

## **A38 Derby Junctions**

**TR010022**

**Volume 6**

### **6.3 Environmental Statement Appendices**

#### **Appendix 13.4: Road Drainage Strategy**

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed  
Forms and Procedure) Regulations 2009

April 2019

## Infrastructure Planning

### Planning Act 2008

#### **The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

### A38 Derby Junctions Development Consent Order 202[ ]

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#### **6.3 Environmental Statement Appendices Appendix 13.4: Road Drainage Strategy**

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# **A38 Derby Junctions**

## **DCO Road Drainage Strategy**

**Report Number: HE514503-ACM-HDG-A38\_SW\_PR\_ZZ-RP-CD-0002 P03 S4**  
**March 2019**

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## **1. INTRODUCTION**

### **1.1 Purpose of this report**

- 1.1.1 A drainage strategy and preliminary drainage design have been developed in conjunction to support the application for the Development Consent Order (DCO) for the A38 Derby Junctions scheme (referred to herein as 'the Scheme').
- 1.1.2 This strategy supersedes Report No: 47071319-URS-06-RP-RD-006-2F. This report is based on the information received to date (e.g. topographical survey, as built drawings, Highways England's Drainage Data Management System (HADDMS)). The principles and main criteria used in the preliminary drainage design of each of the grade separated junctions, namely; Kingsway, Markeaton and Little Eaton junctions are outlined separately.
- 1.1.3 The purpose of the drainage strategy is to outline the methodology proposed to mitigate significant impacts upon the water environment from the Scheme with regard to routine highway runoff.
- 1.1.4 This report describes the various drainage concepts identified for each junction. The concepts include proposed indicative embedded mitigation measures which have been developed through close coordination with the geoenvironmental, flood risk and water quality disciplines to provide an integrated approach.
- 1.1.5 The Outline Environmental Management Plan (OEMP) includes details of measures to protect the water environment during construction of the Scheme and thus construction issues are not considered herein.

### **1.2 Background**

- 1.1.6 The existing A38 is predominantly drained by gullies which discharge directly to carrier pipes/ filter drains or road side ditches. These convey the unattenuated runoff to existing outfalls into watercourses.
- 1.1.7 Consultation with the following parties has informed the drainage strategy and the choice of features included within the preliminary drainage design:

#### **Highways England**

Highways England is the maintaining authority for the A38.

#### **Derby City Council**

Derby City Council (DCiC) is the Lead Local Flood Authority (LLFA) and the internal drainage board (IDB). DCiC is the local council and would be taking ownership and maintenance responsibility for all drainage assets within their authority. This primarily affects Kingsway and Markeaton junctions.

#### **Derbyshire County Council**

Derbyshire County Council (DCC) would be taking ownership and maintenance responsibilities for a proposed highway runoff attenuation pond at Little Eaton junction.

#### **Severn Trent Water**

Severn Trent Water (STW) is responsible for the water main, combined sewer overflow and foul network within the Scheme boundary.

### **Environment Agency**

The Environment Agency was created under the Environment Act 1995 to regulate and police the water environment in England and Wales and dispatches the powers bestowed on the public body under various legislation - namely the Water Resources Act 1991, the Land Drainage Act 1991, the Water Act 1989, the Control of Pollution Act 1989 and the Environmental Protection Act 1990.

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## **2. DRAINAGE STRATEGY OVERVIEW**

### **2.1 Preliminary design**

- 2.1.1 The preliminary drainage design has been undertaken to develop a conceptual design to demonstrate the viability of the Scheme in respect of surface water management and treatment of runoff.
- 2.1.2 The significant drainage features are shown on the General Arrangement Scheme Layout Plans [TR010022/APP/2.5] as well as on the Environmental Masterplans presented in the Environmental Statement (ES) (refer to Figures 2.12a to 2.12i in ES Volume 2 [TR010022/APP/6.2]. The key drainage features included in the Scheme design are also shown in Figures 2.2 to 2.4.

### **2.2 Technical standards**

- 2.2.1 The preliminary drainage design to support the development of the drainage strategy has been undertaken in accordance with the following requirements and advice documents:

Design Manual for Roads and Bridges (DMRB):

- HD 33/16 Design of Highway Drainage Systems.
- HA 37/17 Hydraulic Design of Road-Edge Surface Water Channels.
- HA 39/98 Edge of Pavement Details.
- HA 40/01 Determination of Pipe Bedding Combinations for Drainage Works.
- HA 41/17 A Permeameter for Road Drainage Layers.
- HD 49/16 Highway Drainage Design Principal Requirements.
- HD 45/09 Road Drainage and the Water Environment.
- HA 78/96 Design of Outfalls for Surface Water Channels.
- HA 79/97 Edge of Pavement Details for Porous Asphalt Surface Courses.
- HA 83/99 Safety Aspects of Road Edge Drainage Features.
- HA 102/17 Spacing of Road Gullies.
- HA 104/09 Chamber Tops and Gully Tops for Road Drainage and Services: Installation and Maintenance.
- HA 219/09 Determination of Pipe Roughness and Assessment of Sediment Deposition to Aid Pipeline Design.
- HA 103/06 Vegetated Drainage Systems for Highway Runoff.
- The SuDS Manual 2015, CIRIA C753.

