




# 1MCo3 Main Works - Contract Lot S1

## Surface Water Monitoring Plan

Document no.: 1MCo3-SCJ-EV-PLN-S001-000029

| Revision | Author  | Checked by  | Approved by   | Date approved | Reason for revision |
|----------|---|---|---|---------------|---------------------|
| C03      | Peter Johnson   | Callum Mair   | Geri Badura   |               |                     |
|          |  |  |  | 20/09/2021    | For acceptance      |

**SECURITY CLASSIFICATION: OFFICIAL**

Handling instructions: None

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## REVISION CHANGES, AUTHORISATION & ISSUE RECORD

| Version | Date       | Sections revised  | Brief Description of the revision   | Prepared by    | Checked by                       | Approved by                | Reason for Issue | HS2 Acceptance Decal Code |
|---------|------------|---|---|----------------|----------------------------------|----------------------------|------------------|---------------------------|
| Co1     | 28/06/2019 | All   | Initial draft for presentation to HS2   | Design House   | Geri Badura<br>Marcelle Hornshaw | Stephen Parker             | For acceptance   | Code 2                    |
| Co2     | 07/08/2020 | 4.4, 4.5, 4.8, 6, and Appendices B & C added, Tables 7, 8, 9, 10, 11 edited | Updated draft for acceptance in response to EA and HS2 comments on Co1 and internal review and audit. | Craig Speed    | Andrew Durber                    | Sophie Hart<br>Phil Bailey | For acceptance   | ~                         |
| Co3     | 15/12/2020 | 5.1, 5.7, 5.10, 5.15, 5.16.   | Following HS2, Affinity Water and EA formal review.   | Craig Speed    | Peter Johnston                   | Peter Johnston             | For acceptance   | ~                         |
| Co3.2   | 10/6/2021  | Table 12  | Following HS2, Affinity Water and EA formal review.   | Peter Johnston | Sophie Hart                      | Sophie Hart                | For acceptance   | ~                         |
| Co3.3   | 20/9/2021  | ES, Tables 7, 11 and 12, 5.7.26   | Following HS2, Affinity Water and EA formal review.   | Peter Johnston | Callum Mair                      | Geri Badura                | For acceptance   | ~                         |

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# 1 Executive Summary

- 1.1.1 This plan sets out the High Speed Two (HS2) requirements for surface water monitoring for the activities currently being undertaken as part of the HS2 project on contract areas S1 and S2, to identify future Main Works Civils Contract (MWCC) surface water monitoring proposals to be implemented by Skanska Costain STRABAG Joint Venture (SCSJV).
- 1.1.2 HS2 Phase One MWCC works in the SCSJV scope, covers 26.8 km from Euston Station in the London Borough of Camden to Ickenham in the London Borough of Hillingdon. It involves the construction of tunnels, vents shafts, bridges and other structures along the route.
- 1.1.3 SCSJV cover a range of design and construction activities including utility diversions, excavation, ground works, shaft construction, temporary works, highway construction, tunnelling, demolition and building works and logistics.
- 1.1.4 The SCSJV works divided into two sectors (S1 Euston to Old Oak Common and S2 Old Oak common to West Ruislip).
- 1.1.5 The HS2 Act requires high level environmental and sustainability commitments to be met through implementation of its Environmental Minimum Requirements (EMRs). The EMRs include (amongst other things detailed in this plan) the requirements of the HS2 Code of Construction Practice (CoCP), which shall be adopted and implemented by SCSJV and its sub-contractors in delivering the works. Various mandatory requirements and guidance for surface water monitoring have been developed by HS2 in the Water Resources and Flood Risk Monitoring Technical Standard, which prescribes the methodologies, processes and specifications that SCSJV and its sub-contractors shall comply with in carrying out the works for surface water.
- 1.1.6 In accordance with the Water Resource and Flood Risk Monitoring Technical Standard, surface water monitoring points have been identified:
- Wherever the HS2 Route crosses surface water bodies, unless determined otherwise for below ground stretches of the HS2 Route in consultation with HS2 and the Environment Agency;
  - For Water Framework Directive scale impacts greater than "Negligible" or very low risk have been predicted from the HS2 Scheme based on the Water Framework Directive Assessment for the HS2 Scheme in Area South;
  - In accordance with the CoCP, which requires monitoring for watercourses affected by construction works or the discharge of surface water run-off during pre-construction (to establish a baseline) and during construction; and
  - To ensure compliance with HS2 undertakings and assurances (U&As), Local Environmental Management Plans (LEMPs) and regulatory consent requirements.

- 1.1.7 Consultation has been undertaken with HS2 and the Environment Agency in January 2020, which descoped any requirement for water level or flow monitoring in Area South due to the availability of a fluvial hydraulic models for the watercourses in Sector S2 west of Ruislip. These models allow the estimation of flood flows and levels, thereby making monitoring of these unnecessary. In addition, consultation with the Environment Agency clarified that any water quality monitoring in relation to dewatering discharges can be limited to sampling the discharge only (no upstream or downstream monitoring of the receiving water is necessary in the construction phase).
- 1.1.8 For the pre-construction monitoring, some of the monitoring locations identified by implementation of the technical standard have been removed or amended based on further assessment of location, hydrogeology, hydrology and the potential pathways of contamination and consultation with HS2 and the EA. These include the omission of various ponds for water quality monitoring.
- 1.1.9 The summary table below (reproduced from Table 11) and the figures that follow (reproduced from Figures 7-10) summarise the proposed HS2 monitoring in Area South under the Main Works Civils Contract, the derivation of which is described in detail in the body of this document. The figures break down the monitoring location into both water quality and aquatic ecology monitoring points, as well as during which scheme the monitoring is being undertaken.
- 1.1.10 Water quality monitoring at each monitoring point is to be implemented at a frequency of monthly for the pre-construction phase and weekly for the construction phase. Aquatic ecology monitoring will comprise a single survey for each phase for which monitoring is identified.
- 1.1.11 Methodologies for both water quality monitoring and aquatic ecology monitoring have been outlined in this plan. For both types of monitoring, the requirements of the HS2 Technical Standard for Water Resources and Flood Risk Monitoring (HS2-HS2-EV-STD-000-000029) have been identified and cross referenced. In some instances, these requirements have been modified and/or augmented based on specialist professional judgement in each technical discipline. However, the methodologies proposed in this plan have been verified based on consultation with the Environment Agency.

| Nº | ES (as amended) point and new CoCP points | Location   | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |  | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 1  | SWC-CFA03-01                              | Grand Union Canal at Gloucester Avenue (near Euston Approach)                              | 290,837                | 289,478  | 528,438               | 183,984  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 2  | SWC-CFA04-01                              | Grand Union Canal at South of Saint Mary's Catholic Cemetery (east Old Oak Common Station) | 284,978                | 287,927  | 522,625               | 182,274  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 3  | SWC-CFA05-04                              | Grand Union Canal at East Mandeville Vent Shaft  | 727,2677               | 291909   | 510,223               | 185,918  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 4  | SWC-CFA05-01                              | River Brent  | 279,501                | 288,372  | 517,139               | 182,569  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 5  | SWC-CFA06-01                              | Yeading Brook East   | 273,912                | 290,948  | 511,483               | 184,991  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 6  | SWC-CFA06-04                              | Yeading Brook West   | 272,677                | 291,909  | 510,223               | 185,918  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 7  | SWC-CFA06-05                              | Yeading Brook West   | 272,632                | 291,837  | 510,170               | 185,844  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 8  | SWC-CFA06-02 (1)                          | River Pinn (upstream bridge)   | 269,887                | 293,282  | 507,397               | 187,213  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 9  | SWC-CFA06-02 (2)                          | River Pinn (downstream bridge)   | 269,839                | 293,220  | 507,351               | 187,150  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 10 | SWC-CFA06-02 (3)                          | River Pinn upstream of Golf Course   | 269839                 | 293190   | 508,053               | 187,449  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 11 | SWC-CFA06-03 (1)                          | Ickenham Stream (upstream diversion proposed)  | 270,601                | 293,148  | 508,114               | 187,099  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 12 | SWC-CFA06-03 (2)                          | Ickenham Stream (downstream bridge)  | 270,496                | 293,037  | 508,012               | 186,985  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 13 | SWC-CFA06-07                              | Ickenham East Tributary  | 270,923                | 292,936  | 508,442               | 186,896  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 14 | NP-1 (1)                                  | New Pond 1 West Ruislip Golf Course  | 270,534                | 293,223  | 507,979               | 187,208  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |
| 15 | NP-1 (2)                                  | New Pond 2 West Ruislip Golf Course  | 270,518                | 293,150  | 508,023               | 187,022  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |

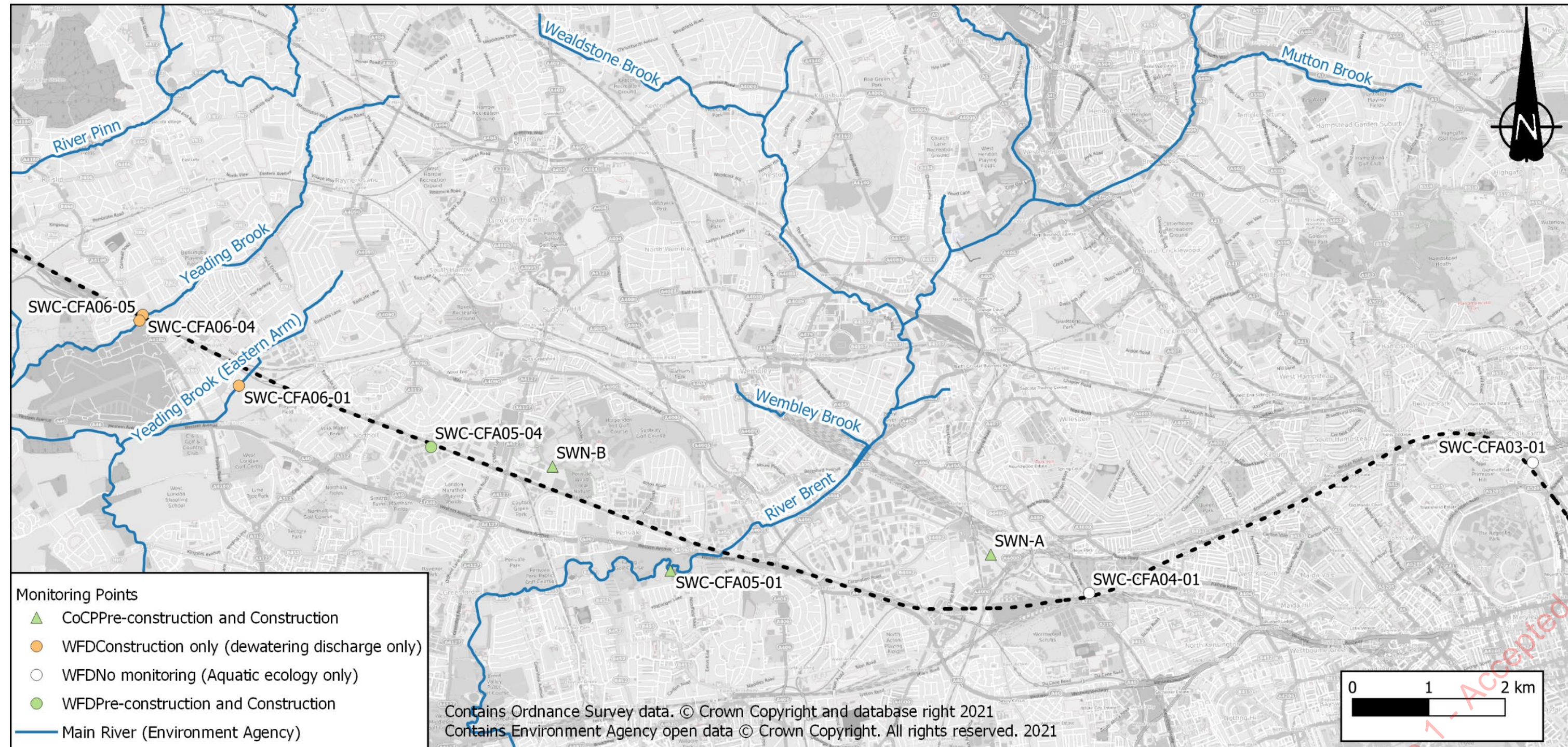
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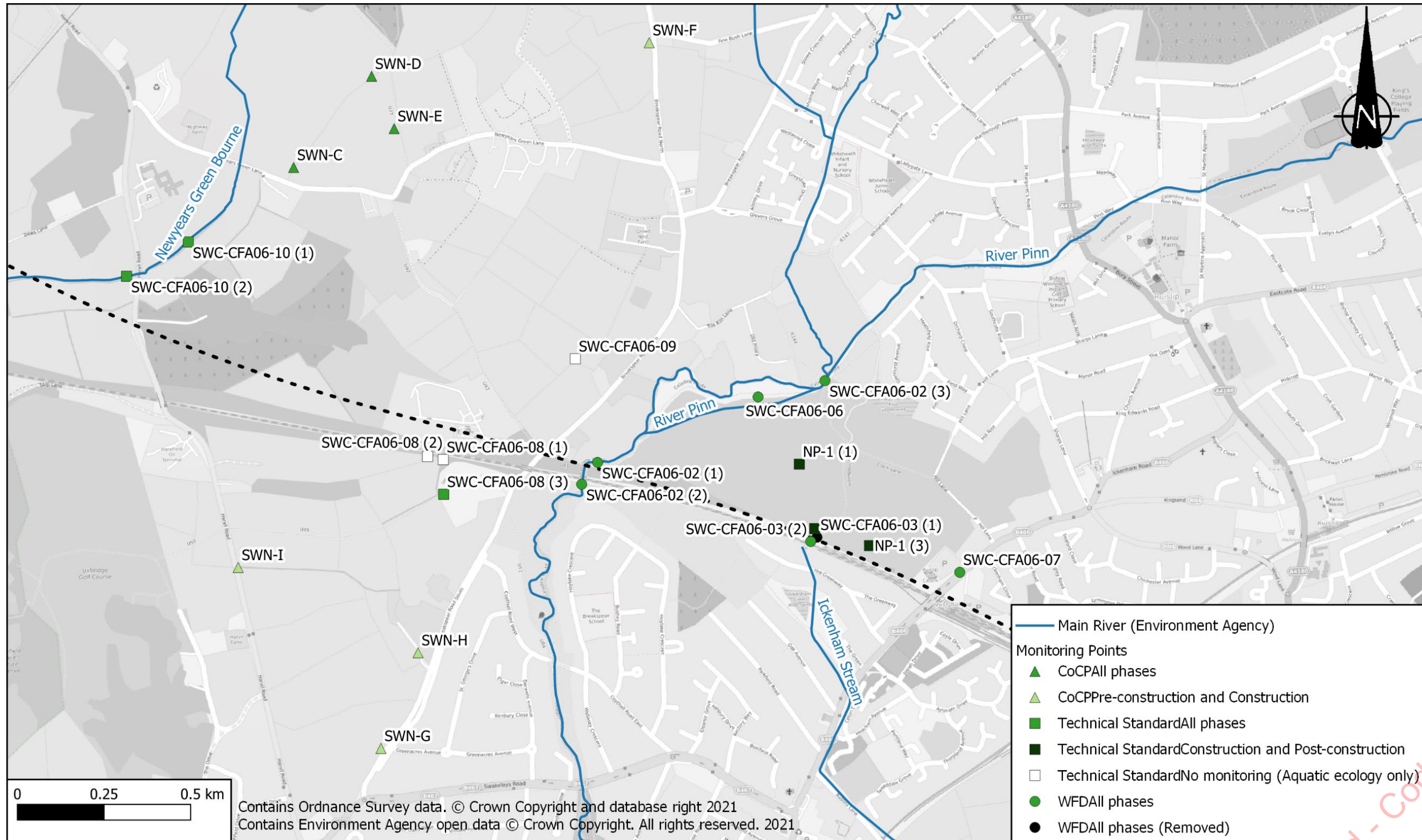
| N° | ES (as amended) point and new CoCP points | Location   | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |  | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 16 | NP-1 (3)                                  | New Pond 3 West Ruislip Golf Course                    | 270,841                | 293,121  | 508,182               | 186,973  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |
| 17 | SWC-CFA06-P05 (1)                         | 1 of 3 Ponds West Ruislip Golf Course                  | 270,469                | 293,261  | 507,979               | 187,208  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 18 | SWC-CFA06-P05 (2)                         | 2 of 3 Ponds West Ruislip Golf Course                  | 270,508                | 293,073  | 508,023               | 187,022  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 19 | SWC-CFA06-P05 (3)                         | 3 of 3 Ponds West Ruislip Golf Course                  | 270,665                | 293,020  | 508,182               | 186,973  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 20 | SWC-CFA06-06                              | West Ruislip Golf Drains                               | 270,355                | 293,458  | 507,860               | 187,402  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 21 | SWC-CFA06-08 (1)                          | Brackenbury Farm north pond 1                          | 269,442                | 293,302  | 506,952               | 187,221  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | x            | ✓                 |
| 22 | SWC-CFA06-08 (2)                          | Brackenbury Farm north pond 2                          | 269,397                | 293,312  | 506,906               | 187,230  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | x            | ✓                 |
| 23 | SWC-CFA06-08 (3)                          | Moat in Brackenbury Farm                               | 269,440                | 293,202  | 506,953               | 187,121  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | x            | ✓                 |
| 24 | SWC-CFA06-09                              | South-east of Newyears Green Covert pond               | 269,831                | 293,582  | 507,333               | 187,512  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 25 | SWC-CFA06-10 (1)                          | Newyears Green Bourne (upstream bridge)                | 268,724                | 293,950  | 506,216               | 187,849  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 26 | SWC-CFA06-10 (2)                          | Newyears Green Bourne (downstream bridge)              | 2268,543               | 293,856  | 506,038               | 187,750  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 27 | SWN-A                                     | Grand Union Canal at Atlas Road Logistics Tunnel       | 283,703                | 288,466  | 521,336               | 182,778  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 28 | SWN-B                                     | Grand Union Canal at North of Greenpark Way Vent Shaft | 277,992                | 289,776  | 515,593               | 183,931  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 29 | SWN-C                                     | Northern Sustainable Placement Areas                   | 269,033                | 294,156  | 506,520               | 188,064  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |

| N° | ES (as amended) point and new CoCP points | Location                             | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--------------------------------------|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |                                      | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 30 | SWN-D                                     | Northern Sustainable Placement Areas | 269,266                | 294,413  | 506,745               | 188,327  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 31 | SWN-E                                     | Northern Sustainable Placement Areas | 269,326                | 294,261  | 506,810               | 188,176  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 32 | SWN-F                                     | Northern Sustainable Placement Areas | 270,069                | 294,488  | 507,546               | 188,424  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | x                 |
| 33 | SWN-G                                     | Southern Sustainable Placement Areas | 269,240                | 292,474  | 506,772               | 186,388  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | x                 |
| 34 | SWN-H                                     | Southern Sustainable Placement Areas | 269,354                | 292,747  | 506,879               | 186,664  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | x                 |
| 35 | SWN-I                                     | Southern Sustainable Placement Areas | 268,842                | 293,007  | 506,360               | 186,910  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | x                 |

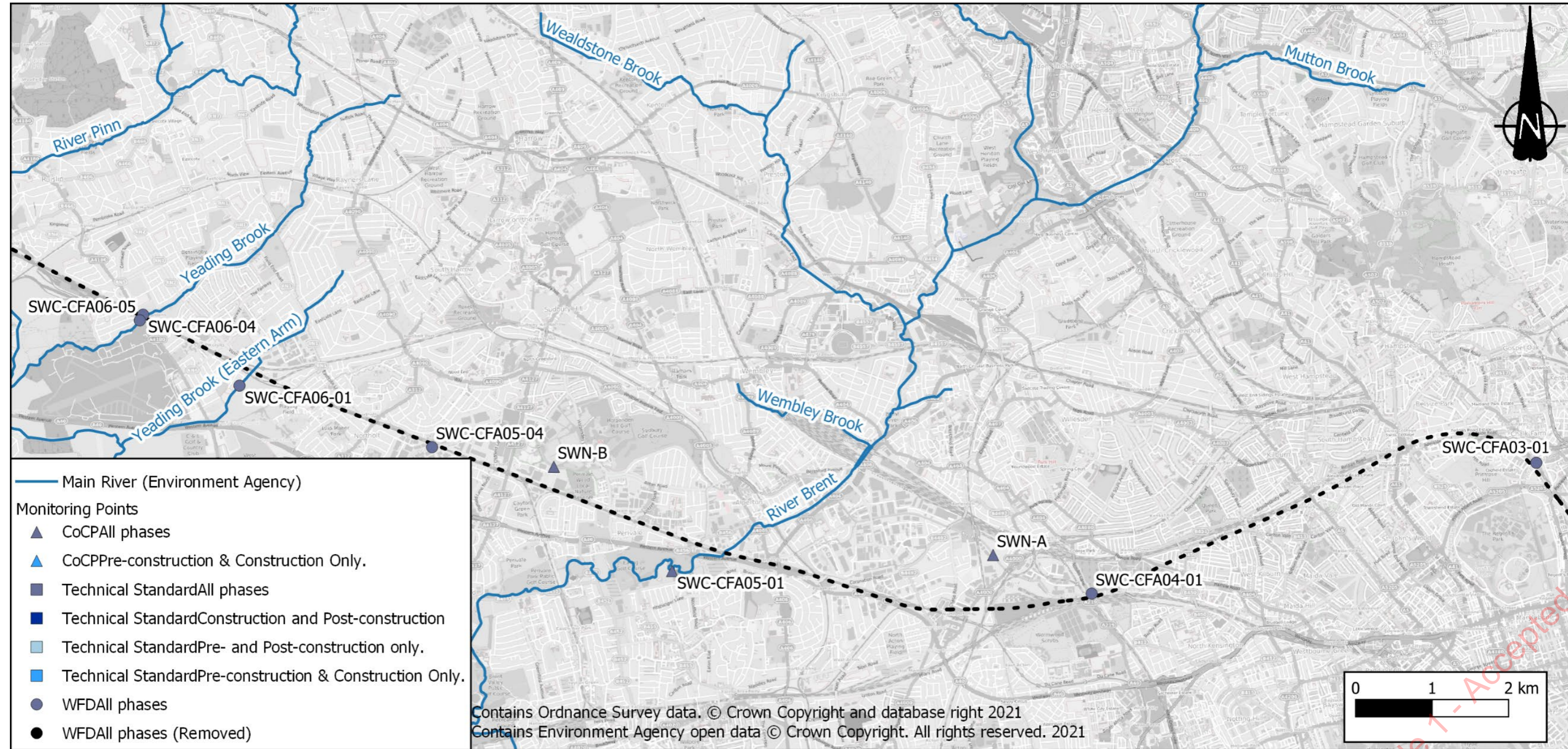
SCSJV Surface water quality monitoring proposal point locations in the S1 and S2 Hs2 project area



