Welsh Government

M4 Corridor around Newport

Environmental Statement: Volume 1
Chapter 2: Scheme Description

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2 Scheme Description

2.1 Introduction

2.1.1 This chapter provides a description of the Scheme and, together with Chapter 3 (Scheme Construction), forms the basis for the environmental assessment provided in this Environmental Statement (ES). Further more detailed information on drainage, traffic data and carbon accounting can be found in the appendices to this chapter provided in Volume 3 of this ES.

2.1.2 The Scheme would consist of a new three-lane motorway to the south of Newport between the existing M4 Junction 29 at Castleton and the existing M4 Junction 23 at Magor and a number of 'Complementary Measures', some of which would be on the existing M4 between the same junctions.

2.1.3 This chapter describes the alignment and general layout of the proposed new section of motorway between its tie-in with the existing M4 to the west of Junction 29 (Castleton) at approximately ch[1] 1,520 and to the east of Junction 23 (Magor) at ch 24,000. The proposed new section of motorway is described conventionally from west to east (i.e. from Castleton to Magor). The national grid references (NGR) for the limits of the proposed new section of motorway are as follows.

- Tie-in with Junction 29 at ch 1,520. NGR ST(3)24408, (1)83939.
- Tie-in with Junction 23 at ch 24,000. NGR ST(3)44954, (1)87482.

2.1.4 Beyond these tie-ins with the existing M4, additional small scale highway infrastructure would be installed (e.g. road signage, lighting columns or vehicle restraining systems). However, these would not require any modifications to be made to the existing highway boundary. The limits of such measures would extend approximately 1,900 metres further to the west and 3,300 metres further to the east.

2.1.5 This chapter describes the design of the proposed new section of motorway, together with details and locations of the proposed structures. It also sets out details of the Complementary Measures included as part of the Scheme.

2.1.6 The effects of the Scheme have been described throughout the ES based on what is likely (i.e. the likely eventuality) taking into account the requirements of the EIA Directive 2011/92/EU, as amended. A number of measures have been incorporated into the design of the Scheme to avoid or reduce potential adverse environmental effects. In some cases, these measures may result in enhancement of environmental conditions. Details of measures forming part of the design of the Scheme (also referred to as embedded mitigation) are listed later in this chapter. These measures have been taken into account in assessing the effects of the Scheme.

2.1.7 Chapters 2 and 3 of this ES, together with the subsequent topic chapters, provide the data and information required to identify and assess the likely significant effects of the Scheme in accordance with Annex IV of the EIA Directive (see Chapter 5 and Appendix 5.3 for further details).

[1] ch or chainage refers to a point in metres from the western end of new section of motorway south of Newport. Thus ch 4670 is 4,670 metres from the western end.

2.2 Context

2.2.1 The majority of the existing M4 motorway between Junctions 23 and 29 lies within the administrative area of Newport City Council. The existing M4 crosses into the administrative area of Monmouthshire County Council to the west of Junction 23A near Magor (Figure 2.1).

2.2.2 As set out in Chapter 1, the M4 is critical to the Welsh economy. It forms part of the Trans-European Transport Network and is the gateway to Wales, transporting people and goods to homes, industry and employment. It provides access to ports and airports and serves the Welsh tourism industry.

2.2.3 The existing M4 motorway between Castleton and Magor does not meet modern motorway design standards and a greater volume of traffic uses it than it was originally designed for.

2.2.4 For many years, traffic congestion has been a fact of life for those using the existing M4 around Newport and living in the area. Journey times are often unreliable, making it more difficult to access job opportunities or services including education. Problems on the existing M4 relate to capacity, resilience, safety and issues of sustainable development. These problems are expected to get worse.

Existing M4 Motorway: Environmental Context

2.2.5 The key geographical characteristics and environmental constraints of the existing M4 are shown on Figure 2.2. The existing M4 motorway passes to the north of the centre of Newport. Existing development, including residential properties, schools, recreational facilities, industrial and commercial premises, lies in close proximity to the existing alignment. In addition to a number of individual properties, several communities are located adjacent, or in close proximity, to the existing M4 motorway between Junctions 23 and 29, including:

- Michaelston-y-Fedw;
- Castleton;
- High Cross/Glasllwch/Bassaleg;
- Brynglas/Barrack Hill/Crindau;
- St Julian's;
- Bishpool/Christchurch;
- Langstone;
- Wilcrick/Llanmartin/Underwood;
- Magor/Undy; and
- Llanfihangel near Rogiet/Rogiet.

2.2.6 Newport City Council, Monmouthshire County Council and Cardiff City Council have designated Air Quality Management Areas (AQMAs). Newport City Council has designated four AQMAs along the existing M4 corridor between Junctions 23 and 29. Further details are provided in Chapter 7 of this ES.

2.2.7 The existing M4 motorway crosses a number of watercourses, including the following.

- The River Ebbw (north of Junction 28).
- The Monmouthshire and Brecon Canal (between Junctions 27 and 28).
- The River Usk (between Junctions 25 and 26).

2.2.8 In addition, the existing motorway crosses a number of local watercourses and ditches.

2.2.9 The River Usk is designated at the national level as a Site of Special Scientific Interest (SSSI) and international level as a Special Area of Conservation (SAC) for its nature conservation value. The existing M4 motorway passes over the designated site immediately to the east of the Brynglas Tunnels. Further details of sites designated for their nature conservation interest are provided in Chapter 10 of this ES.

Proposed New Section of Motorway South of Newport: Environmental Context

2.2.10 The statutory designations and key environmental constraints in the vicinity of the proposed new section of motorway between Castleton and Magor are shown in Figure 2.3.

2.2.11 The proposed new section of motorway would run between Junction 29 at Castleton and Junction 23 at Magor. To the east of the Castleton junction, the proposed new section of motorway would depart from the route of the existing M4 motorway at Junction 29 and would pass to the south of Duffryn before crossing the Rivers Ebbw and Usk to the south of the A48 at Newport Docks.

2.2.12 The route for the proposed new section of motorway would cross the South Wales to London Mainline railway to the south of Duffryn and to the west of Magor. In addition, the route would cross a number of existing highways, rights of way and private means of access. The proposed new section of motorway would cross the Newport Docks between the South Dock and North Dock.

2.2.13 Approximately two thirds of the route for the proposed new section of motorway crosses the Gwent Levels. The Gwent Levels are an area of flat reclaimed coastal marshes that extend up to the Severn Estuary and comprise the Wentlooge Levels and Caldicot Levels to the west and east of Newport respectively. The Gwent Levels are low lying with an elevation typically of between 5 – 6 metres above ordnance datum (AOD).

2.2.14 The Gwent Levels are dissected by an extensive network of tide locked freshwater drains, locally known as reens, and are recognised as being of environmental value. A number of designations apply to the Gwent Levels, including the following.

- The Gwent Levels Landscape of Outstanding Historic Interest.
- A number of Sites of Special Scientific Interest (SSSIs), including:
  - Rumney and Peterstone SSSI.
  - St. Brides SSSI.

- Nash and Goldcliffe SSSI.
- Whitson SSSI.
- Redwick and Llandevenny SSSI.
- Magor and Undy SSSI.

2.2.15 The reen system on the Caldicot and Wentlooge levels is a network of interconnecting watercourses (reens and field ditches). The water levels in the reens are controlled by a series of sluice structures and are divided into winter penning levels and summer penning levels. Winter penning levels are kept lower to provide additional storage capacity. In summer, the penning levels are kept higher to provide a water source for agricultural purposes.

2.2.16 Further details in relation to heritage, nature conservation and hydrology are provided in Chapters 8, 10 and 16 of this ES respectively.

2.2.17 The route for the proposed new section of motorway would cross the Rivers Usk and Ebbw. As set out above, the River Usk is designated nationally and internationally for its nature conservation value. At the location of the proposed crossing, the river is designated as a Site of Special Scientific Interest and Special Area of Conservation.

2.2.18 The geology along the route can be broadly divided into three zones.

- Devonian hills in the west.
- Alluvial areas in the centre (Gwent Levels) that are typically underlain by Triassic bedrock.
- Carboniferous hills in the east.

2.3 Proposed New Section of Motorway South of Newport

2.3.1 The proposed new section of motorway would be approximately 23 kilometres (km) in length and would provide three lanes and a hard shoulder in both directions.

2.3.2 In addition to the junctions at Castleton and Magor, two new junctions would be provided at Newport Docks and at Glan Llyn. New or diverted lengths of highway, public rights of way and private means of access would be provided to replace those affected.

2.3.3 Road drainage would be provided initially through piped systems on the higher ground at both the western and eastern ends of the route and by grassed channels across the Gwent Levels. In both cases, the collected highway runoff would discharge into a series of water treatment areas and reed beds along the route of the proposed new section of motorway. These water treatment areas would attenuate and treat the collected surface water prior to discharging it into existing watercourses. Further details are provided below.

2.3.4 Three sets of figures together define the design for the proposed new section of motorway as follows.

- Figure 2.4: General Arrangement plans, showing the highway layout, horizontal alignment, extent of embankment and cuttings and key structures.
- Figure 2.5: Highway Drainage and Reen Mitigation plans, showing key drainage features and water treatment areas.
- Figure 2.6: Environmental Masterplans (EMPs), showing designated environmental constraints, existing vegetation, proposed landscape and environmental elements (predominantly planting, including noise barriers). Further information is provided in Chapters 9 (Landscape and Visual Effects) and 18 (Environmental Management).

2.3.5 Cross sections at key locations based on the Environmental Management Plans are provided as Figure 2.7. A long section of the proposed new section of motorway is provided at Figure 2.8.

2.3.6 The following text describes the proposed route with reference to the above figures.

General Arrangement

2.3.7 Works on the existing M4 to the west of ch 1,520 would consist solely of the installation of traffic control measures, such as changes to signage, lighting and changes to road markings.

2.3.8 The physical works associated with the proposed new section of motorway would start at ch 1,520. The existing Castleton junction on the M4 (Junction 29) would be modified to incorporate the proposed new section of motorway. The new Castleton Interchange has been designed to provide a free flowing interchange giving priority to the M4 motorway (including the new section of motorway) with three lanes in both directions. The layout would also provide access to and from the A48(M) and the existing M4 motorway to the east, which would be reclassified following completion of construction of the new section of motorway.

2.3.9 The works at the Castleton Interchange would include the construction of a number of new structures, including a replacement footbridge, overbridges and underbridges, together with provision of a gas culvert, a number of piped culverts and retaining structures.

2.3.10 In addition, the proposed highway works at the Castleton Interchange would require the demolition of three existing structures. The existing A48(M) overbridge and Park Farm footbridge would be demolished once the new structures to the west has been completed and opened. The Pound Hill overbridge (including the existing retaining wall) would be demolished once no longer required.

2.3.11 The alignment would follow the centreline of the existing M4 as far as ch 3,160 before curving away from the existing motorway corridor to the south east on embankment, passing to the south of Berryhill Farm.

2.3.12 The alignment would pass beneath a realigned Church Lane. Church Lane would be diverted from its current alignment to tie back into the existing highway to the north at a new roundabout junction. An overbridge would be provided to carry the realigned Church Lane (ch 4,625).

2.3.13 To the south east of Church Lane, the alignment has been designed to follow the Duffryn Link Road corridor, where practicable. The design follows a series of left hand curves to the south of the Duffryn area of Newport. The existing Cardiff to Newport route for non-motorised users (NMUs) along Percoed Lane would be maintained via a new overbridge (Figure 2.9). The proposed new section of motorway would then pass over the South Wales to London Mainline railway on a skewed structure (the Duffryn Railway Underbridge) at ch 6,450, providing a clearance of 5.45 metres to the railway (Figure 2.10).

