LONDON-WEST MIDLANDS ENVIRONMENTAL STATEMENT

Volume 5 | Technical Appendices

Wider effects report (CT-005-000)

November 2013

ES 3.5.0.20

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Department for Transport

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1 Introduction

1.1 Overview

1.1.1 The Environmental Statement (ES) mapping shows the Proposed Scheme on the centre line for the permanent works. Limits of deviation shown on the Parliamentary plans and sections and described in the hybrid Bill enable the Proposed Scheme to deviate slightly from the centre line of the works as may be required following detailed design. This appendix assesses whether the power to deviate within these statutory limits alters the significance of the effects as reported elsewhere in the Environmental Statement or creates new or different significant effects to those reported.

1.1.2 The powers provided by the hybrid Bill allow for changes within the statutory limits of deviation to occur where it is found that the spatial position of the Proposed Scheme may need to be adjusted, mainly for reasons of engineering practicability.

1.1.3 A summary of the extent of the limits of deviation is described in Volume 1. In essence these comprise lateral limits within the lines shown on the Parliamentary plans and vertical limits not exceeding 3m upwards, and downwards to any extent, from the levels shown on the deposited sections, except for certain buildings such as stations, depots and shafts where an upper limit is specified. The limits of deviation for the tunnels allow for the tunnels to deviate so that a clearance of one tunnel diameter from any unexpected obstruction in the ground can be provided.

1.1.4 The degree of adjustment is constrained by the limits of deviation but also by key design elements of the Proposed Scheme such as the alignment of the track system which must allow for high speed trains to operate to the proposed timetable, the position of tunnel portals and ventilation shafts, the height of viaducts and the location of significant third party infrastructure etc.

1.1.5 The power to deviate the vertical or horizontal alignment within statutory limits requires assessment for its likely significant environmental effects at various locations along the route of the Proposed Scheme.

1.2 Analysis and assessment

1.2.1 A sensitivity analysis has been undertaken to identify where such spatial changes are feasible, and assess the environmental implications of such changes, taking account of the reported assessment of likely significant effects and the environmental baseline described for the Proposed Scheme in the Volume 2 community forum area (CFA) reports.

1.2.2 The following sections describe locations within relevant CFA which have been subject to further assessment. A commentary is provided on the likely significant environmental effects which could result from a change in alignment within the statutory limits of deviation.

1.2.3 An assessment of the likely significant effects of raising the heights of stations, shafts or depots up to the upper limit shown on the sections is reported as the assessment elsewhere in the ES has assumed a height lower than the upper limit.

1.2.4 Areas where amendments to the alignment within the statutory limits of deviation are judged not to give rise to likely significant effects are not considered further.

1.2.5 Where appropriate, references have been made to potential mitigation which could be considered in specific locations. Such mitigation could only be confirmed following further assessment and discussion with relevant stakeholders as part of the detailed design process for any alignment modifications.

1.3 Environmental minimum requirements

1.3.1 In order to ensure that the environmental effects of the Proposed Scheme will not exceed those assessed in the ES, the Secretary of State will establish a set of controls known as Environmental Minimum Requirements (EMR). The EMR will be contained in a suite of documents that will sit alongside the provisions set out in the hybrid Bill itself. The nominated undertaker is the body to be appointed to take forward the detailed design and implementation of the Proposed Scheme after the hybrid Bill has been enacted. The nominated undertaker will be required to comply with the EMR and the other hybrid Bill controls.

1.3.2 During the passage of the hybrid Bill, the Secretary of State will confirm to Parliament the scope of, and the documents forming, the EMR; and will make a commitment to Parliament to take whatever steps he/she considers reasonable and necessary to secure compliance with them.

1.3.3 The EMR, together with the controls in the hybrid Bill, will ensure that the impacts assessed in the ES will not be exceeded, unless this results from a change in circumstances that was not foreseeable at the time the ES was prepared; or any such changes will be unlikely to have significant adverse environmental effects; or will be subject to a separate consent process and further environmental impact assessment.

1.3.4 The EMR will also impose a general requirement on the nominated undertaker to use reasonable endeavours to adopt measures to reduce the reported adverse environmental effects, provided that this does not add unreasonable cost or delay to the construction or operation of the Proposed Scheme.

1.4 Operational sound, noise and vibration considerations

Surface sections

1.1.6 To avoid or reduce significant airborne noise effects, the Proposed Scheme incorporates noise barriers in the form of landscape earthworks, noise fence barriers and / or 'low-level' barriers on viaducts. Noise barrier locations are shown on Volume 2: Map Book - Sound, noise and vibration Map series SV-05. The noise barriers identified in these maps also include engineering cuttings and retaining walls where they avoid or reduce significant adverse noise effects.

1.4.1 The height of the noise barriers are described relative to the rail level. Therefore any amendment to the vertical rail level will equally move the noise barrier so that its noise reduction is maintained.

1.4.2 Some landscape earthworks are not provided primarily for noise purposes and therefore removal of these features, or reducing their attenuation by raising the vertical alignment, would not materially alter the assessment presented here.

1.4.3 There are locations where existing features such as hills, roads and railways currently provide mitigation to the Proposed Scheme which if the alignment was raised vertically could be reduced and may result in a new significant effect(s).

1.4.4 Following any change in alignment within the limits of deviation, further detailed modelling would be undertaken to confirm the predicted significant noise effects reported here. If these significant effects are confirmed suitable mitigation in the form of noise barriers would be provided within the limits. The introduction of new noise barriers may require additional visual mitigation in the form of earthworks, planting or external finish. With this mitigation in place no additional residual significant effects are considered to be likely.