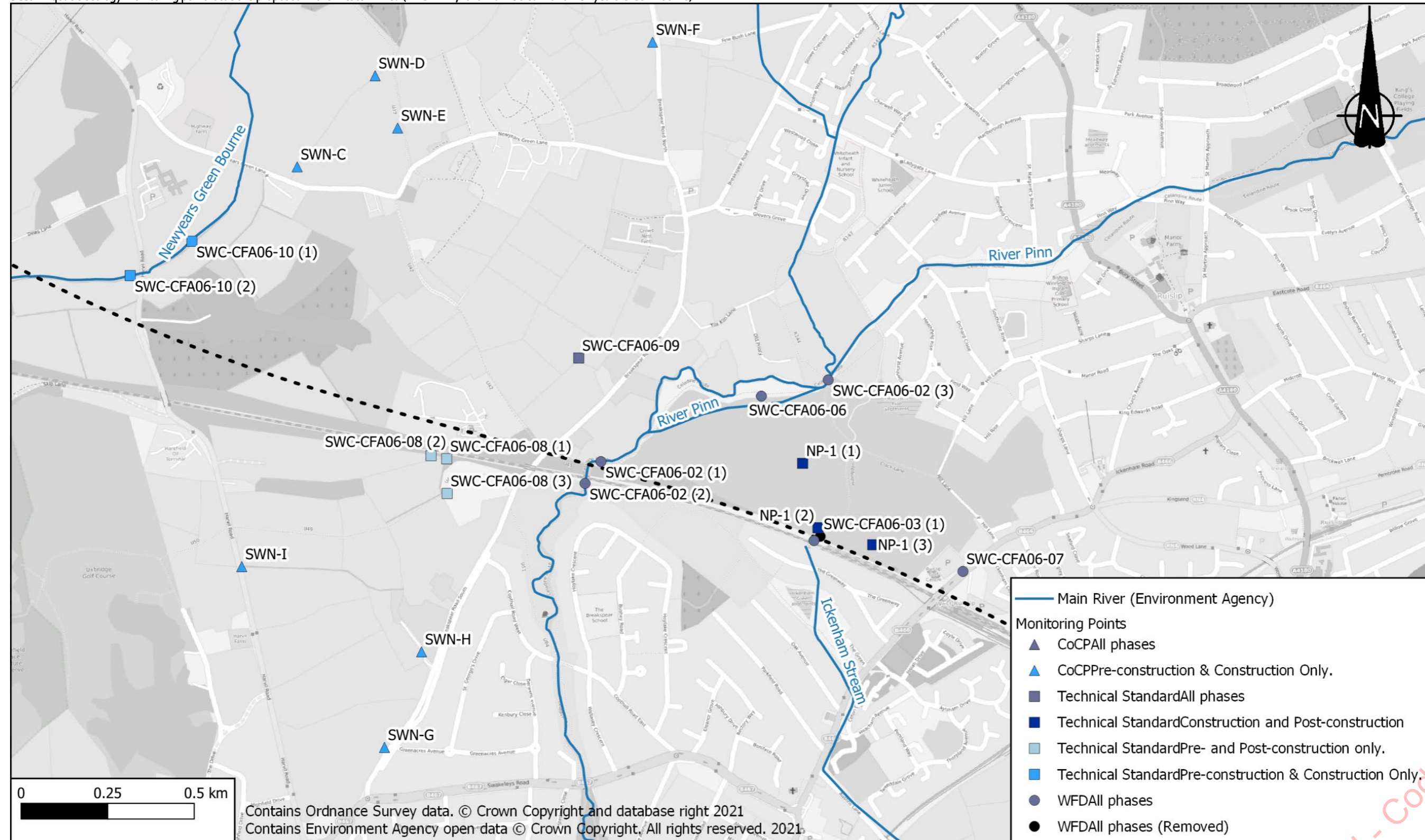
SCSJV Surface water quality monitoring point locations proposed in the Western Area (River Pinn, Ickenham Stream and Newyears Green Bourne)



SCSJV Aquatic ecology monitoring point locations proposed in the S1 and S2 Hs2 project area



SCSJV Aquatic ecology monitoring point locations proposed in the Western Area (River Pinn, Ickenham Stream and Newyears Green Bourne)



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## 2 Definitions and abbreviations

2.1.1 The tables below outline abbreviations and technical terms used within this monitoring plan.

### 2.2 Abbreviations

Table 1 List of Abbreviations

| Abbreviation | Definition   |
|--------------|--|
| BOD          | Biological Oxygen Demand   |
| BS           | British Standards  |
| BTEX         | BTEX Compound Group (Benzene, Toluene, Ethyl benzene and Xylene) |
| CFA          | Community Forum Area   |
| CoCP         | Code of Construction Practice                                    |
| COD          | Chemical Oxygen Demand   |
| DO           | Dissolved Oxygen   |
| DOC          | Dissolved Organic Carbon   |
| D/S          | Downstream   |
| EA           | Environment Agency   |
| EMRs         | Environmental Minimum Requirements                               |
| EMS          | Environmental Management System                                  |
| EQS          | Environmental Quality Standard                                   |
| ES           | Environmental Statement  |
| EWC          | Early Works Contractor (Skanska Costain Joint Venture)           |
| HS2          | High Speed 2 Ltd   |
| LEMPs        | Local Environmental Management Plans                             |
| LLFA         | Lead Local Flood Authorities                                     |
| LOD          | Level of Detection   |
| MWCC         | Main Works Civils Contract                                       |
| PAH          | Polycyclic Aromatic Hydrocarbon                                  |
| pH           | Measurement of acidity (expressed as pH)                         |
| SCSJV        | Skanska Costain STRABAG Joint Venture                            |
| SES          | Supplementary Environmental Statements                           |

| Abbreviation | Definition                                    |
|--------------|---|
| SSECP        | Site Specific Environmental Control Plans     |
| SSSI         | Site of Special Scientific Interest           |
| SPZs         | Source Protection Zones                       |
| T            | Temperature                                   |
| TDS          | Total Dissolved Solids                        |
| TOC          | Total Organic Carbon                          |
| TPH          | Total Petroleum Hydrocarbons                  |
| TSS          | Total Suspended Solids                        |
| U&As         | Undertakings and Assurances                   |
| U/S          | Upstream                                      |
| WFD          | Water Framework Directive                     |
| WFRMP        | Water Resource and Flood Risk Management Plan |

## 2.3 Definitions

2.3.1 The project terminology used in this document can be found in the HS2 Project Dictionary [R31].



## 3 Purpose

- 3.1.1 This document sets out the HS2 requirements for surface water monitoring for the activities currently being undertaken as part of the HS2 project on contract areas S1 and S2, to identify future Main Works Civils Contract (MWCC) surface water monitoring proposals to be implemented by Skanska Costain STRABAG Joint Venture (SCSJV).
- 3.1.2 The objectives of the plan are to start discussion with HS2 and regulators/stakeholders, including the Environment Agency (EA) to agree pre-construction, construction and post-construction surface water monitoring and to commence monitoring relating to the MWCC's advanced critical activities.
- 3.1.3 This plan has been prepared with the available information of the works at time of writing. It should be viewed as a live document and will be reviewed and updated every six months, or as required/in the event of a significant change to the works.
- 3.1.4 This plan should be read in conjunction with the Groundwater Monitoring Plan S1 and S2 [R24] and the SCSJV Water Resource and Flood Risk Management Plan S1 and S2 (WRFMP) [R25].

## 4 Legislation, policy & guidance

### 4.1 Legislation and policy

4.1.1 The Costain Environmental Management System (EMS), adopted for the MWCC by SCSJV, includes a legal register which is a live document maintained by the Costain corporate head office. The Environmental Aspects and Impacts Register identifies which sections of the legal register are applicable to this project and these are shown in the SCSJV Environmental Legal Register.

### 4.2 High Speed Rail (London – West Midlands) Act 2017

4.2.1 On 23 February 2017, Royal Assent was granted for Phase One of HS2. The High Speed Two Bill is now an Act of Parliament (law) i.e. High Speed Rail (London - West Midlands) Act 2017 [R1] including its Environmental Minimum Requirements (EMRs).

4.2.2 The EMRs set out the high level environmental and sustainability commitments and are contained in the EMR General Principles document supported by a series of papers:

- Annex 1: Code of Construction Practice (see below) [R2];
- Annex 2: Planning Memorandum [R3];
- Annex 3: Heritage Memorandum [R4];
- Annex 4: Environmental Memorandum [R5]; and
- Register of Undertakings and Assurances [R6].

### 4.3 Environmental Minimum Requirements - General Principles

4.3.1 The EMRs require that the controls to be implemented in delivering the scheme (including the EMRs, powers contained in the Act and Undertakings and Assurances (U&As)) will ensure that impacts which have been assessed in the ES (as amended) will not be exceeded. If the significant adverse impacts identified in the ES (as amended) are likely to be exceeded, all reasonable steps will be taken to minimise or eliminate those additional impacts.

4.3.2 Annex 1 to the EMRs comprises a Code of Construction Practice (CoCP), which shall be adopted and implemented by SCSJV and its sub-contractors in delivering the works. The high-level requirements of the CoCP are set out below.

4.3.3 In developing the scheme through the Parliamentary process and beyond into the detailed design stage, site-specific control measures are being developed in conjunction with local

authorities. Such measures are to be set out in each of the Local Environmental Management Plans (LEMPs) and shall be implemented in delivering the works.

## 4.4 Code of Construction Practice

- 4.4.1 The CoCP forms part of the EMRs and sets out the general control measures to be implemented and the standards to which the nominated undertaker and its contractors will comply in delivering the scheme. Its aim is to ensure that likely significant construction effects will either be avoided or mitigated. Notwithstanding this, SCSJV and its sub-contractors will adopt appropriate measures to design and construct the scheme so that there are no new significant adverse effects to water bodies. Where reasonably practicable, environmental mitigation will be integrated within the design and implemented by the contractors within the works.
- 4.4.2 The general control measures and monitoring arrangements for water bodies identified in the CoCP have been considered in the development of this plan and, where appropriate, are incorporated in the MWCC monitoring proposal within this plan.
- 4.4.3 Site-specific controls are to be developed in conjunction with regulators, local authorities and other stakeholders. These controls will be captured in Site Specific Environmental Control Plans (SSECP).

## 4.5 Local Environmental Management Plans

- 4.5.1 Local Environmental Management Plans have been published on the gov.uk website for all applicable local authorities. These will be updated on a six-monthly basis or in the event of a significant change to the works.
- 4.5.2 Local Environmental Management Plans focus on area specific topics (including water resource and flood risk) as relevant to construction works within the relevant local authority area. The measures described in LEMPs will be applied by SCSJV for the duration of the MWCC to minimise the potential environmental and community impacts of the works. The specific topics are:
- Sensitive receptors;
  - Local control measures; and
  - Monitoring procedures.
- 4.5.3 The relevant LEMPs for the HS2 MWCC cover the following local authority areas:
- London Borough of Camden [R9]
  - London Borough of Hammersmith and Fulham [R10]
  - London Borough of Brent [R11]
  - London Borough of Ealing [R12]

- City of Westminster [R13]
- London Borough of Hillingdon [R14]; and
- Royal Borough of Kensington and Chelsea [R15]

4.5.4 The sensitive local surface water receptors identified are summarised below for each borough:

- **London Borough of Camden**

4.5.5 Grand Union Canal (Regent's Canal) - The route will pass in tunnel under the Grand Union Canal (Regent's Canal) near Fitzroy Bridge on Gloucester Avenue, Primrose Hill.

4.5.6 Three small ornamental landscaped ponds located close to Fitzroy Road and Regent's Park Road near Primrose Hill.

4.5.7 One Hampstead Theatre pond, 20m north of the Scheme, near Winchester Road.

- **London Borough of Hammersmith and Fulham**

4.5.8 Artificial water bodies, including: Grand Union Canal (Paddington Arm).

- **London Borough of Brent**

4.5.9 Surface watercourses, including River Brent; and

4.5.10 Artificial water bodies, including: Grand Union Canal (Paddington Arm).

- **London Borough of Ealing**

4.5.11 Surface water features, including: River Brent, a Main River; several ponds at Park Royal, Lord Halsbury Memorial Playing Fields, Ealing Golf Course and Horsenden Hill; a number of drains and unnamed watercourses;

4.5.12 Artificial water bodies, including: Grand Union Canal (Paddington Arm).

- **City of Westminster**

4.5.13 Artificial water bodies, including: Grand Union Canal (Paddington Arm).

- **London Borough of Hillingdon**

4.5.14 Source Protection Zones (SPZs): The route passes through Zone 1 and Zone 2 of a SPZ in this area;

4.5.15 Surface water features: Yeading Brook (East and West Arms), Ickenham Stream and tributaries, River Pinn, Newyears Green Bourne, River Colne, Grand Union Canal, Harefield No.2 Lake, Savay Lake and unnamed pond adjacent to Savay Lake, Korda Lake, Harefield Moor Lake, Long Pond, Broadwater Lake Nature Reserve, one small pond at Lord Halsbury Memorial Playing Fields, two drains and one small pond at Ruislip Manor, several small ponds and drains at Ruislip

Gold Course, three small drains and pond south east of Newyears Green Covert, and numerous small ponds within 1km radius of the Scheme; and

4.5.16 Water dependent habitats: River Colne, adjacent flooded gravel pits (including Savay Lake which is an important fishery), the Grand Union Canal and the Mid-Colne Valley Site of Special Scientific Interest (SSSI).

- **Royal Borough of Kensington and Chelsea**

4.5.17 Artificial water bodies, including: Grand Union Canal (Paddington Arm).

## 4.6 Relevant legislation

4.6.1 The Water Resources Act 1991 [R16] sets out the responsibilities of the EA and its regulatory measures associated with the water environment, such as consents for discharges and abstractions, although it should be noted that discharges are now regulated under the Environmental Permitting Regulations (2016).

4.6.2 The Water Act 2003 [R18] updates existing legislation with respect to abstraction, amends the regulation of the water industry and amends legislation relating to the requisition of sewers and drains.

4.6.3 The Environment Act 1995 [R19] can be utilised to prosecute for any discharges that contravene relevant water quality standards (UK Environmental Quality Standards - EQS), and these include those related to remediation and/or construction activities.

4.6.4 The Environmental Protection Act 1990 [R8] seeks to improve control of pollution from certain industrial and other processes.

4.6.5 The Flood and Water Management Act 2010 [R17] seeks to manage water risks in connection with flooding and coastal erosion.

4.6.6 The Directive 2000/60/EC [R20] of the European Parliament (commonly referred to as the 'Water Framework Directive' or simply 'WFD') establishes a framework for community action in the field of water policy. This European Directive establishes a framework for the protection of inland surface waters (rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It aims to ensure that all water bodies maintain or establish 'good status' within the river basin planning cycle (six years). WFD has been transposed into English legislation via The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 [R34].

4.6.7 The Floods Directive [R21] provides a framework for the assessment and management of flood risks, providing a new approach to managing flood risk on a catchment wide scale. The Directive applies to all kinds of floods (river, lakes, flash floods, urban floods, coastal floods, including storm surges and tsunamis).

## 4.7 HS2 Technical Standards

- 4.7.1 Various surface water monitoring related Technical Standards and guidance documents have been developed by HS2.
- 4.7.2 The Water Resources and Flood Risk Monitoring Technical Standard [R22] prescribes the methodologies, processes and specifications that the contractor shall comply with in carrying out the works and implementing the various control measures for surface water. Other relevant technical standards include:
- Technical Standards - Water Framework Directive Compliance Process [R26];
  - Technical Standard - Watercourse Diversions and Realignment [R27];
  - Technical Standard - Water Resources and Flood Risk Consents and Approvals[R28];
  - Technical Standard - Water Resources [R29];
  - Technical Standard – Ecology [R30].

## 4.8 Undertakings and Assurances

- 4.8.1 Undertakings and Assurances (U&As) in relation to surface water monitoring exist both route-wide, and within Lots S1 and S2. Actions needed to fulfil and evidence applicable U&As will be set out in the SSECPs and briefed to site teams to ensure they are met. Evidence of compliance against U&As will be submitted by SCSJV to HS2 Ltd through Commitment Compliance Plans.
- 4.8.2 Surface water monitoring related U&As are captured in Appendix A of this document.
- 4.8.3 The Register of U&As [R6] details all commitments offered throughout the parliamentary process for the High-Speed Rail (London - West Midlands) Bill up until Royal Assent.
- 4.8.4 Undertakings and Assurances related to Lots S1 and S2 surface water include:
- Reducing the impacts and adverse effects on surface water [U&A Ref id. 2783].
  - Monitoring will be undertaken in consultation with the EA prior to and during construction, and if required post construction, to establish baseline conditions for surface water and groundwater and to confirm the effectiveness of temporary and permanent mitigation measures together with any remedial works deemed necessary [U&A Ref id. 2783].
- 4.8.5 The SCSJV and its sub-contractors will comply with the requirements and terms of U&As entered into by the nominated undertaker, as detailed in the "HS2 Register of Undertakings and Assurances" [R6] published by the Department for Transport or as otherwise notified. Specific details of such U&As, including requirements and terms, will be identified in the applicable SSECP.

## 4.9 Consents and licensing

- 4.9.1 Relevant consents and/or approvals under the Environmental Permitting Regime and Schedule 33 (Protective Provisions) Part 5 of the Act are identified in the SCSJV consents register [R7].
- 4.9.2 This is reviewed on a quarterly basis and updated to reflect changes in consent/approval application progress or changes in design/construction works.
- 4.9.3 Once consents and/or approvals have been gained where appropriate, the conditions will be briefed to the project teams and processes introduced to ensure compliance where relevant.
- 4.9.4 All proposed water monitoring locations will be submitted to HS2 for acceptance before works commence so that consents and agreements can be obtained from the relevant housing bodies, local authorities and any private asset holders.
- 4.9.5 Monitoring will not be undertaken until all written consents and agreements are in place and communicated accordingly.
- 4.9.6 The consent process for various water resources and flood risk consents is outlined in the Water Resources and Flood Risk Consents and Approvals Technical Standard [R23].
- 4.9.7 In addition to the statutory monitoring requirements, local planning authorities or the Canal and Rivers Trust (CRT) may also have their own specific requirements or expectations for surface water monitoring on ordinary watercourses and canals in their stewardship in relation to abstractions and discharges. It is recommended that monitoring proposals are discussed with the EA, Lead Local Flood Authorities (LLFA) and CRT prior to consent applications or works commencing.
- 4.9.8 Similarly, third parties may also have requirements or expectations for surface water monitoring where the project affects the assets they own and/or operate e.g. Thames Water drains and Ruislip Golf Course Drainage.
- 4.9.9 Any additional monitoring identified through discussion with third parties is recorded in this plan.

## 4.10 Contract Requirements Technical (CRTs)

- 4.10.1 This document looks to act as evidence in part to fulfil the contract requirement CRT-S1-1256 for S1 and CRT-S2-1254 for S2.

*"Water Resources and Flood Risk shall be monitored in accordance with Technical Standard – Water Resources and Flood Risk Monitoring Strategy (HS2-HS2-EV-STD-000-000029)."*

## 5 Surface water monitoring

### 5.1 Introduction

- 5.1.1 This plan follows the requirements established in the Water Resources and Flood Risk Monitoring Technical Standard [R22], by using the Monitoring Decision Trees supported by Advisory Sheets and the Water Resources and Flood Risk Monitoring Technical Standard<sup>1</sup> to define a Surface Water Monitoring Strategy to be followed before, during and after construction. This strategy will inform what should be measured, how, where, how often and for how long.
- 5.1.2 Other mandatory requirements, such as those included in CoCP, LEMPs, U&As and consents identified at the time of writing have also been considered in this plan. These have been included in relation to the current design of the HS2 Scheme in Area South.
- 5.1.3 This plan shall be reviewed further during detailed design to consider changes to temporary works during construction and their associated surface water monitoring proposals will be submitted to HS2 and the EA for agreement as a revised monitoring plan prior to commencement of any new monitoring associated with new temporary works. Water monitoring relating to the West Ruislip Golf Course redevelopment (subject to separate Town and Country Planning Act application) are not included in this plan, but will be incorporated as and when planning consent is granted for the scheme.

### 5.2 Information available from Enabling Works Contract (EWC)

- 5.2.1 Monthly surface water quality monitoring has been undertaken over a period of twelve months between June 2019 and May 2020 in Sector S2 (West Ruislip, Ickenham and Newyears Green areas) under the EWC as outlined in the EWC Surface Water Monitoring Plan [R33] and associated quality control documents referenced within.
- 5.2.2 The EWC monitoring points are similar to those proposed in this plan. Where the monitoring points are in the same location, the EWC data can be considered to be baseline monitoring data that can be used to inform the pre-construction baseline for the MWCC and help to determine the statistical range of data prior to any effects of construction activities.
- 5.2.3 A summary of EWC surface water monitoring points that overlap with SCS monitoring points is provided in Table 2.

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<sup>1</sup> Water Resources and Flood Risk Monitoring Technical Standard. Document no.: HS2-HS2-EV-STD-000-000029.



Table 2: Summary of SCS monitoring points that overlap with EWC monitoring points monitored by CSJV.

| SCS Reference    | CSJV Ref.*<br>(for info) | Watercourse                                   | Coordinates (approx.) |          |
|------------------|--------------------------|---|-----------------------|----------|
|                  |                          |   | Easting               | Northing |
| SWC-CFA06-03 (1) | ML023-SW203              | Ickenham Stream north of construction works   | 508030                | 187126   |
| SWC-CFA06-03 (2) | ML023-SW204              | Ickenham Stream at The Greenway               | 508008                | 186913   |
| SWC-CFA06-06 (2) | ML023-SW201              | River Pinn upstream of Golf Course            | 508053                | 187449   |
| SWC-CFA06-02 (1) | ML024-SW203              | River Pinn upstream of construction works     | 507457                | 187224   |
| SWC-CFA06-02 (2) | ML024-SW200              | River Pinn downstream of construction works   | 507351                | 187120   |
| SWC-CFA06-10 (1) | ML025-SW201              | Newyears Green Bourne upstream of Harvil Road | 506178                | 187815   |

\*Some CSJV points have been adjusted to accommodate construction works

## 5.3 Definition of surface water

- 5.3.1 For the purposes of this plan and the parallel Groundwater Monitoring Plan (1MCo3-SCJ-EV-PLN-S001-000030), surface water is defined as all water within watercourses (including both main rivers and ordinary watercourses) and ponds. No requirement for monitoring of springs has been identified in Area South.
- 5.3.2 Dewatering discharges from shafts in the construction phase will also be included as surface water and be included in the surface water monitoring, covered by this plan.