2.3.14 To the east of the railway, the alignment would continue on a low embankment across the Wentlooge Levels. A new overbridge (Figure 2.11) would be provided at Lighthouse Road (ch 7,350) to maintain access along Lighthouse Road. The alignment would continue in a north easterly direction towards the River Ebbw. A new overbridge would be provided at New Dairy Farm (ch 8,250) to maintain access to the farm and to carry the Wales Coast Path.

2.3.15 The proposed new section of motorway would cross the River Ebbw (ch 8,525) and pass to the south of the Docks Way Landfill site. The River Ebbw Underbridge (Figure 2.12) would carry the new section of motorway over the River Ebbw. The piers of the bridge would be located above the mean high water mark.

2.3.16 To the east of the River Ebbw, the alignment would continue to the north east towards Newport Docks where a new Docks Way Junction would be provided. This would provide a grade-separated roundabout with four slip roads and a gyratory, which would be positioned beneath the proposed new section of motorway. This junction would provide a connection from the new section of motorway onto the A48 Southern Distributor Road (SDR) and to the centre of Newport. This would be provided through a secondary roundabout to the north of the new section of motorway, which would connect to the gyratory via a short dual carriageway connector road (Docks Way Link Road).

2.3.17 The River Usk Crossing would cross the Newport Docks between the South Dock and North Dock, before straightening out over the main bridge crossing of the River Usk. A number of existing buildings in the Newport Docks area would require demolition.

2.3.18 The bridge crossing is proposed to take the form of a 2.1 km long elevated structure, including a high level cable stayed bridge crossing of the River Usk (see below and Figure 2.13). It would extend from ch 9,224 on the west side to ch 11,376 on the east side. The bridge piers would be located outside the wetted channel (mean high water mark).

2.3.19 The structure would pass over the Wales Coast Path, which runs to the east of the River Usk. Immediately east of the docks area, the alignment would cross the quayside area around Corporation Road. The eastern part of the River Usk Crossing would cross over Uskmouth Railway line and pass to the south of the Solutia Chemical Works on a low embankment. The structure would pass over the Polychlorinated Biphenyl (PCB) cell operated by Solutia UK.

2.3.20 To the east of the River Usk Crossing, the alignment would follow a left hand curve across the Caldicot Levels. A new overbridge would be provided at Nash Road (ch 12,575) to maintain access. Nash Road would be diverted offline to the east. The existing junction between Nash Road and Meadows Lane would be

stopped up. A new at grade connection would be provided between Meadows Road and Nash Road, via Nash Mead.

2.3.21 Continuing east, the alignment would follow a large right hand curve across part of the Caldicot Levels towards the former steelworks. The highway would be supported on a low embankment as it runs to the east towards the former steelworks.

2.3.22 A new junction would be provided at Glan Llyn, in the form of a grade separated roundabout. This would provide a connection for the proposed new section of motorway, via a link road, to the A4810. The new link road would connect with the existing A4810 roundabout via a remodelled southern arm.

2.3.23 From the new Glan Llyn junction, the proposed new section of motorway would run in an easterly direction parallel to the A4810 and to the north of Whitson substation. A new overbridge would be provided at North Row (ch 17,550) to maintain access along North Row (Figure 2.14). North Row would be diverted offline to the west.

2.3.24 An underbridge would be provided at Bareland Street (ch 19,800) to maintain access for users of Bareland Street. Bareland Street would be diverted offline to the east, with a new junction provided to connect to the A4810.

2.3.25 As the proposed alignment continues beyond the Caldicot Levels the vertical alignment would rise up on an embankment over the South Wales to London Mainline railway. The proposed new section of motorway would cross over the railway on a new structure (the Llandevenny Railway Underbridge) at ch 20,075. The structure would pass over the railway and a realigned public right of way.

2.3.26 The alignment would then run in a north easterly direction towards Magor and the existing M4. A new overbridge would be provided for Newport Road (ch 20,850), which would be diverted offline to the north to a new roundabout junction on the A4810. The existing Wilcrick Maintenance Depot would be demolished, with a new depot provided at Glan Llyn.

2.3.27 In the vicinity of St Bride's Road to the north west of Magor, the proposed new section of motorway would merge into the existing M4 immediately to the east of the existing Junction 23A. After approximately ch 21,200 eastwards, the proposed new section of motorway would then utilise the alignment of the existing M4. In addition, a new section of dual carriageway would be constructed to the north of, and parallel with, the existing M4 from Junction 23A eastwards to a new Junction 23 (Magor Interchange) where connections would be provided to the M48 and the B4245. Consequently, the existing Magor Penhow Underbridge would be extended (and is referred to in this ES as the St Bride's Road Underbridge) at ch 21,225. St Bride's Road would broadly follow its current alignment.

2.3.28 To cross the new dual carriageway, a new overbridge would be provided at Knollbury Lane (ch 22,025) and a new underbridge would be provided at Rockfield Lane (ch 22,700) to maintain access.

2.3.29 In addition to the existing structures at Junction 23, the works required for the new Magor Interchange would include the provision of new underbridges and overbridges, providing for Bencroft Lane and access for Red Barn. In addition, the existing Caldicot Road Underbridge would be extended.

2.3.30 In addition, the proposed works at the Magor Interchange would require the demolition of two existing structures. The existing Bencroft Lane Underbridge would be demolished once traffic has been diverted from the structure.

Highway Cross Section

2.3.31 The highway cross section for the proposed three lane motorway is set out in Figure 2.15. Three lanes and a hard shoulder would generally be provided in each direction, separated by a central reserve (including 0.9 metre high concrete safety barrier). The route would occupy a minimum paved width of approximately 30.2 metres (14.3 metres in each direction with a 1.6 metre central reserve). Drainage channels and fencing would be provided beyond the hard shoulder, with safety barriers where appropriate.

2.3.32 This typical profile would vary to accommodate forward visibility and junctions, where merge and diverge slips would be provided.

Junctions

2.3.33 The proposed new section of motorway would connect to the existing highway network at four junctions. The proposed junctions are summarised in Table 2.1.

Table 2.1: Junction Details

Name	Location	Form	Purpose
Castleton	Western tie in to existing M4 at ch 2,200 – 3,800	Grade separated full movement, including three overbridges and two underbridges to carry the A48.	Provide interchange to existing M4 and A48 and access to Castleton.
Docks	East of River Ebbw crossing at Newport Docks at ch 8,800.	Grade separated junction, including underbridge access and roundabout to Docks Link.	Provide access to the centre of Newport, Newport Docks and A48 Southern Distributor Road.
Glan Llyn	South of A4810 at ch 14,650.	Grade separated junction, including overbridge access to A4810 and Glan Llyn Junction Link.	Provide access to eastern areas of Newport, Glan Llyn and A4810.
Magor	Eastern tie in to existing M4 at ch 2300 - 2400.	Grade separated full movement, including roundabouts and underbridges.	Provide interchange to existing M4, M48 and B4245.

New Structures

New Overbridges and Underbridges

2.3.34 The proposed new section of motorway would incorporate a number of new structures, including bridges, culverts and retaining structures. Details of proposed new overbridges and underbridges are summarised in Table 2.2 and the locations are shown on Figure 2.4.

2.3.35 Details of the approach to construction of these structures, including details relating to traffic management during construction, are provided in Chapter 3 and Appendix 3.1.

Table 2.2: Details of New Overbridges and Underbridges

Ref	Chainage	Name	Details
SBR-0200	2,000	Park Farm Footbridge	Replacement for existing footbridge (to be constructed and opened to pedestrians prior to demolition of the existing footbridge). Structure consists of single span steel warren truss bridge with steel deck plate. Structure 49.5 m long with a 2 m clear width between 1.4 m minimum height parapets.
SBR-0245	2,450	Castleton Interchange Overbridge Link A	Proposed overbridge carrying reclassified M4 from Cardiff, connecting to the M4 and reclassified M4 north of Newport (eastbound). Structure consists of steel plate girders and cross girders supporting a reinforced concrete deck slab. Structure 124.89 m long, 17.6 m wide and a minimum headroom of 5.3 m. Foundations reinforced concrete spread footings.
SBR-0355	3,600	Castleton Interchange Overbridge Link C	Proposed overbridge carrying the westbound slip road from the reclassified M4 onto the new section of motorway and the reclassified M4 into Cardiff. Structure consists of steel plate girders and cross girders supporting a reinforced concrete deck slab. Structure 237.75 m long, 18.0 m wide and a minimum headroom of 5.3 m. Foundations reinforced concrete piles.
SBR-0360	3,600	Castleton Interchange Overbridge Link B	Proposed overbridge carrying the westbound slip road from the new section of motorway to the reclassified M4 into Cardiff. Structure consists of steel plate girders and cross girders supporting a reinforced concrete deck slab. Structure 145.75 m long, 14.0 m wide and a minimum headroom of 5.3 m. Foundations reinforced concrete piles.
SBR-0370	3,725	A48 Underbridge Westbound	Proposed underbridge carrying westbound carriageway of new section of motorway over the A48. Structure consists of steel plate girders and cross girders supporting a reinforced concrete deck slab. Structure 95.0 m long, 20.5 m wide and a minimum headroom of 5.3 m. Foundations reinforced concrete piles.
SBR-0375	3,750	A48 Underbridge Eastbound	Proposed underbridge carrying eastbound carriageway of new section of motorway over the A48. Structure consists of steel plate girders and cross girders supporting a reinforced concrete deck slab. Structure 84.75 m long, 21.5 m wide and a minimum headroom of 5.3 m. Foundations reinforced concrete piles.
SBR-0460	4,625	Church Lane Overbridge	Proposed overbridge carrying side road over the new section of motorway. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a concrete deck slab. Structure spans: 30 m and 29.6 m, carrying a single carriageway 5 m wide.
SBR-0580	5,775	Percoed NMU Bridge	Proposed structure to carry the Newport/Cardiff cycle way over the proposed new section of motorway. Structure consists of multi-span steel structure supported on bearings on reinforced concrete piers. Length of spans would vary between 12 m and 13 m. Overall length of structure: 188 m (main span: 48 m).

Ref	Chainage	Name	Details
SBR-0590	N/A	Percoed Reen NMU Bridge	Proposed structure to carry the Newport/Cardiff cycle way over Percoed Reen (Figure 2.9). Structure consists of single span steel and timber structure. Bridge would have clear span of 11.6 m.
SBR-0650	6,500	Duffryn Railway Underbridge	Proposed underbridge carrying new section of motorway over the South Wales to London Mainline (Figure 2.10). Structure spans four tracks of the railway. Structure consists of pre-stressed concrete beams supporting a concrete deck slab. Structure span to be 27.9 m with a minimum headroom of 5.45 m and a length of 191 m. Foundations to be reinforced concrete piles.
SBR-0740	7,350	Lighthouse Road Overbridge	Proposed overbridge carrying side road over the new section of motorway (Figure 2.11). Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 28 m and 30 m, carrying a single carriageway 6.3 m wide.
SBR-0805	8,025	New Dairy Farm Overbridge	Proposed overbridge carrying access over the new section of motorway. Structure consists of pre-stressed concrete beams supporting a concrete deck slab. Structure spans: 32.8 m and 32.2 m, carrying a single carriageway 5 m wide and a 2.5 m wide footpath.
SBR-0850	8,500	River Ebbw Underbridge	Proposed underbridge carrying new section of motorway over the River Ebbw (Figure 2.12). Structure consists of three separate deck structures carrying the proposed new section of motorway, the westbound merge slip and the eastbound diverge slip. All three spans to be formed of steel plate girders supporting a reinforced concrete deck slab. Structure spans to be 50 m, 78 m and 50 m.
SBR-0875	8,750	Docks Junction Underbridge West	Proposed underbridge. The proposed gyratory system for the Docks Interchange would pass under this bridge, which would carry the new section of motorway. Structure consists of single span deck of pre-stressed concrete beams supporting a reinforced concrete slab. Structure span: 18.4 . Deck width: 36.6 m.
SBR-0880	8,800	Docks Junction Underbridge East	Proposed underbridge. The proposed gyratory system for the Docks Interchange would pass under this bridge, which would carry the new section of motorway. Structure consists of single span deck of pre-stressed concrete beams supporting a reinforced concrete slab. Structure span: 18.4 m. Deck width: 36.6 m.
SBR-1000	10,200	River Usk Crossing	See section on River Usk Crossing below and Figure 2.13.
SBR-1210	12,575	Nash Road Overbridge	Proposed overbridge carrying side road over the new section of motorway. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 2 x 31 m, carrying a single carriageway 6.5 m wide.

