at: [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146 -
_Highways_England_Biodiversity_Plan3lo.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146_-_Highways_England_Biodiversity_Plan3lo.pdf) (Accessed January 2016).

Department for Communities and Local Government (DCLG) (2012) National Planning Policy Framework, [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Accessed March 2016).

Office of the Deputy Prime Minister (2005). ODPM Circular 06/2005
<http://www.odpm.gov.uk/index.asp?id=1144318>

17.6

GEOLOGY AND SOILS

Highways England (2008) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5, Assessment and Management of Environmental Effects [online] available at: <http://www.standardsforhighways.co.uk/dmrb/vol11/section2/ha20108.pdf> (Accessed March 2016).

Highways England (1993) Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 11, Geology and Soils [online] available at: <http://www.standardsforhighways.co.uk/dmrb/vol11/section3/11s3p11.pdf> (Accessed March 2016).

Defra (2004) Model Procedures for the Management of Land Contamination Contaminated Land Report 11 [online] available at: [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297401/scho0804bibr-
e-e.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297401/scho0804bibr-e-e.pdf) (Accessed March 2016).

Environment Agency (2008) Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008 Volume 1 [online] available at: http://www.nhbc.co.uk/NHBCpublications/LiteratureLibrary/Technical/filedownload_33595_en.pdf (Accessed March 2016).

Department for Communities and Local Government (2012) National Planning Policy Framework, [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf

(Accessed March 2016).

UK Legislation (2012) The Contaminated Land (England) (Amendment) Regulations [online] available at: <http://www.legislation.gov.uk/ukxi/2012/263/made> (Accessed March 2016).

Department for Environment, Food and Rural Affairs (2012) Contaminated Land Statutory Guidance [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223705/pb13735contaminated-land-guidance.pdf (Accessed March 2016).

Department for Communities and Local Government (2012) Technical Guidance to the National Planning Policy Framework [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf (Accessed March 2016).

UK Legislation (1990) Environmental Protection Act 1990, Part 2A, Section 78 [online] available at: <http://www.legislation.gov.uk/ukpga/1990/43/part/IIA> (Accessed March 2016).

UK Legislation (2003) The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 [online] available at: <http://www.legislation.gov.uk/ukxi/2003/3242/contents/made> (Accessed March 2016).

The Planning Inspectorate (1991) Water Resources Act 1991 (SI 57) (as amended by the Water Act 2003) [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/471036/water_abstraction_guide.pdf (Accessed March 2016).

UK Legislation (1980) Highways Act 1980 Section 105A [online] available at: <http://www.legislation.gov.uk/ukpga/1980/66/section/105A> (Accessed March 2016).

17.7

MATERIALS

Department for Communities and Local Government, (2012), The National Planning Policy Framework. [online] available at: <https://www.gov.uk/government/policies/making-the-planning-system-work-more-efficiently-and-effectively/supporting-pages/national-planning-policy-framework> (Accessed March 2016).

Interim Advice Note (IAN) 153/11 (2011) Guidance on the Environmental Assessment of Material Resources , Volume 11 [online] available at: <http://www.standardsforhighways.co.uk/ians/pdfs/ian153.pdf> (Accessed March 2016).

European Commission (2008) The EU Waste Framework Directive [online] available at: <http://ec.europa.eu/environment/waste/framework/> (Accessed March 2016).

HM Government (2012) The Waste (England and Wales) (Amendment) Regulations [online] available at: <http://www.legislation.gov.uk/ukxi/2012/1889/introduction/made> (Accessed March 2016).

Department for Environment, Food and Rural Affairs (2013) Waste Management Plan for England [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf (Accessed February 2016).

UK Legislation (undated) The Control of Pollution Act 1974 [online] available at: <http://www.legislation.gov.uk/ukpga/1974/40> (Accessed February 2016).

UK Legislation (undated) The Control of Pollution (Amendment) Act 1989 [online] available at:

<http://www.legislation.gov.uk/ukpga/1989/14/contents> (Accessed February 2016).