## 5.4 Phasing of monitoring

- 5.4.1 This version of the plan principally presents the proposals for remaining pre-construction phase monitoring and construction phase monitoring. The proposal for construction phase monitoring should be considered to be subject to change depending on how different construction activities progress. Therefore, the monitoring will have to be adaptable and reactive (e.g. frequencies and choice of parameters; number of ecology surveys) to changing conditions as construction progresses. However, the proposals for construction monitoring are detailed in Table 10.
- 5.4.2 To date, consultation with the Environment Agency and Affinity Water has been undertaken (January 2020; Section 5.7) with respect to the pre-construction phase monitoring. However, this plan now presents the proposal for construction phase monitoring locations, frequencies and risk-based monitoring suites. It is anticipated that these proposals may require further discussion to agree the construction phase monitoring proposal.
- 5.4.3 Post-construction phase monitoring has been populated in an indicative way at this stage and will be subject to change following the construction phase.

## 5.5 Management structure

Table 3: Roles and Responsibilities

| Roles  | Responsibilities  |
|--|---|
| SCS Surface Water Specialist                           | <ul style="list-style-type: none"> <li>• Responsible for review and update of this plan.</li> <li>• Responsible for liaison with stakeholders (Including the EA, CRT, Affinity Water and Lead Local Flood Authorities) with respect to this plan and future updates.</li> <li>• Responsible for establishing monitoring methodologies and specifications for the Surface Water Monitoring Contractor.</li> <li>• Responsible for quality control of monitoring data and checking quality assurance results for SCS, and submission of data to HS2 and the relevant authorities.</li> </ul>  |
| Investigation Supervisor (SCS Nominated Site Engineer) | <ul style="list-style-type: none"> <li>• Schedule the required monitoring activities with the Surface Water Monitoring Contractor as specified by the SCS Surface Water Specialist.</li> <li>• Liaise with the Surface Water Monitoring Contractor to arrange access to site.</li> <li>• Collate blank schedules, logs, calibration certificates, and monitoring results from the Surface Water Monitoring Contractor.</li> </ul>   |
| Surface Water Monitoring Contractor                    | <ul style="list-style-type: none"> <li>• Comply with the monitoring methodologies and specifications provided by the SCS Surface Water Monitoring Specialist, including compliance with relevant British Standards as prescribed.</li> <li>• Provide completed schedules and logs to the Investigation Supervisor within 24 hours of the monitoring activities.</li> <li>• Provide copies of calibration certificates for any equipment used for surface water monitoring to the Investigation Supervisor (e.g. the hand-held physico-chemical probe).</li> <li>• Liaise with the Investigation Supervisor to arrange access to site.</li> <li>• Undertake surface water monitoring activities on site.</li> <li>• Provide monitoring results to the Investigation Supervisor in a format that complies with HS2 / SCS data reporting requirements within one week of the monitoring activity occurring.</li> <li>• Follow SCS procedures and protocols on site for assessing risk, identifying hazards and reporting incidents.</li> </ul> |

## 5.6 Description of the works

- 5.6.1 HS2 Phase One MWCC works in the SCSJV scope, covers 26.8 km from Euston Station in the London Borough of Camden to Ickenham in the London Borough of Hillingdon. It involves the construction of tunnels, vents shafts, bridges and other structures along the route. SCSJV cover a range of design and construction activities including utility diversions, excavation, ground works, shaft construction, temporary works, highway construction, tunnelling, demolition and

building works and logistics. The SCSJV works divided into two sectors (S1 Euston to Old Oak Common and S2 Old Oak common to West Ruislip).

5.6.2 The SCSJV programme of works used to develop this plan was 'HS2 - MWCC Area South Stage Two\_Issued For Gateway 5' (HS2-SCS-MWCC-SOUTH-ST2\_009a).

## 5.7 Technical Standard requirements

5.7.1 The decision trees in the Water Resource and Flood Risk Monitoring Technical Standard [R22] have been applied (see Appendix B). These decision trees have two parts. Each part analyses specific impacts identified in different assessments:

- Part 1: Water Framework Directive (WFD) assessments carried out for the affected water bodies in the HS2 ES and the Supplementary Environmental Statements (SES), listed in Table 4.
- Part 2: Community Forum Areas site-specific water resources assessments also set out in the HS2 ES and the SES.

5.7.2 The latest version of the HS2 WFD Assessment Reports [R35] (1MCo3-SCJ\_SDH-EV-REP-S001-000001 and 1MCo3-SCJ\_SDH-EV-REP-S002-000001) based on the detailed WFD Assessment tables (1MCo3-SCJ\_SDH-EV-ASM-S000-000001 and 1MCo3-SCJ\_SDH-EV-ASM-S000-000002), have been considered in this plan. Water Framework Directive Scale Impacts require monitoring measures for blue, yellow, amber and red effects. Monitoring measures required are detailed in Technical Standard (TS) Advisory Sheets (see Appendix B).

5.7.3 The water bodies identified in the WFD assessments are shown in Table 4 alongside their associated CFAs.

Table 4: WFD Water Bodies affected by the project

| Water Body ID                      | Surface Water Body Name  | CFA           | Catchments |
|------------------------------------|--|---------------|------------|
| GB70610078                         | Grand Union Canal, Uxbridge to Hanwell Locks, Slough Arm, Paddington Arm | 1, 2, 3, 4, 5 | N/A        |
| GB106039023590                     | River Brent (below Silk stream down to the Thames)                       | 4, 5          | London     |
| GB106039023030                     | River Crane (including part of the Yeading Brook)                        | 5             | London     |
| GB106039023051<br>(GB106039023050) | Yeading Brook (East Arm)   | 5, 6          | London     |
| GB106039023051<br>(GB106039023060) | Yeading Brook (West Arm)   | 5, 6          | London     |
| GB106039023070                     | River Pinn   | 5, 6          | Colne      |

5.7.4 The identified affected elements (blue, yellow, amber or red effect type) in each Water Body from the HS2 Routewide WFD Compliance Assessment are listed in Table 5. Additional detail

on how this was used to determine an aquatic ecology monitoring strategy is shown in Appendix C.

Table 5: Summary of affected elements of the project for each WFD Water Body

| WFD Water Body ID                  | ES (as amended) point      | Location   | Potential anticipated risk to WFD Ecological Status   | TS Advisory Sheet applicable |
|------------------------------------|----------------------------|--|---|------------------------------|
| GB70610078                         | SWC-CFA03-01               | Grand Union Canal at Gloucester Avenue (near Euston Approach)                              | Noise and vibration impact  | SW4                          |
| GB70610078                         | SWC-CFA04-01               | Grand Union Canal at South of Saint Mary's Catholic Cemetery (east Old Oak Common Station) | Noise and vibration impact on fish  | SW4                          |
| GB70610078                         | SWC-CFA05-04               | Grand Union Canal at East Mandeville Vent Shaft  | Noise and vibration impact  | SW4                          |
| GB106039023590                     | SWC-CFA05-01               | River Brent  | Noise and vibration impact  | SW4                          |
| GB106039023030                     | N/A                        | N/A  | N/A   | N/A                          |
| GB106039023051<br>(GB106039023050) | SWC-CFA6-01                | Yeading Brook East   | Noise and vibration impact  | SW4                          |
| GB106039023051<br>(GB106039023060) | SWC-CFA6-04<br>SWC-CFA6-05 | Yeading Brook West   | Noise and vibration impact  | SW4                          |
| GB106039023070                     | SWC-CFA06-02               | River Pinn   | Noise and vibration impact<br>Shading impact on Macrophytes and Phytobentos<br>Hydromorphological impacts on Dissolved Oxygen and Specific Pollutants<br>Drainage impact on Dissolved Oxygen, Phosphate and Specific Pollutants | SW1, SW2, SW3 and SW4        |
| GB106039023070                     | SWC-CFA6-03                | Ickenham Stream  | Landtake impact on Macrophytes, Phytobentos, Macroinvertebrates and Fish<br>Hydromorphology impact on Dissolved Oxygen, Phosphate, Specific Pollutants, River Flow  | SW1, SW2, SW3, SW4 and SW5   |

| WFD Water Body ID | ES (as amended) point                                  | Location                         | Potential anticipated risk to WFD Ecological Status  | TS Advisory Sheet applicable |
|-------------------|--|----------------------------------|--|------------------------------|
|                   |  |                                  | Dynamics, and River Bed Structure and Substrate<br><br>Creation of new habitat impact on Dissolved Oxygen,   |                              |
| GB106039023070    | SWC-CFA6-03  | Ickenham Stream                  | Creation of new habitat providing benefits to on Macrophytes, Phytobentos, Macroinvertebrates and Fish   | SW2, SW3, and SW4            |
| GB106039023070    | SWC-CFA6-07  | Ickenham East Tributary          | Landtake impact on Macrophytes, Phytobentos, Macroinvertebrates and Fish<br><br>Hydromorphology impact on Dissolved Oxygen, Phosphate, Specific Pollutants, River Flow Dynamics, and River Bed Structure and Substrate<br><br>Creation of new habitat impact on Dissolved Oxygen | SW1, SW2, SW3, SW4 and SW5   |
| GB106039023070    | SWC-CFA6-07  | Ickenham East Tributary          | Creation of new habitat benefits for Macrophytes, Phytobentos, Macroinvertebrates and Fish   | SW2, SW3, and SW4            |
| GB106039023070    | SWC-CFA6-06  | West Ruislip Golf Drains         | Landtake impact on Macrophytes, Phytobentos, Macroinvertebrates and Fish<br><br>Hydromorphology impact on Dissolved Oxygen, Phosphate, Specific Pollutants, River Flow Dynamics, and River Bed Structure and Substrate<br><br>Creation of new habitat impact on Dissolved Oxygen | SW1, SW2, SW3, SW4 and SW5   |
| GB106039023070    | SWC-CFA6-06  | West Ruislip Golf Drains         | Creation of new habitat to benefit Macrophytes, Phytobentos, Macroinvertebrates and Fish   | SW2, SW3, and SW4            |
| GB106039023070    | SWC-CFA06-P05 being replaced by NP-1 (1), (2) and (3). | 3 Ponds West Ruislip Golf Course | Creation of new habitat impact on Dissolved Oxygen   | SW1                          |

5.7.5 Site Scale Impacts require monitoring when the magnitude of impact is greater than “Negligible” or very low risk. Level of impact greater than “Negligible” or very low risk in the relevant CFAs of the MWCC scope anticipated are summarised in Table 6. Monitoring measures required are detailed in TS Advisory Sheets (see Appendix B).

Table 6: Site Scale impacts greater than Negligible identified in the different CFAs

| CFA   | ES (as amended) ID                        | Location   | Impact Description   | Residual Impact | TS Advisory Sheet applicable   |
|-------|---|--|--|-----------------|--|
| CFA06 | SWC-CFA6-03                               | Ickenham Stream  | Cutting for surface railway and diversion. Ickenham Stream will be severed and diverted into a new channel to the north of the route to flow into the River Pinn | Minor           | SW1, SW2, SW3, SW4 and SW5   |
| CFA06 | SWC-CFA6-08<br>SWC-CFA6-09<br>SWC-CFA6-10 | Brackenbury Farm ponds and moat<br>South-east of Newyears Green Covert pond<br>Newyears Green Bourne | Newyears Green ponds and field drainage. Coverage of 4 ponds that are isolated from other surface water features   | Moderate        | SW1 for Ponds in SWC-CFA06-08 and 09.<br>SW1 for Newyears Green Bourne SWC-CFA06-10. |

5.7.6 A summary of monitoring according to the Technical Standards is provided in Table 7.

Table 7: Summary of identified surface water monitoring locations after the application of the Technical Standard

|    | ES (as amended) ID | Location   | Snake Grid Coordinates |          | British National Grid |            |
|----|--------------------|--|------------------------|----------|-----------------------|------------|
|    |                    |  | Easting                | Northing | Easting               | Northing   |
| 1  | SWC-CFA03-01       | Grand Union Canal at Gloucester Avenue (near Euston Approach)                              | 290,837                | 289,478  | 528,438               | 183,984    |
| 2  | SWC-CFA04-01       | Grand Union Canal at South of Saint Mary's Catholic Cemetery (east Old Oak Common Station) | 284,978                | 287,927  | 522,625               | 182,274    |
| 3  | SWC-CFA05-04       | Grand Union Canal at East Mandeville Vent Shaft  | 272,677                | 291,909  | 510,223               | 185,918    |
| 4  | SWC-CFA05-01       | River Brent  | 279,501                | 288,372  | 517,139               | 182,569    |
| 5  | SWC-CFA06-01       | Yeading Brook East   | 273,912                | 290,948  | 511,483               | 184,991    |
| 6  | SWC-CFA06-04       | Yeading Brook West   | 272,677                | 291,909  | 510,223               | 185,918    |
| 7  | SWC-CFA06-05       | Yeading Brook West   | 272,632                | 291,837  | 510,170               | 185,844    |
| 8  | SWC-CFA06-02 (1)   | River Pinn (upstream bridge)   | 269,887                | 293,282  | 507,397               | 187,213    |
| 9  | SWC-CFA06-02 (2)   | River Pinn (downstream bridge)   | 269,839                | 293,220  | 507,351               | 187,150    |
| 10 | SWC-CFA06-02 (3)   | River Pinn upstream of Golf Course   | 269,839                | 293,190  | 508,053               | 187,449    |
| 11 | SWC-CFA06-03 (1)   | Ickenham Stream (upstream diversion proposed)  | 270,601                | 293,148  | 508,114               | 187,099    |
| 12 | SWC-CFA06-03 (2)   | Ickenham Stream (downstream bridge)  | 270,496                | 293,037  | 508,012               | 186,985    |
| 13 | SWC-CFA06-07       | Ickenham East Tributary  | 270,923                | 292,936  | 508,442               | 186,896    |
| 14 | SWC-CFA06-P05 (1)  | Existing Pond 1 West Ruislip Golf Course   | 270,469                | 293,261  | 507,979.14            | 187,208.31 |
| 15 | SWC-CFA06-P05 (2)  | Existing Pond 2 West Ruislip Golf Course   | 270,508                | 293,073  | 508,023.26            | 187,021.50 |
| 16 | SWC-CFA06-P05 (3)  | Existing Pond 3 West Ruislip Golf Course   | 270,665                | 293,020  | 508,181.61            | 186,972.82 |
| 17 | NP-1 (1)           | New Pond 1 West Ruislip Golf Course  | 270,534                | 293,223  | 507,979.10            | 187,208.30 |
| 18 | NP-1 (2)           | New Pond 2 West Ruislip Golf Course  | 270,518                | 293,150  | 508,023.30            | 187,021.50 |
| 19 | NP-1 (3)           | New Pond 3 West Ruislip Golf Course  | 270,841                | 293,121  | 508,181.60            | 186,972.80 |
| 20 | SWC-CFA06-06       | West Ruislip Golf Drains   | 270,355                | 293,458  | 507,859.83            | 187,402.07 |
| 21 | SWC-CFA06-08 (1)   | Brackenbury Farm north pond 1  | 269,442                | 293,302  | 506,951.65            | 187,221.21 |
| 22 | SWC-CFA06-08 (2)   | Brackenbury Farm north pond 2  | 269,397                | 293,312  | 506,906.41            | 187,229.97 |
| 23 | SWC-CFA06-08 (3)   | Moat in Brackenbury Farm   | 269,440                | 293,202  | 506,952.39            | 187,121.21 |
| 24 | SWC-CFA06-09       | South-east of Newyears Green Covert pond   | 269,831                | 293,582  | 507,332.76            | 187,511.67 |
| 25 | SWC-CFA06-10 (1)   | Newyears Green Bourne (upstream bridge)  | 268,724                | 293,950  | 506,216               | 187,849    |
| 26 | SWC-CFA06-10 (2)   | Newyears Green Bourne (downstream bridge)  | 268,543                | 293,856  | 506,038               | 187,750    |
| 27 | SWN-A              | Grand Union Canal at Atlas Road Logistics Tunnel   | 283,703                | 288,466  | 521,336               | 182,778    |

Table 7: Summary of identified surface water monitoring locations after the application of the Technical Standard

|    | ES (as amended) ID | Location   | Snake Grid Coordinates |          | British National Grid |          |
|----|--------------------|--|------------------------|----------|-----------------------|----------|
|    |                    |  | Easting                | Northing | Easting               | Northing |
| 28 | SWN-B              | Grand Union Canal at North of Greenpark Way Vent Shaft | 277,992                | 289,776  | 515,593               | 183,931  |
| 29 | SWN-C              | Northern Sustainable Placement Areas                   | 269,033                | 294,156  | 506,520               | 188,064  |
| 30 | SWN-D              | Northern Sustainable Placement Areas                   | 269,266                | 294,413  | 506,745               | 188,327  |
| 31 | SWN-E              | Northern Sustainable Placement Areas                   | 269,326                | 294,261  | 506,810               | 188,176  |
| 32 | SWN-F              | Northern Sustainable Placement Areas                   | 270,069                | 294,488  | 507,546               | 188,424  |
| 33 | SWN-G              | Southern Sustainable Placement Areas                   | 269,240                | 292,474  | 506,772               | 186,388  |
| 34 | SWN-H              | Southern Sustainable Placement Areas                   | 269,354                | 292,747  | 506,879               | 186,664  |
| 35 | SWN-I              | Southern Sustainable Placement Areas                   | 268,842                | 293,007  | 506,360               | 186,910  |

5.7.7 It is important to note that all monitoring points, except SWC-CFA6-08, 09 & 10, are a result of the application of Surface Water Decision Tree Part 1 (WFD). SWC-CFA6-08, 09 & 10 monitoring points have been included as a result of the application of Surface Water Decision Tree Part 2.

5.7.8 See Decision Tree applied in Appendix B and description of monitoring measures required in TS Advisory Sheets (see Appendix B).

### Code of Construction Practice (CoCP) requirements

5.7.9 The Water Resources and Flood Risk Monitoring Technical Standard [R22] also requires the MWCC to consider CoCP measures relating to surface water monitoring. According to the CoCP, SCSJV and its sub-contractors are required to:

- prepare and implement surface water monitoring plans as part of their EMS;
- undertake monitoring for watercourses affected by construction works or the discharge of surface water run-off;
- implement water quality monitoring during pre-construction (to establish a baseline) and during construction to check:
  - the effectiveness of mitigation measures to limit pollution risk,
  - identify pollution incidents (spillages and leakages) or suspected pollution incidents, and
  - the effectiveness of treatment and other sustainable drainage systems measures to be determined.



- 5.7.10 Post-construction monitoring is not a requirement in the CoCP. The CoCP only requires monitoring during pre-construction and construction phases relating to activities associated with the working areas and compounds.
- 5.7.11 The monitoring established in the Water Resources and Flood Risk Monitoring Technical Standard [R22] has to be extended to the working areas and compounds that could impact the mentioned water bodies and to the surface water run-off discharge points.
- 5.7.12 In line with the CoCP, all construction areas will require pre-construction and construction water quality monitoring for surface drainage run-off and dewatering discharges. Monitoring requirements should be agreed with the receptor of the discharges, e.g. Thames Water Utilities Limited, the Canal and Rivers Trust and the EA. As particular agreement for each discharge point has not yet been agreed, monitoring frequency and parameter requirements from the Water Resources and Flood Risk Monitoring Technical Standard [R22] will be applied until more detailed information is available for each specific point. Water quality monitoring proposed would fulfil CoCP requirements (monitoring for Temperature, pH, DO, BOD, COD, suspended solids, nitrate, ammonium, chlorophyll, hardness, copper, zinc, major and trace ions, etc.).
- 5.7.13 Watercourses with possible impacts (direct dewatering, discharges or other pollution sources like dust, hydrocarbons or suspended sediments) during construction, include:
1. Grand Union Canal at Euston Area;
  2. Old Oak Common Area (near Willesden Euro Terminal Compound Hoarding and Atlas Road Logistics Tunnel Compound Hoarding);
  3. North of Greenpark Way Ventilation Shaft; and
  4. Southwest of Mandeville Road Ventilation Shaft (direct water discharges, dewatering or pollution sources like dust, hydrocarbons or suspended sediments).
- 5.7.14 Fish monitoring as per the WFD Scale Impacts of the Surface Water Decision Tree of the Technical Standard have already been considered for the following:
1. Grand Union Canal at Euston Area;
  2. Old Oak Common Area (west of Old Oak Station;
  3. south of Saint Mary's Catholic Cemetery); and
  4. south west Mandeville Road Shaft.
- 5.7.15 Therefore, to fulfil the requirements of the HS2 CoCP, it will be necessary to undertake the following monitoring (to be confirmed through consultation with the Canal & Rivers Trust):
1. Grand Union Canal at Atlas Road Logistics Tunnel and Willesden Euro Terminal Compounds – preconstruction and construction additional quality and ecology monitoring;

2. Atlas Road Logistic Tunnel Compound – temporary surface water drainage will be discharged into the canal at the point (SWN-A) shown in Figure 1;
3. Grand Union Canal north of Greenpark Way Ventilation Shaft; preconstruction and construction additional quality and ecology monitoring. Temporary discharge of the dewatering from Greenpark Way Ventilation Shaft construction will be at the point shown in Figure 2 (SWN-B); and
4. Grand Union Canal south west of Mandeville Road Ventilation Shaft preconstruction and construction additional quality and ecology monitoring. Temporary discharge of dewatering from Mandeville Road Ventilation Shaft construction will be at the point shown in Figure 3 (SWC-CFA05-04).