### **2.3 Catchments**

- 2.3.1 The Scheme comprises of three distinct drainage sections; Kingsway junction, Markeaton junction (including Kedleston junction) and Little Eaton junction (refer to Figure 2.1). It is proposed that with the Scheme, each of these drainage sections would use different sustainable drainage features to treat and attenuate the highway

runoff prior to discharge. The drainage approach for each junction is described in Sections 3 to 5.



**Figure 2.1: A38 drainage sections**

2.3.2 The preliminary design drainage catchments for each sector are shown in Figures 2.2 to 2.4.



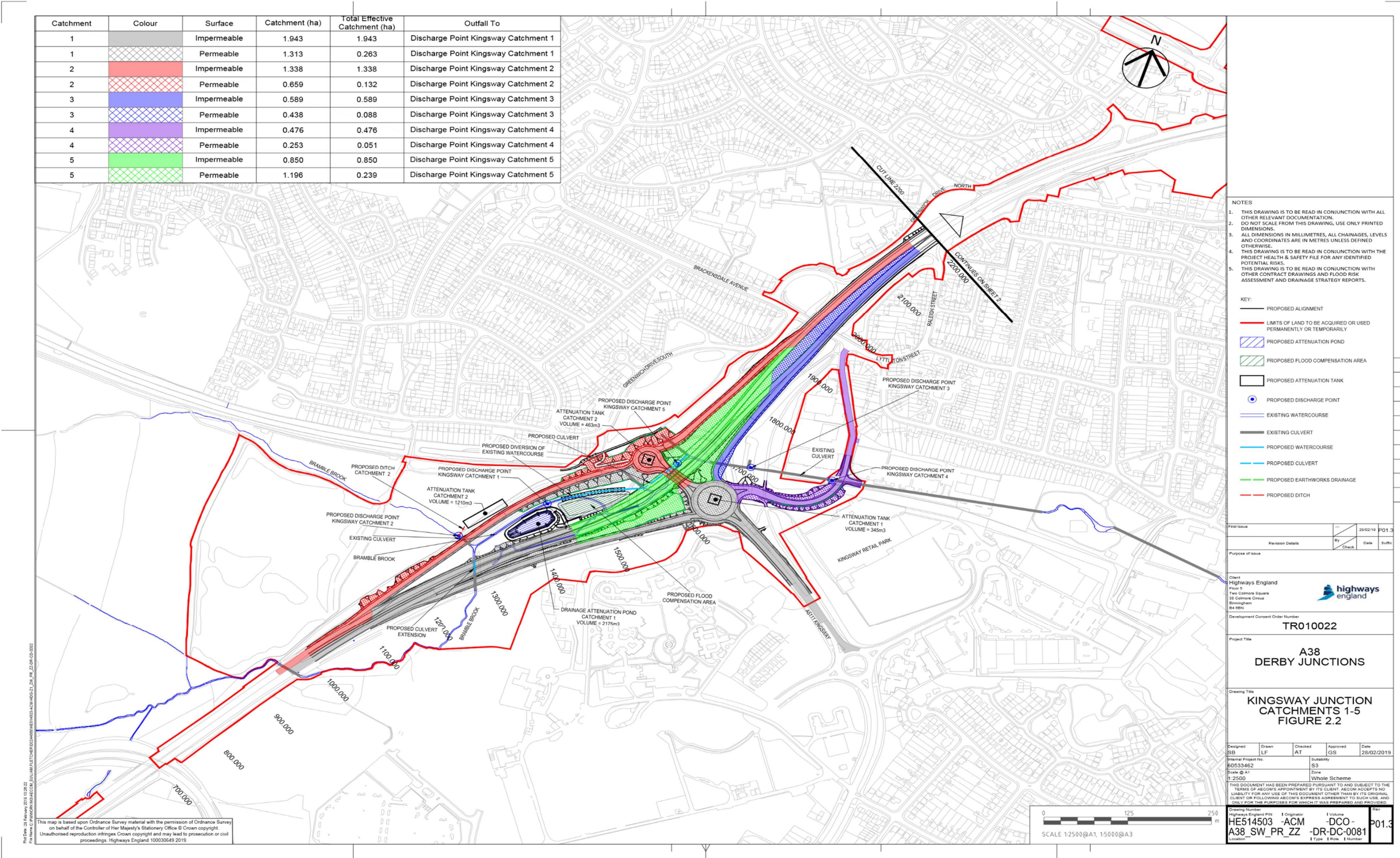


Figure 2.2 – Preliminary Design Drainage Catchment – Kingsway



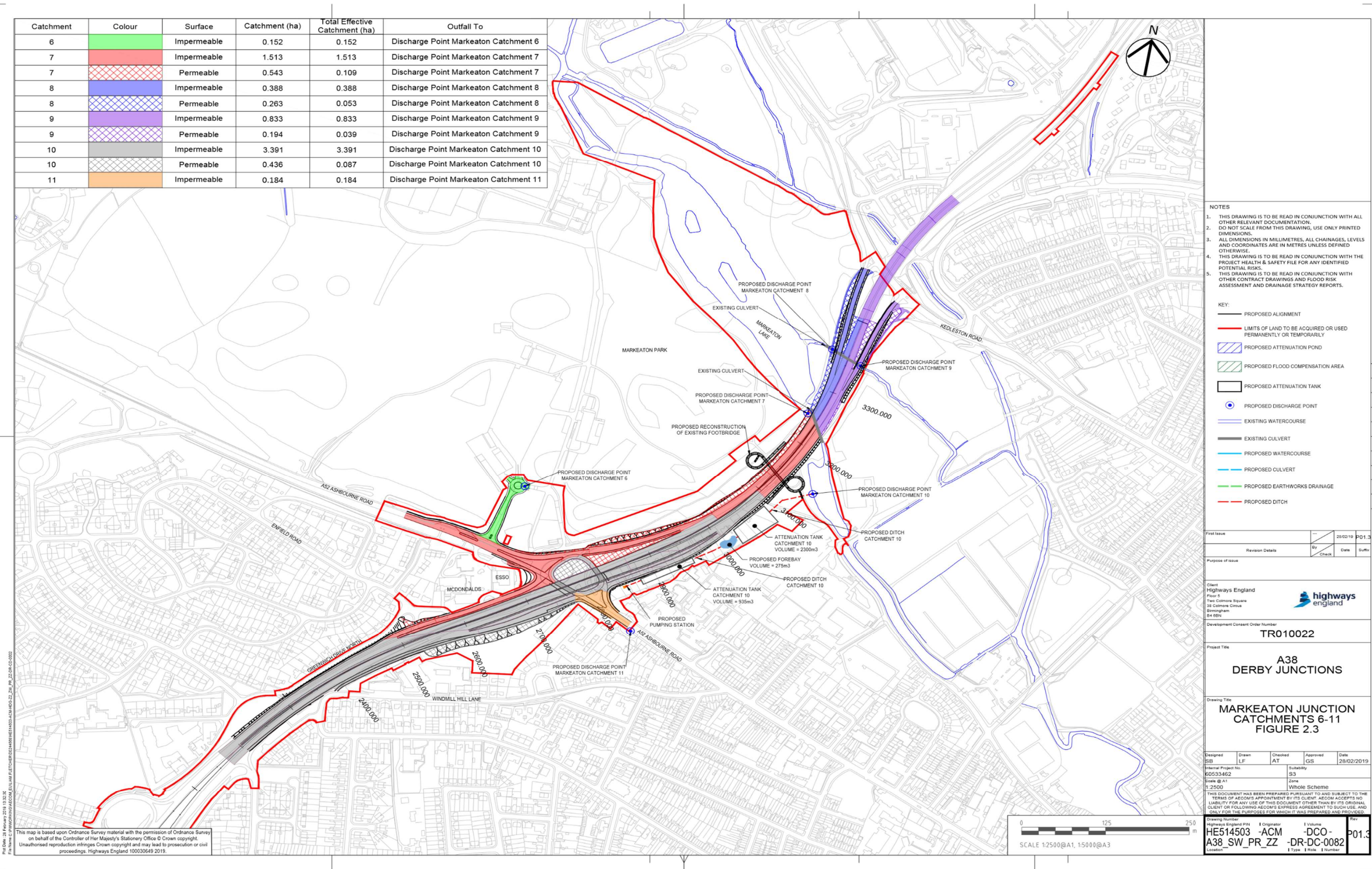


Figure 2.3 - Preliminary Design Drainage Catchment - Markeaton





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## 2.4 Hydrology and Geology

### Kingsway junction

- 2.4.1 The ground conditions near the junction comprise of topsoil and Made Ground underlain by rocks of the Mercia Mudstone Group. A strip of Alluvium is indicated running south-west to north-east through the junction.
- 2.4.2 Geotechnical investigations undertaken between November 2016 and October 2017 indicated average groundwater depths at the monitoring locations ranged from approximately 3.9 to 7.4 m below ground level (bgl) within Made Ground (historic landfill) and 2.5 to 12.3 m bgl within the natural strata (refer to Appendix 10.1 within ES Volume 3 [TR010022/APP/6.3]). Variation in groundwater level within the monitoring installations has been approximately 1m on average across the Kingsway Junction area.
- 2.4.3 Overall, the preliminary design invert levels are designed to be above the anticipated groundwater level. Borehole Kingsway (BK) 11 is near where attenuation is provided for Catchment 2 and has an average monitored groundwater level of 70.54m AoD (Above Ordnance Datum). Consequently, the attenuation tank and ditch would be lined to avoid seepage into the underlying strata. The slip road is at approximately 72.50m AoD.
- 2.4.4 The geotechnical investigations results indicate low permeability; consequently, infiltration to ground has been discounted as a drainage option.

