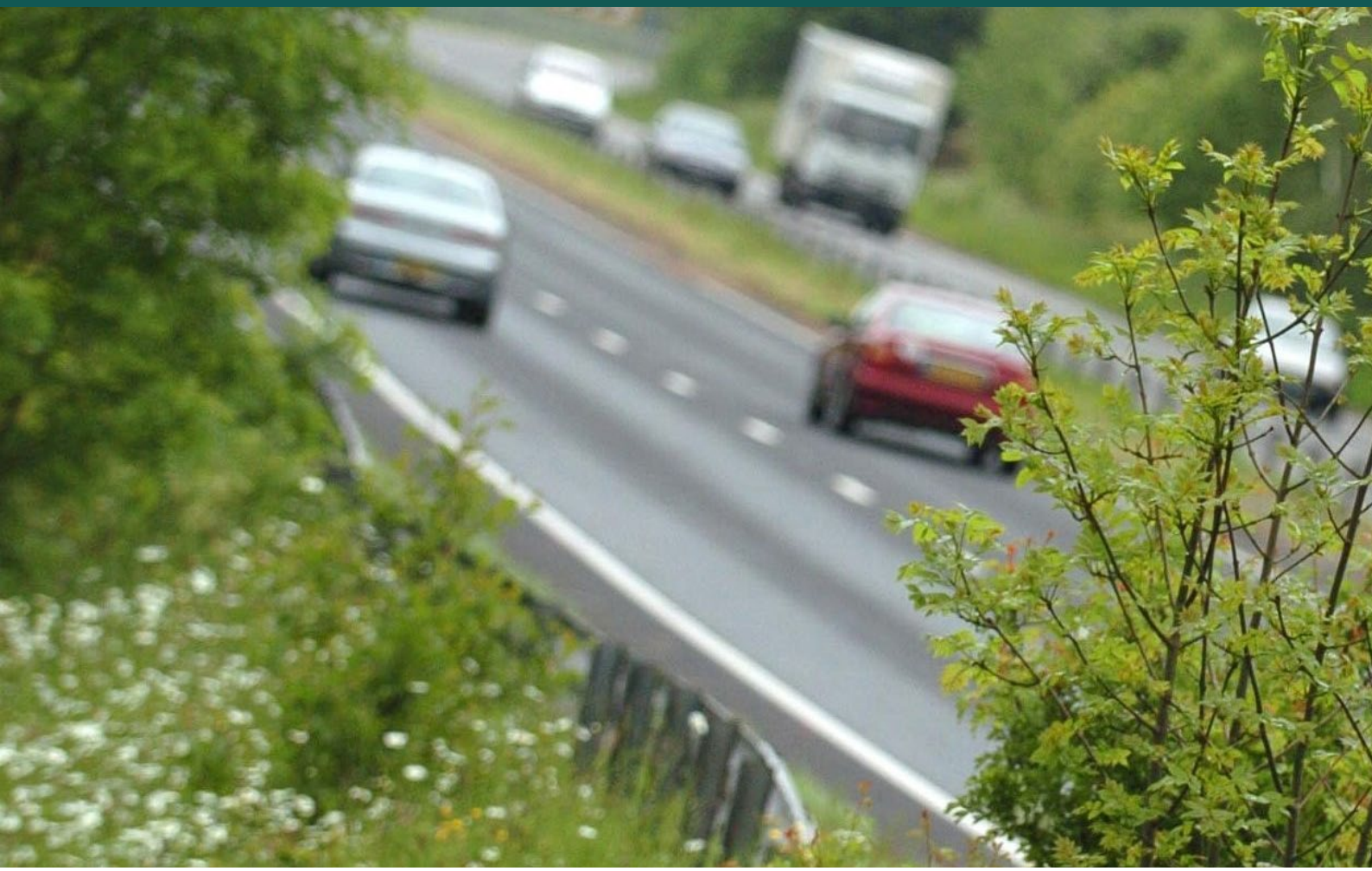
Haldon Green Bridge

Business Case

May 2016



KIER

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Foreword

The construction of the A38 through the Haldon Hills provided a physical barrier for species, recreational activities and the SSSI. The provision of a green bridge at this location would remove this barrier, allowing the reconnection of the SSSI, open up the Harcombe area for walkers, cyclists and horse riders and allow deer to safely cross the A38, reducing accidents. It fits with Devon County Councils' aspirations to connect up a number of settlements and existing cycle routes in the area, further enhancing the cycle network in the county.

A summary of the benefits and costs (in 2010 values) is included in the table below. This shows that the proposed scheme would have a BCR of almost 2, with additional environmental benefits which cannot be monetised.

Tourism Benefits	£2.9m
Health Benefits	£6.1m
Safety Benefits	£9.1m
Journey Quality Benefits	£1.1m
Total Benefits	£19.2m

Cost	£10.5m

BCR	1.83

1. Introduction

1.1 Background

1.1.1 The purpose of this report is to present the business case for a green bridge over the A38 at Haldon Hill. It follows on from an EM Highways Report entitled 'Area 1 Green Bridges – Interim Feasibility' from March 2015 which outlined the possibility of a green bridge at this location.

1.1.2 Green bridges are structures designed to facilitate wildlife and non-motorised users with easy and safe crossings of main roads and railways. They have a layer of soil on the top to enable soft landscaping measures and vegetation planting.

1.1.3 These bridges are becoming a common site in countries such as France, Switzerland, Germany and the Netherlands as well as in the USA and Canada. There are a couple of these structures now in the UK such as over the Lamberhurst bypass in Kent as shown in Figure 1 below.

Figure 1: Green Bridge over the Lamberhurst Bypass in Kent

1.2 Study Area

1.2.1 The Haldon Hills run along a ridge of high ground between the River Exe and the River Teign. These hills are cut into three main sections by the A38 and A380 passing through the site. A map of the area is shown in Figure 2 below.