Figure 1: CoCP quality and ecology monitoring location at Grand Union Canal, near the Atlas Road Logistic Tunnel (ARLT) and Willesden Euro Terminal compounds (SWN-A)

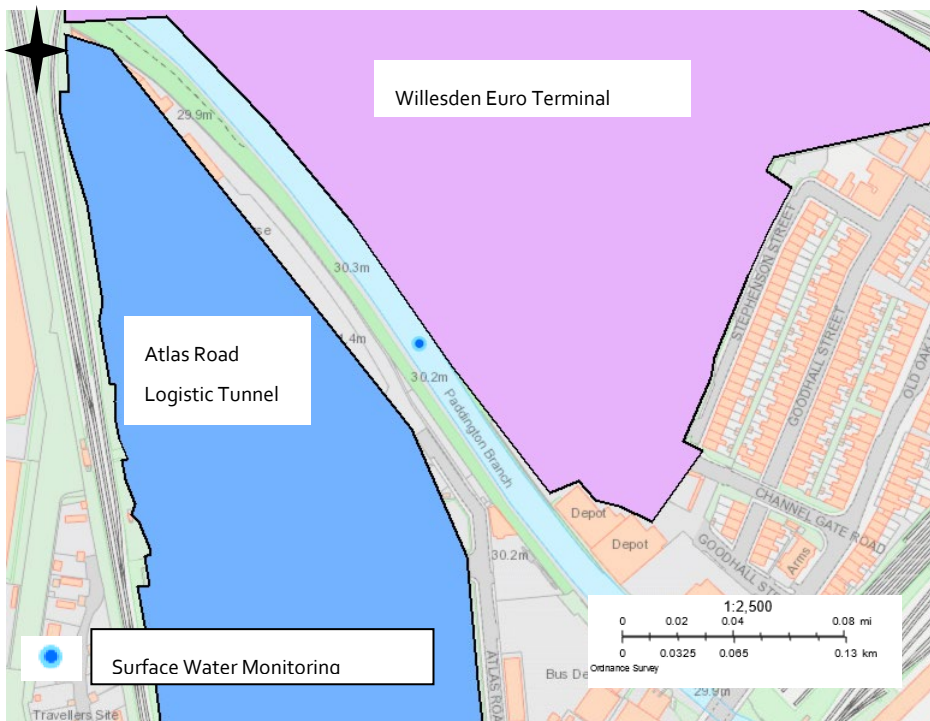


Figure 2: CoCP quality and ecology monitoring location at Grand Union Canal, north of the Greenpark Way Ventilation Shaft (SWN-B)

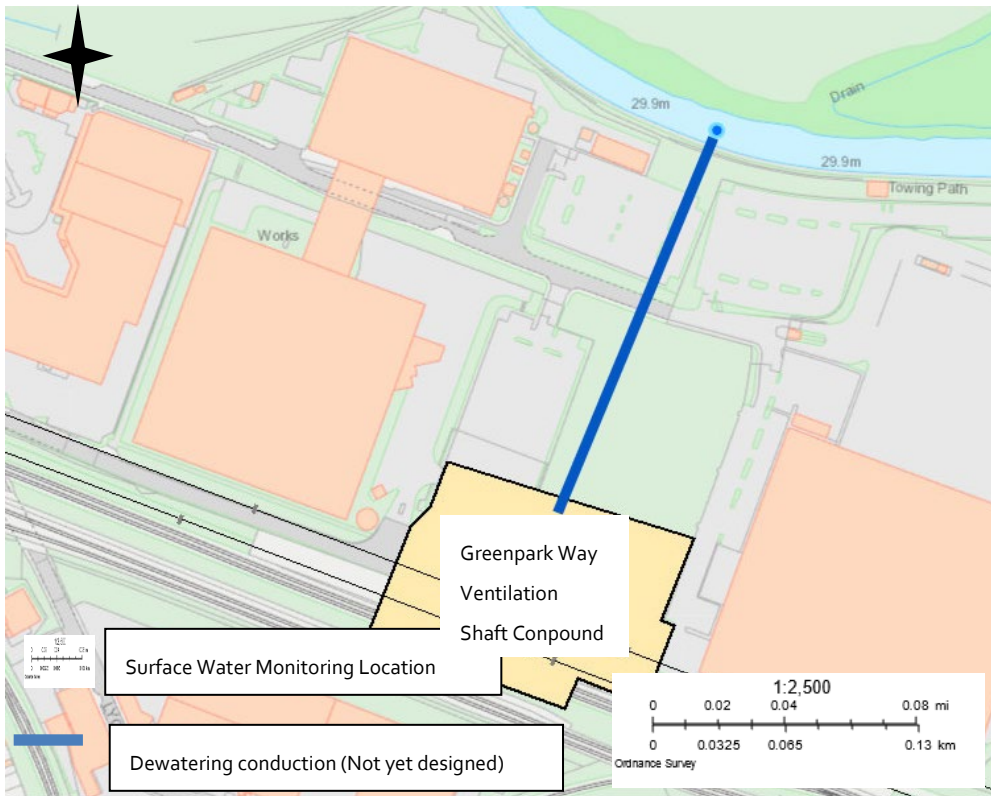
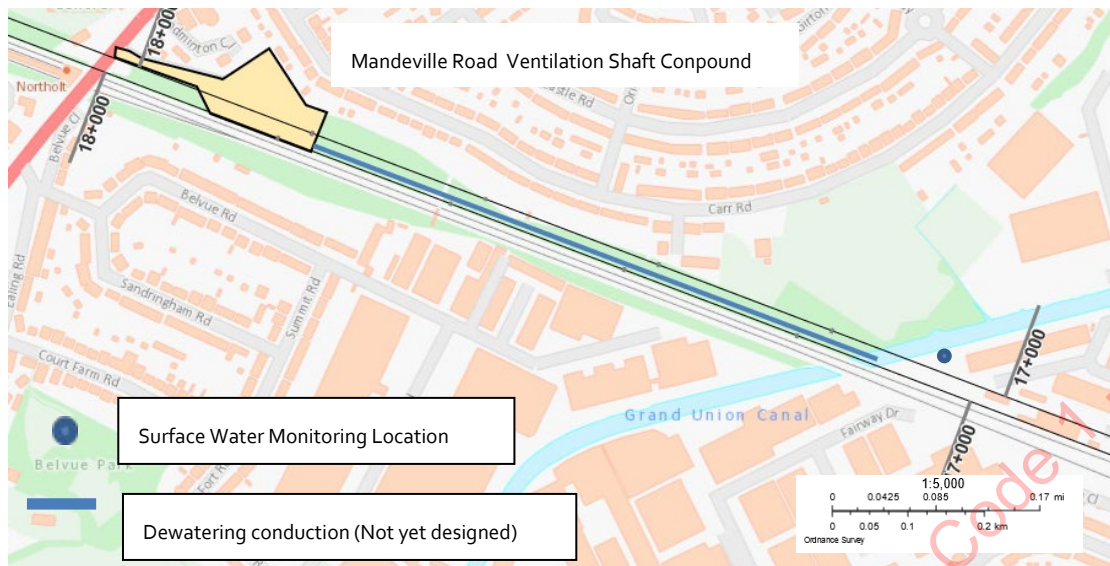


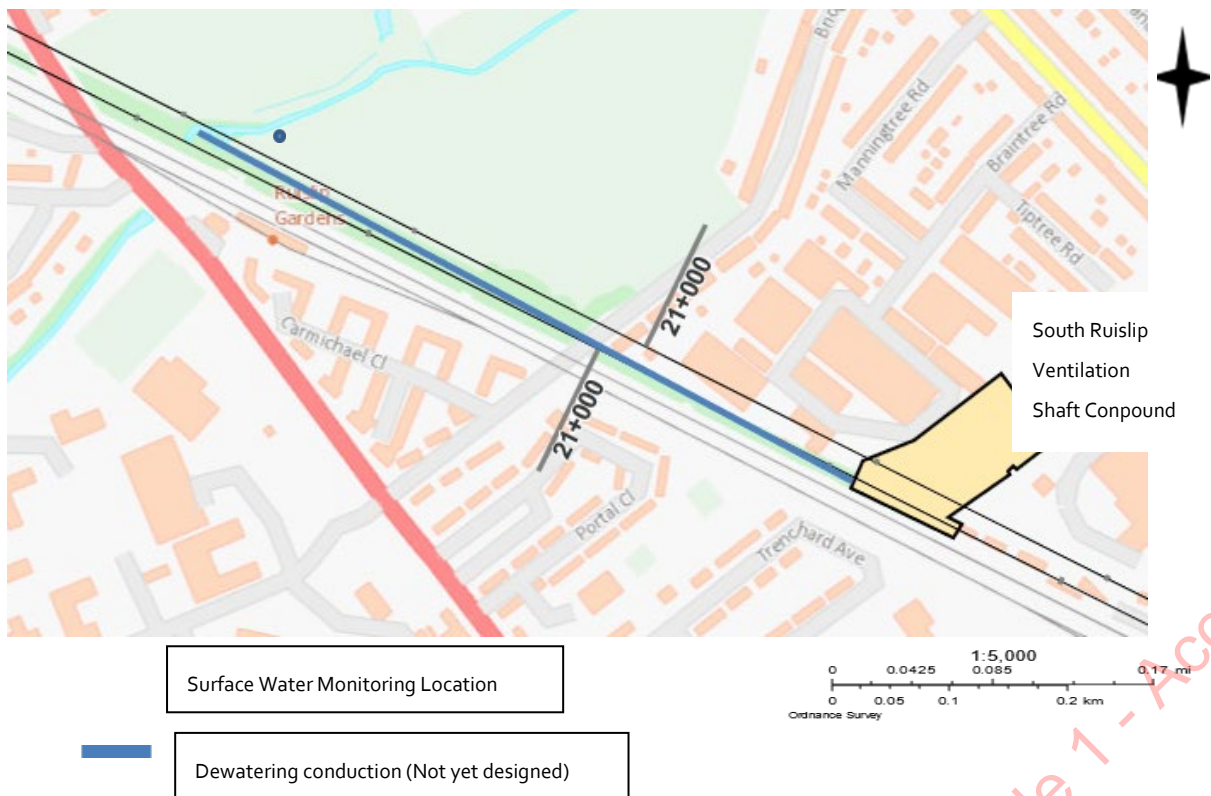
Figure 3: CoCP quality and ecology monitoring location at Grand Union Canal, south west of Mandeville Road Ventilation Shaft (SWC-CFA05-04)



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- 5.7.16 **River Brent at Westgate Ventilation Shaft area** (direct water discharges or other pollution sources like dust, hydrocarbons or suspended sediments). Already considered as per the WFD Scale Impacts of the Surface Water Decision Tree of the Technical Standard: fish monitoring in River Brent. For CoCP fulfilment, it will be necessary to complete the already considered monitoring as following: preconstruction and construction additional quality and ecology monitoring.
- 5.7.17 **Yeading Brook and River Crane at South Ruislip Ventilation Shaft** (direct water discharges or other pollution sources like dust, hydrocarbons or suspended sediments). Already considered as per the WFD Scale Impacts of the Surface Water Decision Tree of the Technical Standard: fish monitoring in Yeading Brook East (SWC-CFA06-01) and River Yeading Brook West (SWC-CFA06-04 and SWC-CFA06-05).
- 5.7.18 **Yeading Brook West (SWC-CFA06-04 and SWC-CFA06-05):** preconstruction and construction additional quality and ecology monitoring. Temporary discharge of dewatering from South Ruislip Ventilation Shaft construction will be at the point shown in Figure 4.

Figure 4: CoCP quality and ecology monitoring location at Yeading Brook West, west of South Ruislip Ventilation Shaft (SWC-CFA06-04 and SWC-CFA06-05)

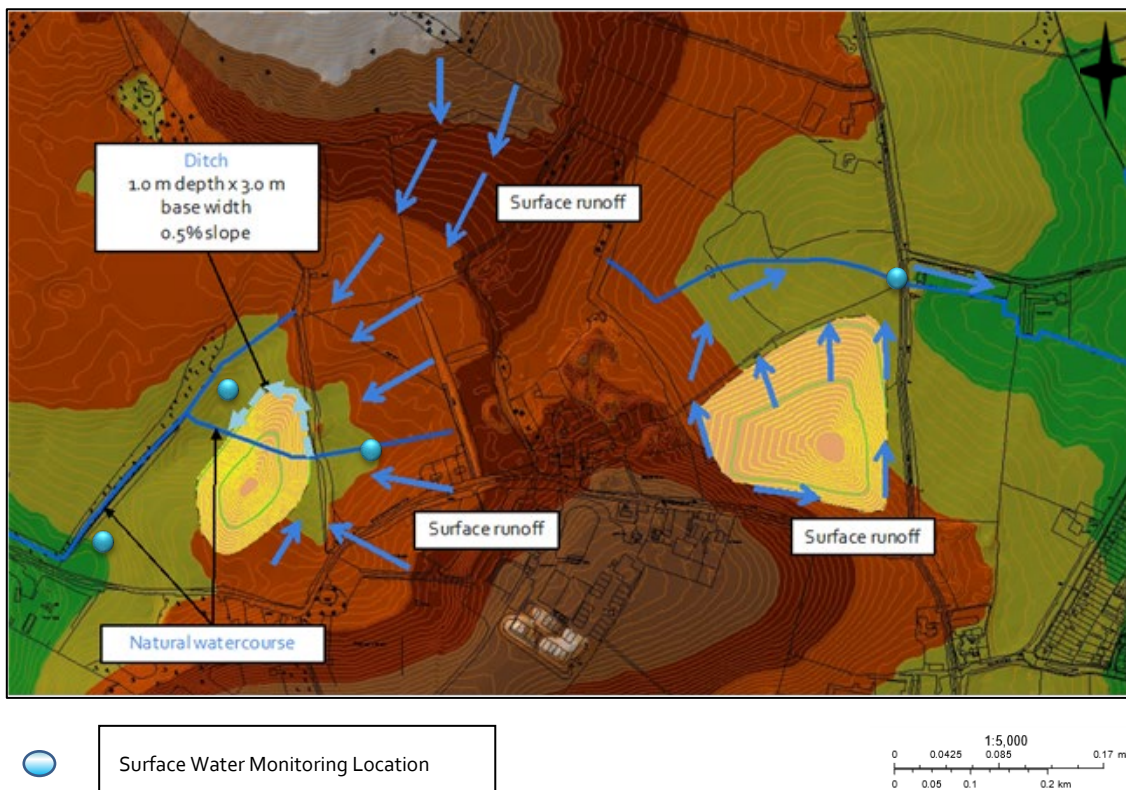


- 5.7.19 **River Pinn and Ickenham Stream at West Ruislip Area** (direct water discharges from West Ruislip Portal Compound, Breakspear Road Compound and Green Trough Compound or other

pollution sources like dust, hydrocarbons or suspended sediments) already have quality monitoring, aquatic ecology monitoring (including fish), as per the WFD Scale Impacts.

- 5.7.20 **River Pinn.** No additional monitoring is required as the River Pinn already has quality monitoring, aquatic ecology monitoring (including fish), proposed as per the WFD Scale Impacts up-stream and down-stream the projected underbridge (SWC-CFA06-02).
- 5.7.21 **Ickenham Stream.** Due to the location of the West Ruislip Portal Compound, the Ickenham stream needs to be re-diverted but **no additional monitoring will be necessary** as Ickenham East Tributary (SWC-CFA06-07) already has quality monitoring, aquatic ecology monitoring (including fish), proposed as per the WFD Scale Impacts.
- 5.7.22 **Northern Sustainable Placement Areas.** Run-off discharges during construction. Due to the Sustainable Placement Areas extension four additional monitoring locations are proposed (Figure 5).

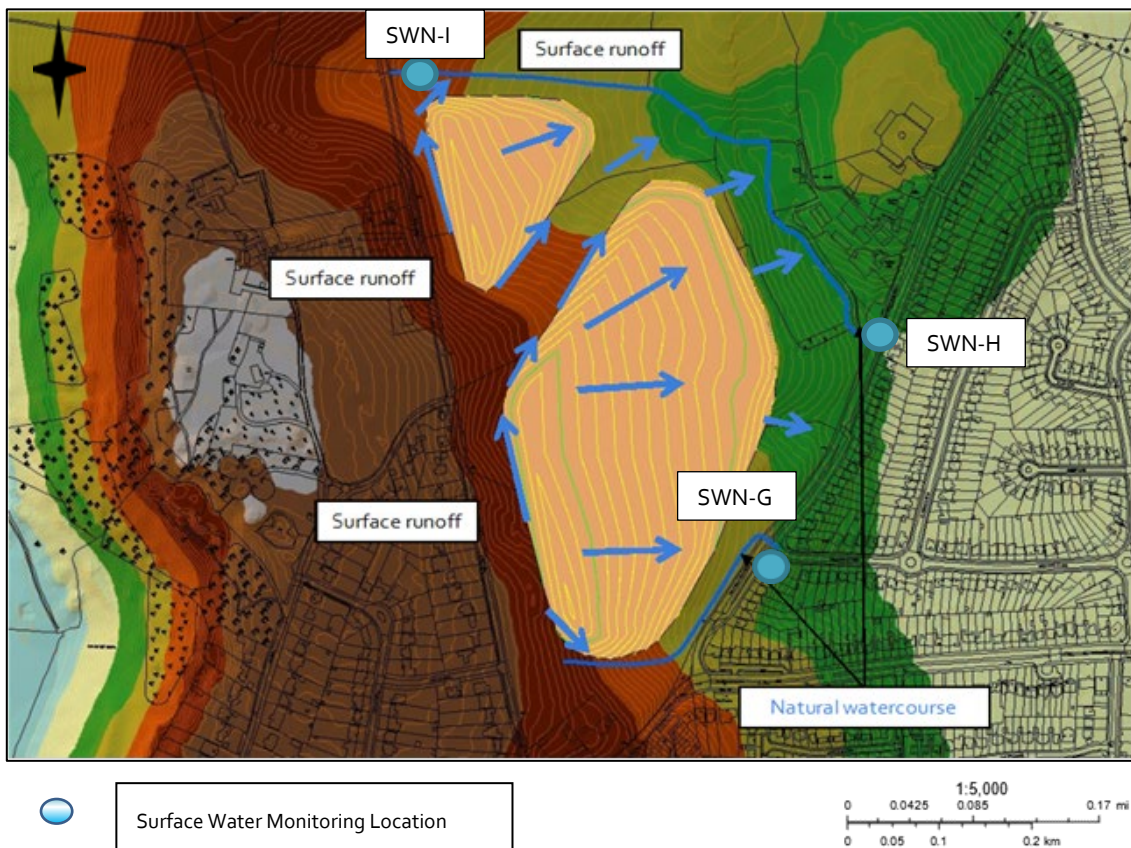
Figure 5: CoCP monitoring locations (shown as blue circles) for the Northern Sustainable Placement Areas (SWN-C, D, E & F)



- 5.7.23 **Southern Sustainable Placement Areas.** Due to the Sustainable Placement Areas extension two additional monitoring locations are proposed (Figure 6).

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Figure 6: Additional monitoring locations (shown as blue circles) at Southern Sustainable Placement Areas (SWN-G, H & I)



5.7.24 Table 8 identifies the monitoring proposed in relation to compound and construction activities.

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Table 8: Proposed CoCP monitoring

| Location            | River Brent  | Grand Union Canal at Atlas Road Logistics Tunnel and Willesden Euro Terminal Compounds   | Grand Union Canal north of Greenpark Way Ventilation Shaft   | Grand Union Canal south west of Mandeville Road Ventilation Shaft   | Yeading Brook West:   | Sustainable Placement Areas   |
|---------------------|--|--|--|---|---|---|
| Element             | SWC-CFA05-01   | SWN-A  | SWN-B  | SWC-CFA05-04  | SWC-CFA06-04 and SWC-CFA06-05   | SWN-C, D, E, F, G, H and I  |
| Figure              | No figure  | Figure 1   | Figure 2   | Figure 3  | Figure 4  | Figures 5 & 6   |
| Monitoring required | Additional aquatic ecology monitoring during pre-construction, construction and post-construction <sup>1</sup> | Additional aquatic ecology monitoring during pre-construction, construction and post-construction <sup>1</sup><br><br>Quality monitoring pre-construction and discharge only during construction | Additional aquatic ecology monitoring during pre-construction, construction and post-construction <sup>1</sup><br><br>Quality monitoring pre-construction and discharge only during construction | Additional aquatic ecology monitoring during pre-construction, construction and post-construction <sup>1</sup><br><br>Quality monitoring pre-construction and discharge only during construction. | Additional aquatic ecology monitoring during pre-construction, construction and post-construction <sup>1</sup><br><br>Quality monitoring pre-construction and discharge only during construction. | Additional quality and aquatic ecology monitoring during preconstruction and construction |

Notes:

<sup>1</sup> Post-construction monitoring is not a CoCP requirement but has been included based on professional judgement by an Aquatic Ecology Specialist.

## Local Environmental Management Plan requirements

5.7.25 More sensitive local surface water resources receptors previously identified in the LEMPs (4.1.12) have been analysed to check if they could be potentially affected by the project:

### London Borough of Camden

5.7.26 *Grand Union Canal (Regent's Canal) - the route will pass in tunnel under the Grand Union Canal (Regent's Canal) at Fitzroy Bridge on Gloucester Avenue, Primrose Hill.* Quality and aquatic ecology monitoring (including fish) at this point (SWC-CFA03-01) were identified as a result of the WFD Scale Impacts and CoCP. No additional monitoring is proposed. Following a site visit to the survey point (SWC-CFA03-01) by the contractor undertaking the aquatic ecology monitoring, fish surveys at this location were removed from the monitoring plan based on the H&S risks posed by the general public and boat traffic. All other ecology surveys (macrophytes, phytobenthos and macroinvertebrates) will be undertaken at this location.

5.7.27 *Three small ornamental landscaped ponds located close to Fitzroy Road and Regent's Park Road near Primrose Hill.* These ornamental ponds are located far from the HS2 tunnels (more than 300m) and from the Adelaide Road compound (more than 500m). As a result, impacts from the MWCC activities are considered to be negligible and no monitoring is proposed.

- 5.7.28 *One Hampstead Theatre pond, 20m north of the Scheme, near Winchester Road.* This pond is situated 20m north of HS2 tunnels but as activities from the MWCC in this area will be underground, therefore impacts are considered to be negligible and no monitoring is proposed.

#### **London Borough of Hammersmith and Fulham**

- 5.7.29 *Artificial water bodies, including: Grand Union Canal (Paddington Arm).* The only water body identified as being affected by the works in the Borough is Grand Union Canal that crosses the HS2 line in the Old Oak Common Station area between Kensal Green Cemetery, Saint Mary's Catholic Cemetery and the Old Oak Common Station. Fish monitoring is required as a result of the WFD Scale Impacts (point SWC-CFA04-01). No additional monitoring proposals are considered necessary to fulfil LEMP requirements at this location.

#### **London Borough of Brent**

- 5.7.30 *Surface watercourses, including River Brent.* The S2 Northolt Tunnel will be constructed and operate beneath the borough south limit and Westgate Ventilation Shaft, located in the Borough of Ealing, is very close (approximately 50m) of the River Brent, just by the limit of both Boroughs (Ealing and Brent). Monitoring in River Brent has been considered included in Borough of Ealing as it is proposed as a result of discharges from Westgate Ventilation Shaft. No additional monitoring proposals are considered necessary to fulfil LEMP requirements at this location.
- 5.7.31 *Artificial water bodies, including: Grand Union Canal (Paddington Arm).* The Grand Union Canal in the London Borough of Brent is situated a minimum distance of 300m from the main works and compounds and new quality and aquatic-ecology monitoring has been already considered as a result of the CoCP at Atlas Road Logistics Tunnel and Willesden Euro Terminal Compounds in Borough of Ealing. No additional monitoring proposals are considered necessary to fulfil LEMP requirements at this location.

#### **London Borough of Ealing**

- 5.7.32 *Surface water features, including: River Brent (a Main river); several ponds at Park Royal, Lord Halsbury Memorial Playing Fields, Ealing Golf Course and Horsenden Hill; a number of drains and unnamed watercourses.* Quality and aquatic ecology monitoring (including fish) at River Brent (SWC-CFA05-01) are required as a result of the WFD Scale Impacts and CoCP requirements. No additional monitoring proposals are considered necessary to fulfil the LEMP requirements at this location.
- 5.7.33 *The HS2 line of route will be in tunnel in the areas near Park Royal, Lord Halsbury Memorial Playing Fields, Ealing Golf Course and Horsenden Hill.* No construction compounds are proposed to be situated near these ponds. As a result, impacts from the MWCC activities on these ponds are considered to be negligible so no monitoring is proposed.
- 5.7.34 *Artificial water bodies, including: Grand Union Canal (Paddington Arm).* Fish monitoring is required as a result of the WFD Scale Impacts south west of Mandeville Ventilation Shaft (SWC-



CFA05-04) and to fulfil CoCP requirements it would be also necessary to include quality and aquatic-ecology monitoring for construction and pre-construction due to discharges from construction compound. No additional monitoring proposals are considered necessary to fulfil LEMP requirements at this location.

