

A417 Missing Link

6.1 Non-Technical Summary

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A417 Missing Link

Development Consent Order 202[x]

6.1 Non-Technical Summary

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Introduction

Highways England proposes to improve the A417 Missing Link by providing a dual two-lane carriageway between Brockworth bypass and Cowley roundabout in Gloucestershire (the scheme).

The proposal is a “Nationally Significant Infrastructure Project” under the Planning Act 2008, which means that permission is required to build and operate the scheme. This permission is called a Development Consent Order. The Development Consent Order application will be examined by the Planning Inspectorate, which will report its findings to the Secretary of State for Transport to aid decision making.

An Environmental Statement (ES) (Document Reference 6.2) has been prepared to accompany the Development Consent Order application which sets out: a description of the scheme and the reasonable alternatives considered in the development of the design, the environmental setting, the likely significant effects of the scheme on local communities and the environment, and the measures proposed to mitigate these effects.

This document provides a summary of the ES in non-technical language.





Why is the scheme needed?

The Government identified the A417 Missing Link in its first Road Investment Strategy (RIS1) 2015-2020, which sets out a five year investment programme for improvements to the Strategic Road Network. Work completed in RIS1 acknowledged that any solution for the Missing Link needs to take into account both the environmental sensitivity of the site and the importance of the route to the local economy.

Funding for delivery of the scheme was confirmed within the second Road Investment Strategy (RIS2 published in March 2020), which covers the period between 2020 and 2025.

The A417/A419 is a strategic route between Gloucester and Swindon that provides an important link connecting the West Midlands and the south of England. The route is an alternative to the M5/M4 route via Bristol. The section of the A417 near Birdlip, known as the 'Missing Link', forms the only section of single carriageway along the route.

Traffic congestion can be frequent and unpredictable, leading to motorists, including heavy goods vehicle drivers, diverting onto smaller local roads to avoid long delays. This causes difficulties for neighbouring communities as these local roads were not built to accommodate such a high level of traffic.

The scheme has many environmental and engineering constraints and is particularly sensitive due to its location in the Cotswolds Area of Outstanding Natural Beauty (AONB), which is rich in cultural heritage and has many special qualities and unique landscape characteristics. It also climbs the Cotswold escarpment, a dramatic steep rocky slope overlooking the Gloucestershire Vale, and passes through areas supporting important habitats and wildlife.

There are also specific planning and regulatory requirements that apply to development within the AONB including that we need to demonstrate a compelling reason for the improvement scheme and show that the scheme demonstrates that any benefits outweigh the costs very significantly.

Over the years, there have been numerous attempts to find a solution, but for various reasons, including affordability and changes in investment priorities, these have never become a reality. However, in recent years, the case for improvement has become far more compelling – to improve safety, support the economy, ease congestion and reduce pollution. On this stretch of road alone, there were 42 collisions that resulted in personal injury between 2014 and April 2019, 9 of which were fatal.



The project

Description of the scheme

The scheme would provide 3.4 miles (5.5 kilometres) of new dual carriageway connecting the existing A417 Brockworth bypass with the existing A417 dual carriageway south of Cowley. If the Development Consent Order is granted, construction is planned to start in early 2023 and the scheme would be due to open to traffic in 2026. The scheme consists of the following features:

- A new crossing near Emma's Grove for walkers, cyclists and horse riders, including disabled users, which would form part of the Cotswold Way National Trail.
- A new junction would be incorporated at Shab Hill, providing a link from the A417 to the A436 (towards the A40 and Oxford) and to the B4070 (for Birdlip and other local destinations).
- A new 37m wide multi-purpose crossing to provide essential mitigation for bats and an enhancement opportunity for ecology and landscape. The public would also further benefit as the crossing would form part of the Gloucestershire Way and provide an improved visitor experience.
- A new junction would be included near Cowley, replacing the existing Cowley roundabout, making use of an existing underbridge to provide access to local destinations. The use of the existing underbridge would allow for all directions of travel to be made.
- The existing A417 between the existing 'Air Balloon roundabout' and 'Cowley roundabout' would be repurposed. Some lengths of the existing road would be converted into a route for walkers, cyclists and horse riders including disabled users. Other sections would be retained as lower-class public roads, maintaining local access for residents. Some of the route would provide common land.

These features are illustrated on the environmental masterplans presented on the following pages.



The scheme's vision: reconnecting the landscape

As part of this improvement, Highways England want to create a landscape-led highways scheme that would deliver a safe and resilient free-flowing road while conserving and enhancing the special character of the Cotswolds AONB; reconnecting landscape and ecology; bringing about landscape, wildlife and heritage benefits, including enhanced residents' and visitors' enjoyment of the area; improving quality of life for local communities; and contributing to the health of the economy and local businesses.

Design principles

The overarching design principles have been developed as part of engagement exercises undertaken with key stakeholders and include:

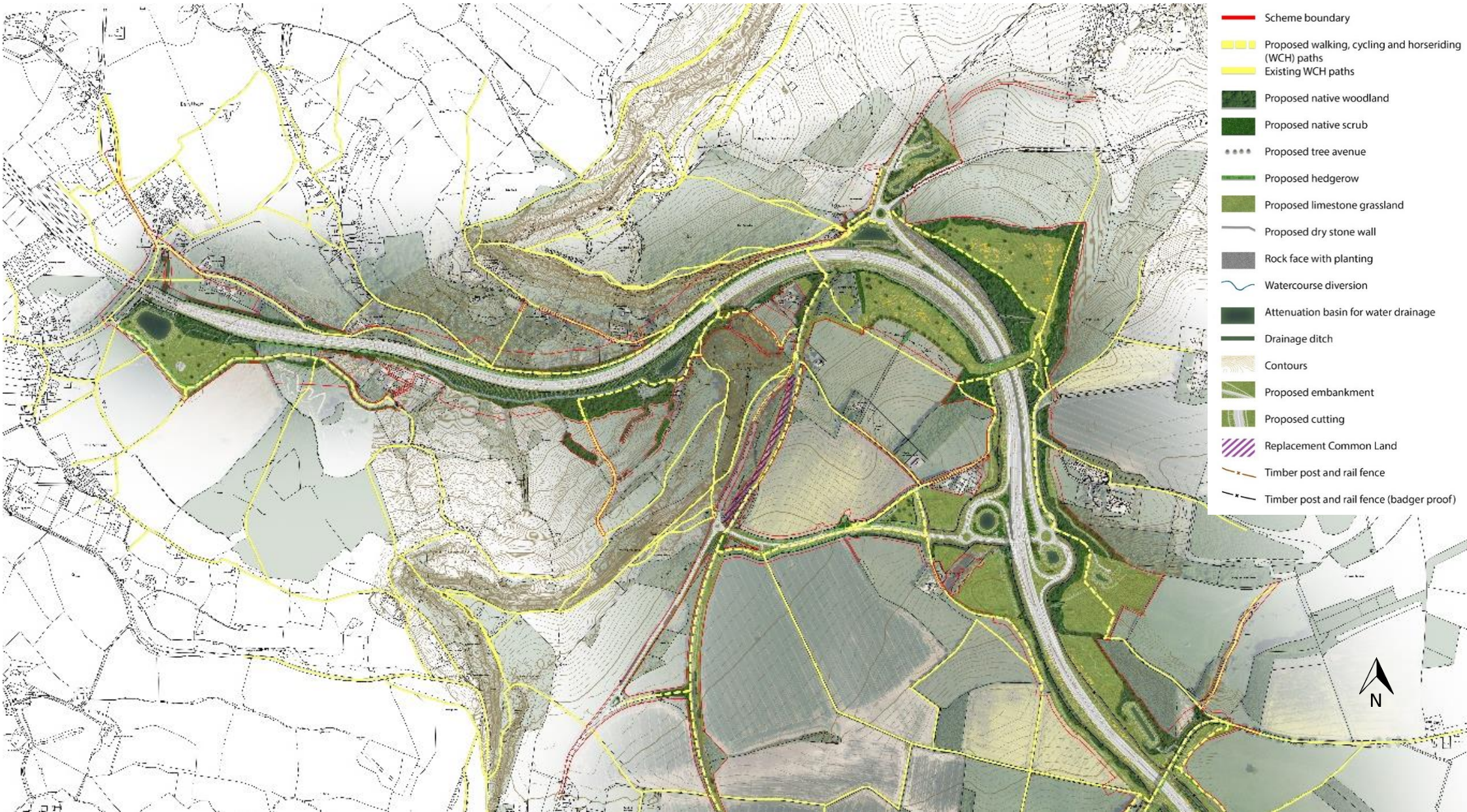
- Any solution involving a new road must ensure that the scheme is designed to meet the character of the landscape, not the other way around.
- Any scheme should bring about substantial benefits for the Cotswolds landscape and environment as well as people's enjoyment of the area.
- Any scheme must have substantially more benefits than negative impacts for the Cotswolds AONB.

The three design principles are underpinned by objectives and are applied throughout the design of the scheme. Information on the scheme objectives can be found in ES Chapter 2 The project (Document Reference 6.2).

What do we mean by 'landscape-led'?

Landscape-led means that landscape is a primary consideration in every design decision that is taken. The proposals have been designed to meet the character of the surrounding area, rather than changing the landscape to fit the proposals.

The environmental masterplans for the scheme show the environmental mitigation and enhancement for the scheme such as planting, habitat creation and the multi-purpose crossing.



- Scheme boundary
- Proposed walking, cycling and horseriding (WCH) paths
- Existing WCH paths
- Proposed native woodland
- Proposed native scrub
- Proposed tree avenue
- Proposed hedgerow
- Proposed limestone grassland
- Proposed dry stone wall
- Rock face with planting
- Watercourse diversion
- Attenuation basin for water drainage
- Drainage ditch
- Contours
- Proposed embankment
- Proposed cutting
- Replacement Common Land
- Timber post and rail fence
- Timber post and rail fence (badger proof)





Alternatives

The scheme has been under consideration for over 20 years and has been subject to a process of staged development and evolution. The process of option identification, route selection and design changes leading to the scheme is summarised in ES Chapter 3 Assessment of alternatives (Document Reference 6.2). The process followed the following stages:

Option Identification (2016 – 2018) – 30 route options including a combination of surface and tunnel options were investigated and assessed.

Option Selection (2018) - As a result of this assessment, two route options were proposed for consultation in February and March 2018. Following this, a preferred route was selected to be taken forward.

Preliminary design (the current stage) – This phase has seen the design evolve in three parts:

- Design development for 2019 statutory consultation following Preferred Route Announcement - The preferred route was developed for statutory consultation, which took place between September 2019 and November 2019. Details of this consultation can be found in the Consultation Booklet at the website below.
- Design development post statutory consultation 2019 - As a result of the statutory consultation 2019 feedback, improvements were made to the scheme. These were presented at the October 2020 and November 2020 supplementary statutory consultation. Details of this consultation can be found in the Consultation Booklet at the website below.
- Design development post supplementary statutory consultation 2020 – Following the supplementary consultation, the scheme was further refined in response to landowner and consultation feedback.

For more information on the route options consultation, the preferred route announcement and the 2019 and 2020 statutory consultation, please visit our scheme's website.