Ref	Chainage	Name	Details
SBR-1465	14,625	Glan Llyn Junction Overbridge West	Proposed overbridge carrying junction gyratory over the new section of motorway. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 28 m and 28.9 m, carrying a single carriageway 8 m wide.
SBR-1470	14,700	Glan Llyn Junction Overbridge East	Proposed overbridge carrying junction gyratory over the new section of motorway. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 28 m and 28.9 m, carrying a single carriageway 8 m wide.
SBR-1760	17,550	North Row Overbridge	Proposed overbridge carrying side road over the new section of motorway (Figure 2.14). Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 27.3 m and 27.4 m, carrying a single carriageway 4.8 m wide.
SBR-1980	19,800	Bareland Street Underbridge	Proposed underbridge carrying the new section of motorway over Bareland Street. Structure consists of pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure to be 37.9 m long, with a clear span of 10.95 m (to accommodate 5.5 m wide carriageway and two 2.5 m wide verges) and a headroom of 7.5 m.
SBR-2000	20,075	Llandevenny Railway Underbridge	Proposed underbridge carrying new section of motorway over the South Wales to London Mainline. Structure spans four tracks of the railway and a realigned non-motorised user route. Structure consists of pre-stressed concrete beams supporting a concrete deck slab. Structure span to be 28.3 m with a minimum headroom of 8.3 m from the rail lines. Foundations to be reinforced concrete piles.
SBR-2080	20,850	Newport Road Overbridge	Proposed overbridge carrying side road over the new section of motorway. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a concrete deck slab. Structure spans: 36 m and 31.7 m, carrying a single carriageway 7.3 m wide with footpath and cycleway widths varying between 2.5 m and 4.1 m along the bridge length.
SBR-2120A	21,225	St Bride's Road Underbridge	Proposed extension to existing Magor Penhow Underbridge to carry the new section of motorway over St Bride's Road. Existing structure has a clear span of 9.14 m and is approximately 40 m long. It is proposed to extend this by 32.7 m on the north side and 20 m on the south side. Headroom would be increased to 5.3 m.
SBR-2205	22,025	Knollbury Lane Overbridge 2	Proposed overbridge carrying side road over the new section of motorway and reclassified M4. Structure consists of two span integral bridge formed from pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure spans: 18.3 m and 24.8 m, carrying a single carriageway 5.5 m wide.
SBR-2265	22,700	Rockfield Lane Underbridge 2	Proposed underbridge carrying the new section of motorway and reclassified M4 over Rockfield Lane. Structure consists of concrete box with internal dimensions 9.0 m by 6.81 m, with a length of 41.28 m. To accommodate 5.5 m wide carriageway and two 1.75 m wide verges).

Ref	Chainage	Name	Details
SBR-2295	22,950	Magor Interchange Bridge	Proposed bridge crossing the westbound merge from the M48 roundabout to the M4 and the eastbound and westbound carriageways of the M4. Structure consists of a five span steel box bridge with concrete deck slab. Structure spans: 71.3 m, 52.8 m, 52.8 m, 71.1 m and 36.0 m.
SBR-2340A	-	Bencroft Lane Underbridge 1	Proposed underbridge carrying reclassified M4 from the M48 roundabout. Structure consists of precast concrete box structure with internal width 7.5 m by 5.6 m and a length of 50 m. Single carriageway 4.5 m wide with 2 x 1.5 m wide verges passes under this structure.
SBR-2360A	-	Caldicot Road Underbridge 1	Extension to existing structure to carry the new westbound off slip to the reclassified M4 and the B4245 (Caldicot Road). Extension would be 13.9 m long.
SBR-2360B	-	Bencroft Lane Underbridge 3	Proposed underbridge carrying new westbound on slip from the M48 roundabout onto the M4. Structure consists of precast concrete box structure with internal width 7.5 m by 5.6 m and a length of 17.3 m. Single carriageway 4.5 m wide with 2 x 1.5 m wide verges passes under this structure.
SBR-2365A	-	Red Barn Access Bridge	Proposed underbridge carrying new link road from the M48 roundabout to the B4245 Caldicot Road. Structure consists of precast concrete box structure with internal width 7.5 m by 5.3 m and a length of 15.9 m. Single carriageway 4.5 m wide with 2 x 1.5 m wide verges passes under this structure.
SBR-2365	-	Llanfihangel Underbridge	Proposed underbridge carrying the on slip eastbound from the M48 roundabout. Structure consists of pre-stressed concrete beams supporting a reinforced concrete deck slab. Structure would be 14.3 m long and would span the B4245.

River Usk Crossing

2.3.36 The River Usk Crossing would be a 2.1 km long elevated structure over Newport Docks, the River Usk and the industrial area around Stephenson Street and Corporation Road. The structure would carry the proposed new section of motorway and would consist of three main elements: a west approach viaduct, a cable-stayed bridge (of the same type as the Second Severn Crossing) and an east approach viaduct.

2.3.37 The west approach viaduct across Newport Docks would be 512 metres long from ch 9,224 to ch 9,736 (Figure 2.13a). The viaduct would be supported on seven piers to provide the following span distribution from the west abutment: 52, 76 (x3), 80 and 76 metres (x2) (seven spans in total).

2.3.38 The cable-stayed bridge (ch 9,736 to ch 10,488) would be 752 metres long comprising two 156 metre long back spans and a 440 metre long main span over the River Usk (Figure 2.13b). The cable stays would be supported on two towers, each 146 metres high. The western tower would be located on the west bank of the River Usk within Newport Docks to the west of the eastern most dock's access road and railway line (see Figure 2.4). The eastern tower would be located within an area of saltmarsh on the east side of the River Usk above mean high water, which at this location is at an elevation of 4.79 metres AOD.

2.3.39 The minimum navigation clearance between the mean high water springs level and the underside of the soffit of the bridge across the River Usk would be 32 metres. A minimum clearance of 25.5 metres above the docks water level of approximately 7.56 metres AOD would be provided.

2.3.40 The east approach viaduct would be 888 metres long from ch 10,488 to ch 11,376 (Figure 2.13c). The viaduct would be supported on twelve piers to provide the following span distribution from the eastern tower: 76 (x8), 80, 72, 76, 52 metres (twelve spans in total).

2.3.41 The viaducts and cable-stayed bridge would be supported on concrete piled foundations and would be constructed with reinforced concrete piers with a steel and concrete composite deck. The west abutment would be a reinforced earth embankment clad with concrete panels.

New Reen Bridges and Culverts

2.3.42 The proposed new section of motorway would cross a number of existing reens and would intersect numerous field ditches.

2.3.43 Culvert crossings or reen bridges would be provided for each main reen in order to maintain connectivity within the reen system. Reen bridges are culverts with spans larger than 3 metres, while culvert crossings would have spans smaller than 3 metres. Details of the main crossings are provided in Tables 2.3 and 2.4, the locations of which are shown on Figure 2.5. Details in relation to the approach to installation of these structures are provided in Chapter 3 and Appendix 3.1.

2.3.44 In addition to the structures set out in Table 2.4, a number of additional small diameter culverts are proposed along the route of the proposed new section of motorway, together with works to an existing pipe at Maes Glas Pill (SMN-0905).

Table 2.3: Details of New Reen Bridges

Ref	Chainage	Name	Details
SBR-0570	5,750	Percoed Reen Bridge	Structure carries realigned Percoed Reen. New section of motorway would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 2.1 x 52.4 m.
SBR-0835	8,400	Sea Wall Reen Bridge	Structure carries realigned Sea Wall Reen. New section of motorway would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 4.5 x 93.6 m.
SBR-1475	N/A	Glan Llyn Junction Link Underbridge	Structure spans Monk's Ditch. New link road from Glan Llyn Junction would pass over this structure. Single span integral bridge. Span would be 20 m.
SBR-1480	14,900	Monk's Ditch Bridge	Structure carries Monk's Ditch. New section of motorway would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 2.1 x 95 m.
SBR-1640	16,375	Steelworks Dedicated Reen Bridge	Structure carries Steelworks Dedicated Reen. New section of motorway would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 4.0 x 54 m.
SBR-1755	N/A	Middle Road Reen Bridge	Structure carries realigned Middle Road Reen. The realigned North Row would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 2.1 x 18 m.
SBR-1770	N/A	North Row Middle Road Diversion Reen Bridge	Structure carries realigned Middle Road Diversion Reen. The realigned North Row would pass over this structure. Single span box culvert. Internal dimensions 4.2 x 2.1 x 25 m.
SBR-1780	17,875	M4 Middle Road Diversion Reen Bridge	Structure carries realigned Middle Road Diversion Reen. New section of motorway would pass over this structure. Single span pre box culvert. Internal dimensions 4.2 x 2.1 x 56 m.

Table 2.4: Details of New Culverts

Ref	Chainage	Name	Details
SBR-0365	3,675	Castleton Interchange Gas Main Culvert	Structure provides maintenance access to high pressure gas pipe. The superstructure comprises a single span integral portal formed of T3 precast pre-stressed concrete beams acting compositely with a 150 mm thick in-situ reinforced concrete topping with infill between the beams. The structure has a span of 9.3 m with a length of 31 m.
SMN-0510	5,100	Nant-y-Moor Reen Culvert	Structure carries Nant-y-Mor Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section to form an extension to existing culvert structure. Internal dimensions would be 1.8 x 1.8 x 30 m.
SMN-0550	5,500	SDR Reen Culvert	Structure carries realigned SDR Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 54 m.
SMN-0680	6,825	Morfa Gronw Reen Culvert	Structure carries realigned Morfa Gronw Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 72 m.
SBR-0735	7,350	Lighthouse Road Highway Drainage Culvert North (part of Lighthouse Road Overbridge)	Structure carries channel drainage system below the approach embankment for Lighthouse Road Overbridge. Approach embankment for Lighthouse Road would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 2.7 x 1.0 x 47 m.
SBR-0740	7,350	Lighthouse Road Highway Drainage Culvert South (part of Lighthouse Road Overbridge)	Structure carries channel drainage system below the approach embankment for Lighthouse Road Overbridge. Approach embankment for Lighthouse Road would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 2.7 x 1.0 x 47 m.
SMN-0770	7,700	Old Dairy Reen Field Access	Structure carries realigned Old Dairy Reen. A field access track would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 10 m.
SMN-0775	7,750	Old Dairy Reen Culvert	Structure carries realigned Old Dairy Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 62 m.
SMN-0800	7,980	Pont-y-Cwcw Reen Culvert	Structure carries realigned Pont-y-Cwcw Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 59 m.
SMN-0805	8,050	Pont-y-Cwcw Compensatory Reen Culvert	Structure carries the compensatory reen from Pont-y-Cwcw Reen to the Sea Wall Reen. The embankment for the New Dairy Farm Overbridge would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 52 m.
SMN-1180	11,950	Picked Lane Culvert	Structure carries realigned unnamed reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 74 m.