- 5.7.35 CoCP requirement identify a proposal to monitor a location north of Greenpark Way Ventilation Shaft with quality and aquatic-ecology monitoring during preconstruction and construction. Therefore, no additional monitoring proposals are considered necessary to fulfil the LEMP requirements at this location.

#### **City of Westminster**

- 5.7.36 *Artificial water bodies, including: Grand Union Canal (Paddington Arm).* The Grand Union Canal is situated a minimum of 400m away from the main works in the City of Westminster Borough. As a result, impacts from the MWCC activities are considered to be negligible so no monitoring is proposed.

#### **London Borough of Hillingdon**

- 5.7.37 *Surface water features: Yeading Brook (East and West Arms), Ickenham Stream and tributaries, River Pinn, Newyears Green Bourne, River Colne, Grand Union Canal, Harefield No.2 Lake, Savay Lake and unnamed pond adjacent to Savay Lake, Korda Lake, Harefield Moor Lake, Long Pond, Broadwater Lake Nature Reserve, one small pond at Lord Halsbury Memorial Playing Fields, two drains and one small pond at Ruislip Manor, several small ponds and drains at Ruislip Golf Course, three small drains and pond south east of Newyears Green covert, and numerous small ponds within 1km radius of the Scheme.* Fish monitoring at Yeading Brook is required as a result of the WFD Scale Impacts (SWC-CFA06-01, SWC-CFA06-04 and SWC-CFA06-05). Additional quality and aquatic-ecology monitoring during pre-construction and construction is required as a result of the CoCP application for SWC-CFA06-04 and SWC-CFA06-05. River Pinn monitoring is required as a result of the WFD Scale Impacts (SWC-CFA06-02). Ickenham Stream monitoring is required as a result of the WFD Scale Impacts (SWC-CFA06-03 and SWC-CFA06-07). Newyears Green Bourne monitoring is required as a result of the WFD Scale Impacts (SWC-CFA06-10). Small ponds and drains at Ruislip Golf Course monitoring is required as a result of the WFD Scale Impacts (SWC-CFA06-06, CFA6-P05, NP-1). Monitoring of the small drains and pond south east of Newyears Green Covert and the small ponds a minimum of 30m from the main works activities are required as a result of the WFD Scale Impacts (SWC-CFA06-08 and SWC-CFA06-09). Finally, a total of 6 monitoring points are required around the Northern Sustainable Placement (4) and the Southern Sustainable Placement (2). The monitoring proposed also fulfils the LEMP requirements.
- 5.7.38 River Colne, Harefield Lake, Savay Lake, ponds adjacent to Savay Lake, Korda Lake, Harefield Moor Lake, Long Pond, Broadwater Lake Nature Reserve are situated in the C1 contract boundary outside of the S2 scope. The Grand Union Canal is situated a minimum of 800m from the main works activities within the London Borough of Hillingdon. As a result, impacts from

the MWCC activities are considered to be negligible so no monitoring is proposed. One small pond at Lord Halsbury Memorial Playing Fields, two drains and one small pond at Ruislip Manor are also a minimum of 100m from the main works activities in the London Borough of Hillingdon, in this area the MWCC activities will be underground, so no monitoring is proposed.

- 5.7.39 Water dependent habitats: River Colne, adjacent flooded gravel pits (including Savay Lake which is an important fishery), the Grand Union Canal and the Mid-Colne Valley SSSI.
- 5.7.40 The River Colne and the Savay Lake habitats are situated in the C1 contract boundary and outside of the S2 scope. As explained above, the Grand Union Canal is a minimum of 800m from the main works activities in the London Borough of Hillingdon. As a result, impacts from the MWCC activities are considered to be negligible so no monitoring is proposed.

### **Royal Borough of Kensington and Chelsea**

- 5.7.41 *Artificial water bodies, including: Grand Union Canal (Paddington Arm).* The Grand Union Canal (Paddington Arm) is located 25m of the main works south of Kensal Cemetery in the Royal Borough of Kensington and Chelsea. A monitoring point is identified as a result of the WFD Scale Impacts (SWC-CFA04-01). As the MWCC activities will be underground no additional monitoring is proposed.
- 5.7.42 Therefore, monitoring requirements from the LEMPs are considered to be fulfilled with the monitoring location, typology and frequencies proposed after applying Technical Standard and CoCP.

## **Undertakings & Assurances**

- 5.7.43 The Register of U&As [R6] details all commitments offered throughout the parliamentary process for the High-Speed Rail (London - West Midlands) Bill up until Royal Assent. Those relevant to surface water monitoring in the S1 and S2 geographic contract areas have been included in Appendix A.

## **Consultation on SCSJV pre-construction surface water monitoring proposal**

- 5.7.44 SCSJV consulted HS2 and the Environment Agency on 22 January 2020 on its pre-construction monitoring proposal following implementation of the HS2 technical standards, WFD monitoring requirements, LEMPs and HS2 CoCP requirements. A summary of the agreed monitoring requirements for water quality is given in Table 9.
- 5.7.45 The agreed outcomes of the consultation discussion were used to refine the pre-construction and construction monitoring plan presented in Table 10.
- 5.7.46 Water level and flow monitoring was discussed with the Environment Agency during the consultation meeting. No need could be identified for surface water quantitative monitoring in relation to the HS2 MWCC construction works in Area South. It was agreed that there is no

requirement for flood risk or flood level monitoring in Area South because an HS2 fluvial hydraulic model has been developed for the River Pinn, Ickenham Stream and Newyears Green Bourne, which predicts the baseline and predicts the flood levels and any changes in flood risk that result from the HS2 scheme.

5.7.47 The aquatic ecology monitoring was not discussed in the consultation as these were not available at the time of the consultation. However, the aquatic ecology monitoring has been devised based on professional judgement from an Aquatic Ecology Specialist.

Table 9: Summary of pre-construction water quality monitoring agreed with the Environment Agency.

| Ref.         | Watercourse  | Monitor (Y/N) | Justification  |
|--------------|--|---------------|--|
| SWC-CFA03-01 | Grand Union Canal at Gloucester Avenue                                 | N             | No pathway with tunnelling works. No surface works in close proximity.   |
| SWC-CFA04-01 | Grand Union Canal at South of Saint Mary's Catholic Cemetery           | N             | No pathway with tunnelling works. No surface works in close proximity.   |
| SWN-A        | Grand Union Canal at ARLT/WET  | Y             | Adjacent WET/ARLT compounds. Quality monitoring only.  |
| SWC-CFA05-01 | River Brent  | N             | No pathway with tunnelling works. No surface works in close proximity. <b>(C03 Revision amendment:</b> River Brent will receive discharge of shaft dewatering and package treatment plant effluent from welfare facility, so monitoring shall continue). |
| SWN-B        | Grand Union Canal at North of Greenpark Way Vent Shaft                 | Y             | Dewatering discharge. Quality monitoring only.   |
| SWC-CFA05-04 | Grand Union Canal at East Mandeville Vent Shaft                        | Y             | Dewatering discharge. Quality monitoring only.   |
| SWC-CFA06-01 | Yeading Brook East   | Y             | Potential dewatering discharge. Single point quality monitoring only.  |
| SWC-CFA06-04 | Yeading Brook West   | Y             | Dewatering discharge. Single point quality monitoring only.  |
| SWC-CFA06-05 | Yeading Brook West   | Y             | Dewatering discharge. Single point quality monitoring only.  |
| SWC-CFA06-07 | Ickenham East Tributary  | Y             | Discharge from Thames Water Surface Water sewer with previously identified contamination. Quality monitoring only.   |
| CFA6-P05     | 3 Existing Ponds West Ruislip Golf Course                              | N             | Ponds to be permanently backfilled. No monitoring required.  |
| NP-1         | 3 Ponds New West Ruislip Golf Course                                   | n/a           | New ponds n/a pre-construction   |
| SWC-CFA06-03 | 2 on Ickenham Stream (at The Greenway and north of construction works) | Y             | Watercourse diversion works. Water quality monitoring required. Flood risk monitoring not required. Known solids in Network Rail discharge may be identified at The Greenway.  |
| SWC-CFA06-06 | Ickenham Stream at confluence with Pinn                                | Y             | Quality monitoring required associated with restoration works on Golf Course.  |

| Ref.         | Watercourse  | Monitor (Y/N) | Justification   |
|--------------|--|---------------|---|
| SWC-CFA06-02 | 2 on River Pinn (within 50m US/DS of works)            | Y             | Permanent and temporary bridges, dewatering and SW discharges. Quality monitoring only.   |
| SWC-CFA6-09  | South-east of Newyears Green Covert pond               | N             | No pathway with works identified.   |
| SWC-CFA6-08  | Brackenbury Farm 2 Ponds + 1 Moat                      | Y             | Adjacent materials treatment facility. Monitor Moat only due to potential linkage with downstream waterbodies and Pinn. Water quality only.             |
| SWN-G, H     | SPA South  | Y             | Significant earthworks proposed. Water quality only to be monitored if discernible watercourse can be identified as may be overland SW only.            |
| SWC-CFA6-10  | Newyears Green Bourne (within 50m US/DS of works)      | Y             | Culverting or bridge over existing watercourse. Water quality monitoring required. Flood risk monitoring not required.                                  |
| SWN-C, D, E  | 3 points on NYG Bourne and tributary at SPA North-West | Y             | Earthworks and watercourse diversion works proposed. Water quality monitoring only.   |
| SWN-F        | SPA North-East   | Y             | Significant earthworks proposed. Water quality only to be monitored if discernible watercourse can be identified as may be overland surface water only. |

## Summary of SCSJV Surface water monitoring planned

- 5.7.48 SCSJV propose to undertake the resulting surface water monitoring activities identified from the application of the Water Resources and Flood Risk Monitoring Technical Standard [R22], CoCP, LEMPs and U&A's is deemed appropriate for MWCC activities.
- 5.7.49 For the pre-construction monitoring, some of the monitoring locations identified by implementation of the technical standard (Table 7) have been removed or amended based on further assessment of location, hydrogeology, hydrology and the potential pathways of contamination and consultation with HS2 and the EA (as outlined in Table 9).
- 5.7.50 For the construction and any postconstruction monitoring, the monitoring proposals in this plan are to be agreed with HS2, the EA and other identified stakeholders (including the Canal & Rivers Trust/ Affinity Water/ Lead Local Flood Authority where appropriate). This will be revised prior to the commencement of the construction phase in consultation with the relevant stakeholders.
- 5.7.51 Table 10 presents the consolidated surface water monitoring activities proposed for the SCSJV works to achieve compliance.
- 5.7.52 The locations of surface water quality monitoring points together with the driver for monitoring and the HS2 scheme phases in which each will be monitored is illustrated in Figures 7 and 8.
- 5.7.53 The locations of aquatic ecology monitoring points together with the driver for monitoring and the HS2 scheme phases in which each will be monitored is illustrated in Figures 9 and 10.

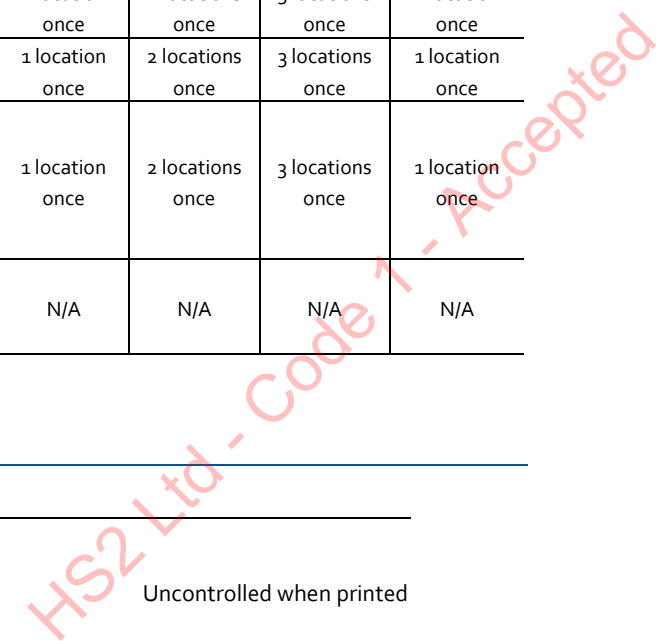
Table 10: SCSJV consolidated surface water monitoring proposal considering WFD, CoCP and LEMP requirements, as well as Environment Agency consultation.

| Description       | Grand Union Canal at Gloucester Avenue | Grand Union Canal at South of Saint Mary's Catholic Cemetery | Grand Union Canal at East Mandeville Vent Shaft | Grand Union Canal at ARLT/WET | Grand Union Canal at North of Greenpark Way Vent Shaft | River Brent     | Yeading Brook West Upstream | Yeading Brook West Downstream | Yeading Brook East | River Pinn         | Ickenham Stream    | West Ruislip Golf Drains | Ickenham East Tributary | 3 Ponds West Ruislip Golf Course                          | 3 Ponds New West Ruislip Golf Course  | Brackenbury Farm Moat and Brackenbury Farm North Ponds 1 and 2 | SPA South   | South-east of Newyears Green Covert pond | Newyears Green Bourne | 3 points on NYG Bourne and tributary at SPA North-West | SPA North-East |
|-------------------|--|--|---|-------------------------------|--|-----------------|-----------------------------|-------------------------------|--------------------|--------------------|--------------------|--------------------------|-------------------------|---|---------------------------------------|--|-------------|--|-----------------------|--|----------------|
| Element           | SWC-CFA03-01                           | SWC-CFA04-01   | SWC-CFA05-04                                    | SWN-A                         | SWN-B  | SWC-CFA05-01    | SWC-CFA06-04                | SWC-CFA06-05                  | SWC-CFA06-01       | SWC-CFA06-02 (1-3) | SWC-CFA06-03 (1-2) | SWC-CFA06-06             | SWC-CFA06-07            | SWC-CFA06-P05 (1-3) (ponds eliminated in New Golf Course) | NP-1 (3 new ponds in New Golf Course) | SWC-CFA06-08 (3) and SWC-CFA06-08 (1-2)                        | SWN-G, H, I | SWC-CFA06-09                             | SWC-CFA06-10 (1-2)    | SWN-C, D, E  | SWN-F          |
| WFD Water Body ID | GB70610078                             | GB70610078   | GB70610078                                      | GB70610078                    | GB70610078   | GB106039023 590 | GB106039023 060             | GB106039023 060               | GB106039023 060    | GB106039023 070    | GB106039023 070    | GB106039023 070          | GB106039023 070         | GB106039023 070   | GB106039023 070                       | N/A  | N/A         | N/A                                      | N/A                   | N/A  | N/A            |

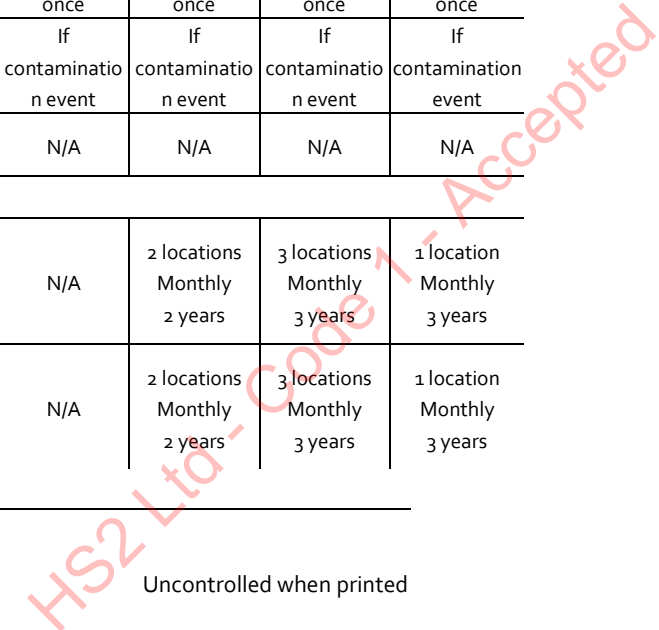
| Pre-construction           |  |                 |                              |                              |                              |                              |                              |                              |                              |                               |                               |                              |                              |     |     |  |                               |                 |                               |                               |                              |
|----------------------------|--|-----------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|-----|-----|--|-------------------------------|-----------------|-------------------------------|-------------------------------|------------------------------|
| Quality-spot sampling      | N/A  | N/A             | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 3 locations Monthly 12 months | 2 locations Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | N/A | N/A | 1 location (moat only) Monthly 12 months | 3 locations Monthly 12 months | N/A             | 2 locations Monthly 12 months | 3 locations Monthly 12 months | 1 location Monthly 12 months |
| Quality-visual inspection  | N/A  | N/A             | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 3 locations Monthly 12 months | 2 locations Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | N/A | N/A | 1 location (moat only) Monthly 12 months | 3 locations Monthly 12 months | N/A             | 2 locations Monthly 12 months | 3 locations Monthly 12 months | 1 location Monthly 12 months |
| Quality-field measurements | N/A  | N/A             | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | 3 locations Monthly 12 months | 2 locations Monthly 12 months | 1 location Monthly 12 months | 1 location Monthly 12 months | N/A | N/A | 1 location (moat only) Monthly 12 months | 3 locations Monthly 12 months | N/A             | 2 locations Monthly 12 months | 3 locations Monthly 12 months | 1 location Monthly 12 months |
| Quality-meteorology        | N/A  | N/A             | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                           | N/A                           | N/A                          | N/A                          | N/A | N/A | N/A                                      | N/A                           | N/A             | N/A                           | N/A                           | N/A                          |
| Flow                       | N/A  | N/A             | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                           | N/A                           | N/A                          | N/A                          | N/A | N/A | N/A                                      | N/A                           | N/A             | N/A                           | N/A                           | N/A                          |
| Level                      | N/A  | N/A             | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                           | N/A                           | N/A                          | N/A                          | N/A | N/A | N/A                                      | N/A                           | N/A             | N/A                           | N/A                           | N/A                          |
| Macrophytes                | 1 location once  | N/A             | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | N/A                          | 3 locations once              | 2 locations once              | 1 location once              | 1 location once              | N/A | N/A | 3 locations once                         | 3 locations once              | 1 location once | 2 locations once              | 3 locations once              | 1 location once              |
| Phytobenthos               | 1 location once  | N/A             | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | N/A                          | 3 locations once              | 2 locations once              | 1 location once              | 1 location once              | N/A | N/A | 3 locations once                         | 3 locations once              | 1 location once | 2 locations once              | 3 locations once              | 1 location once              |
| Macroinvertebrates         | 1 location once  | N/A             | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | N/A                          | 3 locations once              | 2 locations once              | 1 location once              | 1 location once              | N/A | N/A | 3 locations once                         | 3 locations once              | 1 location once | 2 locations once              | 3 locations once              | 1 location once              |
| Fish                       | Removed from monitoring plan based on H&S grounds <sup>2</sup> | 1 location once | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 1 location once              | 3 locations once              | 2 locations once              | 1 location once              | 1 location once              | N/A | N/A | 3 locations once                         | 3 locations once              | 1 location once | 2 locations once              | 3 locations once              | 1 location once              |
| Hydromorphology            | N/A  | N/A             | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                          | N/A                           | 1 location 500m once          | N/A                          | N/A                          | N/A | N/A | N/A                                      | N/A                           | N/A             | N/A                           | N/A                           | N/A                          |

Construction

<sup>2</sup> following a site visit to the survey point (SWC-CFA03-01) by the contractor undertaking the aquatic ecology monitoring, fish surveys at this location were removed from the monitoring plan based on the H&S risks posed by the general public and boat traffic.