### Markeaton junction

- 2.4.5 The ground conditions near the junction comprise of topsoil, overlying Made Ground, both underlain by rocks of the Mercia Mudstone Group.
- 2.4.6 Past borehole records indicated the groundwater level to be present between approximately 2.5m and 6.0m bgl near the junction at the time of the investigations.
- 2.4.7 Geotechnical investigations undertaken between November 2016 and October 2017 and from December 2017 to April 2018 encountered groundwater at depths of around 2.5 to 3.5 m near the junction and at a greater depth of 9m to the south, possibly within semi-confining layers of the Mercia Mudstone Group material. To the north-east of the junction, near Markeaton Lake, shallower groundwater depths of 1 to 3 m bgl were encountered within the River Terrace and Alluvium deposits.
- 2.4.8 The preliminary design invert levels of the highway drainage carrier and attenuation features are designed to be above the anticipated groundwater level.
- 2.4.9 The average groundwater level from exploratory hole locations screened are:
- River Terrace Sand and Gravel ranged between 1.09 m bgl and 2.15 m bgl (56.51 and 57.58 m AOD).
  - Mercia Mudstone - between 2.66 m bgl and 10.44 m bgl (66.83 – 58.47 m AOD), according to monitoring data.
- 2.4.10 The mainline starts at approximately 81.30m AoD and progresses north-easterly to a low point of the mainline of approximately 53.30m AoD before rising again to approximately 56.5m AoD.

- 2.4.11 The results of the geotechnical investigation indicate low permeability; consequently, infiltration to ground has been discounted as a drainage option.

**Little Eaton junction**

- 2.4.12 The ground conditions near the junction comprise of topsoil and Made Ground overlying Alluvium, underlain by rocks of the Millstone Grit Group.
- 2.4.13 The Made Ground primarily comprises embankment fill of the current road construction.
- 2.4.14 The Alluvium comprises a soft to firm silt and clay component to a thickness of up to 2.6m.
- 2.4.15 The Millstone Grit Group materials encountered predominantly comprise fissured or laminated hard mudstone overlain further north by very weak siltstone. Typically, weak Sandstone was also recorded to the north of the junction. The materials are typically weathered near to the surface to firm clay and silt or sandy clay.
- 2.4.16 Past borehole records indicate standing groundwater level ranged between 0.5m and 2.5m bgl at the time of the investigations. However, these boreholes are located some distance from the junction itself.
- 2.4.17 Groundwater monitoring was undertaken monthly between November 2016 and October 2017 (note: no readings were taken in May or June 2017).
- 2.4.18 The average groundwater level from exploratory hole locations screened within the Alluvium ranged between 0.42m bgl and 3.70m bgl (48.83m and 50.80m AOD). Consequently, drainage attenuation provided for Catchments 12 and 13 would require lining.
- 2.4.19 Overall, the preliminary design invert levels of the highway drainage carrier system are designed to be above the anticipated groundwater level. Borehole Little Eaton (BL) 07 is near to the location of the proposed attenuation ponds for Catchments 12 and 13 and has an average monitored groundwater level of 49.35m AOD. Consequently, both attenuation ponds would require lining.
- 2.4.20 The results of the geotechnical investigation indicate low permeability; consequently, infiltration to ground has been discounted as a drainage option.

**2.5 Flood risk**

- 2.5.1 A Flood Risk Assessment (FRA) has been developed for each junction, namely; Kingsway junction (HE514503-ACM-EWE-Z1\_ZZ\_ZZ\_ZZ-RP-HF-0001, Highways England, 2019), Markeaton junction (HE514503-ACM-EWE-Z2\_ZZ\_ZZ\_ZZ-RP-HF-0001, Highways England, 2019) and Little Eaton junction (HE514503-ACM-EWE-Z3\_ZW\_PR\_ZZ-RP-HF-0001, Highways England, 2019). These FRAs are presented in Appendix 13.2 in ES Volume 3 [TR010022/APP/6.3].
- 2.5.2 The FRAs have been developed in parallel with this drainage strategy (as separate reports) and demonstrate that with the implementation of the recommended mitigation measures, flood risk would be controlled by the Scheme.
- 2.5.3 The key findings of the FRA with respect to Kingsway junction are:

- There would be high overall risk of fluvial (river) flooding to the Scheme without mitigation. Mitigation measures have been designed in concept using hydraulic modelling to represent realignment of Bramble Brook within the junction and proposed flood storage areas for the 1 in 100 year flood event plus climate change.
- The mitigation measures modelled demonstrate a workable flood mitigation solution for the junction – the flood risk mitigation strategy includes a flood storage area within the junction and three flood storage areas adjacent to Bramble Brook within the Kingsway hospital site.