<https://highwaysengland.co.uk/our-work/south-west/a417-missing-link/>

In addition to formal consultation, extensive and regular engagement has been undertaken with the relevant stakeholders to inform the development and assessment of the design for the scheme. These stakeholders include Gloucestershire County Council, Tewkesbury Borough Council, Cotswold District Council, Gloucestershire Wildlife Trust, Cotswolds Conservation Board, Historic England, the National Trust, the Environment Agency, Natural England and a range of walking, cycling and horse riding interest groups.



Potential environmental effects

An environmental impact assessment has been undertaken to meet the requirements of the relevant planning policy and legislation and cover the effects of the scheme on the environment.

The scheme is defined under the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 as the type and scale of development that automatically requires an Environmental Impact Assessment.

The environmental impact assessment considers impacts during the construction and operation of the scheme.

- **Construction:** The construction phase assessment addresses both the temporary activities involved in building the scheme and the subsequent permanent presence of the scheme once constructed.
- **Operation:** The operational assessment considers the situation when the scheme is being used by traffic.

During its construction, most of the scheme's potential adverse impacts would be avoided or reduced by the implementation of industry standard practice and control measures, which would be contained within an Environmental Management Plan (ES Appendix 2.1 Environmental Management Plan (Document Reference 6.4)).

Mitigation

Measures to avoid, prevent or reduce adverse (negative) environmental impacts are known as mitigation.

The scheme design includes embedded mitigation, these are measures which are integrated into the design of the scheme, to avoid or reduce adverse effects on the environment.

The scheme also includes essential mitigation, these are measures to reduce and if possible offset likely significant adverse (negative) environmental effects.

Methods used in the assessment

The environmental impact assessment follows standard methodologies set out in Highways England's Design Manual for Roads and Bridges, along with topic-specific guidance as appropriate.

The approach to the environmental impact assessment comprises:

- Gathering information about the environment to establish the environmental baseline, to enable the environmental constraints and opportunities which may influence or be affected by the scheme to be identified.
- Identifying the potential impacts of the scheme (without mitigation);
- Developing mitigation measures to avoid, reduce or offset adverse (negative) environmental impacts, and where possible enhance beneficial effects.
- Assessing the likely significant effects of the scheme on local communities and the environment, after mitigation measures are implemented.

For each environmental topic, a prediction (based on industry guidance and methodologies) in regard to 'significant effects' has been provided. Significant effects can either be adverse (negative) or beneficial (positive) and indicate the greatest environmental impacts. Predictions regarding significant effects take into account mitigation and are the effect that is likely to occur once mitigation has been implemented, for example, noise barriers and landscape planting such as woodland and grassland.

The following sections provide a summary of the assessment of likely significant effects on each environmental topic as a result of the scheme, as reported in the Environmental Statement (Document Reference 6.2).



Air quality

Baseline

Air quality is generally good in the area, however, there are areas of poor air quality around the scheme. There is one Air Quality Management Area within 200m of the scheme, located at the Air Balloon roundabout, known as the Birdlip Air Quality Management Area.

The Cheltenham Air Quality Management Area is within the wider road network but outside of the construction footprint.

Air Quality Management Areas are areas which the local authority has identified as requiring management to achieve desired air quality and to protect health. Birdlip Air Quality Management Area suffers from poor air quality as a result of traffic emissions from vehicles using the existing road. Air quality at the Crickley Hill and Barrow Wake Site of Special Scientific Interest (SSSI) is above the critical air quality levels defined for the SSSI close to the existing A417.

Construction

During construction, potential air quality effects may arise from emissions of construction dust. These emissions could occur as a result of the proposed construction activities such as demolition and earthworks. The quantities of emissions depend on the scale and intensity of the construction works. Best practice mitigation measures to reduce effects from construction dust would be used. These measures typically include dust suppression techniques and road sweeping.



Construction assessment summary

- No significant effects during construction due to emissions of dust from construction activities.
- No significant effects for human health due to traffic emissions during the construction phase.

Operation

Once the scheme is open to traffic, impacts on air quality arise from traffic using the scheme and the wider road network. It is likely that once operational, the scheme would improve air quality at a number of locations nearby, in particular the properties known as Air Balloon cottages which make up the Birdlip Air Quality Management Area. This is due to the road being further away from these properties and predicted improvements to traffic flow.

Adverse effects are predicted on Ullen Wood Local Wildlife Site (LWS) and ancient woodland and a veteran tree due to the increase in nitrogen deposition from vehicle emissions (reported under Biodiversity). Large improvements have been predicted to occur at the Crickley Hill and Barrow Wake SSSI. Air quality is predicted to improve at these locations as the existing A417 would be moved away and the congestion on the A417 would be improved.

Operation assessment summary

- No significant impacts to local air quality for human health are predicted to occur as a result of the scheme. Air quality would likely be improved at properties in the Birdlip Air Quality Management Area.



Cultural heritage

Baseline

Cultural heritage includes archaeology, historic buildings/structures and historic landscapes. The existing A417 runs through a landscape of historical interest, with archaeological evidence present from prehistoric times to the Second World War. Within the study area of the scheme, the landscape comprises historical assets including 10 scheduled monuments, 50 listed buildings, a registered park and garden and two conservation areas.

Construction

During construction, there would be potential for disturbance to unknown archaeological remains where the scheme would require excavation below the existing ground surface. An archaeological geophysical survey has been undertaken, which identified a number of areas in which likely archaeological remains are present. These sites, as well as areas in which the potential for archaeology is unclear have been investigated by targeted archaeological evaluation trenching. The surveys inform the mitigation and help establish pre-construction archaeological investigation and recording strategies.

The Air Balloon public house would be demolished as part of the scheme. Prior to demolition, a detailed record would be made by means of photographic and measured survey.

Construction activity, including movements of plant, temporary lighting and temporary construction compounds, would take place within the wider setting of listed buildings and other heritage assets close to the scheme. These works would be temporary and of limited duration.