Tunnelled sections

1.4.5 Following any change in alignment within the limits of deviation, detailed modelling would be undertaken to confirm the predicted significant noise effects reported here. If these significant effects are confirmed, suitable mitigation in the form of a further acoustically enhanced track system could be provided to mitigate this significant effect and with this mitigation in place no additional residual significant effects are likely.

2 Assessment of likely significant effects

2.1 CFA1 - Euston – station and approach

Bus station

2.1.1 Moving the horizontal alignment to the south would increase the existing loss of land from Euston Square Gardens, with the potential for additional significant adverse effects if, for example, additional mature trees or the Grade II listed war memorial had to be removed. Mitigation could include incorporating additional semi-mature trees into the design of reinstated parts of the gardens and relocating the war memorial to a suitable position within the new station forecourt or elsewhere in the gardens. No change to vertical alignment is considered feasible.

Hampstead Road Bridge replacement

2.1.2 Upward or lateral changes to the alignment of the Hampstead Road bridge, within limits, is feasible within highway standards. Lowering the alignment would not be feasible because of the vertical clearances required for the high speed railway. This presents the potential for an increase or alteration in the significant effects, where the bridge runs alongside the Cartmel residential block, on the Regent's Park Estate. The potential for a small upward change to the vertical alignment and a small change to the horizontal alignment, bringing the bridge and road closer to the residential receptors, from that shown on the Parliamentary plans, has been assessed. Raising the bridge and road level vertically by the permitted 3m or laterally by a similar or greater amount, bringing it closer to Cartmel, would increase the permanent visual effects and change the assessed noise effects, increasing these on certain higher floors. Such an alignment change could also give rise to additional significant daylight impacts at ground floor residential properties during construction and operation. Mitigation for noise effects may be possible with noise insulation or additional barriers.

2.2 CFA2 - Camden Town and HS2-HS1 link

2.2.1 Where the HS2-HS1 link is proposed to run on the connected existing viaducts (i.e. the HS1 viaduct, the North London Line viaduct, the Kentish Town viaduct and the Chalk Farm viaduct), the limits of deviation have been defined by the existing widened viaduct structure. It is therefore not feasible to raise or lower the alignment where this runs on the existing viaduct. Therefore no new or increased significant effects would arise in this location.

2.2.2 Elsewhere, the alignment is fixed by the position of the HS1-HS2 link portal near the former Primrose Hill station and the clearance required where the Proposed Scheme passes over the Morrisons supermarket access road. Therefore no new or increased significant effects would arise in this location.

2.3 CFA3 - Primrose Hill to Kilburn (Camden)

Euston tunnel and HS2-HS1 link tunnel

2.3.1 Using a precautionary approach to the assessment, without further mitigation, moving the alignment within the limits of deviation could result in a new significant groundborne noise or vibration effect(s) for selected residential properties at Gloucester Avenue. Following detailed modelling, if these effects are confirmed mitigation in the form of a further acoustically enhanced track system could be provided to mitigate this significant effect.

Adelaide Road vent shaft

2.3.2 Raising the alignment would require an equivalent increase in the height of the headhouse. This would increase its prominence in the townscape and result in a significant adverse visual effect over a more extensive area, particularly for views from the north including new residential receptors along Adelaide Road and Eton Road, and especially within the Eton Road Conservation Area. There is limited scope for moving the vent shaft horizontally due to the constraints imposed by existing Network Rail infrastructure. The presence of the headhouse is already considered to have a significant adverse visual effect on nearby properties. Because of its constrained location, there is little opportunity for additional screen planting to mitigate this effect.

Alexandra Place vent shaft

2.3.3 Raising the alignment would require an equivalent increase in the height of the headhouse. This would increase the prominence of the upper elements of this structure for viewpoints along Loudon Road and result in a significant adverse visual effect over a more extensive area. There is limited scope for moving the vent shaft horizontally due to the constraints imposed by adjacent Network Rail infrastructure. Because of its constrained location there is little opportunity for additional screen planting to mitigate this effect.

2.4 CFA4 - Kilburn (Brent) to Old Oak Common

Euston tunnel

2.4.1 There would be no significant residual effects associated with changing the vertical alignment of the Euston tunnel within the limits of deviation in this area. This is because the depth of the tunnel (to the upper surface of the rails) varies between about 15m (in the vicinity of Old Oak Common Station) and 45m (beneath Terrace Avenue in Kensal Rise).

Salusbury Road vent shaft

2.4.2 Raising the alignment would require an equivalent increase in the height of the headhouse. There would be no likely significant effects at this location associated with this change as the effects associated with the Proposed Scheme would not be noticeably worse as a result.

Old Oak Common station

2.4.3 There would be no likely significant environmental effects associated with the repositioning of the station box, and consequent realignment of the Proposed Scheme.

2.5 CFA5 - Northolt Corridor

Northolt tunnel

2.5.1 Using a precautionary approach to the sound, noise and vibration assessment, without further mitigation, moving the alignment within the limits of deviation may result in a new groundborne noise adverse effect at the residential communities of Perivale, Greenford and Northolt that would be considered significant on a community basis. Following detailed modelling, if these effects are confirmed, suitable mitigation in the form of a further acoustically enhanced track system could be provided to mitigate this significant effect. If the alignment moves to the north then this significant effect could be avoided by provision of an enhanced track system between Grand Union Canal and the study area boundary with CFA6, close to Lord Halsbury Memorial Playing Fields. If the alignment moves to the south then this significant effect could be avoided by provision of an enhanced track system between Alperton Lane and Grand Union Canal, and Rowdell Road and the boundary with CFA6, close to Lord Halsbury Memorial Playing Fields.