UK Legislation (undated) Environmental Protection Act 1990 (EPA) [online] available at: <http://www.legislation.gov.uk/ukpga/1990/43/contents> (Accessed February 2016).

UK Legislation (undated) The Environment Act 1995 [online] available at: <http://www.legislation.gov.uk/ukpga/1995/25/contents> (Accessed February 2016).

UK Legislation (undated) The Finance Act 1996 [online] available at: <http://www.legislation.gov.uk/ukpga/1996/8/contents> (Accessed February 2016).

UK Legislation (undated) Waste Minimisation Act 1998 [online] available at: <http://www.legislation.gov.uk/ukpga/1998/44/introduction/enacted?view=extent> (Accessed February 2016).

UK Legislation (undated) The Waste and Emissions Trading Act 2003 [online] available at: <http://www.legislation.gov.uk/ukpga/2003/33/contents> (Accessed February 2016).

UK Legislation (undated) The Clean Neighbourhoods and Environment Act 2005 [online] available at: <http://www.legislation.gov.uk/ukpga/2005/16/contents> (Accessed February 2016).

UK Legislation (undated) The Waste (England and Wales) (Amendment) Regulations 2012 [online] available at: http://www.legislation.gov.uk/uksi/2014/656/pdfs/uksi_20140656_en.pdf (Accessed February 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

Department for Communities and Local Government (2014) National Planning Policy for Waste [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364759/141015_National_Planning_Policy_for_Waste.pdf (Accessed March 2016).

Department for Environment, Food and Rural Affairs (2013) Waste Management Plan for England (December 2013) [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265810/pb14100-waste-management-plan-20131213.pdf (Accessed March 2016).

West Sussex County Council (2014) West Sussex Waste Local Plan (2014) [online] available at: https://www.westsussex.gov.uk/media/3241/waste_local_plan_april2014.pdf (Accessed February 2016).

West Sussex County Council (2015) West Sussex Minerals Local Plan (2003) [online] available at: <https://www.westsussex.gov.uk/about-the-council/strategies-plans-and-policies/environment-planning-and-waste-plans-and-policies/minerals-and-waste-policy/minerals-local-plan-2003/> (Accessed February 2016).

West Sussex County Council (2015) New Mineral Local Plan for West Sussex (emerging) <https://www.westsussex.gov.uk/about-the-council/strategies-plans-and-policies/environment-planning-and-waste-plans-and-policies/minerals-and-waste-policy/new-minerals-local-plan/> (Accessed February 2016).

17.8 NOISE AND VIBRATION

Department for Transport (1988) Calculation of Road Traffic Noise (CRTN). [online] available at:

http://www.noiseni.co.uk/calculation_of_road_traffic_noise.pdf (Accessed March 2016).

European Parliament (2002) Directive 2002/49/EC the Environmental Noise Directive – END [online] available at: http://ec.europa.eu/environment/noise/directive_en.htm (Accessed March 2016).

Department for Transport (2011) Design Manual for Roads and Bridges Volume 11, Section 3, Part 7 (HD213/11). [online] available at: <http://www.standardsforhighways.co.uk/ha/standards/dmr/vol11/section3/hd21311.pdf> (Accessed March 2016).

Department for Communities and Local Government (2012) The National Planning Policy Framework. [online] available at: <https://www.gov.uk/government/policies/making-the-planning-system-work-more-efficiently-and-effectively/supporting-pages/national-planning-policy-framework> (Accessed March 2016).

Department for Environment, Food and Rural Affairs, (2010), Noise Policy Statement for England (NPSE). [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

HM Government (1988) Noise Insulation Regulations 1975, as amended 1988 [online] available at: <http://www.legislation.gov.uk/ukxi/1988/2000/regulation/2/made> (Accessed March 2016).

The British Standards Institution (2003), Description and measurement of environmental noise. Guide to quantities and procedures.

The British Standards Institution (2008) Code of practice for noise and vibration control on construction and open sites.