2.5.4 The key findings of the FRA with respect to Markeaton junction are:

- The FRA established that there is a low overall risk of flooding to the Scheme at Markeaton junction and that no flood risk mitigation measures are needed other than the appropriate control and management of highway runoff (as described in this drainage strategy).

2.5.5 The key findings of the FRA with respect to Little Eaton junction are:

- The FRA established that there would be a loss of River Derwent floodplain storage due to the increased footprint of the Scheme at Little Eaton junction and therefore mitigation would be required. Hydraulic modelling has been used to test various floodplain storage and compensation areas for the 1 in 100 year flood event plus climate change. A floodplain compensation area has been identified to the west of the River Derwent (south of the A38) where proposed ground re-profiling would compensate floodplain loss on a level-for-level and volume-for-volume basis.
- A short section of Dam Brook located adjacent to the east of the existing A38 would need to be diverted, whilst a flood alleviation channel would be provided to connect a surface watercourse downstream of Breadsall Manor with the realigned Dam Brook. Hydraulic modelling has been used to design such features for the 1 in 100 year flood event plus climate change.



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### **3. KINGSWAY JUNCTION**

#### **3.1 Introduction**

- 3.1.1 The surface watercourse near the Scheme is Bramble Brook. The brook meanders along the line of the Scheme and is culverted under the A38 in a number of locations.
- 3.1.2 The proposed Kingsway junction comprises of a dumb-bell roundabout arrangement and linkages at existing ground level. The A38 would pass beneath the junction in an underpass - the low point of the mainline A38 would be approximately 6.5m AoD below the level of the existing roundabout. The existing A38 carriageways would form the northbound and southbound slip roads.

#### **3.2 Runoff collection and conveyance**

- 3.2.1 Kingsway junction's preliminary drainage design has been split into five catchments (refer to Figure 2.2).
- 3.2.2 Runoff from the carriageway would be collected via a combination of road edge channels, gullies and combined kerb drainage units (where required). The proposed overbridges allow for bridge drainage/ combined kerb drainage units on the bridge deck.
- 3.2.3 The use of carrier pipes ensures spillages would be contained within the drainage system and would not infiltrate to ground close to source. Subsurface drainage would be provided via narrow filter drains where necessary.

#### **3.3 Attenuation and pollution control**

- 3.3.1 A greenfield runoff rate (GRR) (4.6l/s/ha) has been agreed with DCiC for use within the preliminary design calculations.

##### **Catchment 1**

- 3.3.2 The runoff from this catchment would outfall into Bramble Brook located within the junction. Attenuation storage up to and including the 100 year + 40% climate change (CC) event would be provided by attenuation tanks, oversized pipes and a lined pond. The preliminary design allowable discharge rates have been calculated using a GRR of 4.6l/s/ha for the new impermeable areas and restricted to ensure betterment over the existing situation for the site.
- 3.3.3 Treatment of the runoff prior to discharge would be provided by an attenuation pond located within the junction. The existing highway drainage system includes no vegetative treatment systems, so the Scheme would provide enhancements to highway runoff water quality. Penstocks would be provided upstream of the attenuation pond to allow cut off in the event of spillage on the highway (e.g. following a road accident etc.). The spillage would be contained within the carrier system and road surface.

##### **Catchment 2**

- 3.3.4 The runoff from this catchment would outfall into a tributary of Bramble Brook adjacent to the northbound slip road. Attenuation storage up to and including the 100 year + 40%CC event would be provided by oversized pipes and a lined attenuation tank (buried). The preliminary design allowable discharge rates have been calculated

using a GRR of 4.6l/s/ha for the new impermeable areas and restricted to ensure betterment over the existing situation for the site.

- 3.3.5 A petrol interceptor would be located upstream of the lined attenuation tank. A lined ditch would convey the attenuated runoff from the attenuation tank to the Bramble Brook tributary outfall. The lined ditch would provide water quality enhancements. The existing highway runoff drainage system includes no vegetative treatment systems, so the Scheme would provide betterment with regards to highway runoff water quality. Penstocks would be provided upstream of the buried attenuation tank to allow cut off in the event of a highway spillage. The spillage would be contained within the carrier system and road surface.

### **Catchment 3**

- 3.3.6 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the drainage pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing drainage connections (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions.

### **Catchment 4**

- 3.3.7 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the drainage pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing drainage connections (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions.

### **Catchment 5**

- 3.3.8 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the drainage pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. Catchment 5 would discharge into the Bramble Brook culvert. No vegetative highway runoff treatment would be provided due to the site constraints. A petrol interceptor would be located upstream of the connection to the culvert.

## **3.4 Land drainage**

- 3.4.1 Bramble Brook would be affected by the new junction arrangements and would need to be diverted within the junction.
- 3.4.2 Existing culverted sections of the brook would also be affected by the new road alignment; consequently, a new culverted section would be constructed linking the new Bramble Brook alignment with the existing incoming 900mm diameter culverts to the west of the interchange. Proposed earthwork drainage would be located at the top of cuttings or at the toe of embankment to capture surface flows from natural catchments which would outfall into the carrier pipes.