Greenpark Way vent shaft

2.5.2 Raising the alignment would require an equivalent increase in the height of the headhouse. The alignment could also move northwards within the limits of deviation, with a consequent movement of the headhouse location. There would be no likely significant residual effects at this location associated with these changes as there are no sensitive receptors in the immediate vicinity of the headhouse location.

Mandeville Road vent shaft

2.5.3 Raising the alignment would require an equivalent increase in the height of the headhouse. The alignment could also move northwards within the limits of deviation, with a consequent movement of the headhouse location. The presence of the headhouse is already considered to have a significant adverse visual effect on nearby properties in year one of operation although this will decline with time as the proposed screen planting matures to year 15 and beyond. These changes in location of the headhouse would increase its prominence in the townscape, and significantly affect new residential receptors in Badminton Close, Carr Road, Belle Vue Close and Belle Vue Road. No further screen planting, beyond that which is currently proposed is practicable in this area.

2.6 CFA6 - South Ruislip to Ickenham

Northolt tunnel

2.6.1 Using a precautionary approach to the assessment of sound,noise and vibration, without further mitigation, moving the alignment within the limits of deviation may result in a new groundborne noise adverse effect at the residential community of

Ruislip that would be considered significant on a community basis. Following detailed modelling, if these effects are confirmed, suitable mitigation in the form of a further acoustically enhanced track system could be provided to mitigate this significant effect.

2.6.2 If the alignment moves to the north then this significant effect could be avoided by provision of an enhanced track system between Long Drive and where the Proposed Scheme passes the LU Metropolitan/Piccadilly Lines. If the alignment moves to the south then this significant effect could be avoided by provision of an enhanced track system between the boundary with CFA6 and where the Proposed Scheme passes the LU Metropolitan/Piccadilly Lines.

South Ruislip vent shaft

2.6.3 Raising the alignment would require an equivalent increase in the height of the headhouse. The presence of the head house is already considered to have a significant adverse visual effect on nearby properties. The alignment could also move northwards within the limits of deviation, with a consequent movement of the headhouse location. These changes would increase its prominence in the townscape, and would significantly affect new residential receptors in Trenchard Avenue. There are no opportunities for additional mitigation with further screen planting due to the proximity of the LUL Central line.

West Ruislip portal

2.6.4 The portal could move northwards within the limits of deviation. While this would move the alignment closer to the Ruislip Golf Course clubhouse, there would be no additional likely significant effects resulting from this as no additional environmental features are affected.

2.7 CFA7 - Colne Valley

Colne valley viaduct

2.7.1 The Proposed Scheme will cross the River Colne and New Years Green Bourne on a long viaduct. To ensure that flow in these rivers is unobstructed the crossings will require a local realignment of the watercourses due to the need to construct piers and associated foundations close to the river channels. Any horizontal realignment that would increase the proximity of the piers and associated foundations to the watercourses could result in a further narrowing of these watercourses. This would be mitigated through the introduction of longer channel diversions and the incorporation of design features aligned with Water Framework Directive 2000/60/EC[1] objectives to manage permanent impacts on flows. The detailed design of the realignments would be completed in consultation with the Environment Agency to ensure they address requirements with respect to hydraulic capacity, flood risk, ecology and morphology. The height of the viaduct cannot be raised or lowered significantly, because of the need to maintain clearances over the Grand Union Canal and over the A412 Denham

[1] *Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy*, European Parliament and European Council, Strasbourg.

Way/North Orbital Road. The scope for lateral movement northwards is also constrained by the Copthall retaining structure in CFA6 and the A412 Denham Way.

2.8 CFA8 - The Chalfonts and Amersham

Chiltern tunnel

2.8.1 The Proposed Scheme will pass under the River Misbourne at two locations. It is assumed for the purpose of assessment that a closed faced tunnel boring machine will be used, which will reduce the risk of settlement and control the existing surface water/groundwater interactions where the route passes beneath the river. A minimum cover of two tunnel diameters depth has also been provided between the river bed of the River Misbourne and the tunnel crown to reduce the risk of hydraulic pathways developing during construction. Raising the vertical alignment of the Chiltern tunnel above this minimum cover depth could increase the risk of hydraulic pathways developing during construction. Further detailed ground investigation would be required to demonstrate that a shallower profile could be achieved beneath the river without increasing the risk of hydraulic pathways developing. The primary means of mitigation would remain unchanged: namely the monitoring of ground settlement in the areas where the route passes beneath the River Misbourne and Shardeloes Lake, and for a suitable distance up and downstream, in order to determine appropriate mitigation, if required, as identified in CFA8.

2.9 CFA9 - Central Chilterns

Chiltern tunnel north portal

2.9.1 A lowering of the vertical alignment may require ground stabilisation works in the vicinity of the portal, which could give rise to increased loss of habitat from Mantles Wood, an area of ancient woodland. This effect would be difficult to mitigate, however further habitat compensation land or offsetting would be considered. The further loss of ancient woodland could be compensated by translocation of woodland soil and its associated seedbank.

2.10 CFA10 - Dunsmore, Wendover and Halton

South Heath cutting

2.10.1 A lowering of the alignment through South Heath cutting could, depending on ground conditions, increase the width of the cutting. This would result in a slight increase in the direct landtake to Grim's Ditch Scheduled Monument, as well as slightly reducing the areas of landscape mitigation planting on the west side of the alignment. Further engineering works to restrict the width of the cutting would be considered to reduce these effects. The cutting cannot be raised substantially because of the need to maintain clearances under six overbridge structures that have been designed to negotiate the variation in topography associated with the Chiltern Hills escarpment immediately to the west of the Proposed Scheme.