Construction assessment summary

- Scheduled monument Emma's Grove barrows would experience a permanent adverse significant effect as a result of changes to its surroundings.
- At Shab Hill Barn, a Grade II listed building, the presence of the scheme would result in a permanent adverse significant effect on its surroundings.

Operation

Impacts on the historic environment would take place during the operational phase of the proposed scheme; this would include traffic noise, and views of moving vehicles on the road from heritage receptors. There will be no physical impacts on below-ground archaeology during operation, as these will have occurred during the construction phase.

Operation assessment summary

- Shab Hill Barn, a Grade II listed building, would experience an adverse significant effect as a result of increased traffic noise compared to the existing situation.



Landscape and visual effects

Baseline

The scheme would be situated in the Cotswolds AONB, a landscape which is highly valued and designated for its scenic qualities. Visitors and residents enjoy the local landscape features including Crickley Hill Country Park, Barrow Wake, Leckhampton Hill and Coopers Hill. The landscape has a strong character with a diverse and rich cultural heritage. The special qualities of the AONB include the dramatic escarpment, which rises steeply up from the neighbouring low-lying vales before forming the open, undulating high wolds. Cotswold stone walling, beech hangers (woodland) and open long-distance views all form key characteristics of this landscape. The area's rich cultural heritage is visually evident through Neolithic barrows, Iron Age hill forts, historic medieval field patterns with ridge and furrow and later planned enclosures as well as historic parks and gardens.

Views to and from the escarpment and across the wolds are important to the AONB. Views from recreational routes are available from the Cotswold Way National Trail and Gloucestershire Way long distance footpath, as well as other local public footpaths and cycle networks, along with key locations like Crickley Hill Country Park, Leckhampton Hill, Barrow Wake and The Peak. The scheme has the potential to affect the visual amenity and views across the AONB. Viewpoints which could be affected include those from communities around Shab Hill, Stockwell and Brimpsfield, from The Golden Heart Inn, along with views from the road.

Construction

During construction, there would likely be significant effects on the landscape character within the study area and on the special qualities of the Cotswolds AONB, despite construction mitigation measures. These effects would mostly be temporary in nature, associated with temporary construction compounds and the presence of construction activities. The compounds could include parking, areas for the receipt and storage of materials, areas for the assembly of construction equipment and other supplies. The compounds would have lighting and secure fencing. Construction activities would include tree and vegetation clearance, large scale excavation across the site, earthworks to form landscape bunding and erection of retaining walls, underpasses and overbridges. As the scheme is gradually built throughout the construction phase, permanent effects would increasingly become part of the landscape and views.

Construction assessment summary

- Temporary adverse significant effects on landscape character types that are directly affected by the scheme.
- Temporary adverse significant effects experienced by communities of Nettleton Bottom, Shab Hill, Stockwell, visitors to Crickley Hill Country Park, Barrow Wake, Emma's Grove, Great Witcombe Roman Villa, Leckhampton Hill and users of the public rights of way network, including the Cotswold Way National Trail, Gloucestershire Way long distance footpath and local footpaths, bridleways and byways.



Operation

The design of the scheme has been developed to integrate the A417 into the existing surroundings, enhancing the local environment where possible.

Landscape and visual effects would be likely to occur as a result of the long-term loss or changes to existing landscape features or characteristics, features or composition of a view, or the addition of new features within the landscape or view. Changes include the presence of the widened road, the Cotswold Way and Gloucestershire Way crossings, the overbridges at Cowley and Stockwell, earthworks and bunding, drainage basins and fencing, and the presence of replacement vegetation, particularly along the southern side of the A417 between Brockworth bypass and Air Balloon roundabout.

The visual character of the area would be likely to change as a result of the presence of the widened road, the overbridges, and changes to vegetation along the scheme. Large areas of calcareous grassland and woodland would be created, replacing more than is lost to the scheme. The scheme also includes long sections of hedgerows and Cotswold stone walling to create a rich network of robust landscape features, complementing the special qualities of the Cotswolds AONB.

Operation assessment summary

Following 15 years of operation and the establishment of mitigation planting, the following significant effects would be present:

- Permanent adverse significant effects on landscape character types that would be directly affected by the scheme.
- Permanent adverse effects experienced by visitors to Crickley Hill Country Park and Barrow Wake.
- Combination of permanent adverse and neutral effects experienced by users of the public rights of way network, including the Cotswold Way National Trail.



Biodiversity

Baseline

There are numerous sites designated for ecological interest within the vicinity of the scheme. These include Cotswold Beechwoods Special Area of Conservation and several SSSIs including Crickley Hill and Barrow Wake SSSI of which the Barrow Wake unit is partly within the scheme boundary. There are also many Local Wildlife Sites in the surrounding area adjacent to the scheme including Ullen Wood Ancient Woodland.

There are protected and priority species within the scheme area including bats, badgers, reptiles, Roman snails, barn owl and invertebrates. There are also habitats of principal importance (priority habitats) within or adjacent to the scheme including lowland calcareous grassland, lowland mixed deciduous woodland, (including ancient woodland and veteran trees), lowland meadow and species-rich hedgerows.

Construction

The sites of ecological interest and other priority habitats throughout the scheme have the potential to be affected by the scheme either directly as a result of habitat fragmentation and loss, or indirectly due to changes in air quality from dust and pollution, or hydrological changes resulting in degradation of habitat.

Protected species have the potential to be affected by the scheme both directly and indirectly due to above impacts on habitat and also from disturbance due to noise, light or vibration and direct mortality or injury.

Mitigation measures incorporated in the scheme design include a number of crossings to provide connectivity for wildlife across the new road, including the Gloucestershire Way crossing comprising hedgerows and grassland, two smaller overbridges with hedgerows, wildlife-friendly culverts for badgers, and a bat underpass to maintain connectivity of foraging routes.