1.2.2 The Haldon Forest area is a designated SSSI covering an area over 1000 hectares. It has this status because of its nationally important breeding population of nightjars, 35 species of butterfly (some of which are nationally-scarce), 277 species of moth and an array of bird of prey species. There are also dormice in the area, which are a protected species in Britain.

1.2.3 The area is also an important bird area, with buzzards, sparrow-hawks, peregrines, kestrels and goshawks all known to be present in the area. About 80 pairs of nightjars breed in the forest, representing about 3% of the British population of this declining migratory species. Britain has a responsibility under the European Council Directive of 1979 on the conservation of wild birds to conserve the habitat of this species.

1.2.4 Within the site there are two pockets of UKBAP Lowland Heathland, a nationally scarce and threatened wildlife habitat virtually restricted to the South-West.

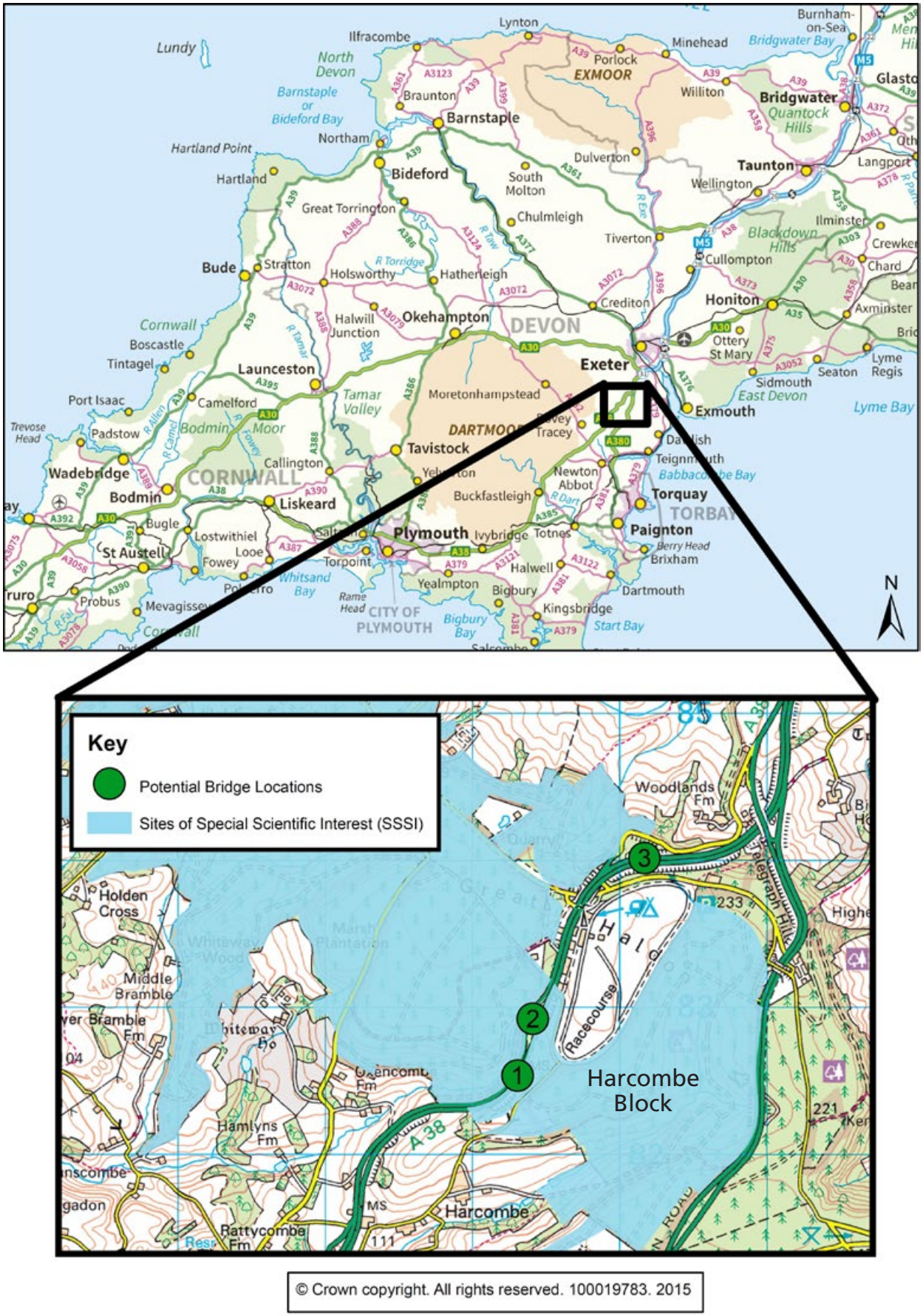

Figure 2: Location Map

2. Current Situation

2.1 Population Growth

2.1.1 In the period to 2031 Devon is set to accommodate 67,000 additional homes. The 2011 census recorded 322,600 houses in Devon therefore this equates to a 20.7% increase. In addition, the ageing population profile of the County shows that over the same period the number of people over 65 is set to rise to 100,000.

2.1.2 This growth plus the increase in the number of retired residents with increased leisure time means improvements to access existing assets such as Haldon Forest are required.

2.1.3 Funding has been a key barrier to fully addressing these problems. This bid is essential for constructing the green bridge at Haldon and will hopefully provide the catalyst for additional cycle schemes in the area.

2.1.4 Devon has 23% of people using outdoor places for health/exercise, with 13% of adults recorded as regularly participating in active recreation. Improving the opportunity for people to cycle as a leisure activity will further increase cycle numbers.

2.2 Cycling

2.2.1 Cycling in Devon is becoming more popular both as a means of travelling to work as well as a leisure activity. Devon County Council have spent significant amounts of money in recent years improving the cycling infrastructure in the County, with the most recent investment project being the Granite and Gears project specifically aiming to improve access to Dartmoor. A map showing the proposed routes is included in Figure 3 opposite.