Wendover Dean viaduct

2.10.2 For receptors with Wendover Dean viaduct in the centre of the view, the effect of a higher viaduct structure would not result in a worsening of visual effects. For other

receptors, such as the dwellings at the junction of King's Lane and Rocky Lane, views of the Proposed Scheme will be partially filtered by the intervening vegetation and landform. Increasing the vertical alignment would reduce the effectiveness of these intervening features and increase the adverse visual effects. Once the reinstated and proposed planting has matured there would be some improvements in the composition of the view; however the magnitude of effects would remain unaltered.

Small Dean viaduct and Small Dean north embankment

2.10.3 A higher viaduct structure and approach embankments would reduce the effectiveness of intervening screening vegetation, particularly for elevated views along the Ridgeway and the Chiltern Link WEN/46 PRoW on Hogtrough Lane. Passing within 200m of the southern part of Wendover, higher viaduct structures and associated infrastructure would increase the adverse effects on the character and setting of a group of assets within Wendover Conservation Area. Most of these effects would be mitigated once the proposed planting has matured and the Proposed Scheme is better integrated into the landscape.

Wendover green tunnel

2.10.4 The limits of deviation extend east of Ellesborough Road to enable the construction of anchors for the retaining walls. As drawn, the limits of deviation impinge on the memorial woodland that the retaining wall is designed to protect. However it is not intended for any works to be carried out from the surface within the woodland. The alignment of the green tunnel cannot be lowered substantially because of the need to maintain clearances for the Proposed Scheme over the A413 London Road at the southern end and the need to meet flood design standards for Stoke Mandeville maintenance loop to the north.

2.11 CFA11 - Stoke Mandeville and Aylesbury

Stoke Mandeville south embankment

2.11.1 The Proposed Scheme crosses Stoke Brook on a low embankment, with the river conveyed under the Proposed Scheme including the Stoke Mandeville maintenance loop in culvert. A horizontal realignment to the south would increase the length of natural channel that is directly affected increasing the potential effects on river conveyance. Raising the alignment would reduce floodplain capacity, would require longer culverts and would increase the length of natural channel that is directly affected. The alignment cannot be lowered substantially because of the need to maintain flood design standards. The detailed design of the river diversion would be completed in consultation with the Environment Agency to ensure that requirements with respect to hydraulic capacity, flood risk, ecology and morphology are addressed. The introduction of headwalls with the design would mitigate the effects of longer culverts and the introduction of additional replacement floodplain storage would address the increased potential for flood risk.

Princes Risborough to Aylesbury Line to the A418 Oxford Road

2.11.2 The landscape to the south and west of Aylesbury is generally, flat and open. Mitigation earthworks with gently profiled slopes are proposed to blend the Proposed

Scheme into the existing surrounding landscape, with further screening of the taller elements achieved through a combination of reinstated, strengthened and new hedgerow planting. Raising the alignment would increase the prominence of the railway within the landscape, although these effects could be mitigated over the longer term by remodelling the effective height of the mitigation earthworks. Lowering the alignment would result in the generation of higher volumes of potentially contaminated materials as the Proposed Scheme crosses a historic landfill to the south of Aylesbury. Detailed ground investigation work would be carried out prior to construction commencing to determine the nature and extent of land contamination and determine the most appropriate remediation strategy, as set out in the draft CoCP.

Lower Hartwell and Hartwell House

2.11.3 The grounds of Hartwell House are recognised as one of Buckinghamshire's finest estates and the landscape is listed as Grade II* on the English Heritage Register of Historic Parks and Gardens of Special Historic Interest in England[2]. Views of the Proposed Scheme will be heavily filtered by intervening vegetation, reinstated and new mitigation planting. The route of the Proposed Scheme has already been moved further from the listed house to its current position; however an increase to the vertical alignment would reduce the effectiveness of these intervening features, particularly for the short section of the Proposed Scheme that crosses the grounds on embankment. Once the reinstated and proposed planting has matured there would be some improvements in the composition of the view, although it would take longer for the mitigation planting to be effective.

Thame Valley viaduct and Thame Valley viaduct north cutting

2.11.4 The Proposed Scheme will cross the River Thame, tributaries and extensive associated floodplain on viaduct. The crossing of the River Thame will require the positioning of one pier footing within 5m of the margins of the watercourse. Any horizontal realignment that increases the incursion into the river margins would need to be modelled to ensure there is no incremental effect on river hydrology. The landscape through this section is open, with limited topographic variation and a large scale field pattern. The presence of the Proposed Scheme in this area is already considered to give rise to a significant adverse visual effect. Raising the alignment would increase the prominence of the railway within the landscape and increase the numbers of residential receptors located on the periphery of Putlowes and Fleet Marston that would experience significant adverse noise and visual effects. The introduction of noise fence barriers could mitigate the noise effects and the mitigation earthworks and associated planting could also be designed to screen these barriers. The height of the viaduct cannot be lowered significantly, because of the need to maintain clearances across the River Thame, its tributaries and the Environment Agency flood defences.

[2] English Heritage, (2008), *English Heritage Register of Parks and Gardens of Special Historic Interest*.

2.12 CFA12 - Waddesdon and Quainton

Quainton south and Doddershall embankments

2.12.1 Raising the alignment would increase the prominence of the Station Road overbridge in the landscape. The presence of the overbridge is already considered to give rise to significant adverse visual effect. Views from nearby receptors on Station Road are already filtered by existing roadside hedgerows and vegetation lining the existing railway. Raising the height of the Proposed Scheme as it passes to the south of Quainton on embankment would cause an increased significant adverse visual effect and further reduce the effectiveness of the intervening screening until the proposed mitigation planting has had time to establish and mature, which will reduce the effect to non-significant.