| Description                            | Grand Union Canal at Gloucester Avenue | Grand Union Canal at South of Saint Mary's Catholic Cemetery | Grand Union Canal at East Mandeville Vent Shaft | Grand Union Canal at ARLT/WET               | Grand Union Canal at North of Greenpark Way Vent Shaft | River Brent                  | Yeading Brook West Upstream | Yeading Brook West Downstream               | Yeading Brook East                          | River Pinn                                | Ickenham Stream             | West Ruislip Golf Drains    | Ickenham East Tributary     | 3 Ponds West Ruislip Golf Course                          | 3 Ponds New West Ruislip Golf Course  | Brackenbury Farm Moat and Brackenbury Farm North Ponds 1 and 2 | SPA South                    | South-east of Newyears Green Cover pond | Newyears Green Bourne        | 3 points on NYG Bourne and tributary at SPA North-West | SPA North-East              |
|--|--|--|---|---|--|------------------------------|-----------------------------|---|---|---|-----------------------------|-----------------------------|-----------------------------|---|---------------------------------------|--|------------------------------|---|------------------------------|--|-----------------------------|
| Element                                | SWC-CFA03-01                           | SWC-CFA04-01   | SWC-CFA05-04                                    | SWN-A                                       | SWN-B  | SWC-CFA05-01                 | SWC-CFA06-04                | SWC-CFA06-05                                | SWC-CFA06-01                                | SWC-CFA06-02 (1-3)                        | SWC-CFA06-03 (1-2)          | SWC-CFA06-06                | SWC-CFA06-07                | SWC-CFA06-P05 (1-3) (ponds eliminated in New Golf Course) | NP-1 (3 new ponds in New Golf Course) | SWC-CFA06-08 (3) and SWC-CFA06-08 (1-2)                        | SWN-G, H, I                  | SWC-CFA06-09                            | SWC-CFA06-10 (1-2)           | SWN-C, D, E  | SWN-F                       |
| WFD Water Body ID                      | GB70610078                             | GB70610078   | GB70610078                                      | GB70610078                                  | GB70610078   | GB106039023590               | GB106039023060              | GB106039023060                              | GB106039023060                              | GB106039023070                            | GB106039023070              | GB106039023070              | GB106039023070              | GB106039023070  | GB106039023070                        | N/A  | N/A                          | N/A                                     | N/A                          | N/A  | N/A                         |
| Quality-spot sampling <sup>2</sup>     | N/A                                    | N/A  | Discharge only: 1 location Weekly (monthly)     | Discharge only: 1 location Weekly (monthly) | Discharge only: 1 location Weekly (monthly)            | 1 location Monthly 12 months | N/A                         | Discharge only: 1 location Weekly (monthly) | Discharge only: 1 location Weekly (monthly) | 3 locations Weekly (monthly) <sup>2</sup> | 1 location Weekly (monthly) | 1 location Weekly (monthly) | 1 location Weekly (monthly) | N/A   | 3 locations Weekly (monthly)          | 1 location (moat only) Weekly (monthly)                        | 3 locations Weekly (monthly) | N/A                                     | 2 locations Weekly (monthly) | 3 locations (NYG) Weekly (monthly)                     | 1 location Weekly (monthly) |
| Quality-visual inspection <sup>5</sup> | N/A                                    | N/A  | 1 location Daily                                | 1 location Daily                            | 1 location Daily                                       | 1 location Monthly 12 months | N/A                         | 1 location Daily                            | 1 location Daily                            | 3 locations Daily                         | 1 location Daily            | 1 location Daily            | 1 location Daily            | N/A   | 3 locations Weekly                    | 1 location (moat only) Daily                                   | 3 locations Daily            | N/A                                     | 2 locations Daily            | 3 locations (NYG) Daily                                | 1 location Daily            |
| Quality-field measurements             | N/A                                    | N/A  | Discharge only: 1 location Weekly (monthly)     | 1 location Weekly                           | 1 location Weekly                                      | 1 location Monthly 12 months | N/A                         | Discharge only: 1 location Weekly (monthly) | Discharge only: 1 location Weekly (monthly) | 3 locations Weekly                        | 1 location Weekly           | 1 location Weekly           | 1 location Weekly           | N/A   | 3 locations Weekly                    | 1 location (moat only) Weekly                                  | 3 locations Weekly           | N/A                                     | 2 locations Weekly           | 3 locations (NYG) Weekly                               | 1 location Weekly           |
| Quality-meteorology                    | N/A                                    | N/A  | N/A   | Daily                                       | Daily  | N/A                          | N/A                         | N/A   | N/A   | N/A                                       | N/A                         | N/A                         | N/A                         | N/A   | N/A                                   | N/A  | N/A                          | N/A                                     | N/A                          | N/A  | N/A                         |
| Flow                                   | N/A                                    | N/A  | N/A   | N/A   | N/A  | N/A                          | N/A                         | N/A   | N/A   | N/A                                       | N/A                         | N/A                         | N/A                         | N/A   | N/A                                   | N/A  | N/A                          | N/A                                     | N/A                          | N/A  | N/A                         |
| Level                                  | N/A                                    | N/A  | N/A   | N/A   | N/A  | N/A                          | N/A                         | N/A   | N/A   | N/A                                       | N/A                         | N/A                         | N/A                         | N/A   | N/A                                   | N/A  | N/A                          | N/A                                     | N/A                          | N/A  | N/A                         |
| Macrophytes <sup>4</sup>               | 1 location once                        | 1 location once  | 1 location once                                 | 1 location once                             | 1 location once  | 1 location once              | 1 location once             | 1 location once                             | 1 location once                             | 3 locations once                          | 1 location once             | 1 location once             | 1 location once             | N/A   | 3 locations once                      | N/A  | 3 locations once             | 1 location once                         | 2 locations once             | 3 locations once                                       | 1 location once             |
| Phytobenthos <sup>4</sup>              | 1 location once                        | 1 location once  | 1 location once                                 | 1 location once                             | 1 location once  | 1 location once              | 1 location once             | 1 location once                             | 1 location once                             | 3 locations once                          | 1 location once             | 1 location once             | 1 location once             | N/A   | 3 locations once                      | N/A  | 3 locations once             | 1 location once                         | 2 locations once             | 3 locations once                                       | 1 location once             |
| Macroinvertebrates <sup>4</sup>        | 1 location once                        | 1 location once  | 1 location once                                 | 1 location once                             | 1 location once  | 1 location once              | 1 location once             | 1 location once                             | 1 location once                             | 3 locations once                          | 1 location once             | 1 location once             | 1 location once             | N/A   | 3 locations once                      | N/A  | 3 locations once             | 1 location once                         | 2 locations once             | 3 locations once                                       | 1 location once             |
| Fish <sup>2</sup>                      | 1 location once                        | 1 location once  | 1 location once                                 | If contamination event                      | If contamination event                                 | 1 location once              | 1 location once             | 1 location once                             | 1 location once                             | 3 locations once                          | 2 locations once            | 1 location once             | 1 location once             | N/A   | If contamination event                | N/A  | If contamination event       | If contamination event                  | If contamination event       | If contamination event                                 | If contamination event      |
| Hydromorphology                        | N/A                                    | N/A  | N/A   | N/A   | N/A  | N/A                          | N/A                         | N/A   | N/A   | Point photography                         | Point photography           | Point photography           | Point photography           | N/A   | N/A                                   | N/A  | N/A                          | N/A                                     | N/A                          | N/A  | N/A                         |
| <b>Post Construction</b>               |  |  |   |   |  |                              |                             |   |   |   |                             |                             |                             |   |                                       |  |                              |   |                              |  |                             |
| Quality-spot sampling                  | N/A                                    | N/A  | N/A   | N/A   | N/A  | N/A                          | N/A                         | N/A   | N/A   | 3 locations Monthly 2 years               | 1 location Monthly 2 years  | 1 location Monthly 2 years  | 1 location Monthly 2 years  | N/A   | 3 locations Monthly 2 years           | 1 location (moat only) Monthly 2 years                         | 3 locations Monthly 3 years  | N/A                                     | 2 locations Monthly 2 years  | 3 locations Monthly 3 years                            | 1 location Monthly 3 years  |
| Quality-visual inspection              | N/A                                    | N/A  | N/A   | N/A   | N/A  | N/A                          | N/A                         | N/A   | N/A   | 3 locations Monthly 2 years               | 1 location Monthly 2 years  | 1 location Monthly 2 years  | 1 location Monthly 2 years  | N/A   | 3 locations Monthly 2 years           | 1 location (moat only) Monthly 2 years                         | 3 locations Monthly 3 years  | N/A                                     | 2 locations Monthly 2 years  | 3 locations Monthly 3 years                            | 1 location Monthly 3 years  |



| Description                | Grand Union Canal at Gloucester Avenue           | Grand Union Canal at South of Saint Mary's Catholic Cemetery | Grand Union Canal at East Mandeville Vent Shaft  | Grand Union Canal at ARLT/WET                    | Grand Union Canal at North of Greenpark Way Vent Shaft | River Brent                                      | Yeading Brook West Upstream                      | Yeading Brook West Downstream                    | Yeading Brook East                               | River Pinn  | Ickenham Stream   | West Ruislip Golf Drains                         | Ickenham East Tributary                          | 3 Ponds West Ruislip Golf Course                          | 3 Ponds New West Ruislip Golf Course              | Brackenbury Farm Moat and Brackenbury Farm North Ponds 1 and 2 | SPA South                   | South-east of Newyears Green Cover pond          | Newyears Green Bourneat SPA North-West | 3 points on NYG Bourne and tributary at SPA North-East | SPA North-East             |
|----------------------------|--|--|--|--|--|--|--|--|--|---|---|--|--|---|---|--|-----------------------------|--|--|--|----------------------------|
| Element                    | SWC-CFA03-01                                     | SWC-CFA04-01   | SWC-CFA05-04                                     | SWN-A  | SWN-B  | SWC-CFA05-01                                     | SWC-CFA06-04                                     | SWC-CFA06-05                                     | SWC-CFA06-01                                     | SWC-CFA06-02 (1-3)                                | SWC-CFA06-03 (1-2)  | SWC-CFA06-06                                     | SWC-CFA06-07                                     | SWC-CFA06-P05 (1-3) (ponds eliminated in New Golf Course) | NP-1 (3 new ponds in New Golf Course)             | SWC-CFA06-08 (3) and SWC-CFA06-08 (1-2)                        | SWN-G, H, I                 | SWC-CFA06-09                                     | SWC-CFA06-10 (1-2)                     | SWN-C, D, E  | SWN-F                      |
| WFD Water Body ID          | GB70610078                                       | GB70610078   | GB70610078                                       | GB70610078                                       | GB70610078   | GB106039023590                                   | GB106039023060                                   | GB106039023060                                   | GB106039023060                                   | GB106039023070                                    | GB106039023070  | GB106039023070                                   | GB106039023070                                   | GB106039023070  | GB106039023070                                    | N/A  | N/A                         | N/A  | N/A                                    | N/A  | N/A                        |
| Quality-field measurements | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | 3 locations Monthly 2 years                       | 1 location Monthly 2 years  | 1 location Monthly 2 years                       | 1 location Monthly 2 years                       | N/A   | 3 locations Monthly 2 years                       | 1 location (moat only) Monthly 2 years                         | 3 locations Monthly 2 years | N/A  | 2 locations Monthly 2 years            | 3 locations Monthly 2 years                            | 1 location Monthly 2 years |
| Quality-meteorology        | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A  | N/A                         | N/A  | N/A                                    | N/A  | N/A                        |
| Flow                       | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A  | N/A                         | N/A  | N/A                                    | N/A  | N/A                        |
| Level                      | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A   | N/A   | N/A  | N/A  | N/A   | N/A   | N/A  | N/A                         | N/A  | N/A                                    | N/A  | N/A                        |
| Macrophytes                | N/A  | N/A  | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 2 locations 1 year and 3 years after construction                       | 1 location 1 year and 5 years after construction | 1 location 1 year and 5 years after construction | N/A   | 3 locations 1 year and 5 years after construction | 3 locations 1 year and 5 years after construction              | N/A                         | 1 location 1 year and 5 years after construction | N/A <sup>3</sup>                       | N/A  | N/A                        |
| Phytobenthos               | N/A  | N/A  | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 2 locations 1 year and 3 years after construction                       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 3 locations 1 year and 3 years after construction | 3 locations 1 year and 3 years after construction              | N/A                         | 1 location 1 year and 3 years after construction | N/A <sup>3</sup>                       | N/A  | N/A                        |
| Macroinvertebrates         | N/A  | N/A  | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 2 locations 1 year and 3 years after construction                       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 3 locations 1 year and 3 years after construction | 3 locations 1 year and 3 years after construction              | N/A                         | 1 location 1 year and 3 years after construction | N/A <sup>3</sup>                       | N/A  | N/A                        |
| Fish                       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction             | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | 3 locations 1 year and 3 years after construction | 2 locations 1 year and 3 years after construction                       | 1 location 1 year and 3 years after construction | 1 location 1 year and 3 years after construction | N/A   | 3 locations 1 year and 3 years after construction | 3 locations 1 year and 3 years after construction              | N/A                         | 1 location 1 year and 3 years after construction | N/A <sup>3</sup>                       | N/A  | N/A                        |
| Hydromorphology            | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A  | N/A   | 1 location 500m 3 months, 1 year 3 years and 5 years after construction | N/A  | N/A  | N/A   | N/A   | N/A  | N/A                         | N/A  | N/A                                    | N/A  | N/A <sup>4</sup>           |

- <sup>1</sup>During construction, quality monitoring based on spot sampling will be weekly for core suite and monthly for full suite.
- <sup>2</sup>Based on Table 5, otherwise reactive monitoring following an incident if sufficient data available from pre-construction survey or if sensitive species present.
- <sup>3</sup>Scoped out unless adverse effect identified in the construction phase.
- <sup>4</sup>Subject to change depending on the outcome of the first construction phase survey.
- <sup>5</sup>To include monitoring point photographs on a weekly basis.

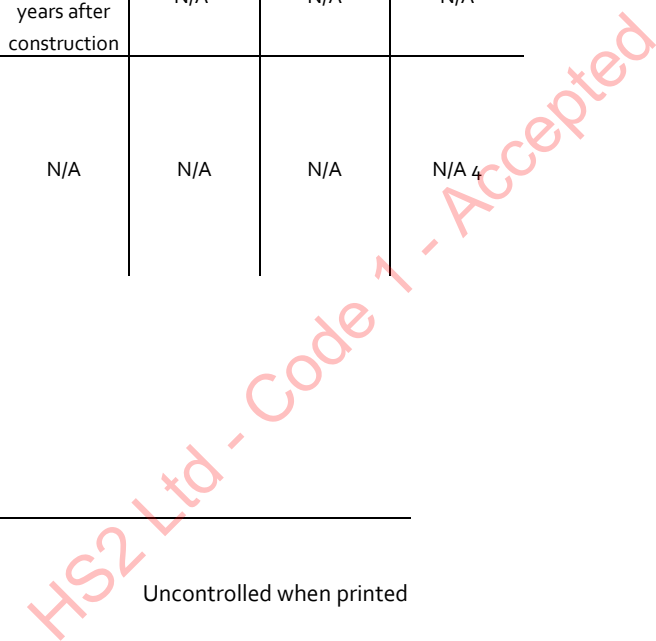
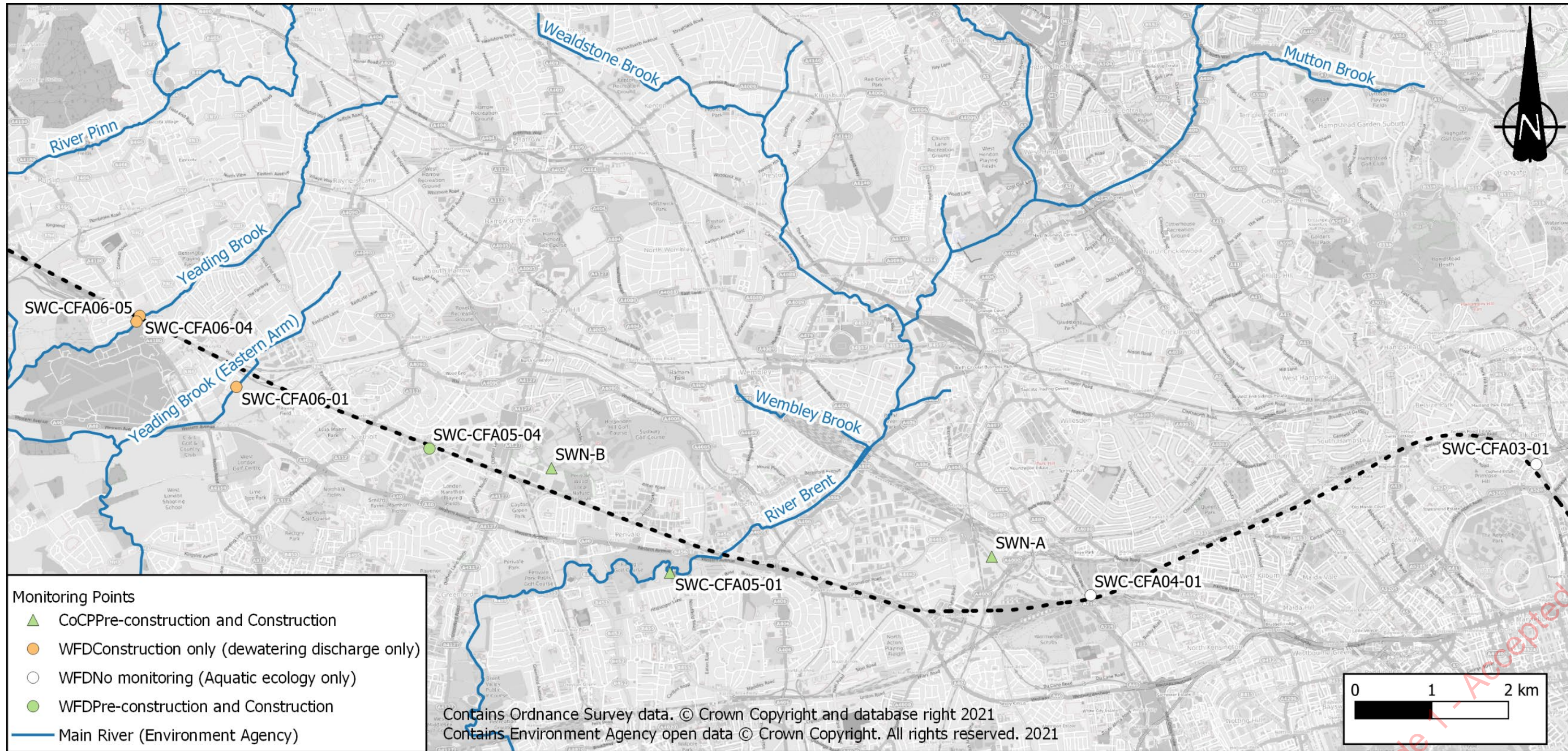


Figure 7: SCSJV Surface water quality monitoring proposal point locations in the S1 and S2 Hs2 project area



HS2 Ltd - Code 1 - Accepted



Figure 8: SCSJV Surface water quality monitoring point locations proposed in the Western Area (River Pinn, Ickenham Stream and Newyears Green Bourne)

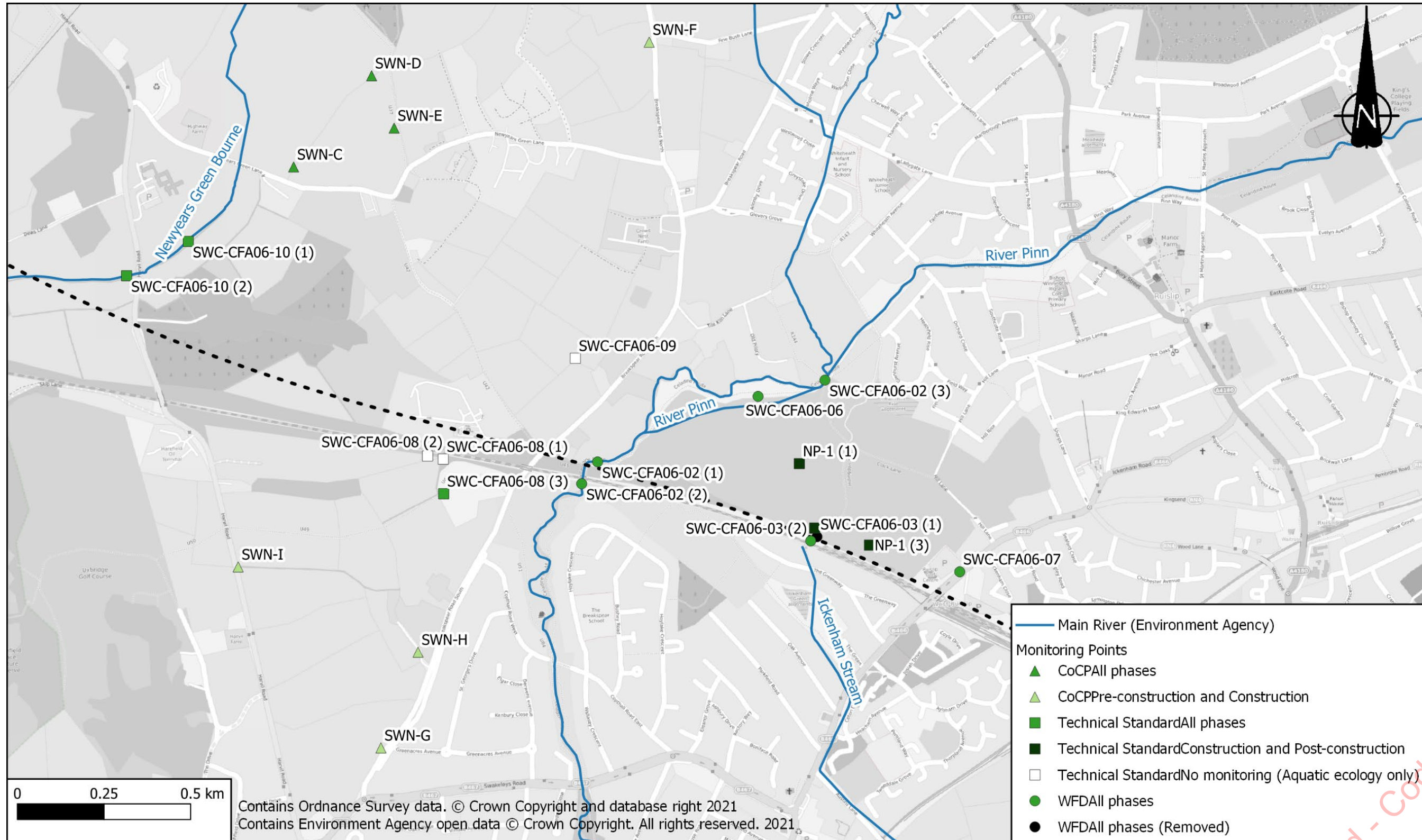
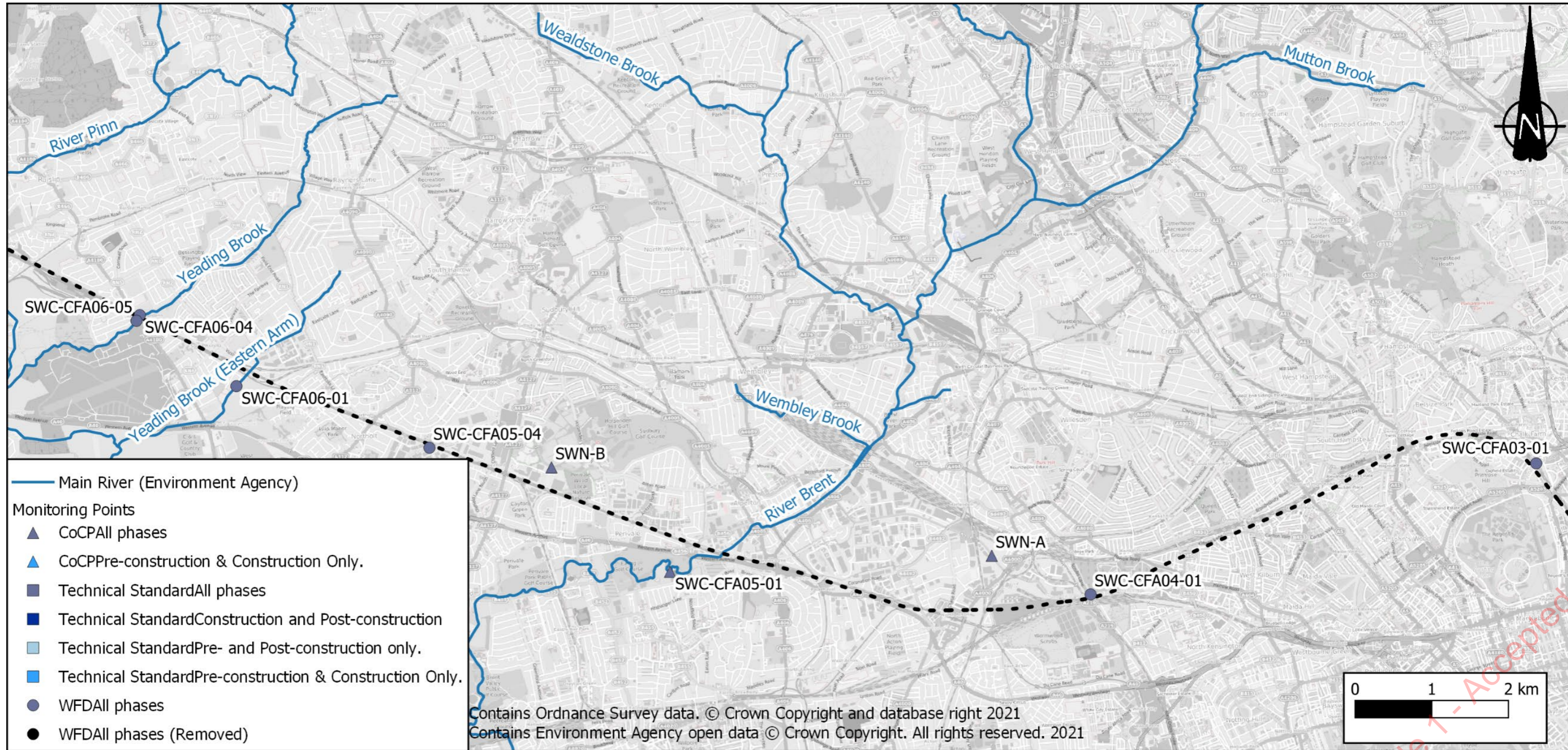
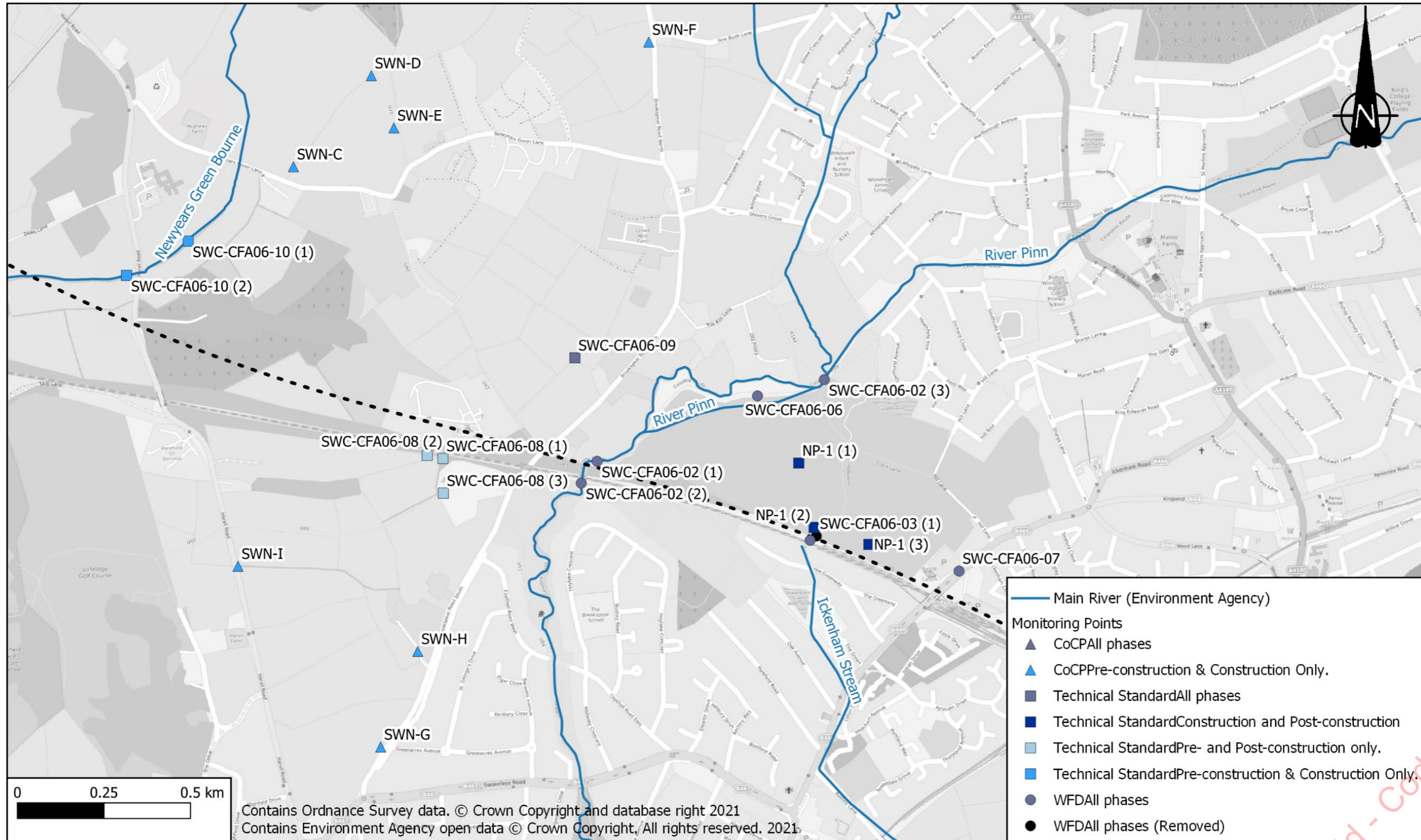