2.2.2 This included a proposed link between the Wray Valley Trail and the Exe Estuary Trail but one major constraint of this route was crossing the A38.

2.2.3 Cycle growth in Devon continues to increase as shown Figure 4 opposite. This increase is closely linked to new infrastructure being built as providing safer, off-road cycle routes makes cycling more attractive.

2.2.4 Haldon Forest is managed by the Forestry Commission and covers an area of 3,500 acres with numerous leisure activities on offer ranging from walking and off-road cycling to orienteering and a high ropes adventure course.

2.2.5 A study carried out by the University of Exeter entitled 'Pedal Power: an Analysis of the Economic Contribution of Off-road Cycling at Haldon Forest Park' February 2014 included information about the number of cyclists using the area. This revealed that over 33,000 cyclists visit the area each year to make use of the 10 purpose built off-road cycling routes of varying difficulty.

2.2.6 The study also interviewed visitors to the area which revealed that visitors have an average dwell time of between 3 and 4 hours.

Figure 3: Dartmoor Cycle Route Plan

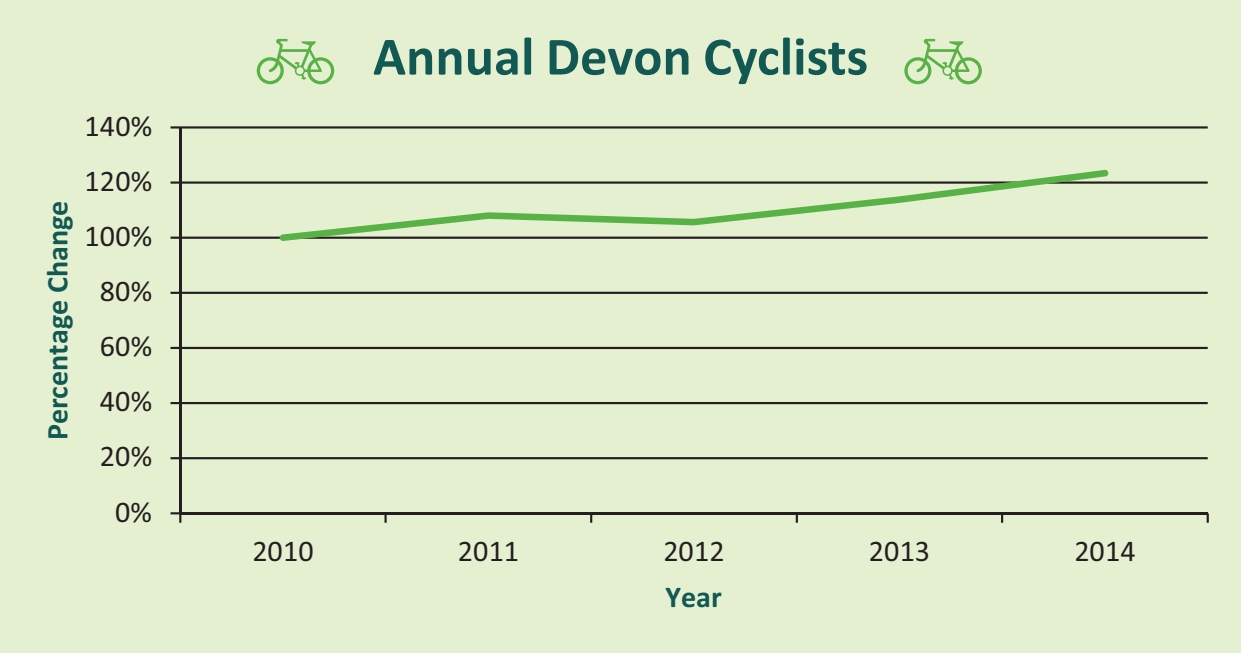

Figure 4: Cycle growth in Devon

2.2.7 At present, cyclists are limited to the area of the park to the north-west of the A38, with access to the Harcombe block currently being isolated and therefore under-utilised by the public.

2.2.8 There is currently access between the two blocks via the underpass next to the racecourse access. However, this requires cyclists to navigate the hazardous roundabout associated with the A38 eastern slip road and the anti-social behaviour of the traveller's camp. This makes the route unattractive to cyclists.

2.3 Deer Collisions

2.3.1 There is a large population of deer living in the Haldon Hills area, with over 500 fallow deer along with a smaller population of roe and red deer, and they can frequently be seen at the side of the A38 carriageway, as shown below. These deer often try and cross the road and despite installing deer lights to dissuade them from crossing, it leads to a significant deer-vehicle collisions (DVC) issue. The Highways England 'Area 1 Deer and Existing Trunk Roads Structures Study: 2010' indicated that there were on average between 13 and 27 DVCs every year at Haldon Hills, one of the worst locations for this in the UK. DVCs in Area 1 of the Highways England network have increased by 30% in the last 3 years.

2.3.2 These accidents can have a considerable impact on vehicle drivers, with the severity of accidents ranging from damage only to the occasional fatal. There is currently only one slight injury accident with recorded evidence of deer involvement. 'It appears that a wild animal, possibly a deer ran across the carriageway in front of vehicle causing the driver to swerve and lose control of her vehicle'. The vehicle left the carriageway and collided with a road sign. However, it is possible that there are more of these incidents but the record did not include reference to animals in the report.

2.3.3 These collisions also impact on animal welfare. A high proportion of deer and other animals hit by vehicles are not killed outright and may have to be put down at the roadside, while others escape to die later of their injuries.