2.13 CFA13 - Calvert, Steeple Claydon, Twyford and Chetwode

Twyford embankment to Godington viaduct

2.13.1 Views of the Proposed Scheme from Twyford will be partially filtered by intervening vegetation and, once established, will be well screened by mitigation planting and screening earthworks. Increasing the height of the alignment would increase the prominence of the Proposed Scheme and associated infrastructure in the landscape and result in adverse visual effects over a wider area. The currently proposed mitigation should mitigate these effects from residential receptors located on the periphery of Twyford. The taller railway structures and mitigation fence barriers are likely to remain a prominent feature in the landscape for scattered receptors to the north of the Proposed Scheme, including transport receptors using Perry Hill Road. Raising the alignment or moving it horizontally could result in adverse effects on the hydrology and flood characteristics of the Padbury Brook. The Proposed Scheme crosses the twin channels associated with the Padbury Brook seven times at four locations and further modelling would be required to confirm the likely effects on river hydrology and flood plain storage. The scope for lowering the alignment in the vicinity of Godington is limited by the need to maintain clearance for a bridleway (CHW/24) that passes under the viaduct structure.

Chetwode cutting

2.13.2 Increasing the depth of the cutting could alter flows to springs in the immediate vicinity of the cutting, resulting in additional significant adverse effects. Track drainage to the north of Barton Hill Farm could be directed towards the north and the watercourse at Barton Hartshorn so there would be no change in flows downstream of the cutting.

2.14 CFA14 - Newton Purcell to Brackley

Barton to Mixbury cutting

2.14.1 The scope for raising the alignment is limited by the need to maintain clearances for the A4421 Buckingham Road, A421 London Road and Featherbed Lane overbridges. Some increase in height within highway design limits is possible with the potential for increased adverse visual effects for scattered residential receptors, including those

along the existing A4421. The effects of the road overbridges could be softened by mitigation earthworks and tree planting designed to integrate the engineered overbridges into the landscape. A lowering of the alignment could alter the base flow to springs in the vicinity of the cutting, resulting in additional significant adverse effects.

Westbury viaduct

2.14.2 Raising the height of the viaduct across the River Great Ouse and its associated approach embankment would remove the natural screening effect offered by the existing topography. This would create additional noise and visual impacts resulting in significant adverse effects for some residential receptors on the outskirts of Westbury. The design currently incorporates scattered planting to mitigate visual effects, which could be strengthened to increase the filtering effect for views. Consideration would also need to be given to additional replacement floodplain storage if the approach embankments were to increase in size. Using a precautionary approach to the assessment of sound, noise and vibration, without further mitigation, moving the alignment within the limits of deviation could result in a new adverse airborne noise effect at the residential community of Westbury that would be considered significant on a community basis. This significant effect could be avoided by approximately 2km of noise barrier located to the east of the alignment adjacent to Westbury.

Turweston cutting

2.14.3 The southern section of Turweston Manor Grassland Local Wildlife Site (LWS) is directly affected by the Proposed Scheme and the retention of the extent of the fen and lowland calcareous grassland habitat and the plant species assemblage is important to the integrity of the site. Lowering the vertical alignment through Turweston cutting could result in changes to groundwater flows and, depending on depth, could result in hydrological impacts to this site. Mitigation in the form of new areas of grassland and replacement habitats could be provided, reducing the significance of the effects. However, there is the potential for increased adverse effects on Turweston Manor Grassland in the event that groundwater flows are affected. Raising the alignment would increase the magnitude of change experienced by residential receptors on the outskirts of Turweston, resulting in adverse visual effects over a wider area than the currently reported significant adverse visual effects. The position of the approach embankment within Turweston Manor Grassland LWS restricts the scope for providing additional screening planting adjacent to the Proposed Scheme. Once the currently proposed off-site planting has matured there will be some improvements in the composition of the view; some further strengthening of this planting could also be possible.

2.15 CFA15 - Greatworth to Lower Boddington

Greatworth south cutting

2.15.1 The current design of Greatworth cutting will require very little or no dewatering given its position relative to the water table. Increasing the depth of the cutting would involve some dewatering of the aquifer, introducing the potential for adverse effects on a number of springs and spring fed abstractions to the north of the Proposed

Scheme. The scope for lowering the cutting is also constrained by Helmdon culvert at the southern end and Greatworth dry valley and associated culvert at the northern end. A horizontal realignment eastwards would marginally increase the landtake to Halse Copse South, an area of ancient woodland. It would also reduce the size of the ecological mitigation area that has been identified as a precautionary area for great crested newts. However, further habitat compensation land or offsetting could be considered.

Thorpe Mandeville embankment to Lower Thorpe north cutting

2.15.2 The historic settlement of Thorpe Mandeville occupies an elevated position relative to the alignment and the upper elements of the Proposed Scheme will be visible for a number of residential receptors. There will also be open views from the churchyard of the Grade I listed Church of St John the Baptist and a number of public footpaths in the immediate area. The presence of the Proposed Scheme is already considered to have significant adverse visual effects on properties and users of public rights of way. Raising the alignment would increase the prominence of the Proposed Scheme within the landscape and increase the potential for adverse visual effects for some residential receptors, users of public footpaths and visitors to the churchyard. The design currently incorporates mitigation planting at an intermediate point between key receptors and the Proposed Scheme. Once established, there will be some improvements in the composition of the view, but significant adverse visual effects would still remain at year 15 of operation. This would also be the case if the alignment was raised in this area. Raising the alignment would also take an additional area of the boating lake, which has been identified as the optimal location for replacement floodplain storage. An alternative area for replacement floodplain storage would therefore be necessary to avoid flood risk. It is not possible to lower the alignment due to the need to maintain clearances over Banbury Lane, which is situated immediately above the floodplain.