During construction, measures to avoid or reduce the impacts on habitats and species include the sensitive timing of works such as vegetation clearance, sensitive use of lighting and buffer zones for the protection of existing woodland and trees.

Mitigation measures are provided for specific species including replacement bat roosts where habitats would be lost during construction, and the creation of replacement habitat for reptiles, badgers and Roman snails. These would be undertaken in advance of construction.

Habitats appropriate for the Cotswolds AONB - native broadleaved woodland, calcareous grassland and species rich hedgerows - would be created along the scheme to connect existing habitat and wildlife corridors, which would mitigate the loss and fragmentation of habitat due to the scheme.

Species selection for new planting would include a diverse mix of species of local provenance. The scheme has sought to maximise all opportunities for biodiversity and would provide an increase in priority habitats.



Construction assessment summary

- Adverse significant effect on the Barrow Wake unit of Crickley Hill and Barrow Wake SSSI due to loss of calcareous grassland and woodland.
- Beneficial significant effect on the Barrow Wake unit of Crickley Hill and Barrow Wake SSSI due to conversion of hardstanding (existing A417) within the SSSI boundary to calcareous grassland.
- Adverse significant effect on veteran trees, semi-natural woodland and hedgerows due to habitat loss.
- Beneficial significant effect on semi-natural woodland and hedgerows due to areas of new planting.
- Adverse significant effect on species-rich neutral grassland.
- Beneficial significant effect on calcareous grasslands due to creation of new species-rich calcareous grassland.
- Adverse significant effect on tufa habitat due to loss of tufa formation. Tufa is a limestone habitat formed from calcium carbonate deposited by springs and streams.
- Beneficial significant effect on tufa habitat due to restoration of other tufa spring habitat.
- Adverse significant effects on bats due to loss and fragmentation of habitat.
- Adverse significant effects on barn owls due to loss and fragmentation of habitat.

Operation

Potential impacts on protected species during the operation of the scheme may include, but would not be limited to, disturbance from increased levels of noise or lighting from traffic and incidental mortality through animal vehicle collisions.

Potential impacts on habitat include damage or degradation due to pollution, changes in air quality from vehicle emissions and from recreational visitor pressure.

Wildlife fencing would be included throughout the scheme to reduce the risks to badgers and other wildlife. Hedgerow, woodland, tree and scrub planting would assist in encouraging badgers away from the highway and through safe culverts, underpasses and overbridges. Tree planting adjacent to the road would encourage bats and barn owls to fly towards overbridges to reduce the risk of mortality from traffic collisions.

Operation assessment summary

- Adverse significant effects on parts of Ullen Wood local wildlife site and ancient woodland from an increase in nitrogen deposition from vehicle emissions.
- Adverse significant effect on a veteran tree due to an increase in nitrogen deposition from vehicle emissions.
- Adverse significant effect on barn owls through increased risk of mortality and injury through traffic collisions due to severance of habitat.



Geology and soils

Baseline

The scheme passes through Crickley Hill and Barrow Wake SSSI, which is a designated geological site. The Cotswold escarpment, a steep rocky slope, dominates the landscape. A large plateau exists above the escarpment, underlain by limestone, which was historically quarried across Crickley Hill and Leckhampton Hill. The scheme would pass through an area of old landslide deposits around Brockworth bypass and Crickley Hill. Agricultural land includes areas classified as very good and good quality land. A number of possible sources of contamination have been identified.

Construction

The scheme would not directly affect the existing geological exposures within the Crickley Hill and Barrow Wake SSSI therefore would not result in any impact on the geological importance of the SSSI. New geological exposures would be created within the highway cuttings.

The construction of the scheme would affect approximately 19 hectares of very good agricultural land. It also has the potential for adverse impacts related to contaminated materials that may be present in the ground. Construction activity could result in the mobilisation of contaminants and the generation of contaminant transport pathways from site activities.

The findings from the completed and historical ground investigations have been used to inform options for appropriate mitigation with respect to land contamination risks. A management plan has been produced, detailing measures to limit or completely remove these effects. The mitigation measures include targeting identified areas of concern with detailed land contamination assessments and remediation.

Construction assessment summary

- Permanent adverse significant effect on very good and good quality agricultural land.
- Permanent adverse significant effect on moderate quality agricultural land.

Operation

Operation of the scheme would not include any activities that would have an impact on geology and soils.

Operation assessment summary

- No significant effects during the operation of the scheme.



Material assets and waste

Baseline

The use of materials and the generation of waste has been considered as part of the assessment. The baseline situation includes the availability of materials including primary minerals within the region and the capacity of waste management infrastructure. Gloucestershire County Council have identified areas of finite mineral resources within the area of the scheme that should be safeguarded for the future. There is capacity in the waste management infrastructure in Gloucestershire should this be required for the scheme.

Construction

During construction, the scheme would require the import of materials to site which may have an impact on local sources of material, although this is anticipated to be small in the context of suppliers which regularly provide material for similar projects.

The excavation works would result in a surplus of material (approximately 66,000 cubic metres). Opportunities to use this material as part of the scheme have been identified to reduce this to the point that no surplus material would remain.

The scheme would impact on a small area of safeguarded mineral resources but would not diminish access to this or sterilise the use of the wider resource.

There would likely be some waste arising from the scheme, however, where possible, waste would be prevented and designed out. Any waste generated would be managed in accordance with the waste hierarchy, with a preference to reduce and reuse prior to disposal.

Construction assessment summary

- There would be no likely significant effects related to materials or waste during construction.

Operation

Material use and waste generation is expected to be very small during operation of the scheme, with no significant effects expected. Operational waste and materials have consequently been scoped out of the assessment.

Operation assessment summary

- There would be no likely significant effects relating to materials or waste during operation.