2.4 Devon Cycle Programme

2.4.1 In recent years, £13 million has been invested in delivering cycle schemes across Devon. The County Council has considerable experience in delivering significant cycle schemes in challenging locations including the Exe Estuary, Drake's Trail and Granite Way as part of the Granite and Gears project. Issues include routes within Network Rail boundaries, parallel to rail lines, crossing rivers and valleys and negotiating with a large number of sometimes challenging landowners. The majority of schemes have been delivered on time and to budget. The cycle programme has also included the successful delivery of three Connect2 projects in partnership with Sustrans.

Figure 5: A38 Stover Way crossing, new Clyst Bridge, Gem Bridge and Peekhill Bridge

2.4.2 Devon County Council have recently released their 'Cycling and Multi-Use Trail Network Strategy' which shows their commitment to improving the cycle routes around the county and continue increasing the number of people cycling.

3. Solution

3.1 Introduction

3.1.1 Provision of deer fencing along the A38 could be installed to prevent deer from crossing the road, however evidence suggests that without a designated crossing point, animals can force their way through such barriers and could potentially be trapped on the road by the barriers.

3.1.2 A green bridge over the A38 in the Haldon Hill area would allow deer, other wildlife and cyclists to safely cross the road and open up the Harcombe block to further cycle routes; a strategy the Forestry Commission are strongly in favour of.

3.1.3 The green bridge would be required to encourage deer to use it but fencing would be necessary along the length of the A38 to prevent the deer crossing the road and funnel them towards the bridge. Evidence suggests that this offers the greatest potential to reduce deer-vehicle collisions.

3.1.4 Three possible locations for a green bridge at Haldon were identified as shown in Figure 6.

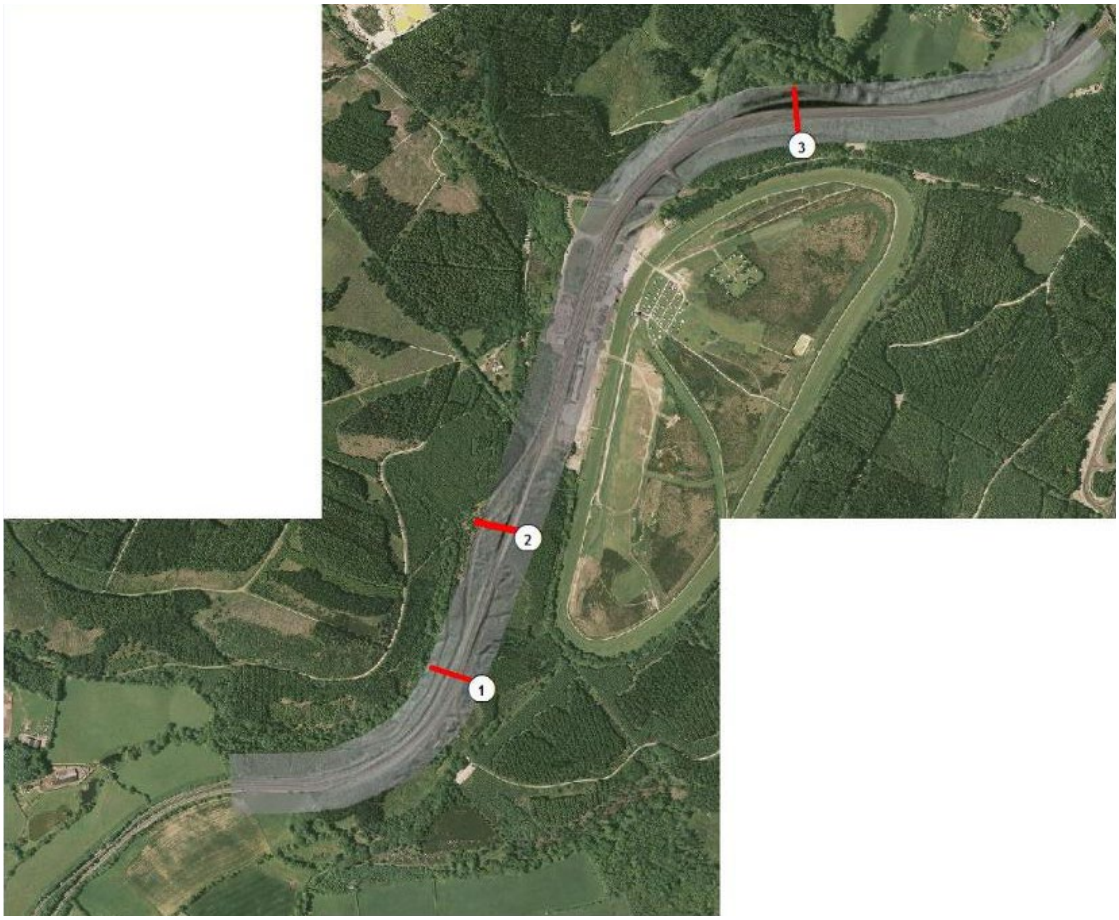

Figure 6: Potential Bridge Locations

3.1.5 There is a significant change in height of the existing land and a bridge at location 1 would require a gradient of 1 in 2 to gain the height required to cross the A38. This would make it very difficult to access for pedestrians and cyclists.

3.1.6 An alternative approach would be to use approximately 12m of material to fill in the height difference at the valley bottom. However, this would have significant environmental and cost implications. A plan of the cross-section of this option is shown in Figure 7 below.