Edgcote south embankment to Edgcote cutting

2.15.3 Raising the alignment through this section would increase the height of the viaduct across the River Cherwell and reduce the depth of Edgcote cutting at the southern end. There is limited scope for raising the alignment at the northern end of the cutting, as this would affect the drainage characteristics of Chipping Warden green tunnel. A shallower cutting would reduce the screening effect inherent in the cutting and existing topography and increase the potential for adverse effects to the setting of the Grade I listed Edgcote House and associated parkland. A key view is identified from the salon of Edgcote House looking eastward across the park and the ornamental lakes. Raising the alignment would increase the incursion of the upper elements of the Proposed Scheme into this view. It is not possible to lower the height of the viaduct at the southern end due to the need to maintain clearances over the Wardington Road, which is situated immediately above the River Cherwell floodplain.

2.16 CFA16 - Ladbroke and Southam

Oxford Canal south embankment and Footpath SM116a underpass

2.16.1 Making a horizontal realignment of the Proposed Scheme by 5m to the north east at this location would require a new retaining structure. The Proposed Scheme in this area has been assessed to give rise to significant adverse visual effects. Changes to the horizontal alignment would give rise to a greater adverse visual effect on the Oxford Canal and its setting and on the users of the towpath and Footpath SM116a who would pass near the retaining wall. There is limited scope to provide additional planting as mitigation for this effect. By year 15 and beyond to year 60 of operation, currently proposed planting would mature, filtering the overhead line equipment and new fence line from views and integrating the embankment. This would be likely to reduce effects to some extent.

River Itchen viaduct and Leamington Road embankment

2.16.2 If the vertical alignment of the Proposed Scheme is raised by up to 3m at this location there would be a greater adverse effect on the setting of Grade II listed buildings/structures and parkland at Stoney Thorpe Hall. This effect would be difficult to mitigate, although some additional tree planting may be possible which, over time, could reduce the significance of the effect.

Long Itchington Wood tunnel

2.16.3 Raising the vertical alignment of the tunnel and its approaches by up to 3m may adversely affect the amenity of a residential property, during construction and operation, where the tunnel passes under Bascote Heath Road. Additional adverse effects could occur on Long Itchington and Ufton Woods Site of Special Scientific Interest (SSSI) related to increased need for tunnel de-watering. At the north portal a 3m raise in the vertical alignment may require further ground stabilisation which could give rise to adverse effects relating to settlement and loss of habitat from the Long Itchington and Ufton Woods SSSI.

Ladbroke and Southam

2.16.4 Using a precautionary approach to the assessment of sound, noise and vibration, without further mitigation, moving the alignment within the limits of deviation could result in new airborne noise adverse effects at the residential communities of Ladbroke and Southam that would be considered significant on a community basis. This significant effect could be avoided by approximately 2km of noise barrier located to the west of the alignment adjacent to Ladbroke, and approximately 2.2km of noise barrier located to the east of the alignment adjacent to Southam.

2.17 CFA17 - Offchurch and Cubbington

Offchurch Greenway green overbridge

2.17.1 Raising the level of the green overbridge by up to 3m would increase the gradient of the cycleway and adversely affect cyclists using this route. It would also adversely affect the character of the Offchurch Greenway and give rise to significant adverse

visual effects on the continuity of the route for which there would be no scope to mitigate.

Ash Beds cutting and Footpath W129y diversion

2.17.2 Raising the vertical alignment of the cutting and the associated footpath diversion by up to 3m has the potential to give rise to a greater visual impact on residential properties at the northern end of Offchurch village, on Fields Farm and on users of Footpath W129y. Some tree planting may be possible adjacent to the cutting which, over time, would reduce the significance of these effects.

Cubbington retaining wall

2.17.3 A horizontal movement in the retaining wall of 5m at this location would change the line of severance through the adjoining ancient woodland at South Cubbington Wood LWS. This would result in a permanent adverse effect on the integrity of the LWS which would be significant. Whilst this effect is similar to that with the Proposed Scheme on its current alignment, the nature and degree of severance may differ. The loss of ancient woodland and effect on the LWS would be compensated by translocation of woodland soil and its associated seedbank.

Cubbington cutting

2.17.4 Raising the vertical alignment of the cutting by up to 3m could result in additional visual effects at residential properties in north east Cubbington on either side of the B4453 Rugby Road. This would result from the B4453 overbridge being higher in the field of view and the potential for the upper sections of the overhead line equipment being visible from these properties. This effect could be mitigated by enhanced landscape planting alongside the Cubbington cutting and adjacent to the overbridge which would reduce the effect over time and replicate the character of existing views of North and South Cubbington Woods.

2.18 CFA18 - Stoneleigh, Kenilworth and Burton Green

Dalehouse Lane overbridge

2.18.1 A horizontal movement of the overbridge by up to 5m would bring the Proposed Scheme in closer proximity to Dalehouse Farm which is a Grade II listed building. This would have a greater adverse effect on its setting than is currently assessed with the Proposed Scheme and may result in the loss of structures within its curtilage. The visual effect on Dalehouse Farm would also be major adverse as is currently assessed for the Proposed Scheme.

Black Waste Wood embankment

2.18.2 Raising the vertical alignment of the porous portal of the Burton Green green tunnel (and the associated enbankment) has the potential for greater visual impact on the community in Burton Green. There could also be adverse visual effects of greater magnitude on users of the greenway and Footpath W169. The raised height of the portal could also give rise to a greater severance effect in Burton Green, for which there is little or no scope to mitigate.