Ref	Chainage	Name	Details
SMN-1225	12,250	Lake's Reen South Access Culvert	Structure carries realigned Lake's Reen. A field access track would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 12 m.
SMN-1230	12,350	Lake's Reen Culvert	Structure carries Lakes Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 56 m.
SMN-1235	12,350	Lake's Reen North Access Culvert	Structure carries realigned Lake's Reen. An access road would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 10 m.
SMN-1240	12,450	Julian's Reen Side Road Culvert	Structure carries Julian's Reen on current alignment. Existing side road would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 15 m.
SMN-1250	12,500	Julian's Reen Farm Access Culvert	Structure carries realigned Julian's Reen. A field access track would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 10 m.
SMN-1300	13,000	Julian's Reen Culvert	Structure carries Julian's Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 56 m.
SMN-1305	13,050	Tatton Farm Access Culvert	Structure carries realigned an unnamed waterway. An access track would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 11 m.
SMN-1310	13,050	Julian's Reen Access Track Culvert	Structure carries Julian's Reen on current alignment. The access road to Tatton Farm would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 11 m.
SMN-1330	13,300	Tatton Farm Culvert	Structure carries realigned unnamed waterway. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 55 m.
SMN-1350	13,540	Field Culvert	Structure carries realigned unnamed waterway. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 54 m.
SMN-1430	13,900	Ellen's Reen Culvert	Structure carries Ellen's Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 56 m.
SMN-1445	14,400	Ellen's Reen Diversion Track Culvert	Structure carries the diverted Ellen's Reen on a new alignment. Access road to Water Treatment Area 8 would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 11 m.
SMN-1480	14,880	Black Wall Reen Culvert	Structure carries Black Wall Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 101 m.
SMN-1655	16,575	Elver Pill Reen Culvert	Structure carries Elver Pill Reen on current alignment. New section of motorway would pass

Ref	Chainage	Name	Details
			over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 61 m.
SMN-1720	17,220	New Cut Reen Culvert	Structure carries New Cut Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 60 m.
SMN-1760	17,550	North Row Highway Drainage Culvert North	Structure carries channel drainage system below the approach embankment for North Row Bridge. Approach embankment for North Row would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 2.7 x 1.0 x 44 m.
SMN-1765	17,550	North Row Highway Drainage Culvert South	Structure carries channel drainage system below the approach embankment for North Row Bridge. Approach embankment for North Row would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 2.7 x 1.0 x 44 m.
SMN-1850	18,500	Cock Street Reen Culvert	Structure carries Cock Street Reen on current alignment. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 60 m.
SMN-1925	19,275	Petty Reen Culvert	Structure carries realigned Petty Reen. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 60 m.
SMN-1940	19,400	Rush Wall Reen Culvert	Structure carries realigned Rush Wall Reen. A field access track would pass over this culvert. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 12 m.
SMN-1970	19,700	Bareland Street East North Culvert	Structure carries new drainage ditch system to the south of the new motorway embankment. Bareland Street would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.5 x 1.5 x 25 m.
SMN-1980	19,750	Bareland Street East South Culvert	Structure carries realigned unnamed waterway. New section of motorway would pass over this structure. Single span pre-cast box culvert section. Internal dimensions would be 1.8 x 1.8 x 37 m.
SBR-2140	21,375	Mill Reen Culvert	Proposed extension to existing culvert carrying Mill Reen. New section of motorway would pass over this structure. Existing structure is an in situ reinforced concrete arch roof structure. Proposed extension would be similar in form and appearance. Proposed structure would have a clear span of 6 m, a clear height of 4 m above the right of way and a length (including the existing culvert) of 135 m.

New Retaining Structures

2.3.45 At some locations along the proposed new section of motorway, retaining structures would be required. This would include the following locations.

- Duffryn Railway Underbridge. A retaining wall would be required on the south side of the new section of motorway opposite the proposed National Rail electricity feeder station (Figure 2.4, Sheet 4).
- Docks Way Junction: Retaining walls would be required to the east and west of the new Docks Way Junction and on highway links forming part of this gyratory system (Figure 2.4, Sheet 5).
- Magor Interchange: Retaining walls would be required on the approach to the new junctions at Magor (Figure 2.4, Sheet 14).

Existing Features

Demolition of Existing Features

2.3.46 Twelve residential properties would be demolished as part of the Scheme, as follows:

- The Conifers, Coedkernew, Newport;
- White Cottage, Newport Road, Coedkernew, Newport;
- San Remo, Coedkernew, Newport;
- The Glen, Coedkernew, Newport;
- Quarry Cottage, Coedkernew, Newport;
- Myrtle House, Pound Hill, Coedkernew, Newport;
- Berryhill Cottage, Coedkernew, Newport;
- Berryhill Farm, Coedkernew, Newport;
- Barecroft House, Barecroft Common, Magor;
- Woodland House (Magor Vicarage), Newport Road, Magor;
- Undy House, Undy; and
- Dunline, Knollbury, Magor.

2.3.47 Of these, five are currently in Welsh Government ownership. One, Woodland House (Magor Vicarage), is a Listed Building.

2.3.48 Some existing commercial properties would require demolition in the following locations.

- Buildings located at Newport Docks to allow for construction of the River Usk Crossing, the Docks Way Junction and the link to the A48.
- Buildings located within the Stevenson Industrial Estate owned/operated by Marshalls Mono Ltd.

2.3.49 A number of existing highway structures would require demolition. These include the following existing structures:

- Park Farm Footbridge (SBR-0200);
- A48(M) Overbridge (Castleton 1C) (SBR-0250);
- Pound Hill Overbridge (SBR-0340); and
- Pound Hill Retaining Wall (SRW-0340).

2.3.50 The existing Wilcrick Maintenance Depot would be demolished. A new depot at Glan Llyn would be provided.

2.3.51 Details of the approach to demolition during the construction phase are provided in Chapter 3 and Appendix 3.1.

Side Roads and Modifications to the Highway Network

2.3.52 The existing highway network would be modified at a number of locations, where the proposed new section of motorway would join or cross existing routes. Details are provided in Table 2.5.

Table 2.5: Side Roads and Local Highway Modifications

Chainage	Road	Proposed Works
Castleton Interchange	M4	Improvements to M4 to tie new section of motorway in to existing M4.
N/A	A48(M)	Trunk road (A48(M)) to be improved to tie into the proposed new section of motorway and reclassified M4.
N/A	A48(M)/M4	Trunk road interchange to be stopped up, with new link roads provided as part of the new section of motorway.
3,300	Pound Hill	Pound Hill to be stopped up from north of the existing Pound Hill Overbridge to its junction with the A48 east of Pound Hill Overbridge.
4,625	Church Lane	Church Lane would be diverted to pass over the new Church Lane Overbridge and tie back into the existing highway to the north at a new roundabout junction.
N/A	Blacksmith Way	Unclassified Road named Blacksmith Way to be improved to tie in with new Church Lane Overbridge.
N/A	Duffryn Roundabout and Duffryn Link	Existing Duffryn roundabout and part of Duffryn Link to be stopped up and replaced with new roundabout 120 metres north of existing Duffryn roundabout.
5,650	Percoed Lane	Percoed Lane to be stopped up and diverted via the Percoed bridge for pedestrians, equestrians and cyclists.
6,075	Green Lane	Green Lane to be stopped up and public bridleway and private means of access to be provided.
7,350	Lighthouse Road	Lighthouse Road to be stopped up and diverted over the new Lighthouse Road Overbridge.
N/A	A48 Southern Distributor Road	To be stopped up to tie in with proposed link between the A48 Southern Distributor Road and other highway improvement works. New highway proposed.
12,575	Nash Road , Nash Mead, Meadows Road	Nash Road and Meadows Road to be stopped up and diverted offline to the east over the Nash Road overbridge. The existing junction between Nash Road and Meadows Lane to be stopped up. A new at grade connection would be provided between Meadows Road and Nash Road, via Nash Mead.

Chainage	Road	Proposed Works
N/A	Broadstreet Common	Broadstreet Common to be stopped up close to Pye Corner and a new at grade crossing to be provided for National Cycle Network Route 4.
N/A	A4810	The A4810 to be improved, together with A4810 Roundabout to tie in with highway works at Glan Llyn.
17,550	North Row	North Row to be diverted offline to the west to tie in with North Row Overbridge.
N/A	Rush Wall	Rush Wall to be improved near cross roads with North Row to tie in with highway works and for provision of a public bridleway along Rush Wall.
19,800	Barecroft Common	An underbridge to be provided at Barecroft Common to maintain access for users of Barecroft Common. Barecroft Common would be diverted offline to the east, with a new junction provided to connect to the A4810.
20,225	Green Moor Lane	Green Moor Lane to be stopped up for motor vehicles. A new footpath to be provided.
20,850	Newport Road	A new overbridge to be provided at Newport Road. Newport Road to be diverted offline to the east to a new roundabout junction. The new roundabout would be provided at the intersection of Newport Road and the A4810.
N/A	A4810	A4810 to be improved to tie in with new highway, new roundabout along B4245 and other highway improvement works.
N/A	B4245	B4245 to be stopped up from junction with A4810. Existing junctions to be stopped up.
21,225	St Bride's Road	St Bride's Road to be stopped up and new highway constructed along broadly the same alignment to allow for extension of existing Magor Penhow Underbridge to carry the new section of motorway over St Bride's Road.
22,025	Knollbury Lane	Knollbury Lane to be improved to allow for construction of the Knollbury Lane Overbridge to carry existing road over the new section of motorway and reclassified M4.
22,700	The Elms	The Elms to be stopped up and new highway to be constructed along broadly the same alignment to allow for an extension of the existing underbridge to carry the new section of motorway over The Elms.
N/A	Bencroft Lane	The existing route of Bencroft Lane to be stopped up at the Magor Interchange and new highway provided to tie into highway and new underbridges and allow for demolition of existing structure.
N/A	B4596	Road to be stopped up and new highway provided to tie in to improvement works at Junction 25.
Magor Interchange	M4	Improvements to M4 to tie in new section of motorway in to existing M4.

Public Rights of Way

2.3.53 The following public rights of way would require modification. Further details are provided in Chapter 14 (All Travellers) and are shown on Figure 2.4.