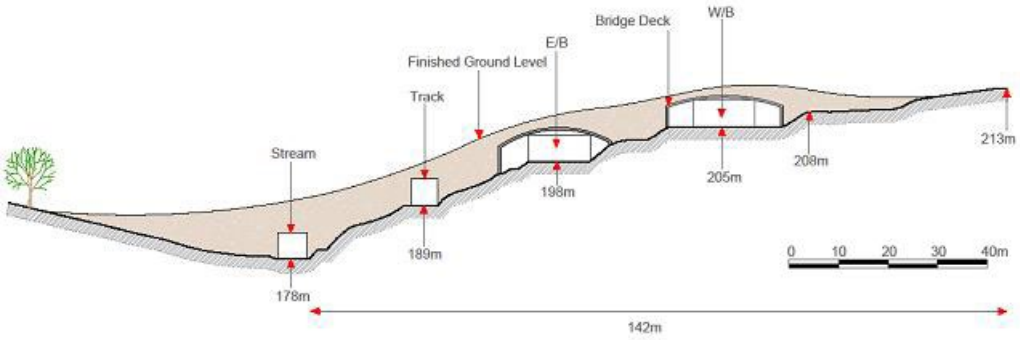

Figure 7: Cross Section of Site 1

3.1.7 Site 2 makes use of the 45m gap between the northbound and southbound carriageways and the road is in a cutting, resulting in minimal earthworks being required to achieve gradient standards for pedestrians and cyclists. This option has the added bonus of allowing access to the central reservation for maintenance. This is of particular benefit to Highways England and their subcontractors since they adopted their zero carriageway crossing policy. The cross-section is shown below.

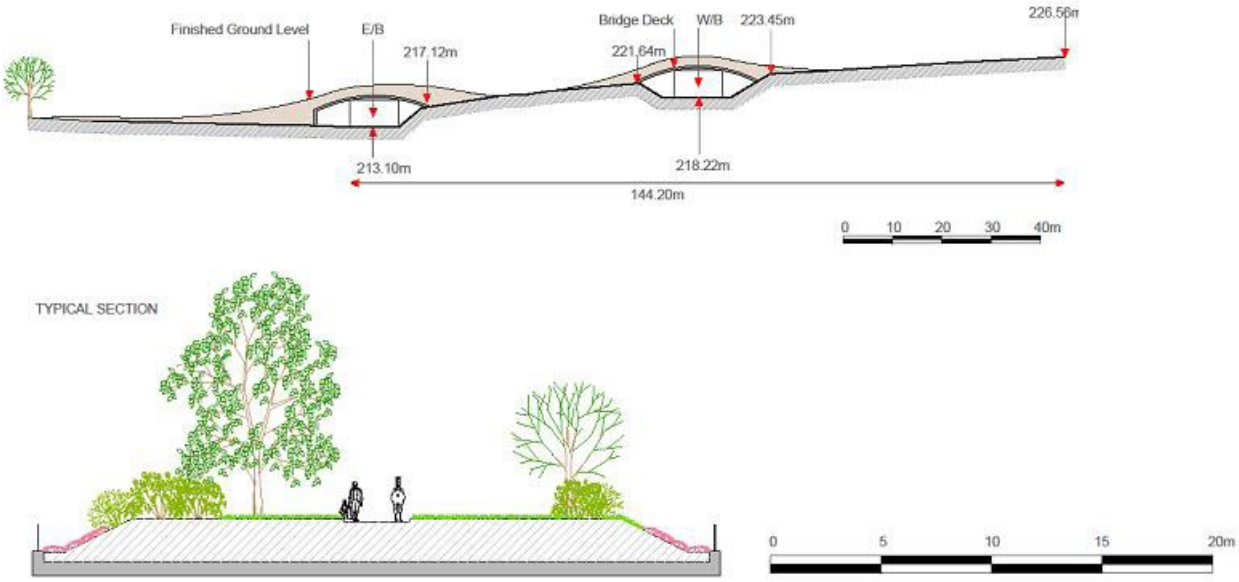

Figure 8: Cross Section of Site 2

3.1.8 Option 3 is further north where the carriageways are close together, meaning there is insufficient width for a central pier. There is also the added issue in this location of an access track which also requires bridging, so more than one structure could be required. A cross-section plan of this option is shown below.

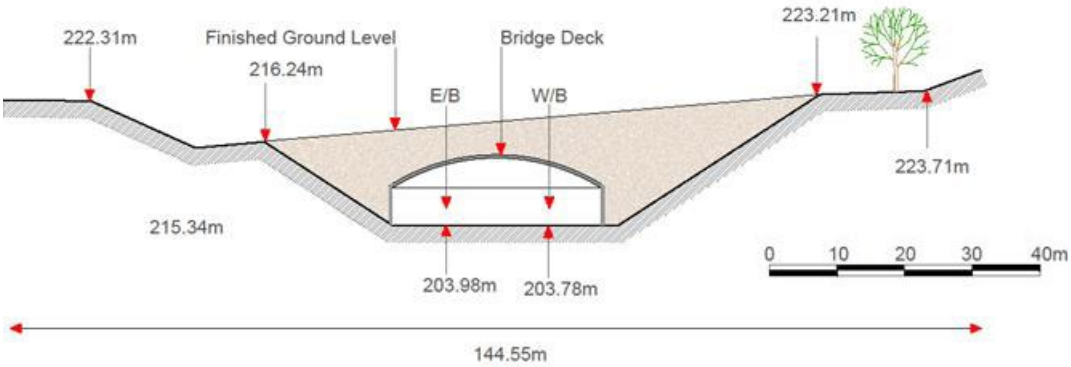

Figure 9: Cross Section of Site 3

3.1.9 Considering these three options, the best location for the bridge is site 2, so this is the option that will be considered in the rest of this report. An initial cost estimate for a 20m wide green bridge at this location is £11.4m. This is broken down as shown in Table 1.

Pre-Design Budget Estimate Summary	
Series Description	**Estimate £**
Prelims	1,705,544.11
Traffic Management	1,006,948.00
Site Clearance	8,870.00
Fencing	88,950.21
Road Restraint Systems	263,487.00
Service Ducts	61,230.88
Earthworks	1,456,138.02
Piling	107,200.00
Structural Concrete	4,203,017.88
Waterproofing	156,627.50
Landscape and Ecology	101,024.00
Subtotal	**9,159,037.60**
Fee	412,156.69
20% Risk	1,831,807.52
Total	**11,403,001.81**

Table 1: Preliminary Cost Estimate of Site 2

3.1.10 In 2010 prices the scheme cost is £10,469,837. It is noted that the scheme cost does not include an allowance for optimism bias, but does include 20% risk. Department for Transport guidance on Transport Appraisal (TAG) Unit A1.2 suggests that a bridge scheme in the early stages of design should allow 66% of the scheme cost for optimism bias.