17.9

PEOPLE AND COMMUNITIES

DMRB (1993) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 9 Views from the Road [online] available at: <http://www.standardsforhighways.co.uk/dmr/vol11/section3/11s3p09.pdf> (Accessed March 2016).

Department for Communities and Local Government (2015) Indices of Multiple Deprivation [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf (Accessed March 2016).

Department for Communities and Local Government (2007) Indices of Multiple Deprivation [online] available at: <http://geoconvert.mimas.ac.uk/help/imd-2007-manual.pdf> (Accessed March 2016).

Office for National Statistics (2011) 2011 Census: Key Statistics [online] available at: <http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/2011censuskeystatisticsforenglandandwales/2012-12-11> (Accessed March 2016).

Arun District Council (2012) Arun District Council Local Development Framework: Local Plan. Equalities Impact Assessment [online] available at: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjV1-DXzNbLAhXIKB4KHV5cCvcQFggfMAA&url=http%3A%2F%2Fwww.arun.gov.uk%2Fdownload.cfm%3Fdoc%3Ddocm93jjm4n2649.pdf%26ver%3D2299&usq=AFQjCNGIz2APx_XSXERb9z1RVIL1Odx

[RQ&bvm=bv.117218890,d.dmo](#) (Accessed March 2016).

Office for National Statistics (2011) 2011 Census: Key Statistics, Health and Provision of Unpaid Care [online] available at:

http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwiJ7MuAzdbLAhVF_R4KHcVcAvoQFggpMAE&url=http%3A%2F%2Fwww.ons.gov.uk%2Fons%2Frel%2Fcensus%2F2011-census%2Fkey-statistics-for-local-authorities-in-england-and-wales%2Frft-table-ks301ew.xls&usg=AFQjCNGsLbMIHZuyTHeZ3hW31cKZoMhOzg (Accessed March 2016).

Public Health England (2015) Health Profile 2015: Arun District [online] available at:

http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi0ure0zdbLAhVFJx4KHUqgAxoQFggfMAA&url=http%3A%2F%2Fwww.apho.org.uk%2Fresource%2Fview.aspx%3FRID%3D171928&usg=AFQjCNHhAhByTnsex9_3TpSXF5Ewwm3c0A&bvm=bv.117218890,d.dmo (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

Department for Communities and Local Government (2012) National Planning Policy Framework [online] available at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (Accessed March 2016).

UK Legislation (2000) Countryside and Rights of Way Act 2000 [online] available at:

<http://www.legislation.gov.uk/ukpga/2000/37/contents> (Accessed February 2016).

UK Legislation (1995) Disability Discrimination Act [online] available at:

<http://www.legislation.gov.uk/ukpga/2000/37/contents> (Accessed February 2016).

Arun District Council (2014) Emerging Arun Local Plan 2011 - 2031 [online] available at:

<http://www.arun.gov.uk/emerging-local-plan> (Accessed February 2016).

Arun District Council (2003) Arun District Local Plan 2003 [online] available at:

<http://www.arun.gov.uk/2003-local-plan> (Accessed February 2016).

17.10

WEST SUSSEX COUNTY COUNCIL (2011) WEST SUSSEX TRANSPORT PLAN 2011 – 2026 [ONLINE] AVAILABLE AT: [HTTPS://WWW.WESTSUSSEX.GOV.UK/MEDIA/3042/WEST_SUSSEX_TRANSPORT_PLAN_2011-2026_LOW_RES.PDF](https://www.westsussex.gov.uk/media/3042/west_sussex_transport_plan_2011-2026_low_res.pdf) (ACCESSED FEBRUARY 2016).ROAD DRAINAGE AND THE WATER ENVIRONMENT

Highways England (2009) Design Manual for Roads and Bridges, Road Drainage and The Water Environment, Volume 11, Section 3, Part 10 (HD 45/09) [online] available at:

<http://www.standardsforhighways.co.uk/dmrb/vol11/section3/hd4509.pdf> (Accessed March 2016).