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## **4. MARKEATON JUNCTION**

### **4.1 Introduction**

- 4.1.1 The existing roundabout at Markeaton junction is at-grade, generally surrounded by built-up urban areas, with Markeaton Park situated to the north-west of the Scheme.
- 4.1.2 Surface watercourses near the Scheme comprise of the Markeaton Brook system, and associated lakes. The Markeaton Lake culvert beneath the A38 connecting Markeaton Lake with Mill Pond would remain in situ and would not need to be extended. Similarly the culvert beneath the A38 connecting Markeaton Lake with Middle Brook would be retained and would not need to be extended.
- 4.1.3 The proposed Markeaton junction comprises of an enlarged two-bridge roundabout at existing ground level with the A38 passing beneath and to the south-east of the existing roundabout (maximum depth approximately 7.8m below existing ground level). Large retaining walls would be constructed between the A38 and the slip roads to reduce the footprint of the junction. The northbound merge slip road would be approximately on the line of the existing northbound carriageway adjacent to Markeaton Park.
- 4.1.4 The existing outfall for highway drainage and the STW surface water sewer is into the Markeaton Lake culvert.

### **4.2 Runoff collection and conveyance**

- 4.2.1 Markeaton junction's preliminary drainage design consist of six catchments (refer to Figure 2.3).
- 4.2.2 Runoff from the carriageway would be collected via a combination of road edge channels, gullies and combined kerb drainage units (where required). The proposed overbridges allow for bridge drainage/ combined kerb drainage units on the bridge deck.
- 4.2.3 The use of carrier pipes would ensure that spillages would be contained within the drainage system and would not infiltrate to ground close to source. Subsurface drainage would be provided via narrow filter drains throughout where necessary.
- 4.2.4 To provide groundwater exclusion from the new underpass and avoid post-construction groundwater pumping, a secant form of pile construction is proposed, combined with a water excluding reinforced concrete base slab. Due to potential high groundwater levels, the structural arrangement would be required to exclude groundwater, with the capacity to resist uplift pressures. Temporary pumping of groundwater would be required during construction. Permanent pumping of surface water would be required, as the underpass would be below the level of nearby watercourses.
- 4.2.5 The carriageway within the A38 mainline cut would be approximately 7.8m below existing ground level near chainage 2,850m (approximately 400m to the west of the nearest watercourse).
- 4.2.6 A pumping station would be required to convey surface water runoff from the majority of the new A38 mainline to the surface. The pumping station would be located beside the junction's southbound diverge slip road.

- 4.2.7 Further consultation is required to determine the electrical supply to the pumping station and would be carried out in the detail design stage. A risk-based approach at detailed design stage would be completed to fully understand the implications of the inclusion or exclusion of an electrical backup system or systems. Access to the pumping station would be from the adjacent slip road.

### **4.3 Attenuation and pollution control**

- 4.3.1 A GRR of 4.6l/s/ha has been agreed with DCiC for use within the preliminary design calculations.

#### **Catchment 6**

- 4.3.2 The widening of the Markeaton Park entrance road would provide an increase in impermeable area. The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the existing pipe network/ upgraded pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. Drainage information regarding the existing network would be ascertained through a drainage survey during the detailed design stage.
- 4.3.3 Catchment 6 would discharge into the existing drainage network within Markeaton Park.

#### **Catchment 7**

- 4.3.4 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections to the existing Markeaton Lake culvert (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions. An open highway runoff attenuation and treatment feature was not feasible in this location as it would require land take from Markeaton Park.
- 4.3.5 A petrol interceptor would be located upstream of the connection to the culvert.

#### **Catchments 8 and 9**

- 4.3.6 The northbound and southbound slip roads of Kedleston Junction would discharge to the existing culvert connecting Markeaton Lake with Middle Brook.
- 4.3.7 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections to the existing culvert (subject to condition assessment) would be retained. No vegetative highway runoff treatment would be provided due to the site constraints, matching existing conditions.

#### **Catchments 10**

- 4.3.8 Attenuation up to and including 100 year + 40% climate change storm event would be provided within the pipe network, lined attenuation tanks (underground) and a lined vegetated treatment forebay (open water storage pond). The runoff from this catchment would outfall into Mill Pond.