3.2 Cycling Benefits

3.2.1 There are currently over 33,000 cyclists a year visiting Haldon Forest and the area can become busy during peak periods. Providing the green bridge over the A38 would open up the Harcombe area for further off-road cycle routes and the Forestry Commission are keen to develop this.

3.2.2 Due to expected housing growth in Devon, the local population is expected to grow by 20.7% to 2031. Therefore, without intervention visitor numbers have been assumed to grow by 20.7%.

3.2.3 The Granite and Gears Business Case stated that 43% growth in cycling numbers is predicted through the intervention of a new cycle route, so it is predicted that the construction of a green bridge at Haldon will increase cycling in the area by 43%. An opening year of 2019 has been assumed.

3.2.4 Using the WHO HEAT (Health Economic Assessment Tool), it is possible to calculate and monetise the health benefits of these additional people cycling in the area. The assessment values the benefit of reduced mortality in line with recommendations in TAG Unit A5.1, using the value of a prevented fatality given in the TAG databook of £1,841,455. Alternative benefits have also been calculated using the value £3,229,114 which is given as a default value for the UK by the WHO HEAT tool.

3.2.5 Table 2 below summarises the current benefits (discounted to 2010, in 2010 prices), which are calculated to be almost £5m over 120 years.

Criteria	Without Scheme	With Scheme
Annual Cyclists	40,020 (33,157x1.207)	57,229 (40,020x1.43)
Daily Cyclists	110 (40,020/365)	158 (57,229/365)
Average Dwell Time	3.1 Hours	3.1 Hours
Average Cycling Time	2.5 Hours (assumed 80% of dwell time)	2.5 Hours (assumed 80% of dwell time)
Appraisal Period	120 years	120 years
Total Benefits	**£4,870,344**	
Total Benefits - Alternative Assumption	**£8,540,473**	

Table 2: Summary of Cycling Health Benefits

3.2.6 In addition to the cyclists using Haldon Forest, Devon County Council also have a long-term aspiration to connect the Wray Valley Trail to the Exe Estuary Trail, through Haldon Forest as shown in Figure 10 below. This is included in the recent Dartmoor: Granite and Gears project but identifies that the main barrier to this route is the ability to cross the A38. A green bridge in this location will overcome this issue.

3.2.7 A bridge over the A38 at this location (site 2) would support Teignbridge District Council with their proposals of a pedestrian/cycle route connecting Exeter to Kenton via Haldon.

3.2.8 There is also potential to connect through to Dawlish by making use of the recently constructed bridge over the A380. Since opening, this bridge has been very popular with cyclists so connecting it up to Haldon Forest will further increase use.

3.2.9 All of these improvements tie in with Devon County Council's ongoing aspiration to continue improving cycle routes within the county as outlined in the Granite and Gears project.

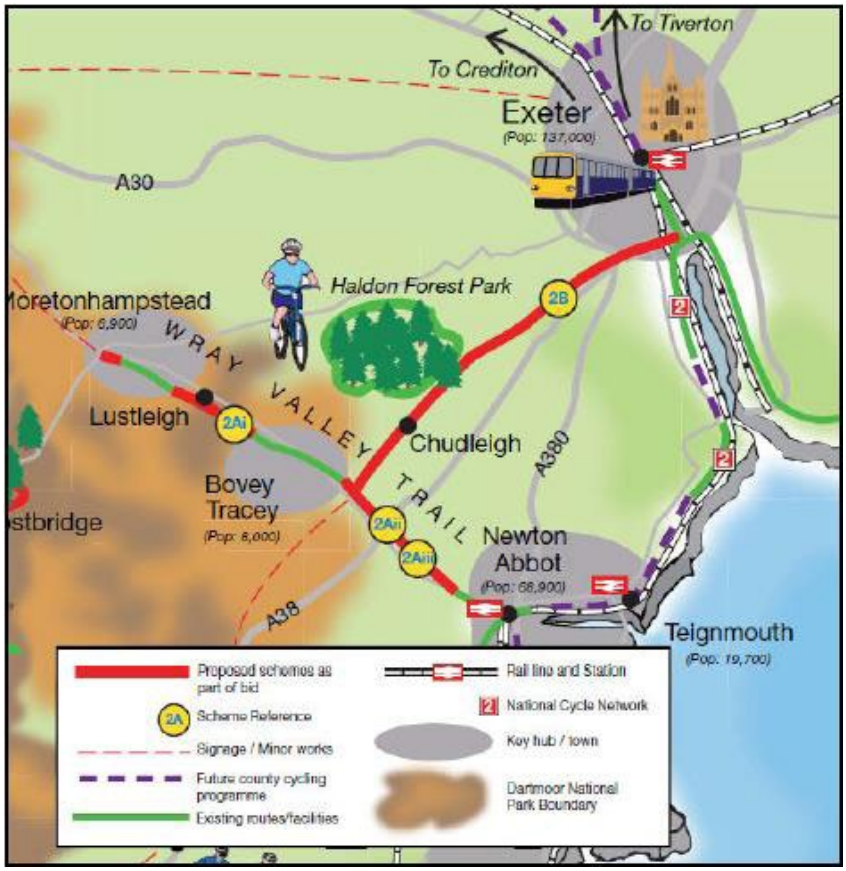

Figure 10: Dartmoor Granite and Gears Proposed Route

3.3 Walking Benefits

3.3.1 There will also be walking benefits which will produce some smaller but quantifiable health benefits.

3.3.2. In a study of Devon cycling and walking trails[1], which included the Exe Estuary, Tarka and Drake's Trails, it was found that there were on average 0.56 walkers and dog walkers per cyclist. This has been assumed to be representative of the number of walkers at Haldon in relation to the number of cyclists from section 3.2.