- Sections of public footpaths 400/2, 400/10 and 400/11 would be diverted to link to the new Park Farm Footbridge (SBR 0200) and to maintain linkages with the wider public rights of way network.
- Public footpath 399/29 between the existing M4 and the A48 to the north of Castleton would be within the area required for earthworks associated with the Castleton Interchange. No diversion would be put in place for this no-through route, which does not link to any other public rights of way.
- The western section of public footpath 390/11 to the north of the existing M4 and south of Gwaunshonbrown Farm is within the area required for earthworks associated with the Castleton Interchange. This public footpath would be diverted to run along the fence line of the new section of motorway to meet Pound Hill further to the north.
- The northern section of public footpath 390/15 would be diverted to run along the fence line of the new section of motorway to meet public footpath 390/12.
- The western section of public footpath 390/17 to the south of the A48 would be within the area required for the new section of motorway and associated earthworks. The western section of the footpath would be stopped up and the eastern section to its junction with Church Lane would remain on its existing alignment. This section would then be diverted along the fence line of the new section of motorway to the east and then to the north to meet the new roundabout on the Duffryn Link to the north of the new Church Lane Overbridge (SBR 0460).
- The northern section of public footpath 390/18 would be diverted to run parallel to and south of its existing alignment adjacent to the proposed water treatment area.
- Public footpath 390/22 to the east of Church Lane and south of the Duffryn Link would be within the area required for the new section of motorway and the Church Lane Overbridge. This public footpath would be diverted along the fence line of the new section of motorway to the west towards Church Lane and then south to meet the new Church Lane Overbridge (SBR 0460).
- Sections of the Wales Coast Path and Newport Coast Path that run along the alignment of public footpath 412/11 on the track to New Dairy Farm to the east of Lighthouse Road would be within the area required for the new section of motorway. These sections would be diverted across the New Dairy Farm Overbridge (SBR 0805) in a similar position to the current alignment of the route.
- A section of the Wales Coast Path and Newport Coast Path that runs along the alignment of public footpath 401/4 to the south of the Solutia works would be within the area required for the new section of motorway and parts of the supporting structure for the new River Usk Crossing (SBR 1000). This route would be diverted around the supporting structure of the new River Usk Crossing and to the south of the new section of motorway to link with the remaining section that runs southwards, west of Pye Corner.
- The eastern section of public footpath 372/92/1 lies to the west of the A4810 and would be within the area required for the new section of motorway and the bridge over the South Wales to London Mainline. This public footpath would be diverted to the south to a point opposite the new alignment of Barecroft Common.

- Public footpaths 372/69/2, 372/69/5, 372/69/8 372/69/10 and 372/69/11 to the north west of Magor would be within the area required for the new section of motorway and associated works to the south of Junction 23A. They would be diverted along the fence line of the new section of motorway as a public bridleway from public footpaths 372/12/4 and 372/86/1 on the north side of the existing M4 to meet St Bride's Road to the east.
- The southern part of public footpath 372/85/1 to the north of the existing M4 and west of Magor Services would be within the area required for a water treatment area and associated earthworks. This public footpath would be diverted to the west to meet public footpath 372/86/1.
- The southern sections of public footpaths 372/30/1 and 372/86/1 as they approach the extended Mill Reen culvert (SMN 2140) would be diverted to the west to meet the entrance to the extended culvert.
- Restricted byway 372/30/1 and 372/30/2 which run along a track from public footpath 372/29/1 to meet The Elms road to the immediate north of the existing M4 would be within the area required for the new section of motorway and associated earthworks. This route would be diverted to the east along the fence line of the new section of motorway to meet Rockfield Road.

2.3.54 In addition to these permanent diversions, the following new routes would be created.

- A new public footpath would be created along the fence line of the new section of motorway, running from public footpath 400/1 eastwards to meet Pound Hill to the north of the existing M4.
- A new public bridleway would be created from Green Lane, to the south of the new section of motorway, to run along the same alignment as the private means of access to Maerdy Farm to meet Percoed Lane on the southern side of the Percoed Lane NMU Bridge.
- A new public bridleway would be created along the fence line of the new section of motorway from public footpath 372/86/1 to the north of the existing M4 to meet St Bride's Road to the west.
- A new public bridleway would be created from public footpath 372/12/4 to the south of the existing M4 to meet St Bride's Road to the west.
- A new public bridleway would be created from public footpath 372/12/4 to the south of the existing M4 to meet Grange Road to the east.

Cycle Routes

2.3.55 National Cycle Route 4 (NR4), which is part of the national cycle network, would be permanently stopped up where it is crossed by the proposed new section of motorway on the eastern side of the River Usk between Traston Road and Pye Corner to the south of the Solutia works. This route would be diverted to the south (Figures 2.4 and 2.6). NR4 shares this section of the route with the Wales Coast Path and both resources would continue to share the diverted route.

2.3.56 A section of the Cardiff to Newport Cycleway, a new route for cyclists and pedestrians between the two cities, would be permanently stopped up where it is crossed by the new section of motorway on the track alongside Percoed Reen,

near to Green Lane and diverted across the Percoed Reen NMU Bridge (SBR0590) (Figures 2.4 and 2.6).

2.3.57 In addition to these existing resources, five new public bridleways would be created as part of the new section of motorway (see section above). These would also be available for use by cyclists. One of these would run eastwards along Rush Wall from North Row to the south of the new carriageway, linking to the existing alignment of Barecroft Common (Figures 2.4 and 2.6).

Modifications to Existing Structures

2.3.58 In addition to the main structures set out in the previous sections, a number of existing structures would require modification. Details of the key structures are summarised in Table 2.6.

Table 2.6: Modifications to Existing Structures

Ref	Chainage	Name	Details
SMN-0310	N/A	Castleton Garden Centre Culvert	Works required for drainage of earthworks.
SMN-0310	3,500	The Glen (Nant-Selsig) Culvert	Extension to existing culvert to accommodate junction.
SMN-0315	3,500	Penylan (Nany-y-Seig) Culvert	Extension to existing culvert to accommodate junction.
N/A	6,525	Duffryn Railway Culvert	Culvert to be infilled.

Highway Depot

2.3.59 A new motorway maintenance depot would be constructed close to the new Glan Llyn Junction. As set out above, the existing Wilcrick Maintenance Depot would be demolished. The proposed new depot is anticipated to be a like for like replacement for the facilities currently provided at Wilcrick. This would include a garage, salt barn, offices and hardstanding areas for the parking of maintenance vehicles and car parking for office staff operatives and visitors.

2.3.60 In total, the depot would occupy a fenced area of approximately 190 x 100 metres. The maximum heights of the buildings within the depot area are anticipated to be as follows.

- Garage: 7.2 metres.
- Salt barn: 10.6 metres.
- Offices: 4.1 metres.

2.3.61 The Glan Llyn depot would provide space for the River Usk Crossing maintenance vehicles and offices.

Design Speed

2.3.62 The proposed new section of motorway has been designed with a 120 kilometres per hour design speed and a mandatory 70 miles per hour enforced speed limit for all of its length.

2.3.63 The speed limits at either end of the proposed new section of motorway would generally be 70 mph, with the exception of the toll booth area associated with the Severn Crossing.

Highway Drainage

Overview

2.3.64 Following consultation and review undertaken during the preliminary design process, a set of design criteria for drainage was developed which promote sustainable drainage and meet the requirements of Natural Resources Wales (NRW) and South Wales Trunk Road Agency (SWTRA) and the Design Manual for Roads and Bridges (DMRB) guidelines. These design criteria reflect the unique hydrological environment of the Gwent Levels.

2.3.65 The normal design standards for trunk roads and motorways are that drainage pipework is designed to accommodate a 1 year return period storm within the pipework and to ensure that a 5 year return period storm does not result in surface flooding.

2.3.66 This was recognised as being an inappropriate standard for the proposed new section of motorway due to the risk of potentially contaminated surface water finding its way into the reen system on the Gwent Levels. Consequently, the highway drainage systems have been designed to contain all flows up to a 100 year storm, including a 30% increase in precipitation to account for climate change. Such an event could be expected to be exceeded, on average, only once every 100 years. The drainage systems are capable of conveying this flow to the water treatment areas for attenuation and treatment.

2.3.67 A Drainage Strategy Report has been produced and is provided at Appendix 2.2. The content of the Drainage Strategy Report has been discussed and agreed in principle with NRW. In summary, the specification for the proposed drainage considerably exceeds that required by the standards normally adopted for trunk roads and motorways

Carriageway Drainage, Basic Spillage Control and Water Treatment

2.3.68 For the majority of its length, the proposed new section of motorway would be located within the Caldicot and Wentlooge Levels. Typical ground conditions comprise very soft subsoils with a very high water table. In order to minimise settlement, impact upon the ground water level and visual intrusion, it is proposed to maintain a low level embankment on which the new section of motorway would be constructed. Discharge to lined drainage channels would be adopted because a conventional gulley and pipe drainage system would require longitudinal falls which could only be created by raising the embankment.

2.3.69 The drainage strategy requires the surface water runoff, after attenuation and treatment, to discharge to major NRW reens where there is a greater flow of water. This would either be directly by pipe or by the addition of engineered field ditches, which would discharge to the main reens.

2.3.70 Runoff from the new section of motorway would be intercepted by grassed channels in the verge of the carriageway. These channels would route surface water overland from the drained carriageway to the water treatment areas. Where the carriageway is super elevated in the central reserve of the motorway,

the introduction of concrete barriers and maintenance restrictions excludes the use of grassed channels. Here concrete channels would be utilised.

2.3.71 The grassed channels would be dry during dry weather, enhancing their pollutant removal capability, but during a rainfall event the water would flow into them from the carriageway and move slowly to the outfall point. The flow of water would be retarded and filtered by the grass. Sediment would be deposited and oily residues and organic matter retained and broken down in the top layer of soil and vegetation. During a rainfall event, a proportion of the runoff may be lost due to evaporation and transpiration. The use of grassed channels has been identified as a means of reducing pollution and promoting a more sustainable drainage system compared to conventional drainage systems.

2.3.72 The grassed channels would follow the gradient of the motorway and would be lined with a geo-synthetic clay liner below topsoil to eliminate the risk of surface water runoff containing possible pollutants seeping into the underlying ground.

2.3.73 The grassed channels would be maintained by the South Wales Trunk Road Agency and would require a minimum of three cuttings a year in late spring and summer to maintain a grass length of not longer than 75 mm, in accordance with DMRB guidance (HA 119/06) (Highways Agency *et al.,* 2006).

2.3.74 The grassed channels within the Sites of Special Scientific Interest are proposed to cater for a 1 in 100 year storm event with an allowance for climate change. Substantial storms in excess of this return period event would overflow over the highway embankment into the adjacent field reens, but it is considered that a storm intensity of this magnitude would dilute any pollutants to acceptable levels, and that the statistical probability of the storm occurring is very low. A typical section of the road across the Levels is shown in Figure 2.15.

2.3.75 The runoff in the grassed channels would be captured in collection sumps or catch pits. On the motorway carriageway, the catch pits would include provision to capture hydrocarbons and grit prior to flows entering the main attenuation lagoons.

2.3.76 From the sumps the water would flow into the water treatment and attenuation areas, the locations of which are shown on Figure 2.5.

2.3.77 Where the highway alignment dictates that steeper falls are introduced or the carriageway drains to the centre of the road (the median), conventional drainage would be used, typically concrete surface water channels.

2.3.78 With the exception of discharges to the River Usk and the River Ebbw, all drainage would be treated through the water treatment areas. These areas are listed below in Table 2.7.

Table 2.7: Water Treatment Area Details on Main Carriageway

Outfall No	Receiving Watercourse	Estimated Highway Runoff Storage Volume (m^3)	Attenuated Discharge Rate (l/s)	Contributing Impermeable Area (Ha)	Area of Attenuation Lagoon (m^2)	Area of Reed bed (m^2)
1	Pwll Bargoed Reen	9,000	32.5	9.3	9,305	7,100
2	Tyn-y-Brwyn Reen	10,500	40.1	11.5	10,540	7,210
3	Outfall to Newport City Council (NCC) drainage network without attenuation (Existing or modified side roads only). No motorway drainage to be discharged to the NCC system and overall contributing areas will be reduced.					
4a	Percoed Branch East	4,200	15	4.3	8,590	3,890
4b	Percoed Branch East	42,00	15	4.2	6,790	3,750
5	Morfa Gronw Reen	7,000	25.6	7.3	6,992	6,329
6	Lakes Reen	4,000	16.8	4.8	1,332	3,336
7	Julian's Reen	3,600	14.4	4.1	1,050	2,859
8	Ellen Reen	8,400	31.5	9.0	1,848	6,379
8a	Black Wall Reen	3,500	3.5	1.0	758	3,373
9	Middle Road Reen Diversion	13,000	55.3	15.8	12,006	10,299
10	Rush Wall Reen South	2,700	11.6	3.3	6,490	8,062
11b	St. Bride's Brook	7,950	17.7	6.0	11,875	2,770
11c	St. Bride's Brook	5,100	17.6	5.0	4,805	3,200
12a	Prat Reen	18,000	50.5	14.4	16,630	11,595
12b	Vurlong Reen	675	2.6	0.73	1,620	450

2.3.79 Flows entering the water treatment areas would first pass through a forebay pollution control lagoon area before entering the main attenuation lagoon. The forebay would contain systems designed to retain a minimum of 50 cubic metres of oil/hydrocarbon. This is in excess of the capacity of two large articulated oil tankers.