- 4.3.9 Due to the size of attenuation required, it would not be possible to attenuate all highway runoff using open water features, especially as this area would be used for replacement public open space offered in exchange for public open space lost due to the Scheme. As such, a combination of buried attenuation and surface water features compatible with a public open space land use is proposed.
- 4.3.10 Markeaton junction's preliminary drainage design includes a vegetated lined open ditch to convey highway runoff water from the pumping station to the initial lined attenuation tank (buried). The flow would then conveyed via a vegetated lined open ditch from this tank to the lined open forebay pond which would provide further treatment of the runoff. The lined forebay (which would be planted) would consist of water to a depth of approximately 300mm and would be sized to hold the first flush generated from the catchment, equal to the first 10mm of rainfall across the road surface from a 10 year storm event (HA103/06). Another vegetated lined open ditch would convey the water from the forebay to a second buried attenuation tank. A further vegetated lined open ditch would convey the runoff from the second buried attenuation tank to the proposed discharge point into Mill Pond.
- 4.3.11 The first flush would be held back by the lined forebay and which would drain through to the second buried attenuation tank via a filter drain. The retention time of the lined forebay would be greater than 24 hours.
- 4.3.12 The preliminary design allowable discharge rates have been calculated using a GRR of 4.6l/s/ha for the new impermeable areas as agreed with DCiC and restricted to ensure betterment over the existing situation for the site.
- 4.3.13 Penstocks would be provided upstream of the attenuation tanks to allow cut off in the event of a spillage on the highway. The spillage would be contained within the carrier/ system and/ or lined ditches.

#### **Catchments 11**

- 4.3.14 South-east of the proposed A38 underpass, the A52 would drain via existing gullies into the DCiC highway drainage system on Ashbourne Road. There would be a reduction in the drained area with the Scheme and consequently a reduction in peak runoff flows.

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## **5. LITTLE EATON JUNCTION**

### **5.1 Introduction**

- 5.1.1 The surface watercourse closest to the Scheme is Dam Brook located to the east of the junction. The River Derwent is situated to the west of the Scheme. There are two existing culverts which pass under the A38 that ultimately deliver runoff into Dam Brook.
- 5.1.2 The existing highway consists of an at-grade roundabout with five arms; two arms for the A38 dual carriageway, an arm for the A61 dual carriageway, plus connections to Ford Lane and the B6179 Alfreton Road.
- 5.1.3 The proposed Little Eaton junction would comprise an enlarged roundabout at existing ground level with the A38 passing above on two roundabout overbridges to the east and south of the existing roundabout. The existing northbound carriageway would form the northbound slip roads. Commencing at the southern tie in, the proposed A38 would swing to the south of the existing A38 immediately after crossing the River Derwent Bridge, which would not be affected, and would pass over a Flood Relief Arch/ Accommodation Bridge which would need to be extended. Continuing north the existing railway bridge would be extended to the south to carry the widened A38 cross section. The existing northbound carriageway would be retained on the railway bridge and would form the northbound diverge slip road.
- 5.1.4 The A38 would pass over the new roundabout on two bridges on embankment (around 11m above existing ground level at the highest point on the north side of the junction before quickly dropping down to around 3m above existing ground level; it would be around 9m above the existing roundabout carriageway level on the high side of the mainline) before continuing to the west of the existing A38 and re-joining the existing A38 alignment immediately south of the Water Treatment Works Accommodation Bridge, which would not be affected.

### **5.2 Runoff collection and conveyance**

- 5.2.1 Little Eaton junction's preliminary drainage design has five catchments (refer to Figure 2.4).
- 5.2.2 Runoff from the carriageway would be collected via a combination of road edge channels, gullies and combined kerb drainage units (where required). The proposed overbridges allow for bridge drainage/ combined kerb drainage units on the bridge deck.
- 5.2.3 The use of carrier pipes would ensure that spillages would be contained within the drainage system and would not infiltrate to ground close to source. Subsurface drainage would be provided via narrow filter drains where necessary.

### **5.3 Attenuation and pollution control**

- 5.3.1 A GRR of 4.6l/s/ha has been agreed with DCiC for use within the preliminary design calculations.

#### **Catchment 12**

- 5.3.2 The runoff from this catchment would outfall into the realigned Dam Brook. Attenuation storage up to and including the 100 year + 40%CC event would be provided by a lined attenuation pond and oversized pipes. The preliminary design

allowable discharge rates have been calculated using a GRR of 4.6l/s/ha for the new impermeable areas and restricted to ensure betterment over the existing situation for the site.

- 5.3.3 Treatment of the runoff prior to discharge would be provided by the lined attenuation pond. The existing highway drainage design includes no vegetative treatment systems, so the Scheme would provide enhancements to runoff water quality. Penstocks would be provided upstream of the attenuation pond to allow cut off in the event of spillage on the highway. The spillage would be contained within the carrier/ system.
- 5.3.4 The attenuation pond is to be owned and maintained by HE, a shared access track with Derbyshire County Council (DCC) is included within the preliminary design to service the pond.

### **Catchment 13**

- 5.3.5 The runoff from this catchment would outfall into the realigned Dam Brook. Attenuation storage up to and including the 100 year + 40%CC event would be provided by a lined attenuation pond and oversized pipes. The preliminary design allowable discharge rates have been calculated using a GRR of 4.6l/s/ha for the new impermeable areas and restricted to ensure betterment over the existing situation for the site.
- 5.3.6 Treatment of the runoff prior to discharge would be provided by the lined attenuation pond. The existing highway drainage design includes no vegetative treatment systems, so the Scheme would provide enhancements to runoff water quality. Penstocks would be provided upstream of the attenuation pond to allow cut off in the event of spillage on the highway. The spillage would be contained within the carrier/ system.
- 5.3.7 The attenuation pond is to be owned and maintained by DCC, a shared access track with HE is included within the preliminary design to service the pond.