Noise and vibration

Baseline

The existing A417 passes close to residential properties resulting in high existing noise levels along the A417. This is reflected in the designation of six 'Noise Important Areas' (areas identified by the Government as being most exposed to noise) in the vicinity.

Construction

During the construction of the scheme, temporary adverse noise effects would occur at 45 residential locations, and four non-residential locations as well as certain public rights of way in the AONB. Construction noise would be managed through the application of best practice measures which would include the selection of quiet and low vibration equipment, locating equipment away from residential areas to reduce noise disturbance, the use of enclosures for stationary equipment, the use of temporary screening hoarding/bunds, and the implementation of a construction traffic management plan. Potential construction vibration impacts are identified at a number of properties, however, the duration of these impacts is estimated to be less than ten days. Vibration effects from construction would be controlled with suitable mitigation such as lower vibration plant.

Construction assessment summary

- Construction activities would result in significant temporary adverse noise effects at 45 residential properties, along with four non-residential locations as well as some public footpaths which would be in close proximity to the works.

Operation

Once operational, changes in the noise environment would arise from changes in the road layout which would alter the distance between road traffic and residential properties and public rights of way. Changes in noise levels would also be associated with changes in traffic flows, composition and speed on the local road network

During operation, benefits would mainly occur in areas where the existing A417 would be removed, such as near Birdlip. However, potential significant adverse noise effects would occur at some dwellings across the area of the scheme. There would be considerably more beneficial effects than adverse.

Noise mitigation measures have been included where practicable within the scheme where these would achieve beneficial noise reductions. These mitigation measures comprise a combination of earthwork bunding, stone wall and vertical screening (noise barriers). The use of lower noise surfacing has been included along all new and altered highways related to the scheme.

At Crickley Hill Country Park and footpaths rising up to the Country Park, along with other local trails, there would be a little change in road traffic noise. At the top of the escarpment, there would be some areas of noise reduction.

There is a reduction in noise for public rights of way near to where the existing alignment would be removed (e.g. the Cotswold Way National Trail). There are also some footpaths, including part of the Gloucestershire Way long distance footpath, which would be subject to greater noise near the new alignment between the existing Air Balloon roundabout and Cowley junction.

Five Noise Important Areas would benefit from noise reductions such that they would be lower than the current noise levels without the scheme.

Operation assessment summary

- Permanent beneficial significant effects at a total of 71 residential properties and some public rights of way where the existing A417 would be removed.
- Permanent significant adverse effects at 21 residential properties and some public rights of way along the route.
- Permanent significant beneficial effects at 83 residential properties and significant permanent adverse effects at 17 residential properties well beyond the new roads associated with the scheme.
- Permanent significant beneficial effects at several non-residential receptors including Birdlip Primary School, Birdlip Village Hall and part of the Cotswold Way National Trail.
- Permanent significant adverse effects on part of the Gloucestershire Way long distance footpath and on footpath links to the east from Stockwell.



Population and human health

Baseline

The assessment of population and human health considers the potential effects on private property and housing, community land and assets, development land and businesses, agricultural holdings, walkers, cyclists and horse riders including disabled users, and human health.

For the affected communities in Badgeworth to the west (in Tewkesbury District) and Ermin to the east (in Cotswold District), the health and well-being of the local community has been considered.

The area surrounding the scheme is largely rural with a number of agricultural holdings as well as dispersed residential properties and businesses. There is an extensive public rights of way network and local routes in the vicinity of the scheme which have the potential to be affected, including the Cotswolds Way National Trail and Gloucestershire Way long distance footpath. These connect into wider recreational resources such as the Crickley Hill Country Park.

Construction

During construction, three residential properties would be directly affected with two of these three properties being demolished. Two businesses would also be demolished, and one agricultural holding would be affected due to land take for the scheme.

Some community assets (including National Star College and Crickley Hill Country Park), public rights of way and agricultural holdings in close proximity to the scheme are likely to be affected through temporary land take, changes in access as a result of severance, and changes in air quality and noise and vibration arising from construction activities.

The scheme would also bring both temporary and permanent effects on open space land (including Common Land, Open Access Land and Country Park). Common Land removed during construction would be replaced with an area greater than that being lost.

Mitigation measures during construction would include temporary diversions and signage to limit the impacts of any temporary closures of public rights of way and agricultural accesses. Access to businesses and residential properties would also be maintained.



Construction assessment summary

- Permanent adverse significant effects on demolished residential properties and businesses.
- A permanent adverse significant effect on one agricultural holding due to extent of land take.
- Temporary adverse significant effects at National Star College and on users of Crickley Hill Country Park.
- The effect of construction on human health is assessed to be neutral.

Operation

- Once operational, the scheme is anticipated to bring beneficial effects to the health and well-being of the community in terms of overall accessibility and connectivity, businesses and for those visiting the area.
- The scheme includes a number of new crossing points that would provide better and safer links across the A417 for road users and walkers, cyclists and horse riders including disabled users.
- The scheme also includes proposals for new and improved rights of way through a Public Rights of Way Management Plan (Annex F of Appendix 2.1 Environmental Management Plan (Document Reference 6.4)).

Operation assessment summary

- Permanent beneficial significant effects for users of the public rights of way network, including the Cotswold Way National Trail.
- The effect of operation of the scheme on human health is assessed to be a combination of neutral and positive



Road drainage and the water environment

Baseline

The water environment comprises the road drainage system, surface water features such as watercourses, groundwater resources in relation to water supplies and flood risk within the study area. The links between the surface water, groundwater and nature creates a very complex and sensitive environmental setting.

The land within the scheme drains to the River Severn and its tributaries to the west, and to the River Churn, a tributary of the River Thames, to the east and south-east. There are areas of surface water flood risk across the route of the scheme. The value of the water environment results from the ground and surface water features themselves, and the biodiversity and landscape features they support.