Figure 9: SCSJV Aquatic ecology monitoring point locations proposed in the S1 and S2 Hs2 project area



HS2 Ltd - Code 1 - Accepted

Figure 10: SCSJV Aquatic ecology monitoring point locations proposed in the Western Area (River Pinn, Ickenham Stream and Newyears Green Bourne)



- 5.7.54 A summary of the identified SCSJV Surface water monitoring proposal according to locations and types of monitoring can be found in Table 11 summarised for each phase of construction.
- 5.7.55 Monitoring points will be characterised further through site visits and further suitability assessments to identify any watercourses that are not water bearing (e.g. ordinary watercourses) due to flow being episodic and wholly rainfall generated. Monitoring points found to be characterised by these conditions may be descope from monitoring.

Table 11: Summary of identified SCSJV Surface water monitoring proposal

| N° | ES (as amended) point and new CoCP points | Location   | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |  | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 1  | SWC-CFA03-01                              | Grand Union Canal at Gloucester Avenue (near Euston Approach)                              | 290,837                | 289,478  | 528,438               | 183,984  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 2  | SWC-CFA04-01                              | Grand Union Canal at South of Saint Mary's Catholic Cemetery (east Old Oak Common Station) | 284,978                | 287,927  | 522,625               | 182,274  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 3  | SWC-CFA05-04                              | Grand Union Canal at East Mandeville Vent Shaft  | 272,677                | 291,909  | 510,223               | 185,918  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 4  | SWC-CFA05-01                              | River Brent  | 279,501                | 288,372  | 517,139               | 182,569  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 5  | SWC-CFA06-01                              | Yeading Brook East   | 273,912                | 290,948  | 511,483               | 184,991  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 6  | SWC-CFA06-04                              | Yeading Brook West   | 272,677                | 291,909  | 510,223               | 185,918  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 7  | SWC-CFA06-05                              | Yeading Brook West   | 272,632                | 291,837  | 510,170               | 185,844  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 8  | SWC-CFA06-02 (1)                          | River Pinn (upstream bridge)   | 269,887                | 293,282  | 507,397               | 187,213  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 9  | SWC-CFA06-02 (2)                          | River Pinn (downstream bridge)   | 269,839                | 293,220  | 507,351               | 187,150  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 10 | SWC-CFA06-02 (3)                          | River Pinn upstream of Golf Course   | 269839                 | 293190   | 508,053               | 187,449  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 11 | SWC-CFA06-03 (1)                          | Ickenham Stream (upstream diversion proposed)  | 270,601                | 293,148  | 508,114               | 187,099  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 12 | SWC-CFA06-03 (2)                          | Ickenham Stream (downstream bridge)  | 270,496                | 293,037  | 508,012               | 186,985  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 13 | SWC-CFA06-07                              | Ickenham East Tributary  | 270,923                | 292,936  | 508,442               | 186,896  | x  | x     | ✓                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 14 | NP-1 (1)                                  | New Pond 1 West Ruislip Golf Course  | 270,534                | 293,223  | 507,979               | 187,208  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |

| N° | ES (as amended) point and new CoCP points | Location   | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |  | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 15 | NP-1 (2)                                  | New Pond 2 West Ruislip Golf Course                    | 270,518                | 293,150  | 508,023               | 187,022  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |
| 16 | NP-1 (3)                                  | New Pond 3 West Ruislip Golf Course                    | 270,841                | 293,121  | 508,182               | 186,973  | x  | x     | x                | x                   | x                     | ✓            | ✓                 | x                | ✓            | ✓                 |
| 17 | SWC-CFA06-P05 (1)                         | 1 of 3 Ponds West Ruislip Golf Course                  | 270,469                | 293,261  | 507,979               | 187,208  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 18 | SWC-CFA06-P05 (2)                         | 2 of 3 Ponds West Ruislip Golf Course                  | 270,508                | 293,073  | 508,023               | 187,022  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 19 | SWC-CFA06-P05 (3)                         | 3 of 3 Ponds West Ruislip Golf Course                  | 270,665                | 293,020  | 508,182               | 186,973  | x  | x     | x                | x                   | x                     | x            | x                 | x                | x            | x                 |
| 20 | SWC-CFA06-06                              | West Ruislip Golf Drains                               | 270,355                | 293,458  | 507,860               | 187,402  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | ✓                 |
| 21 | SWC-CFA06-08 (1)                          | Brackenbury Farm north pond 1                          | 269,442                | 293,302  | 506,952               | 187,221  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | x            | ✓                 |
| 22 | SWC-CFA06-08 (2)                          | Brackenbury Farm north pond 2                          | 269,397                | 293,312  | 506,906               | 187,230  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | x            | ✓                 |
| 23 | SWC-CFA06-08 (3)                          | Moat in Brackenbury Farm                               | 269,440                | 293,202  | 506,953               | 187,121  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | x            | ✓                 |
| 24 | SWC-CFA06-09                              | South-east of Newyears Green Covert pond               | 269,831                | 293,582  | 507,333               | 187,512  | x  | x     | x                | x                   | x                     | x            | x                 | ✓                | ✓            | ✓                 |
| 25 | SWC-CFA06-10 (1)                          | Newyears Green Bourne (upstream bridge)                | 268,724                | 293,950  | 506,216               | 187,849  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 26 | SWC-CFA06-10 (2)                          | Newyears Green Bourne (downstream bridge)              | 2268,543               | 293,856  | 506,038               | 187,750  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 27 | SWN-A                                     | Grand Union Canal at Atlas Road Logistics Tunnel       | 283,703                | 288,466  | 521,336               | 182,778  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |
| 28 | SWN-B                                     | Grand Union Canal at North of Greenpark Way Vent Shaft | 277,992                | 289,776  | 515,593               | 183,931  | x  | x     | x                | x                   | ✓                     | ✓            | x                 | ✓                | ✓            | ✓                 |

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| N° | ES (as amended) point and new CoCP points | Location                             | Snake Grid Coordinates |          | British National Grid |          | Quantitative, Hydromorphology, Meteorology |       |                  |                     | Surface water quality |              |                   | Aquatic Ecology  |              |                   |
|----|---|--------------------------------------|------------------------|----------|-----------------------|----------|--|-------|------------------|---------------------|-----------------------|--------------|-------------------|------------------|--------------|-------------------|
|    |   |                                      | Easting                | Northing | Easting               | Northing | Flow                                       | Level | Hydro-morphology | Quality-meteorology | Pre-construction      | Construction | Post Construction | Pre-construction | Construction | Post Construction |
| 29 | SWN-C                                     | Northern Sustainable Placement Areas | 269,033                | 294,156  | 506,520               | 188,064  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 30 | SWN-D                                     | Northern Sustainable Placement Areas | 269,266                | 294,413  | 506,745               | 188,327  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 31 | SWN-E                                     | Northern Sustainable Placement Areas | 269,326                | 294,261  | 506,810               | 188,176  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 32 | SWN-F                                     | Northern Sustainable Placement Areas | 270,069                | 294,488  | 507,546               | 188,424  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 33 | SWN-G                                     | Southern Sustainable Placement Areas | 269,240                | 292,474  | 506,772               | 186,388  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 34 | SWN-H                                     | Southern Sustainable Placement Areas | 269,354                | 292,747  | 506,879               | 186,664  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |
| 35 | SWN-I                                     | Southern Sustainable Placement Areas | 268,842                | 293,007  | 506,360               | 186,910  | x  | x     | x                | x                   | ✓                     | ✓            | ✓                 | ✓                | ✓            | x                 |

## 5.8 Monitoring methodologies – Surface Water Quality

### 5.9 Introduction

5.9.1 This section summarises water monitoring that will be undertaken by SCSJV's monitoring contractor, under the management of SCSJV.

5.9.2 The surface water sampling methodology includes the following activities:

- Monitoring Point and Sample Observations
- Physico-chemical Measurements
- Collecting Surface Water Quality Samples
- Laboratory Analysis
- Quality Control Procedures for Monitoring
- Reporting of data

### 5.10 Chemical Parameters

#### Chemical Analysis

5.10.1 All samples will be analysed by a UKAS/ ISO17025 accredited laboratory.

#### Risk-based monitoring

5.10.2 Surface water quality monitoring shall be undertaken in accordance with the principles of risk-based monitoring outlined in the Water Framework Directive (2000/60/EC). Chemical parameters to be monitored are divided into two groups: (1) Core suite; and (2) Full suite.

5.10.3 During the pre-construction phase, surface water monitoring points will be monitored monthly for both the Full suite. During the construction phase, monthly monitoring using the Full suite will continue and will be complemented with weekly monitoring using the Core suite.

5.10.4 Analytical parameters have been chosen based on baseline concentrations observed by the HS2 Enabling Works Contract for surface water in Area South, in addition to construction related parameters broadly comprising suspended silt, hydrocarbons and heavy metals.



5.10.5 The principle of risk-based monitoring requires that if parameters in the Full Suite are found to exceed EOS or are found to be significantly elevated, those parameters will be monitored with the Core suite until such time that the concentration is restored to compliant or background levels.

### Core suite

5.10.6 There are four physico-chemical parameters that will be measured on-site for every sample, which are as follows:

- Temperature (°C, accurate to 0.1°C).
- pH (accurate to 0.1pH units).
- Electrical Conductivity (accurate to 2µS/cm).
- Dissolved Oxygen (mg/l and % saturation, accuracy to within 2% saturation or 0.1mg/l).
- Redox Potential (mV accurate to 0.1mV).
- Turbidity<sup>3</sup>.

5.10.7 In addition to the physico-chemical parameters listed above, the following will also be analysed in the Core suite by the laboratory:

- pH.
- Electrical Conductivity.
- Total suspended solids (TSS)<sup>4</sup>.
- Turbidity.
- Total petroleum hydrocarbons (TPH), unspecified.

### Full suite

5.10.8 In addition to the field and laboratory analytical parameters of the Core suite, the proposed analytical parameters for the Full suite will include the following:

- Suspended solids
- Hydrocarbons and BTEX compounds (Benzene, Ethyl benzene, Toluene, Xylene)
- Polycyclic Aromatic Hydrocarbons (PAHs)

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<sup>3</sup> Include if Turbidity (NTU) is an available as an output parameter on the Contractor's field multiparameter probe.

<sup>4</sup> TSS monitoring can be discontinued from the Core suite if/when a clear relationship is established between on site turbidity measurements and TSS.

- Major ions
- Redox sensitive metals
- Heavy metals

5.10.9 HS2 Suite I (Table 12) and dissolved Iron, Manganese and Aluminium (Table 13) have been selected on a risk basis to cover the main parameter groups listed above. It should be noted that although this table is based upon the HS2 Suite I, it has been amended where necessary based upon professional judgement and consultation with the Environment Agency.

Table 12: SUITE I – Surface water samples (Source: Schedule 1: Specification for Ground Investigation HS2-HS2-GT-SPE-000-000001)

| Parameter                    | Limit of detection | Accreditation required |
|------------------------------|--------------------|------------------------|
| BTEX                         | 10 µg/l            | UKAS                   |
| Total petroleum hydrocarbons | 10 µg/l            | UKAS                   |
| Phenol (total monohydric)    | 10 µg/l            | UKAS                   |
| Arsenic dissolved            | 1 µg/l             | UKAS                   |
| Barium dissolved             | 1 µg/l             | UKAS                   |
| Beryllium dissolved          | 1 µg/l             | UKAS                   |
| Boron dissolved              | 20 µg/l            | UKAS                   |
| Cadmium dissolved            | 0.5 µg/l           | UKAS                   |
| Chromium III dissolved       | 1 µg/l             | UKAS                   |
| Chromium VI dissolved        | 30 µg/l            | UKAS                   |
| Copper dissolved*            | 1.6 µg/l           | UKAS                   |
| Cyanide (total)              | 0.1 µg/l           | UKAS                   |
| Lead dissolved*              | 0.05 µg/l          | UKAS                   |
| Mercury dissolved            | 0.05 µg/l          | UKAS                   |
| Nickel dissolved*            | 1.5 µg/l           | UKAS                   |
| Selenium dissolved           | 1 µg/l             | UKAS                   |
| Vanadium dissolved           | 1 µg/l             | UKAS                   |
| Zinc dissolved*              | 5 µg/l             | UKAS                   |
| pH                           | +/- 0.1 units      | UKAS                   |
| Electrical conductivity      | 10 µS/cm           | UKAS                   |

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| Parameter  | Limit of detection | Accreditation required |
|--|--------------------|------------------------|
| Total dissolved solids (TDS)   | 5 mg/l             | UKAS                   |
| Total suspended solids (TSS)   | 2 mg/l             | UKAS                   |
| Dissolved organic carbon (DOC)   | 2 mg/l             | UKAS                   |
| Total organic carbon (TOC)   | 2 mg/l             | UKAS                   |
| Hardness   | 10 mg/l            | UKAS                   |
| Major ions (Ca, Mg, Na, K, Cl, SO <sub>4</sub> , bicarbonate, carbonate)   | 1 mg/l             | UKAS                   |
| Ionic balance  | ±0.1%              | -                      |
| Nitrogen species (Total N, NO <sub>3</sub> -N, NO <sub>2</sub> -N, NH <sub>4</sub> -N, unionised ammonia (NH <sub>3</sub> -N). | 0.2 mg N/l         | UKAS                   |
| Total P, Orthophosphate PO <sub>4</sub> -P   | 0.05mg P/l         | UKAS                   |

\*Represents parameters for which the bioavailable concentrations are to be determined for EQS screening. This will be done separately during data analysis.

Table 13: Iron and Manganese (total and dissolved) - Surface water Samples

| Parameter              | Limit of detection | Accreditation required |
|------------------------|--------------------|------------------------|
| Iron (total)           | 100 µg/l           | UKAS                   |
| Iron (dissolved)       | 100 µg/l           | UKAS                   |
| Manganese (total)      | 25 µg/l            | UKAS                   |
| Manganese (dissolved)* | 25 µg/l            | UKAS                   |
| Aluminium (total)      | 10 µg/l            | UKAS                   |
| Aluminium (dissolved)  | 10 µg/l            | UKAS                   |

\*Represents parameters for which the bioavailable concentrations are to be determined for EQS screening. This will be done separately during data analysis.

## Construction Phase Discharge Consent Compliance Monitoring

5.10.10 It is proposed that in addition to the routine surface water monitoring outlined in this plan, monitoring of any discharges will be undertaken by SCS on a weekly basis for the following basic parameters and their standard discharge consent limits (DCL) as required for Schedule 33 discharge consents approved by the Environment Agency:

- Total Suspended Solids (DCL=50mg/l).
- pH (within 6-9 range).
- No visible oil and grease.

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- 5.10.11 Given the importance of avoidance of hydrocarbon pollution from construction activities, SCS will undertake weekly monitoring for Total Petroleum Hydrocarbons (TPH, unspecified) at discharge points during the construction phase. Concentrations of TPH should not exceed the baseline established from the EWC or Pre-construction monitoring, otherwise detections/elevated concentrations will require investigative monitoring/investigation by construction teams to find and rectify the source of any pollution.
- 5.10.12 Compliance monitoring may require additional parameters to be analysed on a case-by-case basis, for instances where specific/non-standard discharge consent limits are set by the Environment Agency.

## 5.11 Monitoring Point and Sample Observations

- 5.11.1 At each monitoring point, all field observations and measurements will be recorded on a Monitoring Record Sheet. The Monitoring Record Sheet will record the monitoring point, date and time the monitoring was undertaken, description of the appearance of the sample (covering colour, opaqueness/transparency, any cloudiness, presence of suspended sediment or other material, smell if there is a smell, and weather conditions. The Monitoring Record Sheet need to be collated and provided as a project deliverable together with the spreadsheet.

## 5.12 Physico-chemical Measurements

- 5.12.1 Physico-chemical parameters (pH, temperature, Electrical Conductivity and Dissolved Oxygen) will be measured in the field using a water quality multi-meter. The multi-meter sensor should be placed in a flow cell to take the measurements. The flow cell should be supplied via an appropriate pump, providing the added benefit of allowing the samplers to sample the water without descending the bank. The pump intake should be lowered or placed directly into the flowing part of the watercourse. The order of parameter stabilization is pH > temperature > Electrical Conductivity > Dissolved Oxygen (DO), so physico-chemical measurements should only be recorded and a sample should only be taken once DO has stabilized to within 10% of its value for three consecutive readings. Manual records will be recorded on the Monitoring Record Sheet and electronically on the hand-held multimeter, for later download.

## 5.13 Collecting Surface Water Quality Samples

- 5.13.1 The surface water samples will be taken using the bottle types in accordance with the parameters being sampled, following all procedures with respect to pre-treatment (e.g. filtration) and sample preservation, and taking all measures to prevent sample contamination (e.g. wearing sampling gloves whenever a sample is being collected and replacing gloves between samples).
- 5.13.2 The approach to sampling for dissolved metals must be to undertake filtration and preservation of samples on site in accordance with BS EN ISO 5667-3 (2018), as required under the Water Resources and Flood Risk Monitoring Technical Standard (HS2-HS2-EV-STD-000-000029 P07)

in order to provide accurate concentration results for dissolved metals. The field equipment (disposable filters and syringes and bottles prepared with preservatives), should be requested from the laboratory. If the correct field equipment for on-site filtration and preservation cannot be supplied, then the laboratory should be changed for one that does supply it.

5.13.3 The same requirement applies for any other parameters that are prone to chemical changes or changes in state in transit or during storage and can include the following:

- Ammonium – sulphuric acid preservative.
- Cyanide – sodium hydroxide preservative.
- Iron/manganese – hydrochloric acid preservative.
- Dissolved metals/heavy metals – nitric acid.

5.13.4 The samples will be stored in cool boxes containing ice blocks to keep the samples at approximately 4°C in accordance with BS ISO EN 5667-3: 2018. Samples will be transported to the laboratory quickly and safely by courier following the end of each day's monitoring round.

5.13.5 Quality control procedures will be carried out as described in Section 4.12.

## 5.14 Laboratory Analysis

5.14.1 The parameters required to be monitored at each surface water monitoring point are summarised in the following suites (listed in full in Section 5.2) and include:

- Suite I – Laboratory physico-chemical parameters, major ions, nutrients (nitrogen and phosphorus species), heavy metals and metalloids, Total Petroleum Hydrocarbons (TPH), total BTEX compounds, Phenol (total monohydric), TDS, TSS, TOC and hardness.<sup>5</sup>
- Iron, manganese and aluminium (total and dissolved for each).