3.3.3. The average time spent walking has been assumed to be 1 hour with and without the scheme.

3.3.4. Table 3 summarises the benefits of increased walking over 120 years discounted to 2010, in 2010 prices. As with cycling health benefits, an alternative value of benefits has also been calculated using an alternative value of a prevented fatality.

Criteria	Without Scheme	With Scheme
Annual Walkers	22,411 (40,020x0.56)	32,048 (57,229x0.56)
Average Walking Time	1 Hour	1 Hour
Appraisal Period	120 years	120 years
Total Benefits	**£1,198,579**	
Total Benefits - Alternative Assumption	**£2,101,789**	

Table 3: Summary of Walking Health Benefits

3.4 Journey Quality (Journey Ambience)

3.4.1 Journey quality (or journey ambience) is a measure of the real and perceived physical and social environment experienced while travelling. Methodology in TAG Unit A4.1 has been used to estimate the monetised benefits of journey quality impacts which may arise from implementation of the Green Bridge.

3.4.2. New and existing cyclists have been considered from the previous section. It has been assumed that use of the new facility would be for 30 minutes to account for the additional time spent cycling in the Harcombe area which is opened up as a result of the bridge.

3.4.3. The value of journey quality benefit has been assumed at 4.06 pence/minute, derived from the difference between providing an off-road segregated cycle track compared to on-road facilities (as currently exist at the A38 underpass) in the TAG databook.

3.4.4. Table 4 shows the estimated journey quality benefits over 120 years, discounted to 2010 in 2010 prices.

1. Devon Cycling and Walking Trails: Economic impact analysis for Devon County Council, SQW, November 2015

Existing Cyclists	33,157
New Cyclists	14,258
Minutes	30
Total Benefits	**£1,105,051**

Table 4: Journey Quality Benefits

3.5 Accident Benefits

3.5.1 It is envisaged that the provision of the green bridge over the A38 in addition to the deer fence on either side of the road will reduce the number of DVCs from the current 13 to 27 a year to next to none.

3.5.2 The cost of an accident depends on the severity. Taking the costs of accidents from the WebTAG database November 2014, the cost of each type of accident is given in Table 5 below. This assumes a value year of 2015 and a base year of 2010.

Accident Severity	Cost
Fatal	£1,943,672
Serious	£222,711
Slight	£23,422
Damage Only	£2,085

Table 5: Cost of Accidents

3.5.3 At present, the accidents involving deer are damage only, with just the one slight collision on record. However, with the deer population growing and traffic levels also increasing, it can be assumed that the severity of accidents will grow in future. WebTAG 3.4.1 states that every 7.8 damage only accidents equates to one personal injury accident (PIA) for rural roads.

3.5.4 To categorise the severity of these PIAs, the accident data from the A-roads in Devon was assessed. This revealed that 84% of all PIA accidents are slight, 14% serious and 2% fatal. Assuming the number of accidents is constant over the appraisal period and applying the assumptions stated above, the total accident saving benefits can be calculated, taking into account of inflation and discounted to 2010 prices. A sensitivity test has been carried out for different numbers of accidents, as shown below.

	Low	Medium	High
Damage Only Accidents (per year)	13	20	27
Personal Injury Accidents (per year)	1.7	2.6	3.5
Total Accident Saving (over 120 years)	**£4,388,165**	**£6,751,023**	**£9,113,881**

Table 6: Summary of Accident Savings

3.5.5 This shows that providing a green bridge to allow the deer to safely cross the road will result in around £4m - £9m of accident benefits over the 120 year design life of the bridge.

3.5.6 Reducing the number of accidents related to deer will also be of benefit to the Forestry Commission, with the wildlife ranger currently having to track down and dispatch injured deer. However, it is not possible to monetise these benefits.

3.6 Environmental Benefits

3.6.1 Providing a safe crossing over the A38 has the potential to provide large environmental benefits to the area including:

- Reducing the fragmentation of habitats and species in the Haldon area by mitigating the severance impacts of the road on wildlife by providing a crossing point for a range of species including deer, bats, birds and dormice.
- Providing resilience for semi-natural habitats and species from the impacts of climate change through improved connectivity.
- The bridge becoming a wildlife home in its own right through the incorporation of design features such as bat roosts and water features as well as providing resources for pollinator species.
- Better integration of the road into its surrounding landscape and reduce the visual impact of transport infrastructure.

3.6.2 Natural England recently issued their 'Green Bridges – A literature Review' document which concluded that green bridges are an effective mitigation in addressing ecological fragmentation, with evidence of wildlife use recorded on a large number of bridges.

3.6.3 An investigation by Natural England into green bridges states that there is evidence that these environmental structures, constructed in the right way, can become flight paths for bats, improving connectivity between both sides of the Haldon Hills in addition to the animals crossing the bridge at ground level.

3.7 Tourism, Recreation and Leisure Benefits

3.7.1 The recreational facilities at Haldon Forest currently employ three full-time staff and eight regular volunteers, with additional staff employed during the summer. Annual visitor numbers to the area have reached 250,000 and it is anticipated that the provision of a green bridge would unlock a larger area for activities, only 2km from the main visitor hub, increasing the number of visitors to the area and the number of jobs on the site. The green bridge would also make it possible for an exciting new Haldon Ridge Trail to be established, linking the Haldon Belvedere (Lawrence Castle) at the north with Mamhead Obelisk to the south.

3.7.2 The Harcombe area of the Haldon Hills has historically been popular with horse riding, with 10 miles of trails and a ¼ mile gallop. Improving the connectivity to the surrounding areas will further benefit local riders and riding stables.