European Commission (2000) Water Framework Directive (2000/60/EC). [online] available at:

<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060> (Accessed March 2016).

European Commission (2006) Groundwater Directive (2006/118/EC). [online] available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:372:0019:0031:EN:PDF> (Accessed March 2016).

Department for Communities and Local Government (2012) The National Planning Policy Framework. [online] available at: <https://www.gov.uk/government/policies/making-the-planning-system-work-more->

[efficiently-and-effectively/supporting-pages/national-planning-policy-framework](#) (Accessed March 2016).

Department for Transport (2014) National Policy Statement for National Networks [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387222/npsnn-print.pdf (Accessed March 2016).

Environment Agency, (2013), Groundwater Protection: Principles and Practice (GP3) [online] available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297347/LIT_7660_9a3742.pdf (Accessed March 2016).

UK Legislation (2010) Environmental Permitting (England and Wales) Regulations 2010 [online] available at: <http://www.legislation.gov.uk/ukdsi/2010/9780111491423/contents> (Accessed March 2016).

17.11 ASSESSMENT OF CUMULATIVE EFFECTS

European Union (EU) (1999) European Directorate XI: Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions [online] available at: <http://ec.europa.eu/environment/archives/eia/eia-studies-and-reports/pdf/guidel.pdf> (Accessed March 2016).

Arun District Council (2014) Arun Local Plan 2011 – 2031 Publication Version [online] available at: <http://www.arun.gov.uk/emerging-local-plan> (Accessed March 2016).

18 GLOSSARY

AAWT	Annual Average Weekly Traffic
ALC	Agricultural Land Classification
ANA	Archaeological Notification Area
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Areas
AWI	Ancient Woodland Inventory
BGS	British Geological Survey
BMV	Best and Most Versatile
BOA	Biodiversity Opportunity Areas
BPM	Best Practicable Means
BRDB	British Red Data Book
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CIfA	Chartered Institute for Archaeologists
CRoW	Countryside and Rights of Way Act
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
D2AP	Dual all-purpose carriageway
dB	Decibel(s)
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EclA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
END	Environmental Noise Directive
ESR	Environmental Study Report
FRA	Flood Risk Assessment
GCN	Great Crested Newt
GLVIA	Guidelines for Landscape and Visual Impact Assessment
HPI	Habitat of Principal Importance
HER	Historic Environment Record
IAN	Interim Advice Note
IAQM	Institute of Air Quality Management
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LBAP	Local Biodiversity Action Plan
LBCA	Listed Buildings and Conservation Areas
LCA	Landscape Character Area
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MAFF	Ministry for Agriculture, Fisheries and Food
MAGIC	Multi Agency Geographic Information for the Countryside
MNR	Marine Nature Reserve
MT	Motorised Travellers
NCA	Natural Character Area
NERC	Natural Environment Research Council

NIA	Noise Important Area
NIR	Noise Insulation Regulations
NMU	Non-Motorised Users
NPSNN	National Policy Statement for National Networks
NNR	National Nature Reserves
NPPF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Project
ONS	Office National Statistics
PCF	Project Control Framework
PRA	Preliminary Risk Assessment
PRoW	Public Rights of Way
RIGS	Regionally Important Geological Sites
RIS	Road Investment Strategy
RoWIP	Rights of Way Improvement Plan
SAC	Special Area of Conservation
SEGI	Site of Ecological or Geographical Interest
SDNP	South Downs National Park
SDPMP	The South Downs Partnership Management Plan
SINC	Sites of Importance for Natural Conservation
SLM	Sound level meter
SoCoMMS	South Coast Multi Modal Study
SPA	Special Protection Areas
SPI	Species of Principal Importance
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Urban Drainage Systems
SWMP	Site Waste Management Plan
VER	Valued Ecological Receptors
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WPZ	Water Protection Zone
WSCC	West Sussex County Council
WSLCA	West Sussex Landscape Character Assessment
ZVI	Zone of Visual Influence