2.3.80 Each attenuation lagoon has been designed to cater for a 1 in 100 year storm event with an allowance for climate change. The main attenuation lagoon for each water treatment area has been designed to restrict flow to the equivalent 'greenfield runoff' rate within the Gwent Levels. Historically, the greenfield runoff rate has been restricted to 3.5 litres per second per hectare as set by NRW. In meetings during the preliminary design phase in 2015, NRW stated that this value is appropriate for the design for the new section of motorway.

2.3.81 The attenuated flow from the lagoons would be trickle fed through a reed bed for final polishing and treatment before discharging to the main reen system. Penstocks would be provided on the discharge points from the forebay, lagoon and reed bed to provide additional pollution control if required.

2.3.82 Discharge at the outfalls from the water treatment areas would be of a quality and quantity to enable these parts of the drainage system to support the features for which the Gwent Levels are designated as Sites of Special Scientific Interest.

2.3.83 For outfalls to the River Usk and River Ebbw, there is no requirement for flow attenuation as the flows outfall to a tidal river. Pollution control would be provided by oil separators. These would be either baffle arrangements within open lagoons or within bespoke underground units.

2.3.84 For side roads where there would be no increase in impermeable area, existing outfalls would be utilised.

2.3.85 For side roads where impermeable areas are increased and at new junctions, outfalls would include pollution protection using oil separators and attenuation lagoons. These outfalls are outlined below in Table 2.8 and shown on Figure 2.5.

Table 2.8: Side Roads and Main River Outfalls

Receiving Watercourse	Estimated Highway runoff storage volume (m^3)	Attenuated Discharge Rate (l/s)	Contributing Impermeable Area (Ha)
Ebbw West Outfall	N/A	N/A	1.3
Ebbw East Outfall (inc SDR link)	N/A	N/A	11
Usk Outfall	N/A	N/A	2.9
Meadows Road North	350	1.2	0.34
Meadows Road South	350	1.2	0.34
North Row North	350	1.1	0.31
North Row South	350	1.2	0.34

2.3.86 Fin drains designed to prevent seepage of water into the road sub-base would be installed along the edge of the carriageway between the edge of the pavement and the safety barriers. These would run for 200 metres before discharging into a 1,050 mm diameter catchpit, which would outfall into a replacement reen or field ditch at the toe of the embankment or to the granular drainage blanket below the road formation.

Median Drainage

2.3.87 Over some stretches of the proposed new section of motorway, the road would be super elevated and drainage to the median channel would be required. The central reserve would be hardstanding, with a concrete vertical concrete barrier and, as described above, a concrete channel would be used.

2.3.88 The size of the channel would be limited by the amount of space available in the central reserve. Generally this would be 1.5 metres, however as a result of widening for visibility on some curved sections the size may vary. The depth of the channel would be limited to 0.15 metres as this is the largest allowable depth which is not required to have a barrier between the channel and the road edge.

River Usk Crossing Drainage

2.3.89 The drainage on the River Usk Crossing would consist of kerb drainage outfalling to a pipe that runs along the central reservation. Kerb drainage would be provided on the central reservation and the westbound carriageway, as the deck is super elevated along its length.

2.3.90 On the west side of the River Usk Crossing, drainage would discharge into the River Ebbw via an oil separator. An attenuation lagoon would not be required as the River Ebbw is tidal at this point and would not be impacted by additional fluvial flows.

2.3.91 On the east side of the River Usk Crossing, the drainage would outfall into the River Usk via a small storage lagoon and a field ditch (Figures 2.4 and 2.5). The lagoon would be provided to store surface water runoff during periods when the outfall is surcharged by tide levels in the estuary. The pond would also act as a large petrol interceptor in that it has the ability to retain hydrocarbon spillages using baffle plates at the outfall.

Cross Flow Culverts

2.3.92 The culverts beneath the proposed motorway embankment with discernible catchments would be designed to cater for the 1 in 100 year storm event, including allowance for climate change.

2.3.93 The majority of the reens to be culverted have only a small catchment and therefore a box culvert, sufficient to cater for the flows and provide sufficient headroom for maintenance, would be provided. The culverts would be designed to allow the invert level to be placed at a minimum of 150 mm below the bed level of the reens being culverted. In addition, a minimum of 200 mm free board would be allowed above the summer penning level of the reens. Mammal crossings would be provided independently to the hydraulic culverts.

2.3.94 The crossflow culverts would generally be located perpendicular to the proposed new section of motorway, permitting the shortest length of culvert. This would also allow the existing flows in the reens to be maintained while the culvert is constructed off-line (see Appendix 3.1).

2.3.95 The primary culverts are shown in Table 2.4, with further details provided in Appendix 2.2.

2.3.96 In addition to the primary culverts, a number of small diameter culverts would be required. These include culverts for access tracks for water treatment areas, culverts to take runoff from cut off ditches, and to allow connectivity of field ditches. They would be pipes with a diameter of no more than 900 mm.

Reen Network

2.3.97 A Reen Mitigation Strategy has been produced and is provided at Appendix 2.3. The content of the Reen Mitigation Strategy has been discussed and agreed in principle with NRW.

The Existing Reen Network

2.3.98 The current reen system on the Caldicot and Wentlooge levels is a network of interconnecting watercourses (reens and field ditches), which feed into the Severn Estuary. As the area is below high tide, the reens serve as a storage facility when outfalls are tide locked. The water levels in the reens are controlled by a series of sluice structures. Maintenance of the reens is undertaken by NRW on a seven year cycle.

2.3.99 The water levels in the reens are divided into winter penning levels and summer penning levels. The winter penning level is the water level in the reen during winter, which is kept lower to provide additional storage capacity. The summer penning level is the water level during summer, which is kept higher to provide a water source for agricultural purposes. During extreme storm events it is possible for water levels to rise above these levels.

2.3.100 Reens typically have 1 in 1 side slopes, and vary in depth and width, typically 3 metres width at the top and 1 metre at the base. As the water levels are controlled by sluices there is typically very little flow and most of the reens have no recognisable catchment within the Flood Estimation Handbook (FEH) software.

2.3.101 Field ditches are smaller than the reens and are frequently dry. They commonly run along existing hedgerows on the edge of fields and connect to the reens.

Replacement Reens and Field Ditches

2.3.102 The proposed new section of motorway would cross reens and field ditches at a series of locations, which would be infilled. The estimated length of reens that would be infilled and culverted is approximately 2,570 metres. The estimated length of field ditch crossings that would be infilled as part of the Scheme is approximately 9,150 metres. Details are provided in Appendix 2.3.

2.3.103 In order to replace the loss in length of reen and field ditch, new reens would be provided along the north of the highway in areas in which existing reens are being infilled. These reens would be excavated to a depth of 2 metres with 1 in 1 side slopes, a 0.7 metre berm and a width of approximately 5.7 metres at the surface.

2.3.104 Replacement reens would generally be provided on the north side of the new section of motorway to provide improved connectivity with the cross flow culverts.

2.3.105 On the south side, smaller field ditches would be used to connect the existing field ditches to the nearest main reens. These would be 2.5 metres wide with 1 in 1 slopes and 1 metre deep. These would connect to the nearest main reens to provide connectivity and offset losses.

2.3.106 Figure 2.5 shows the current proposals for the reen mitigation. Reens and field ditches would be replaced at a ratio of greater than 1:1. It is proposed to provide 2,657 metres of new reen and 9,771 metres of new field ditches. Further details are provided in Appendix 2.3.

Fencing

2.3.107 Timber fencing would be provided at the highway boundary, typically including stock proof meshing. It is anticipated that fencing would also be provided to each water treatment area to prevent/restrict access to the ponds and lagoons.

2.3.108 As shown on the Environmental Masterplans (Figure 2.6), permanent mammal fencing would be provided along most of the length of the new section of motorway, other than the elevated section through Newport Docks and the viaduct to the east of the River Usk, where fencing would not be necessary.

Signage and Communications

2.3.109 The proposed new section of motorway would incorporate signage in relation to junctions, destinations, service areas and diversion routes, where appropriate, In addition, a number of tourist destinations would be signed from the existing M4 and proposed new section of motorway. Both verge and gantry mounted signs would be used, the locations of which are shown on Figure 2.4.

2.3.110 The new section of motorway would incorporate an Intelligent Transport System (ITS) including, for example, variable message signing, radar vehicle detection and weather detection equipment.

Utilities

2.3.111 At a number of locations along the route of the proposed new section of motorway, the alignment has been constrained by existing National Grid high voltage overhead power lines. The design has taken into account the required horizontal and vertical clearances to avoid the need for diversions of National Grid infrastructure.

2.3.112 With respect to other utilities, a range of protection and below ground diversion works would be required during the construction phase. Details are provided in Chapter 3 of this ES.

2.3.113 In addition, a number of permanent above ground works would be required, including the following.

- Diversion of existing 132 kV power line to accommodate Lighthouse Road Overbridge (ch 7,290-7,700). The existing pylon conflicts with location of the proposed overbridge.
- Existing 132 kV overhead lines to be diverted underground to accommodate the eastern approach for the River Usk Crossing (ch 10,900-11,550). New pylons to be provided.
- Existing towers carrying 132 kV overhead line to be extended to provide sufficient clearance (ch 12,000 and 12,300).
- Provision of new tower carrying 132 kV overhead line due to conflict between existing tower and proposed new section of motorway (ch 12,650).
- Provision of new towers carrying 132 kV overhead line to provide sufficient clearance (ch 19,600).
- Diversion of 11 kV overhead lines at locations along alignment of new section of motorway and relocation of existing substation at Wilcrick Depot.

2.3.114 The existing 'clean' and 'dirty' ditches, forming part of the existing drainage system for the Tata Steelworks site, would be diverted to accommodate the new section of motorway.

Long Term Management

2.3.115 On completion of the construction phase, there would be a five year aftercare period in order to ensure the establishment of the landscape and ecological elements. The environmental requirements for this period would be implemented through an Environmental, Landscape and Ecology Aftercare Plan as set out in Chapter 18 of this ES. During this post-construction period, the Joint Venture team would review the effectiveness of the environmental mitigation against the intended function and provide any remedial actions required.

2.3.116 At completion of the five year period, the management of the soft estate and environmental mitigation measures would be transferred to the South Wales Trunk Road Agency.

2.3.117 The new Glan Llyn highway depot would be in place prior to completion of the construction phase for the new section of motorway (in order to allow for demolition of the existing Wilcrick Maintenance Depot). It is anticipated that the facilities associated with the River Usk Crossing would be provided after completion of construction in 2021.