The understanding of the baseline is supplemented by groundwater and surface water surveys. These provide greater certainty about the nature and scale of potential impacts and inform the design of mitigation and enhancement measures.



Construction

During construction, there would be potential adverse impacts on surface water and groundwater flow and quality, due to works including cuttings and embankments near to springs and watercourses, new structures (with associated foundations), and the risk of accidental spillages. The scheme would also require the realignment of the tributary of Norman's Brook.

There are established construction practice guidelines to manage pollution risks during construction. Measures to mitigate adverse effects on the water environment during construction would include best practice pollution control measures including emergency spill procedures and the approach to managing storage areas and stockpiles. The appropriate sequencing of works would seek to reduce the impact on the tributary of Norman's Brook and groundwater resources. Environmental monitoring of the water environment would be undertaken throughout construction.

Construction assessment summary

- Temporary adverse significant effect on surface water due to the realignment of the tributary of Norman's Brook during the construction phase.

Operation

The excavation of the cuttings through Shab Hill and the top of Crickley Hill may change groundwater levels and flows and therefore impact groundwater dependent features like springs or divert water between catchments. Hydrogeological assessments have however shown that there would not be significant effects resulting from these works. The drainage design would be developed to maintain existing catchments.

Road drainage for the scheme would be developed to protect the water environment from highway pollution and to prevent increases in flood risk. A sustainable drainage system would be developed that would discharge into a series of road drainage attenuation basins to provide treatment before allowing water to discharge to a watercourse. This approach would control pollution from road run-off to higher standards than the existing road.

Operation assessment summary

- No significant adverse effects on the water environment.

Climate

Baseline

The assessment of climate includes the effects of greenhouse gas emissions associated with the scheme and resilience of the scheme to cope with extreme weather events.

The baseline for the assessment of climate resilience is made up of the current climate observations and future projected climate conditions and extreme weather events in the local area. UK climate projections predict an increase in annual temperatures and rainfall, with wetter winters and drier summers and increases in the frequency of heatwaves, prolonged periods with no rainfall and days with heavy rainfall (when precipitation is greater than 25mm).

Construction

The scheme would result in greenhouse gas emissions during construction from the raw materials required, transport and construction processes. The estimate of emissions from the construction phase total approximately 58,000 tCO_{2e} (metric tonnes of carbon dioxide equivalents).

Mitigation measures would be implemented to reduce emissions during construction of the scheme, for example through management and reduction of energy use, sourcing recycled or secondary materials from the local area and exploring the use of lower carbon materials.

The scheme would be designed to be resilient to impacts arising from projected future weather events and climatic conditions and designed in accordance with current planning, design and engineering practice and codes.

Construction assessment summary

- No significant effects with regard to greenhouse gas emissions during the construction of the scheme.
- No significant effects with regard to the vulnerability of the scheme to climate change during construction.

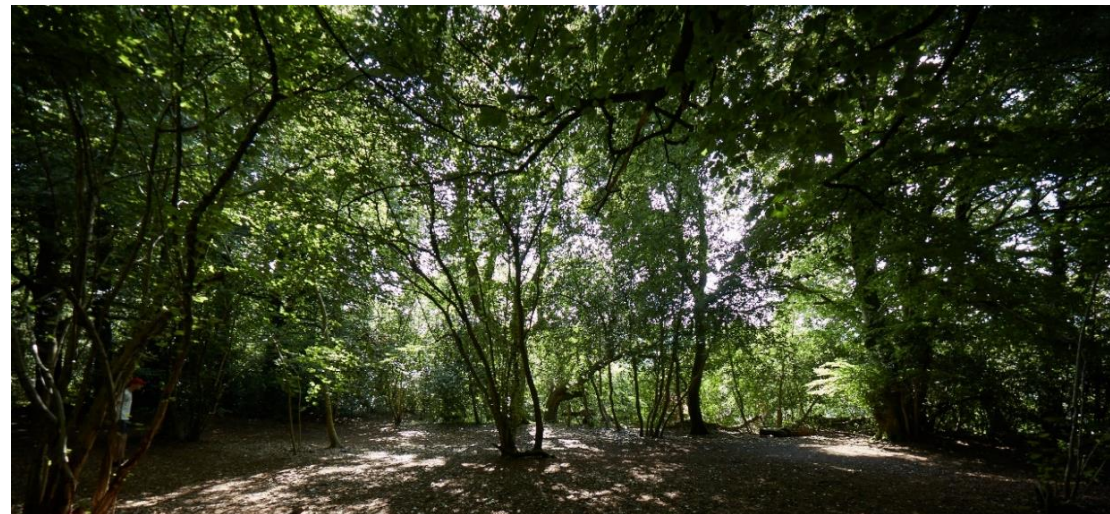
Operation

During operation, emissions would be generated primarily from the exhaust pipes of vehicles using the road network, and from maintenance and refurbishment of the scheme. Vehicles using the scheme would constitute the vast majority of the greenhouse gas emissions across the scheme's assumed lifetime (including both construction and operation). It is considered that the emissions from the scheme in isolation would not have a material impact on the ability of the government to meet its carbon budgets, and therefore is not anticipated to give rise to a significant effect on climate.

Climate change risks to the scheme assets have been assessed during operation of the road. Potential impacts include increased heat stress for maintenance workers, damage to road surfaces from high temperatures, flooding and weakening of embankments from storms. The design has embedded measures to ensure resilience to these potential impacts. Climate change risks to the scheme have been assessed and found to be not significant because of mitigation measures already built into the design and regular maintenance reviews during operation to ensure the design is working as intended. These measures would make the scheme resilient to future climate conditions.

Operation assessment summary

- No significant effects with regard to greenhouse gas emissions during the operation of the scheme.
- No significant effects with regard to the vulnerability of the scheme to climate change during operation.