### **Catchment 14**

- 5.3.8 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections (subject to condition assessment) would be retained. No vegetative treatment has been provided within the design due to site constraints, matching existing conditions.
- 5.3.9 A petrol interceptor would be located upstream of the connection to the proposed discharge point.

### **Catchment 15**

- 5.3.10 The discharge from the catchment would be restricted to match existing discharge rates, ensuring no detriment in terms of downstream flood risk. Attenuation would be provided within the pipe network to ensure no flooding from the site in a 1 in 100 year + 40% CC rainfall event. The existing connections (subject to condition assessment) would be retained. No vegetative treatment has been provided due to site constraints, matching existing conditions.

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- 5.3.11 A petrol interceptor would be located upstream of the connection to the proposed discharge point.

**Catchment 16**

- 5.3.12 The proposed earthworks drainage would discharge via the existing outfall into Dam Brook. At catchment 16 there would be a reduction in the drained area and consequently a reduction in peak runoff flows.

**5.4 Land drainage**

- 5.4.1 Dam Brook would be affected by the Scheme and would need to be realigned.
- 5.4.2 Proposed earthwork drainage would be located at the top of cuttings or at the toe of embankments to capture surface flows from natural catchments. These would outfall into the carrier pipe system.

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## 6. WATER QUALITY

- 6.1.1 Water quality assessments, which assess the road drainage preliminary design proposals, have been undertaken in accordance with DMRB HD45. The results of the assessment are included in Appendix 13.1 in ES Volume 3 **[TR010022/APP/6.3]**.
- 6.1.2 The Highways Agency Water Risk Assessment Tool (HAWRAT) assessment indicates passes for each of the highway drainage catchments. The HAWRAT assessments assessed the effects of accidental spillages and routine road drainage runoff on surface water quality.
- 6.1.3 The features included within the Scheme design as reported in Sections 3 to 5 have the potential to result in an improvement in terms of runoff water quality as compared to the existing situation. Overall, the effects of the Scheme on surface water quality during the Scheme operational phase have been assessed as being neutral, and therefore not significant (refer to ES Chapter 13: Road Drainage and the Water Environment **[TR010022/APP/6.1]**).

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## **7. HYDRAULIC MODELLING**

### **7.1 Preliminary Modelling**

- 7.1.1 Preliminary hydraulic modelling has been undertaken to demonstrate the validity of the drainage design proposals.



## 8. MAINTENANCE

- 8.1.1 Maintenance of any conventional pipe network and sustainable drainage systems (SuDS) would be required during Scheme operation. For a conventional pipe network, access for maintenance and inspection would be provided with pipework laid to achieve self-cleansing velocities. Table 8.1 shows the maintenance activities for typical SuDS components as advised in HA 103/06 Vegetated Drainage Systems for Highway Runoff (Highways Agency, 2006).
- 8.1.2 Access tracks to ponds would be provided as required by Highways England and DCC, allowing maintenance vehicles to safely park up and undertake inspections, grass cutting etc.

	Swale	Infiltration Basin	SF Wetland	SSF Wetland	Balancing Pond/ Sedimentation Pond
<b>INSPECTIONS:</b> <ul style="list-style-type: none"> <li>• Inflow/outfalls</li> <li>• Integrity/erosion</li> <li>• Debris/rubbish</li> </ul>	Quarterly or after each major storm	Quarterly	Quarterly or after each major storm	Monthly or after each major storm	Monthly
<ul style="list-style-type: none"> <li>• Build-up of sediment or invasive weeds</li> </ul>	Annually	Twice annually	Annually	Annually	Annually
<ul style="list-style-type: none"> <li>• Vegetation cover/vigour</li> </ul>	Monthly or after each major storm	Annually	Annually	Annually	Annually
<ul style="list-style-type: none"> <li>• Check for protected species/breeding birds</li> </ul>	Specialist advice to be sought, as described in paragraph 6.2				
<b>ROUTINE WORKS:</b> <ul style="list-style-type: none"> <li>• Clearance of rubbish/debris</li> </ul>	Monthly or after each major storm	Quarterly	Quarterly	Monthly or after each major storm	Quarterly
<ul style="list-style-type: none"> <li>• Cutting vegetation</li> </ul>	Monthly or after each major storm	Annual	10 year cycle and remove	1-5 year cycle and remove	5-10 year cycle and remove
<ul style="list-style-type: none"> <li>• Removal of plant litter</li> </ul>	N/A	N/A	N/A	5-10 year cycle if required	N/A
<ul style="list-style-type: none"> <li>• Removal of sediment</li> </ul>	To be determined annually	To be determined annually	To be determined annually	To be determined annually	To be determined annually

**Table 8.1: Inspection and maintenance requirements for vegetative systems (extract from HA 103/06)**