2.3.118 On completion of construction, the carriageway and the slip roads at the junctions would be owned and maintained by the Welsh Government, whilst the local connector roads would be adopted by the local highway authorities - Newport City Council or Monmouthshire County Council as appropriate.

2.3.119 General inspections and maintenance of the motorway, structures, highway drainage, water treatment areas and landscape/soft estate areas would be undertaken on a regular basis in accordance with the Design Manual for Roads and Bridges (DMRB) and maintenance manuals. More detailed maintenance would be undertaken as and when required. The inspections and maintenance on and adjacent to the motorway may involve traffic management for access and to ensure the safety of the workforce. Water treatment areas and reed beds would be accessed from the local side roads. Specific laybys would be provided for access to maintain the Intelligent Transport System.

2.3.120 Side roads would be adopted by the relevant local highway authority and maintenance would form part of their general regime. This may involve traffic management to ensure the safety of the workforce.

2.3.121 The existing and replacement reens and field ditches would be maintained on a regular basis. This would involve clearing out debris that has built up within the reens and field ditches bi-annually. Access would be provided from side roads to existing or new access routes adjacent to the reen network.

2.4 Complementary Measures

2.4.1 In addition to the new section of motorway, the Scheme would incorporate Complementary Measures, including the following.

- Improvements to safety, access arrangements and the ability to manage traffic by reclassifying the existing M4 between Magor and Castleton as a trunk road.
- Relief to Junction 23A of the existing M4 and the local road network with a new M4/M48/B4245 connection (described within Section 2.3 above).
- Provision of cycle and walking friendly infrastructure.

2.4.2 Reclassification of the existing M4 around Newport as a trunk road, or 'A' road, would allow changes to be made to traffic management, safety and revised access arrangements.

2.4.3 Reclassification would include works to re-open the west facing slip roads of Junction 25 (Caerleon), improving access to Caerleon and St. Julian's areas along the northern fringe of Newport.

2.4.4 The existing Variable Speed Limit would continue to operate along the existing M4 between Junction 24 (Coldra) and Junction 28 (Tredegar), but with a maximum speed limit of 60 miles per hour imposed at the Brynglas Tunnels.

2.4.5 The existing number and widths of lanes would be maintained, with the exception of the following.

- From Junction 23A to Junction 24 the cross section would be reduced to two lanes in both directions. The existing Lane 1 and hard shoulder would be hatched out of use by road markings.
- From Junction 24 to Junction 25, the cross section on the westbound carriageway would be reduced to two running lanes. The existing Lane 1 would be hatched out of use by road markings. The eastbound carriageway would have three lanes to accommodate climbing vehicles on the steep gradient of St Julian's Hill.
- Through Junction 28, the cross section would be reduced to two lanes in both directions. The existing Lane 1 and hard shoulder would be hatched out of use by road markings.

2.4.6 The two lane sections would take the form of a dual carriageway, with two lanes in each direction. In addition, there would be a hard shoulder in each direction of 3.3 metres width. Safety barriers would be provided on either side of the road and in the central reserve.

2.4.7 Some works would be required to the existing diverge and merge slips to accommodate the predicted changes in traffic flow. Such works would generally be located within the existing built footprint.

2.4.8 The east facing connections from Junction 25A to the M4 would be closed and traffic would be routed through Junction 25 to join/leave the motorway via the east facing slip roads of Junction 25. The westbound diverge slip road for Junction 25 would be widened (within the highway boundary) to provide additional capacity, via a new retaining wall built within the footprint of the existing motorway.

2.4.9 On the western side, new connecting slip roads would be constructed between the Junction 25-25A link roads and the motorway. These new slip roads would allow eastbound traffic using the existing motorway to access Junction 25 and

Caerleon Road and would allow westbound access to the existing motorway from Junction 25 and Caerleon Road. The slip roads and link roads would continue to be subject to a 40 mph speed limit. The circulatory carriageway of Junction 25 would be signalised at all entries.

2.4.10 The reclassification of the existing M4 would require changes in the signage strategy, including the removal and/or replacement of existing signs.

2.5 Scheme Land Take

2.5.1 As set out in Section 2.3, a number of existing properties would require demolition to accommodate the proposed new section of motorway. In addition, land would be required along the new section of motorway for junctions, works to local highways, rights of way, means of access and water treatment areas. Details of existing land uses and effects arising from the proposed new section of motorway are set out in the topic chapters of this ES, particularly Chapters 8, 9, 10, 11, 15 and 16.

2.5.2 As set out in Section 2.4, some works would be required to existing slip roads as part of the reclassification of the existing M4. However, such works would be generally undertaken within the existing highway corridor and would not require land take from other uses.

2.5.3 Figure 2.16 indicates the total permanent land take required. Further details of temporary land take required during the construction phase are provided in Chapter 3 of this ES.

2.6 Traffic Flows

2.6.1 Table 2.9 below provides a summary of the total (all vehicles) existing and predicted traffic flows on the new section of motorway and the reclassified M4 in the base year (2014), the Opening Year (2022) and the Design Year (2037).

2.6.2 Table 2.10 provides a summary of the existing and predicted flows of heavy goods vehicles only on the new section of motorway and the reclassified M4 in the base year (2014), the Opening Year (2022) and the Design Year (2037).

2.6.3 Further details of traffic flows are provided in Appendix 2.1 and in the Traffic Forecasting Report.

Table 2.9: Forecast Annual Average Daily Traffic (AADT) Flows with New Section of Motorway open (All Vehicles)

Location	Direction	Base Year: 2014	Opening Year: 2022		Difference from Do Minimum	Design Year: 2037		Difference from Do MInimum
			Do Minimum	Do Something		Do Minimum	Do Something	
Junction 29-28	Eastbound	52,900	62,600	38,200	-39%	70,200	43,100	-39%
	Westbound	51,900	61,500	35,000	-43%	69,100	41,000	-41%
Junction 28-27	Eastbound	50,700	58,300	37,900	-35%	65,700	44,500	-32%
	Westbound	52,400	58,200	36,600	-37%	65,200	42,900	-34%
Junction 27-26	Eastbound	50,200	58,600	38,300	-35%	66,400	45,800	-31%
	Westbound	52,500	59,800	39,300	-34%	66,100	45,500	-31%
Junction 26-25A	Eastbound	33,800	39,800	25,400	-36%	45,600	32,100	-30%
	Westbound	34,600	39,900	23,400	-41%	45,800	29,500	-36%
Junction 25A-25	Eastbound	43,200	50,900	18,000	-65%	59,600	23,900	-60%
	Westbound	43,700	51,600	18,000	-65%	59,000	23,000	-61%
Junction 25-24	Eastbound	46,700	55,900	29,700	-47%	65,500	37,400	-43%
	Westbound	46,700	55,600	30,600	-45%	64,000	37,100	-42%
Junction 24-23A	Eastbound	36,600	45,300	17,400	-62%	51,500	22,400	-57%
	Westbound	36,600	47,100	21,800	-54%	54,700	25,700	-53%
Junction 23A-23	Eastbound	34,600	43,400	15,200	-65%	51,700	19,200	-63%
	Westbound	34,200	44,900	20,600	-54%	52,500	24,200	-54%
New section of motorway (Junction 29 to Docks Way Junction	Eastbound	N/A	N/A	26,400	N/A	N/A	31,800	N/A
	Westbound	N/A	N/A	28,400	N/A	N/A	33,700	N/A
New section of motorway (Docks Way Junction to Glan Llyn Junction)	Eastbound	N/A	N/A	28,800	N/A	N/A	35,800	N/A
	Westbound	N/A	N/A	28,500	N/A	N/A	35,200	N/A
New section of motorway (Glan Llyn Junction to Junction 23A)	Eastbound	N/A	N/A	29,700	N/A	N/A	36,900	N/A
	Westbound	N/A	N/A	26,800	N/A	N/A	32,700	N/A

Note: Figures rounded up or down to nearest 100 vehicles

Table 2.10: Forecast Annual Average Daily Traffic (AADT) Flows with New Section of Motorway open (HGVs)

Location	Direction	Base Year: 2014	Opening Year: 2022		Difference	Design Year: 2037		Difference
			Do minimum	Do Something		Do minimum	Do something	
Junction 29-28	Eastbound	5600	6260	2580	-59%	6310	2450	-61%
	Westbound	5270	5830	2210	-62%	5940	2360	-60%
Junction 28-27	Eastbound	5130	5600	1970	-65%	5600	1980	-65%
	Westbound	4940	5480	1800	-67%	5470	1940	-65%
Junction 27-26	Eastbound	5150	5630	1980	-65%	5650	2050	-64%
	Westbound	5000	5570	1920	-66%	5600	2130	-62%
Junction 26-25A	Eastbound	4560	5040	1580	-69%	5060	1680	-67%
	Westbound	4370	4960	1460	-71%	5070	1680	-67%
Junction 25A-25	Eastbound	5520	6120	1410	-77%	6110	1500	-75%
	Westbound	5280	6030	1260	-79%	6180	1480	-76%
Junction 25-24	Eastbound	5570	6180	2440	-60%	6190	2520	-59%
	Westbound	5310	6060	2330	-62%	6230	2560	-59%
Junction 24-23A	Eastbound	4920	5350	1550	-71%	5080	1410	-72%
	Westbound	4330	5490	1680	-69%	5360	1600	-70%
Junction 23A-23	Eastbound	5210	6410	2510	-61%	6540	2690	-59%
	Westbound	4620	6570	2710	-59%	6700	2900	-57%
New section of motorway (Junction 29 to Docks Way Junction	Eastbound	N/A	N/A	3750	N/A	N/A	3950	N/A
	Westbound	N/A	N/A	3770	N/A	N/A	3760	N/A
New section of motorway (Docks Way Junction to Glan Llyn Junction)	Eastbound	N/A	N/A	4390	N/A	N/A	4470	N/A
	Westbound	N/A	N/A	4320	N/A	N/A	4330	N/A
New section of motorway (Glan Llyn Junction to Junction 23A)	Eastbound	N/A	N/A	3940	N/A	N/A	3930	N/A
	Westbound	N/A	N/A	3870	N/A	N/A	3880	N/A

Note: Figures rounded up or down to nearest 10 vehicles

2.7 Sustainability and Carbon Accounting

2.7.1 A Carbon Assessment Report has been produced for the Scheme (see Appendix 2.4), providing an assessment of the carbon emissions associated with the construction and operational use of the Scheme.

2.7.2 The total user carbon emissions on the South Wales network would reduce (albeit by a negligible amount - less than 1%) with the Scheme, even though the number of vehicle trips would increase. This is due to reduction of the 'stop-start' traffic and smoother, more efficient traffic flow.

2.7.3 The South Wales road network contributes 4.3% of the total carbon emissions in Wales each year. The emissions from the construction of the Scheme would be 522,500 tonnes of carbon dioxide equivalent, which would be a small fraction (1%) of the total emissions by 2037. The annual emissions on the existing South Wales network would be 2,277,300 tonnes of carbon dioxide equivalent in 2022 and the introduction of the Scheme would reduce this by less than 1%. This means that the total user carbon emissions on the network from 2022 to 2037 would be 73,000 tonnes of carbon dioxide equivalent less than the predicted future emissions on the existing network.

2.7.4 A separate Sustainable Development Report has been produced for the Scheme. This considers the Scheme against the well-being goals identified in the Well-being of Future Generations Act 2015.

2.7.5 The Sustainable Development Report demonstrates that there are opportunities to improve the economic prosperity of the region as a result of the Scheme, as well as to help create a healthier and more cohesive community. During construction, the Scheme would include measures to ensure the efficient use of resources and would provide employment opportunities, including commitments to employ local workers. Details of the construction process, including the approach to sustainable construction, are provided in Chapter 3 of this ES.