Cumulative effects

An assessment has been undertaken of likely cumulative effects arising from the following:

- Proposed developments in the vicinity of the scheme that are under construction or have been consented, combined with the effects of the scheme; and
- Combined effects from the scheme on a single resource/receptor from a number of individual environmental impacts, for example noise, dust and traffic.

Cumulative effects with other developments

A review of the planning applications and allocations within the area around the scheme was undertaken to identify any other developments which may result in a cumulative effect together with the scheme, which is a greater, new or different significant effect than would result from the scheme on its own. The search area for these other developments was the largest combined area based on the likely distances from which developments could influence each environmental topic.

Summary of cumulative effects assessment

- No significant cumulative effects with other developments.

Combined effects on a single receptor

Combined impacts are from the action of a number of different impacts upon a single resource/receptor and are considered within the environmental topic chapters of the ES (Document Reference 6.2). The results of this assessment do not indicate that any additional mitigation measures are required.



Summary of significant environmental effects

Topic	Construction stage	Operation stage
Air quality	<ul style="list-style-type: none"> No significant effects. 	<ul style="list-style-type: none"> No significant effects.
Cultural heritage	<ul style="list-style-type: none"> Permanent adverse significant effect on Shab Hill Barn Grade II Listed Building resulting from the scheme altering the setting of the resource. Permanent adverse significant effect on Emma's Grove scheduled monument resulting from the scheme altering the setting of the resource. 	<ul style="list-style-type: none"> Permanent adverse significant effect on Shab Hill Barn Grade II Listed Building due to increased traffic noise compared to the existing situation.
Landscape and visual	<ul style="list-style-type: none"> Temporary adverse significant effects on landscape character types that are directly affected by the scheme. Temporary adverse significant effects experienced by communities of Nettleton Bottom, Shab Hill, Stockwell, visitors to Crickley Hill Country Park, Barrow Wake, Emma's Grove, Great Witcombe Roman Villa, Leckhampton Hill and users of the public rights of way network, including the Cotswold Way National Trail, Gloucestershire Way long distance footpath and local footpaths, bridleways and byways. 	<ul style="list-style-type: none"> Permanent adverse significant effects on landscape character types that would be directly affected by the scheme at year 15 of operation. Permanent adverse effects experienced by visitors to Crickley Hill Country Park and Barrow Wake at year 15 of operation. Combination of permanent adverse and neutral effects experienced by users of the public rights of way network, including the Cotswold Way National Trail at year 15 of operation.
Biodiversity	<ul style="list-style-type: none"> Adverse significant effect on the Barrow Wake unit of Crickley Hill and Barrow Wake SSSI due to loss of calcareous grassland and woodland. Beneficial significant effect on the Barrow Wake unit of Crickley Hill and Barrow Wake SSSI due to conversion of hardstanding (existing A417) to calcareous grassland. Adverse significant effect on veteran trees, semi-natural woodland and hedgerows due to habitat loss. Beneficial significant effect on semi-natural woodland and hedgerows due to areas of new planting. Adverse significant effect on species-rich neutral grassland. Beneficial significant effect on calcareous grasslands due to creation of new species-rich calcareous grassland. Combination of adverse significant effect on tufa habitat due to loss of tufa formation and beneficial significant effect due to restoration of other tufa spring habitat. Tufa is a limestone habitat formed from calcium carbonate deposited by springs. 	<ul style="list-style-type: none"> Adverse significant effects on parts of Ullen Wood local wildlife site and ancient woodland from an increase in nitrogen deposition from vehicle emissions. Adverse significant effect on a veteran tree due to an increase in nitrogen deposition from vehicle emissions. Adverse significant effect on barn owls through increased risk of mortality and injury through traffic collisions due to severance of habitat.

Topic	Construction stage	Operation stage
	<ul style="list-style-type: none"> Adverse significant effects on bats and on barn owls due to loss and fragmentation of habitat. 	
Geology and soils	<ul style="list-style-type: none"> Permanent adverse significant effect on very good, good and moderate quality agricultural land. 	<ul style="list-style-type: none"> No significant effects.
Material assets and waste	<ul style="list-style-type: none"> No significant effects. 	<ul style="list-style-type: none"> No significant effects.
Noise and vibration	<ul style="list-style-type: none"> Temporary adverse significant noise effects from construction activities for 45 residential properties. Temporary adverse significant noise effects from construction activities at four non-residential locations as well as some public footpaths which would be in close proximity to the works. 	<ul style="list-style-type: none"> Permanent beneficial significant effects at a total of 71 residential properties and some public rights of way. Permanent significant adverse effects at 21 residential properties and some public rights of way along the route. Permanent significant beneficial effects at 83 residential properties and significant permanent adverse effects at 17 residential properties well beyond the new roads associated with the scheme. Permanent significant beneficial effects at several non-residential receptors including Birdlip Primary School, Birdlip Village Hall and part of the Cotswold Way National Trail. Permanent significant adverse effects on part of the Gloucestershire Way long distance footpath and on footpath links to the east from Stockwell.
Population and human health	<ul style="list-style-type: none"> Permanent adverse significant effects on demolished residential properties and businesses. A permanent adverse significant effect on one agricultural holding due to extent of land take. Temporary adverse significant effects at National Star College and on users of Crickley Hill Country Park. All health outcomes are neutral. 	<ul style="list-style-type: none"> Permanent beneficial significant effects for users of the public rights of way network, including the Cotswold Way National Trail. Positive and neutral health outcomes.
Road drainage and the water environment	<ul style="list-style-type: none"> Temporary adverse significant effect on hydromorphology due to the removal of the tributary of Norman's Brook. 	<ul style="list-style-type: none"> No significant effects.
Climate	<ul style="list-style-type: none"> No significant effects. 	<ul style="list-style-type: none"> No significant effects.

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