2.19 CFA19 - Coleshill Junction

M6 Motorway box structure, M6 Motorway south viaduct, Coleshill No 1 embankment, M6 Motorway north viaduct, Coleshill No 2 embankment, Coleshill west viaduct, and Coleshill No 3 embankment

2.19.1 Raising the vertical alignment of the Proposed Scheme at these locations by up to 3m could lead to a greater number of residential properties in Chelmsley Wood being affected by adverse visual effects than are currently affected in this area (as reported in CFA24 below). Residential properties on the B4117 Coventry Road in Coleshill would also be subject to increased adverse visual effects resulting from more open views of the overhead line equipment and trains.

Footpath M62 overbridge

2.19.2 A rise of up to 3m in the vertical alignment of the overbridge could increase the magnitude of the adverse visual effects on properties to the east in Gilson Road because of the close proximity to these properties. Enhanced planting alongside the overbridge would, over time, reduce the significance of this effect.

Lichfield Road embankment

2.19.3 Raising the vertical alignment of the embankment by up to 3m could increase the magnitude of the adverse visual effects on residential properties in Chattle Hill and Gorsey Way and on Coleshill Industrial Estate receptors due to their close proximity. There is limited scope to provide additional planting to mitigate this effect.

Attleboro Farm embankment, Attleboro flyover, Attleboro Lane overbridge, Water Orton No 1 viaduct, Marsh Lane embankment, and Water Orton No 3 viaduct

2.19.4 Raising the vertical alignment of the Proposed Scheme at these locations by up to 3m could give rise to greater adverse visual impacts on residential and other properties in Water Orton. There is limited scope to provide additional planting to mitigate these effects.

Water Orton

2.19.5 Using a precautionary approach to the assessment of sound, noise and vibration, without further mitigation, moving the alignment within the limits of deviation could result in new airborne noise adverse effects at the residential communities of Water Orton and Smith's Wood, Birmingham that would be considered significant on a community basis. This significant effect could be avoided by approximately 1.8km of noise barrier located to the north of the northern chord adjacent to Water Orton, and approximately 1.5km of noise barrier located to the east of the Birmingham chord adjacent to Smith's Wood.

2.20 CFA20 - Curdworth to Middleton

M42 Marston box structure

2.20.1 Raising the vertical alignment of this structure by up to 3m would increase the visual impact on the cottage adjacent to the Birmingham and Fazeley Canal and on the users

of the canal. In addition to the embankment overhead lines and trains would be highly visible in the foreground. Raising the vertical alignment would also increase the adverse effect on the setting of the canal. Because of the proximity of the Proposed Scheme to the canal and the lack of space to provide intervening planting there is limited scope to mitigate these effects.

2.21 CFA21 - Drayton Bassett, Hints and Weeford

Drayton Lane embankment

2.21.1 Raising the vertical alignment by up to 3m would increase the visibility of the embankment in middle distance views and could give rise to greater adverse visual impacts on properties in Drayton Lane, including Oak Farm. Over time, currently proposed planting would integrate views of the Proposed Scheme, including the landscape earthworks, into the local landscape setting, which would reduce the significance of the effect.

Hints cutting and Milditch Wood embankment

2.21.2 Raising the vertical alignment in this location by up to 3m would limit the scope to include a false cutting in the Proposed Scheme and as a consequence there would be adverse visual effects of greater magnitude on residential properties in Hints and on users of Footpath 14, Brockhurst Lane and other local routes. Additional tree planting would be possible alongside the route which, over time, would reduce the significance of these effects.

2.22 CFA22 - Whittington to Handsacre

Fulfen Wood north embankment, Streethay viaduct and Streethay embankment

2.22.1 Raising the vertical alignment of the Proposed Scheme at these locations by up to 3m could give rise to greater adverse visual impacts on residential properties in the north eastern part of Streethay, resulting from the greater prominence in views of overhead line equipment and trains. Enhanced planting alongside these embankments and the viaduct would, over time, reduce the significance of this effect.

Curborough embankment, Trent and Mersey Canal east viaduct, Pyrford Brook east embankment, Pyrford Brook viaducts, Pyrford Brook west embankment, Trent and Mersey Canal west viaducts, Ravenshaw Wood embankment, Trent and Mersey Canal north viaduct, and Brokendown Wood embankment

2.22.2 Raising the vertical alignment of the Proposed Scheme by up to 3m would increase the adverse visual impacts on the setting of the Trent and Mersey Canal Conservation Area and on its associated listed buildings, including Wood End Lock and Wood End Lock Cottage.

Streethay

2.22.3 Using a precautionary approach to the assessment of sound, noise and vibration, without further mitigation, moving the alignment within the limits of deviation could

result in a new airborne noise adverse effect at the residential community of Streethay that would be considered significant on a community basis. This significant effect could be avoided by approximately 1.5km of noise barrier located to the west of the alignment adjacent to Streethay.

2.23 CFA23 - Balsall Common and Hampton-in-Arden

Carol Green underbridge extending to Balsall Common viaduct

2.23.1 Raising the vertical alignment of the underbridge, embankment and viaduct in this area, possibly combined with bringing the horizontal alignment closer to receptors, would increase the visual impact on residents in Balsall Common. An increase in vertical alignment would also give rise to potentially significant noise effects on residents on the north eastern edge of Balsall Common. This would represent an increase to an existing significant effect which could be addressed by the provision of additional noise mitigation, which would maintain the height of the noise barrier relative to the rail level. However, the visual effects due to the increased height of the Proposed Scheme would be difficult to mitigate although some additional tree planting may be possible, which over time would reduce the significance of the effect.