3.7.3 Exeter Racecourse currently allows camping and caravanning onsite and providing a better connection between the overnight accommodation and the outdoor recreational facilities could benefit both the Forestry Commission and the racecourse.

3.7.4 The Exeter University study concluded that on average, each cyclist spends £9.73 while visiting Haldon Forest. This includes parking, bike hire, the café and any other expenses. Assuming the number of cyclists grows by 43%; this will generate £2,902,388 of additional income over the 120 year appraisal period in 2010 prices discounted to 2010. This is considered a conservative estimate given that improving the access to the area will likely increase all visitors to the area, not just cyclists.

3.8 Key Constraints

3.8.1 The land on either side of the A38 is leased by the Forestry Commission for forestry purposes only. There have been informal discussions of the proposal with the freeholder but the creation of recreational access will require a variation to the lease and possible transfer of land.

4. Partnership Bodies

4.1.1 A number of stakeholders are involved in the scheme as outlined below.

- **Highways England** – responsible for the A38 and sponsor for the project
- **Kier** – Responsible for the maintenance of nearly ⅓ of England's Strategic Road Network, including the section of the A38 by the proposed bridge
- **Devon County Council** – commissioned to draft Business Case and develop designs of the bridge
- **Whiteway Estate** – landowner for the area the scheme is located within
- **Forestry Commission** – currently lease the Haldon Hills land and are responsible for the existing cycle trails and other activities in the area
- **Teignbridge District Council** – the Planning Authority for the area the scheme is within
- **Natural England** – statutory consultee for schemes within a SSSI

4.1.2 All of these organisations are aware and support the scheme and will be involved as it progresses. Public consultations will also take place to get the opinions of members of the public.

5. Conclusion

5.1 Problem

5.1.1 A significant number of deer-vehicle collisions have been recorded on the section of the A38 that passes through the Haldon Hills, with between 13 and 27 recorded each year, making it a hot-spot for deer-vehicle collisions in the country. The majority of these are damage only but there is a report of one slight injury as a result of a driver swerving to avoid a deer and skidding off the carriageway.

5.1.2 With both the deer population in the area and the number of vehicles on the road set to increase in the future, the number and severity of these collisions will get worse.

5.1.3 Haldon Forest is a popular tourist destination, with over 250,000 annual visitors to the area, consisting of over 33,000 cyclists. The Harcombe block to the south-east of the visitors centre is currently isolated given the unattractive access via the underpass, through a dangerous roundabout and past a traveller site.

5.2 Solution

5.2.1 The provision of a green bridge over the A38 in the vicinity of Haldon Hill, along with deer fencing funnelling the animals to the crossing point will significantly reduce accidents on the road by providing a safe crossing point. This has the potential to provide up to £9m of benefits.

5.2.2 The bridge will allow cyclists, horse riders and other members of the public access to the Harcombe block by avoiding the current crossing under the A38 with its associated anti-social behaviour of the traveller site and dangerous roundabout, increasing the visitors to the area and boosting the local economy.

5.2.3 The crossing will also improve the Forestry Commission's logistics by having better access between their sites.

5.2.4 A green bridge will also provide additional environmental benefits by reconnecting the SSSI which will improve the habitat and enhance connectivity for a variety of species in the area.

5.3 BCR (Benefit Cost Ratio)

5.3.1 Table 7 summarises the economic benefits and BCR for the Haldon Green Bridge.

Tourism Benefits	£2.9m
Health Benefits	£6.1m
Safety Benefits	£9.1m
Journey Quality	£1.1m
Total Benefits (120 years)	**£19.2m**
Cost	£10.5m
BCR	**1.83**

Table 7: BCR Calculations (2010 prices)

5.3.2 Health benefits have been estimated using a value of £1,841,455 for a prevented fatality as recommended in Department for Transport TAG guidance. An alternative BCR of 2.27 is obtained if the value £3,229,114 is used which is given as a default value in the assessment tool.

5.4 Summary of Benefits

5.4.1 The table below includes a summary of the benefits predicted from the scheme.

Impact	Reason	+ / -	Comments	Quantified
Increase in cyclists at Haldon Forest.	Provides off-road, direct access to Harcombe block of Forest.	Positive	Expect growth to replicate other locations where new network has been improved/created. 43% growth[2] is expected within 3 years of opening.	
Increase revenue from visitors.	An increase in visitors plus length of stay will increase revenue.	Positive	Surveys of Haldon Forest users suggest average visitors spend £9.73 per head.	£2,902,388
Job creation.	Increased tourism will lead to jobs created to handle demand.	Positive	Potential to create 1 additional full time job plus 2 volunteers, with more in the summer periods.	
Health benefits.	Improved access to area and more route choice leads to more active community.	Positive	Assuming 20.7% population growth and 43% growth in walkers and cyclists in the area, as a result of the scheme. This would generate significant health benefits.	£6,068,923
Increased safety.	Safety benefits from creation of safe crossing point for cyclists and deer.	Positive	Reduction of majority of deer/vehicle collisions from 27 a year to next to 0.	£9,113,881
Improved Journey Quality	Improvement in environment for cycle journeys.	Positive	Assume improved journey quality for cyclists of 30 minutes per journey.	£1,105,051
Change of use on Haldon Hills.	More visitors to the area reduce its isolation and charm.	Negative	Aim to see a net increase in satisfaction amongst existing users.	
Environmental Benefits.	Haldon Hills is a SSSI containing rare species of flora and fauna.	Positive	Improved connectivity and reduced severance of SSSI site caused by construction of the A38.	
Total Benefits				**£19,190,243[3]**

2. From Granite and Gears Business Case.
3. Presented in 2010 values, discounted to 2010 and calculated over 120 year appraisal period, the design life of a bridge.

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