2.8 Use of Natural Resources

2.8.1 The EIA Directive refers to the use of land, soil and biodiversity resources. The Scheme would result in permanent land take. Effects associated with this land take on biodiversity, land and soil resources are set out in Chapters 10, 11 and 15 of this ES.

2.8.2 Information relating to the construction phase is provided in Chapter 3 of this ES.

2.9 Residues and Emissions

2.9.1 Operation of the new section of motorway would result in runoff from the road surface. Details of the proposed drainage strategy are provided in Section 2.3 above. Further details of the effects associated with residues and emissions in relation to land and water are provided in Chapters 11 and 16 respectively of this ES.

2.9.2 Details of air, noise and vibration emissions arising from traffic using the new section of motorway are provided in Chapters 7 and 13 respectively of this ES.

2.9.3 Details of lighting for the new section of motorway are provided within this chapter (see below) and considered within Chapters 9 and 10, where relevant. As set out in Chapter 5 of this ES, the project is not likely to give rise to heat or radiation emissions during its operational phase.

2.9.4 Details of the construction process, including the approach to sustainable construction, details of the materials required and details of likely waste arising during construction are provided in Chapter 3 of this ES.

2.10 Environmental Design Principles

2.10.1 The environmental design principles for the Scheme reflect the environmental context and key requirements of the environmental drivers for integration and include the following.

- Providing appropriate visual, landscape, ecological and environmental mitigation whilst minimising land take and impact on the areas of Sites of Special Scientific Interest and Special Area of Conservation.
- Retaining as much existing maturing vegetation as possible.
- Establishing new planting to screen and integrate the Scheme into the surrounding landscape whilst retaining cohesion with retained landscape features.
- Maintaining the quality of views to and from surrounding receptors.
- Creating cohesive connectivity north and south of the Scheme for ecology and landscape character through design and planting methods.
- Introducing innovative landscape planting to conserve and enhance areas with specific landscape/ecological importance providing a sustainable and future focussed solution.
- Using new planting to integrate the scale, layout, form and massing of the Scheme, to reduce the scale of earthworks and filter views of the Scheme, and to reinforce existing planting.
- Using locally indigenous local plants and species rich grass on embankments and in landscape areas to reflect the distinct local character and to link the Scheme design to existing features – providing physical connectivity e.g. habitat and wildlife corridors and visual continuity.
- Using habitat creation to offset habitat loss and nature conservation value – integrating the Scheme into the distinct landscape enhancing the appearance and ecology of new drainage ditches and reens with marginal planting and planting reed beds in balancing ponds and attenuation areas.
- Using lighting with low spillage and careful consideration given to the design and siting of road signs, traffic signals, environmental barriers and other street furniture.
- Improving cycle and pedestrian approaches along the Scheme as well as the interface at junctions and crossings, providing opportunity to create potential ‘gateways’ to Newport.

2.10.2 Further explanation of the environmental design principles is set out in Chapter 9 (Landscape and Visual Effects).

Landscape Design

2.10.3 The following Landscape Design Objectives have informed the Environmental Design.

- Avoid, then minimise and mitigate adverse effects of the Scheme upon designated sites and features and, where necessary, provide exchange land.
- Where practicable, conserve and enhance the environment through which the Scheme passes.
- Reflect the landscape character through which the Scheme passes including land use, topography, heritage and landscape pattern.
- Respect the landscape, biodiversity and cultural heritage resource, in particular the Gwent Levels.
- Increase areas of Biodiversity Action Plan habitats.
- Maintain the connectivity of existing networks for non-motorised users.
- Maximise the positive aspects of the Scheme and its surroundings through creative design and use of local materials, including planting. This would enhance the local sense of place and historic character, with emphasis on environmental quality and sustainability.
- Reflect existing landscape character and retain existing features. Creating opportunities to improve landscape character through an integrated approach to mitigation providing adequate land for tree planting.
- Give careful consideration to the location and design of lighting to minimise impacts at both day and night.
- Give careful consideration to the design and integration of new structures into a sensitive landscape throughout the design process with careful selection of materials and planting treatments
- Where possible create essential features to support the Scheme in areas where they have least impact on designated landscapes and minimise physical intrusion on the landscape.
- Re-use and enhance existing ditches and reens whilst maintaining functionality and connectivity.
- Create a sustainable and future focused proposal to support the growing needs of South Wales and its infrastructure.

River Usk Crossing Design

2.10.4 The following constraints have influenced the design of the River Usk Crossing and/or restrict the area and timing where work can take place.

- No works in the wetted channel (marked by the mean high water mark coincident with an elevation of 4.79 metres AOD).
- No works in the no entry zone at the PCB cell on the east side.
- Existing hydrogen/oxygen pipes on Solutia land, near the new structure.
- Constraints associated with Network Rail when working next to/above the Uskmouth railway line.

- Seasonal constraints associated with underwater noise impacts on fish migration (see Appendix 3.1 and Chapter 10: Ecology and Nature Conservation).

Consultation on Design

2.10.5 The Design Commission for Wales promote the importance of good design for the built environment across all sectors, including infrastructure. The Design Commission reviewed the Scheme in June and October 2015 having been consulted on it previously in 2007 and 2008.

2.10.6 With regard to the River Usk Crossing, the Commission commented that the design concept was '*elegant and well-considered'*. Further commentary from the Commission is reviewed in Chapter 9: Landscape and Visual Effects.

2.11 Environmental Measures Forming Part of the Scheme (Embedded Mitigation)

2.11.1 A range of environmental design measures are included as part of the new section of motorway. These are known as embedded mitigation and are described below. Key features are shown on Figure 2.6. A summary of the key measures is provided below, with further details provided in Chapters 7 to 16 of this ES.

Ecology and Nature Conservation

2.11.2 Welsh Government have a duty under Section 28G of the Wildlife and Countryside Act 1981 (as amended) to '*take reasonable steps, consistent with the proper exercise of the authority's functions, to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which the site is of special scientific interest*'. To comply with that duty the following elements have been integrated into the highway and engineering design of the Scheme.

Avoidance

2.11.3 Measures to avoid adverse effects that are intrinsic to the design include the following.

- No construction in the wetted channels of the Rivers Usk and Ebbw.
- Minimising land take within the Gwent Levels Sites of Special Scientific Interest and, where practical, avoiding land take to the south of the line of the new section of motorway.

Reduction

2.11.4 Measures to reduce adverse effects that are integral to the design include the following.

- Provision of water treatment areas to control the volume and quality of water discharged to the reen system.
- Maintaining all existing reen connections across the line of the new road.
- Provision of permanent mammal fencing along the new road.

- Avoidance of lighting other than at junctions and the river crossings.

Offsetting

2.11.5 Measures to offset adverse effects that are integral to the design include the following.

- Replacement of reens at a ratio of greater than 1:1.
- Replacement of field ditches at a ratio of greater than 1:1.
- Landscape/habitat provision as shown on the Environmental Masterplans (see Figure 2.6).
- Replacement of saltmarsh.

The Water Environment

2.11.6 As set out in Section 2.3 and Appendix 2.2, the proposed new section of motorway would include a drainage strategy. This would incorporate pollution control measures, culverts, reen bridges and replacement reens and field ditches. Crossings would be provided for each main reen in order to maintain connectivity within the reen system. Details are provided in Tables 2.3 and 2.4.

2.11.7 The network of new reens, ditches and culverts would capture overland water flow and route these flows to culverts and reen bridges beneath the embankment of the new section of motorway.

2.11.8 The total length of replacement reens and field ditches would be greater than the length of reens and field ditches to be lost as a result of the new section of motorway. Details of the reen mitigation strategy are provided in Appendix 2.3.

Public Rights of Way

2.11.9 As set out in Section 2.3, a number of diversions for existing public rights of way are proposed as part of the Scheme. The diversion routes affecting the Wales Coast Path have been developed in consultation with Newport City Council and NRW.

2.11.10 In addition to these existing resources, five new public bridleways would be created as part of the new section of motorway, which would also be available for use by cyclists. One of these would run eastwards along Rush Wall from North Row to the south of the new carriageway, linking to the existing alignment of Barecroft Common, along an alignment discussed with Newport City Council and Sustrans. This cycleway route would provide an off-road link between National Cycle Network Route 4 at North Row and Magor in accordance with the requirements of the Active Travel Act to enhance the provision for walkers and cyclists.

Lighting

2.11.11 The proposed new section of motorway would generally be unlit, except at junctions. Lighting is proposed at the following locations.

- On the approaches to and throughout the Castleton Interchange.
- On the approaches to the Docks Way Junction and over the full extent of the River Usk Crossing.

- On the approaches to and throughout the Glan Llyn Junction and on the new link road connecting the new section of motorway with the A4810 and the A4810 junction and approaches.
- On the approaches to and throughout the Magor Interchange.

2.11.12 Lighting columns are anticipated to be aluminium and to generally have the following characteristics.

- 15 metres high along the mainline of the new section of motorway, mounted in the verge in an opposite arrangement.
- 12 metres high along slip roads, mounted in a single sided arrangement.
- 12 metres high on the River Usk Crossing.

2.11.13 Luminaires would be designed to emit no light above the horizontal level. LED luminaires are proposed as these can be aimed more precisely, reducing light spill.

Noise

2.11.14 The following measures are integral to the design of the new section of motorway.

- A thin surface course system would be used as the new asphalt highway surface for the carriageway, slip roads and side roads. This would provide up to 3.5 db(A) attenuation.
- Apart from at tie-ins, existing roads including the existing motorway at Magor would not be resurfaced.
- The pre-cast concrete step barriers in the central reserve would provide acoustic attenuation.

2.11.15 It should noted that safety barriers along the highway verge would be of the open steel Armco type and would not provide acoustic attenuation.

2.12 Additional Mitigation

2.12.1 In addition to the embedded mitigation set out above, the following mitigation is proposed. Further details are provided in Chapters 7 to 16 of this ES.

Ecology

2.12.2 The following measures are proposed to further reduce effects on ecology and nature conservation.

Reduction

- Design of lighting of the River Usk and River Ebbw crossings to avoid lighting of the river channels and banks.
- Minimise light spill through lighting design.
- Provision of mammal crossings at suitable locations across the line of the road.
- Provision of mammal tunnels adjacent to all reen culverts.

- Design of planting to guide bats to culverts.
- Provision of eel passes on all new sluices.
- Use of plant material from existing reens and ditches to encourage colonisation of new reens and ditches by aquatic macrophytes.

Offsetting

- Ecological enhancement of land (e.g. recutting of former ditches, removal of hedgerows, reseeding grassland) at Maerdy Farm, Tatton Farm and Caldicot Moor.
- Provision of three replacement badger setts.
- Provision of bat barn north of Magor.
- Use of woodland soils and rootstocks in new planting areas.
- Provision of bat boxes.
- Investigate the potential for translocation of waxcap turf.

Noise

2.12.3 The following acoustic barriers are proposed as additional mitigation for residents.

- At Magor, a 2 metre high acoustic barrier would be provided on the east side of the westbound carriageway between ch 20,700 and ch 21,800 (1,100 metres), and between ch 19,600 and ch 20,350 (750 metres)
- Opposite Duffryn, a 2 metre high acoustic barrier would be provided on the north side of the eastbound carriageway to the west of Lighthouse Road between ch 5,690 and ch 7,360 (1,670 metres).
- Opposite Duffryn, a 2 metre high acoustic barrier would be provided on the north side of the eastbound carriageway to the east of Lighthouse Road between ch 7,400 and ch 7,920 (520 metres).