Park Lane cutting, west of the Heart of England Way overbridge

2.23.2 Increasing the depth of the Park Lane cutting would potentially impede groundwater flow to the Berkswell Marsh SSSI - a potential new significant adverse effect. Depending on ground conditions, such an increase could also result in widening of the cutting, thereby preventing the implementation of the habitat connectivity planting included as part of the Proposed Scheme. This would be a new significant adverse effect on barbastelle bats. Further engineering works to restrict the width of the cutting may be considered to facilitate the implementation of the habitat connectivity mitigation measures and hence reduce this effect.

Lavender Hall Lane overbridge

2.23.3 Raising the vertical alignment at Lavender Hall overbridge would have the potential to give rise to increased impacts on the setting of Lavender Hall farm (a Grade II* listed building) and barn (a Grade II listed building) with bat roosts in associated structures. This would represent an increase to already significant adverse heritage effects. Raising the alignment may also impinge on the floodplain of the Bayleys Brook. While potentially this could be mitigated by increased provision of replacement flood storage area within the Proposed Scheme limits, this in turn would lead to increased adverse impacts on agricultural land use.

Western end of Sixteen Acre Wood embankment

2.23.4 Raising the vertical alignment here would increase the visual impact and significant effect on residents of Marsh Farm and users of Footpath M216. The visual effects due to the increased height of the embankment would be difficult to mitigate although some additional tree planting may be possible, which over time would reduce the significance of the effect.

A452 Kenilworth Road overbridge

2.23.5 Raising the vertical alignment of this major structure may result in increased visual impact and significant adverse effects on local residents on Marsh Lane and users of Bridleway M218. While additional planting may be possible, which over time would reduce the significance of the effect to a degree, given the scale of this structure, the increased visual impact would be difficult to fully mitigate.

Patrick embankment up to and including the River Blythe viaduct

2.23.6 Raising the vertical alignment of the embankment and viaduct here would increase the visual impact on residents in Hampton-in-Arden. It may also possibly introduce visual impacts and significant adverse effects to new residents who would not currently experience such effects with the Proposed Scheme. The visual effects due to the increased height of the Proposed Scheme would be difficult to mitigate although some additional tree planting may be possible, which over time would reduce the significance of the effect.

2.24 CFA24 - Birmingham Interchange and Chelmsley Wood

Birmingham Interchange station car parks

2.24.1 The Proposed Scheme at Birmingham Interchange includes car parking and access roads in close proximity to the Grade II* listed Park Farm. Should the horizontal alignment of these change or, in particular, the vertical alignment of these increase, this could potentially increase the already significant adverse effects on the setting of this designated cultural heritage asset. This could also give rise to an increase in effects on the Grade II* Packington Hall Registered Park. These setting effects would be difficult to mitigate due to the proximity to the listed building and park, although some additional tree planting may be possible, which over time could reduce the significance of the adverse effect.

Pool Wood embankment and M6 crossing structures

2.24.2 Raising the vertical alignment at the northern end of this embankment and across the M6 box structure and M6 south and north viaducts would likely have significant adverse visual effects for residents in Chelmsley Wood. The associated increased embankment footprint and/or a western shift in the horizontal alignment could also reduce public open space in Heath Park, with potential implications for the football pitches there. Additional tree planting may be possible, which over time could reduce the significance of the visual effect. Also, further engineering works may be possible to restrict the footprint of the embankment and thereby reduce any potential adverse effects on Heath Park.

2.25 CFA25 - Castle Bromwich and Bromford

Parkhall Wood embankment, across the River Tame viaduct, to Langley Hill embankment

2.25.1 Raising the vertical alignment of these structures by up to 3m would increase existing adverse visual impacts and significant effects for residents of Castle Vale. It may also introduce visual impacts and significant adverse effects to new residents who would

not currently experience such effects with the Proposed Scheme. This may also affect the setting of cultural heritage assets principally the registered park and garden and listed buildings at Castle Bromwich Hall and Gardens as well as the Scheduled Monument of Castle Bromwich Castle. The visual effects due to the increased height of the structures would be difficult to mitigate although some additional tree planting may be possible, which over time could reduce the significance of the effect.

Bromford tunnel

2.25.2 Moving the alignment of the tunnel within the limits of deviation could result in a new significant groundborne noise or vibration effect for the residents of Bromford. Following detailed modelling, if new significant groundborne noise or vibration effects are identified by the change in alignment, then suitable mitigation in the form of a further acoustically enhanced track system would be provided to mitigate this significant effect. With this mitigation in place no additional residual significant adverse effects are likely.

2.26 CFA26 - Washwood Heath to Curzon Street

Washwood Heath depot

2.26.1 Raising the vertical alignment of the depot buildings and/or infrastructure by up to 3m would increase existing adverse visual impacts and significant effects for residents in Washwood Heath to the south, including introducing significant effects at Year 1 to new residents who would not currently experience such adverse effects with the Proposed Scheme. Some additional tree planting may be possible, which over time could reduce the significance of the adverse effect.

Duddeston Junction viaduct and Curzon Street viaducts 1, 2 and 3

2.26.2 Raising the vertical alignment of these viaducts by up to 3m would cause new significant adverse visual effects for residents in Nechells Green and Vauxhall to the north. Mitigation would be difficult due to the existing height of these structures and the constraints of existing infrastructure.

Curzon Street station and associated highway works

2.26.3 Changes to the vertical and/or horizontal alignment to the station and associated highways have the potential to increase existing significant adverse effects on the setting of listed buildings including the Grade 1 listed original Curzon Street Station and the Woodman (Grade II listed) and Eagle and Tun (locally listed) public houses. These listed buildings are all in close proximity to the station and are currently either accommodated by, or integrated into, the station design. Changes to the horizontal alignment could also increase adverse effects on the community by reducing public open space at Eastside City Park.