5.14.2 The level of detection (LOD), which describes the analytical precision for each parameter is specified in Table 12 and 13.

5.14.3 In addition, temperature, pH, Electrical Conductivity and dissolved oxygen should also be measured in the field at every monitoring point (see Section 5.2).

5.14.4 Temperature of the samples will be checked upon receipt at the laboratory and recorded to demonstrate that the samples had been transferred in refrigerated conditions (cool boxes containing ice blocks).

5.14.5 The laboratory analysis for each sample will be completed within 10 working days.

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<sup>5</sup> TDS, TSS, TOC – Total Dissolved Solids, Total Suspended Solids and Total Organic Carbon

## 5.15 Quality Control Procedures for Monitoring

- 5.15.1 Best practice monitoring should include provisions for quality control procedures to be built into the design of the monitoring. The purpose of these procedures is to provide confidence that the monitoring has delivered high quality data that is suitable as baseline data. The baseline for pre-construction conditions is a crucial benchmark against which construction impacts and post construction recovery can be analysed.
- 5.15.2 Quality control procedures are designed to check the effectiveness and reproducibility of the monitoring, sampling process and laboratory analytical procedures. Such procedures also help to demonstrate that correct sampling techniques have excluded the possibility of sample contamination occurring. Any exceptional results from the quality control sampling will be investigated and repeat analysis undertaken where necessary.
- 5.15.3 Field measurements of pH and Electrical Conductivity require validation in the laboratory. If there is a marked difference between the field and laboratory measurements of pH and conductivity, this will be investigated for the source of the difference.
- 5.15.4 For the purposes of the surface water quality sampling to be undertaken by SCSJV's monitoring contractor, three main quality control procedures will be undertaken in addition to those described for physico-chemical parameters:
- **Ionic balance** – for every sample, an ionic balance should be calculated to assess the level of precision and confidence in the major ion analyses. The sum of the chemical activities for the cation should equal those of the anions to within 10% (as a minimum requirement).
  - **Field blanks** – these are samples prepared in the field using laboratory grade de-ionised water, which are analysed in the laboratory to demonstrate that no sampling contamination occurs on the monitoring round.
  - **Split duplicate samples** – these are surface water samples that are prepared in the field by splitting one well mixed sample into two sample bottles for analysis. The purpose of this is to demonstrate the degree of precision delivered by the laboratory analysis for all parameters monitored at a given location.
- 5.15.5 The monitoring will include 10% quality assurance samples to be collected as part of the best practice approach in water sampling. Analytical results from these quality assurance samples will be self-assured by the appointed monitoring contractor.

## 5.16 Reporting Requirements

- 5.16.1 The results of the water monitoring will be provided on a monthly basis to the CMO for review and quality control. At the end of the pre-construction monitoring phase, a report will be provided that summarises the Pre-construction phase. It is anticipated that this will become a publicly available document.

5.16.2 The report will contain information on the following:

- Summary statistics of all parameters in the pre-construction phase.
- Summary of results with concentrations of parameters that exceed the Environmental Quality Standards (EQS) and by what percentage the EQS is exceeded.
- Using the baseline data to set inform consent limits and trigger levels for pH, silt (Total Suspended Solids) and Total Hydrocarbons as the most likely pollutants resulting from construction works that would trigger additional monitoring and pollution investigation as appropriate.

5.16.3 The data should be collated in a one row per record format as per Appendix D and in AGS format.

## 6 Monitoring methodologies – Aquatic Ecology

### 6.1 Introduction

6.1.1 The following section describes aquatic ecology methods that are required based on the Water Resources and Flood Risk Monitoring Technical Standard (HS2-HS2-EV-STD-000-000029), which has been updated and additional best practice methods included by an Aquatic Ecologist.

6.1.2 It should be noted that as this is based on the technical standard that any changes to the technical standard that are relevant to Aquatic Ecology monitoring will need to be applied to this section in order for SCSJV and its monitoring contractor to meet any changes to HS2 requirements.

### 6.2 Design of ecological study

6.2.1 Water Resources and Flood Risk Monitoring Technical Standard (HS2-HS2-EV-STD-000-000029) Appendices C (Section 5) and D (Section 5) provide general principles for ecological site selection and guidelines for monitoring point specification, respectively. This section details how ecological monitoring surveys should be conducted via activities including desk and field-based assessment. It also provides details of the timing and frequency needed for monitoring and requirements for data analysis.

### 6.3 Desk based assessment

6.3.1 Where the Decision Tree in Appendix B identifies the need for ecological monitoring, existing reports and data (e.g. HS2 Ltd; EA biological monitoring data) should be reviewed spatially and temporally to determine whether existing information provides an appropriate proxy that negates the need for baseline monitoring. This should be undertaken by an aquatic ecologist.

### 6.4 Field based monitoring

6.4.1 Where required, and upon identification of suitable monitoring sites with reference to Appendices B of this document, plus Appendix A of the Water Resources and Flood Risk Monitoring Technical Standard [R22], all field monitoring for aquatic ecology should be undertaken with reference to specific guidance as follows:

#### Aquatic Macrophytes

- River LEAFACS 2: WFD-UKTAG, 2014. UKTAG River Assessment Method Macrophytes and Phytobenthos. Macrophytes (River LEAFACS2). A report by the Water Framework Directive – United Kingdom Technical Advisory Group: <http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20w>



ater%20environment/Biological%20Method%20Statements/River%20Macrophytes%20UKTAG%20Method%20Statement.pdf; and

- British Standard BS EN ISO 14184\_2003\_Guidance standard for the surveying of aquatic macrophytes in running waters.

#### **Aquatic Macroinvertebrates**

- UK Aquatic Macroinvertebrate RIVPACS Sampling Method: <http://www.eu-star.at/pdf/RivpacsMacroinvertebrateSamplingProtocol.pdf>;
- Canal PSYM (Predictive SYstem for Multimetrics, (pronounced sim)): <https://freshwaterhabitats.org.uk/wp-content/uploads/2019/12/PSYM-MANUAL-AUG-2019.pdf>; and
- British Standard EN ISO 10870\_2012\_Guidance for the selection of sampling methods and devices for macroinvertebrates in fresh waters.

#### **Aquatic Phytobenthos**

- Standard DARLEQ2 aquatic phytobenthos survey method.

#### **Fish**

- Environment Agency (2006) and SEPA (2002) should be used as the key source of information where fish habitat management, maintenance and monitoring are required.
- The requirements for monitoring any fish populations will be agreed with the Environment Agency on a case by case basis.
- Habitat types provide a useful guide when selecting fisheries monitoring methodologies, as appropriate survey methods are affected by the physical characteristics of a water body. Key considerations when selecting a survey methodology include timing of surveys with regards to both the behaviour and life stage of fish species being targeted. Specific aims and objectives of surveys will dictate what factors take priority.
- Guidelines for Electric Fishing Best Practice. R&D Technical Report W2-054/TR: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/290344/sw2-054-tr-e-e.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/290344/sw2-054-tr-e-e.pdf); and
- British Standard EN ISO 14011\_2003\_Sampling fish with electricity.

6.4.2 Timing and frequency of monitoring is crucial for capturing data which accurately reflects ecological and environmental conditions. Monitoring needs to be frequent enough to detect change over time and data collection must be proportionate to the duration of the monitoring programme.

- 6.4.3 For ecological variables (e.g. macroinvertebrates and macrophytes) life history must be considered. Monitoring needs to take place at a time when the ecological parameters are most likely to be present, and consideration made to account for any seasonal or regional variation in abundance and community structure.
- 6.4.4 Timing and frequency often need to be considered together – for example phytobenthic communities can fluctuate in composition and abundance at different rates depending upon the season.
- 6.4.5 WFD and pollution control laws apply to all waters not just classified water bodies. Ditches and drainage channels should be assessed for their ecological quality and vulnerability in order to screen them in or out of surveys. Small ditches, for example, may feed into sensitive catchments or habitats and so the wider ecological and hydrological needs to be considered. Similarly, historical survey information (even from just a couple of years prior) should not be relied upon as they are likely to be out of date (i.e. due to improvements in effluent discharges or river restoration projects), hence watercourses should be assessed prior to construction to scope them in or out of any potential surveys.
- 6.4.6 Professional judgement may be required to adapt the monitoring strategy based on an evolving understanding of site conditions and the ecological variables present. For example, in the case of canal habitats, alternative methodologies such as seine netting may be more appropriate. Justification should, however, be provided for any deviation from the proposed monitoring methodologies set out in this Plan. Any justification should also include details of how the proposed alternative methodology aligns with UK industry standards.
- 6.4.7 Monitoring surveys of aquatic macrophytes and phytobenthos are not required during the construction phase.
- 6.4.8 Further details on the timing and duration of ecological sampling are provided in Water Resources and Flood Risk Monitoring Technical Standard (HS2-HS2-EV-STD-000-000029), Appendix C – Site selection for monitoring locations, Section 5.

## 6.5 Ecological Data Analysis

- 6.5.1 Following field survey, summary ecological data and a number of standard ecological metrics should be calculated. These will be used to determine whether the nature and extent of ecological impacts as a result of the design element or activity, and whether ecological and WFD objectives in respect to the riverine environment have been met.
- 6.5.2 Professional judgement should be applied to determine the most appropriate taxonomic resolution for aquatic surveys. Justification should, however, be provided for any taxonomic level chosen. Any justification should also include details of how the proposed alternative methodology aligns with UK industry standards.

### Aquatic Macrophytes

- 6.5.3 For aquatic macrophytes, a range of biological metrics should be calculated. They include the following:
- River Macrophyte Nutrient Index (RMNI);
  - Number of macrophyte taxa (NTAXA);
  - Number of Functional Groups (NFG); and
  - Cover of Green Filamentous Algae (ALG) (see 5.4.17).
- 6.5.4 The above all form part of the LEAFPACS<sub>2</sub> suite of indices used for WFD classification.
- 6.5.5 River Macrophyte Nutrient Index (RMNI) is designed to categorise a macrophyte community's preferences to nutrient levels. Scores range from 1 to 10 with scores of 1 representing plant communities with preference for very low levels of nutrients and 10 representing communities with a preference for very enriched conditions.
- 6.5.6 The Number of Macrophyte Taxa (NTAXA). This is a community richness index and simply describes the number of truly aquatic taxa present. Higher values represent a more diverse and rich aquatic plant community.
- 6.5.7 The Number of Functional Groups (NFG) is another richness or diversity index and describes the number of functional macrophyte groups existing within a surveyed plant community. Twenty-three different functional groups have been defined. The higher the NFG value, the more diverse and rich the plant community is considered to be.
- 6.5.8 Both the NFG and NTAXA indices are very useful indicators of habitat quality. High quality habitats with good flow regime, habitat heterogeneity, upstream connectivity and low sedimentation pressures will have higher values for both these indices. In areas where channel modifications exist both these indices will often be reduced.

#### **Aquatic Macroinvertebrates**

- 6.5.9 For aquatic macroinvertebrates, a range of biological metrics should be calculated including the following:
- Whalley, Hawkes, Paisley & Trigg (WHPT) metric;
  - Number of Taxa (N-TAXA);
  - Average Score per Taxon (ASPT);
  - Community Conservation Index (CCI) (Chadd & Extence, 2004);
  - Lotic-invertebrate Index for Flow Evaluation (LIFE) (Extence et al, 1999); and
  - Proportion of Sediment-sensitive Invertebrates (PSI) (Extence et al 2013).

- 6.5.10 The Whalley, Hawkes, Paisley & Trigg (WHPT) metric enables the assessment of invertebrates in rivers (in relation to general degradation, including organic pollution) according to the requirements of the Water Framework Directive (WFD). WHPT metrics replace the BMWP (Biological Monitoring Working Party) metrics used for status classifications in the first river basin planning cycle.
- 6.5.11 The Number of Taxa (N-TAXA) is a simple diversity index. It is a non-specific index of environmental pressure and is useful when pressure specific indices such as ASPT and LIFE show no response. Habitat-rich rivers, such as lowland chalk streams will often have N-Taxa scores exceeding 30. Upland systems with restricted habitats tend to have lower values. Stretches of river with impoverished habitat quality, siltation issues or reduced water quality will often have reduced N-TAXA scores from similar un-impacted stretches of river.
- 6.5.12 Average Score Per Taxon (ASPT) is derived from the BMWP index and is the average BMWP sensitivity score of all the taxa occurring in the sample. It is primarily used as an indicator of organic pollution. This index is directly comparable between samples collected from different river types and in different seasons. ASPT scores above 5, are considered to represent invertebrate communities living in good water quality. Lower scores are indicative of invertebrate communities suffering from stress due to reduced water quality.
- 6.5.13 The Community Conservation Index (CCI) incorporates both rarity and taxon richness. Individual species are assigned a Conservation Score (CS) based on their known conservation status in the UK, both locally and nationally. CCIs can range from 0 to >40; a guide to the interpretation of scores is included in the paper text.
- 6.5.14 The Lotic-invertebrate Index for Flow Evaluation (LIFE) was developed as a means of assessing flow as a stressor of the macroinvertebrate community of flowing watercourses. Individual species and family groups are assigned to a flow group depending on their documented flow preferences (current velocity) ranging from I (Rapid) to VI (Drought Resistant). Species LIFE (S) provides a more precise measure than Family LIFE (F) as a number of aquatic invertebrate families contain species with wide-ranging flow requirements. A full list of assigned family/species flow groups is included in paper text.
- 6.5.15 The Proportion of Sediment-sensitive Invertebrates (PSI) is a biotic index designed to describe an invertebrate community's sensitivity to sedimentation. It is based on the known ecological responses of different macroinvertebrate species or family groups to the accumulation of sediment on riverine substrata. The index declines as the pressure of fine sediments cover the river bed.
- 6.5.16 Those taxa that are known to benefit from, or that are largely unaffected by, sedimentation, are given a high score, known as a 'Sediment Sensitivity Rating (SSR)'. Those taxa that are known to suffer from the accumulation of sediment are given a low SSR. The metric also depends on the relative abundance of different taxa and so is not just dependent on 'presence-absence', but also on the numbers of different taxa recorded. The PSI score describes the

percentage of sediment-sensitive taxa present in a sample with high values indicating a greater proportion (percentage) of silt intolerant invertebrate species present within the macroinvertebrate community sampled i.e. the less a site is affected by silt the greater the PSI score. A full guide to the interpretation of scores is included in Extence et al (2013).

### **Aquatic Phytobenthos**

- 6.5.17 The Cover of green filamentous algae (ALG) provides a measure of how much of the survey reach is covered in filamentous algae. High cover can often occur in situations where there has been a sudden increase in nutrient levels or high background nutrient levels. The index is a good indicator of acute nutrient releases rather than long term eutrophication as well as sudden physical disturbances that can result in sudden nutrient pulses. This is because algae respond more quickly than higher plants to nutrient increase. Only algal species such as *Cladophora agg.* and *Enteromorpha* that respond to nutrient enrichment are included in this index.

### **Fish**

- 1.1.1 Fish survey data should be used to calculate species richness, density and standing crop estimates, based on catch-depletion methods (Carle and Strubb, 1978). With reference to species tolerance to environmental disturbance within the Fisheries Classification Scheme 2 (FCS<sub>2</sub>) (WFD-UKTAG, 2008), changes in the composition, density and standing crop of the assemblage can be used to assess the impact of the design element or activity.

## **6.6 Reporting and review**

- 5.4.19 Reporting for aquatic ecology monitoring, which will also be carried out on a monthly basis, will encompass and include all ecologically-relevant monitoring actions undertaken during that calendar year. This includes a summary of all monitoring activities and the results of the ecological monitoring undertaken. The reporting should be undertaken by an aquatic ecologist.
- 5.4.20 Reporting should be accompanied by a review of the approaches and methodologies used to collect the data. Once obtained, the ecological monitoring data should be assessed to identify any potential errors or anomalies. As well as quality control, this review stage will hence provide an opportunity for any significant changes to be identified either prior to or during the early stage of the next phase of monitoring.
- 5.4.21 In some months, there may not be any aquatic ecology monitoring work carried out. A short report confirming this and a situation of no change should be submitted at the time to complete the auditable trail.
- 5.4.22 The ecological monitoring data from each month will be combined in the final factual report at the end of the Surveys Work Package Contract and submitted along with the monitoring data to SCSJV for review. It will contain a summary of the key findings for aquatic ecology.

- 5.4.23 GIS data recording should follow guidelines set out in the HS2 Water Resources and Flood Risk GIS Specification (Document no.: HS2-HS2-GI-SPE-000-000010). The purpose of this document is to provide Contractors with a standard approach on the GIS deliverables required to complete the reports required, to ensure there is consistency across all contracts.
- 5.4.24 In line with reporting submissions, a discussion should be held annually with SCSJV to feedback and discuss results of the monitoring surveys at the end of the monitoring year. In conjunction with this, the report should also be reviewed and discussed with the relevant stakeholders.
- 5.4.25 Should the ecological monitoring data suggest the need for change to any element of the monitoring strategy, this will be discussed between all relevant parties to decide upon and agree those changes prior to actioning.

## 7 References

7.1.1 The documents in Table 14 are client and industry related documents from which the above information is drawn or to be referred to:

Table 14: Reference documents

| Reference | Title   | Document Number   |
|-----------|---|---|
| R1        | High Speed Rail (London - West Midlands) Act 2017                             | Publicly available here:<br><a href="http://www.legislation.gov.uk/ukpga/2017/7/contents/enacted">http://www.legislation.gov.uk/ukpga/2017/7/contents/enacted</a>   |
| R2        | HS2 Environmental Minimum Requirements Annex 1: Code of Construction Practice | LWM-HS2-EV-STA-000-000107   |
| R3        | HS2 Environmental Minimum Requirements Annex 2: Planning Memorandum           | HS2-HS2-EV-STD-000-000003   |
| R4        | HS2 Environmental Minimum Requirements Annex 3: Heritage Memorandum           | HS2-HS2-EV-STD-000-000001   |
| R5        | HS2 Environmental Minimum Requirements Annex 4: Environmental Memorandum      | HS2-HS2-EV-STD-000-000004   |
| R6        | Register of Undertakings and Assurances                                       | Publicly available here:<br><a href="https://www.gov.uk/government/publications/high-speed-rail-london-west-midlands-bill-register-of-undertakings-and-assurances">https://www.gov.uk/government/publications/high-speed-rail-london-west-midlands-bill-register-of-undertakings-and-assurances</a> |
| R7        | SCSJV consents register   | 1MC03-SCJ-TP-REG-S001-000001  |
| R8        | The Environmental Protection Act 1990   | <a href="https://www.legislation.gov.uk/ukpga/1990/43/contents">https://www.legislation.gov.uk/ukpga/1990/43/contents</a>   |
| R9        | London Borough of Camden Local Environmental Management Plan                  | P1S-HS2-EV-REP-S000-000006  |
| R10       | London Borough of Hammersmith and Fulham Local Environmental Management Plan  | P1S-HS2-EV-REP-S000-000005  |
| R11       | London Borough of Brent   | P1S-HS2-EV-REP-S000-000002  |
| R12       | London Borough of Ealing Local Environmental Management Plan                  | P1S-HS2-EV-REP-S000-000004  |
| R13       | City of Westminster Local Environmental Management Plan                       | P1S-HS2-EV-REP-S000-000003  |
| R14       | London Borough of Hillingdon Local Environmental Management Plan              | P1S-HS2-EV-REP-S000-000007  |
| R15       | Royal Borough of Kensington and Chelsea Local Environmental Management Plan   | P1S-HS2-EV-REP-S000-000008  |

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| Reference | Title   | Document Number   |
|-----------|---|---|
| R16       | Water Resource Act 1991   | <a href="http://www.legislation.gov.uk/ukpga/1991/57/contents">http://www.legislation.gov.uk/ukpga/1991/57/contents</a>                                     |
| R17       | Flood and Water Management Act 2010   | <a href="https://www.legislation.gov.uk/ukpga/2010/29/contents">https://www.legislation.gov.uk/ukpga/2010/29/contents</a>                                   |
| R18       | Water Act 2003  | <a href="https://www.legislation.gov.uk/ukpga/2003/37/contents">https://www.legislation.gov.uk/ukpga/2003/37/contents</a>                                   |
| R19       | Environment Act 1995  | <a href="https://www.legislation.gov.uk/ukpga/1995/25/contents">https://www.legislation.gov.uk/ukpga/1995/25/contents</a>                                   |
| R20       | Directive 2000/60/EC (Water Framework Directive)  | <a href="https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3A128002b">https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3A128002b</a> |
| R21       | Directive 2007/60/EC  | <a href="https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060">https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060</a>     |
| R22       | Water Resources and Flood Risk Monitoring Technical Standard                            | HS2-HS2-EV-STD-000-000029 P06   |
| R23       | Technical Standard – Water Resources and Flood Risk Consents and Approvals              | HS2-HS2-EV-STD-000-000015 P05   |
| R24       | Groundwater Monitoring Plan S1 and S2   | 1MC03-SCJ-EV-PLN-S001-000030  |
| R25       | SCSJV Water Resource and Flood Risk Management Plan S1 and S2                           | 1MC03-SCJ-EV-PLN-S001-000015  |
| R26       | Technical Standard- Water Framework Directive Compliance Process                        | HS2-HS2-EV-STD-000-000012   |
| R27       | Technical Standard - Watercourse Diversions and Realignment                             | HS2-HS2-EV-STD-000-000014   |
| R28       | Technical Standard - Water Resources and Flood Risk Consents and Approvals              | HS2-HS2-EV-STD-000-000015   |
| R29       | Technical Standard - Water Resources  | HS2-HS2-EV-STD-000-000016   |
| R30       | Technical Standard – Ecology  | HS2-HS2-EV-STD-000-000017   |
| R31       | HS2 Project Dictionary  | HS2-HS2-PM-GDE-000-000002   |
| R32       | Specification for Ground Investigation  | HS2-HS2-GT-SPE-000-000001   |
| R33       | 1EW02 Enabling Works – Area South: Surface Water Monitoring Plan                        | 1EW02-CSJ-EV-PLN-S000-000078  |
| R34       | The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. | <a href="https://www.legislation.gov.uk/uksi/2017/407/contents/made">https://www.legislation.gov.uk/uksi/2017/407/contents/made</a>                         |
| R35       | HS2 WFD Assessment Reports and WFD Assessment tables                                    | 1MC03-SCJ_SDH-EV-REP-S001-000001<br>1MC03-SCJ_SDH-EV-REP-S002-000001  |



Document Title: Surface Water Monitoring Plan S1 and S2

Document no.: 1MC03-SCJ-EV-PLN-S001-000029

Revision: C03

| Reference | Title | Document Number  |
|-----------|-------|--|
|           |       | 1MC03-SCJ_SDH-EV-ASM-S000-000001<br>1MC03-SCJ_SDH-EV-ASM-S000-000002 |

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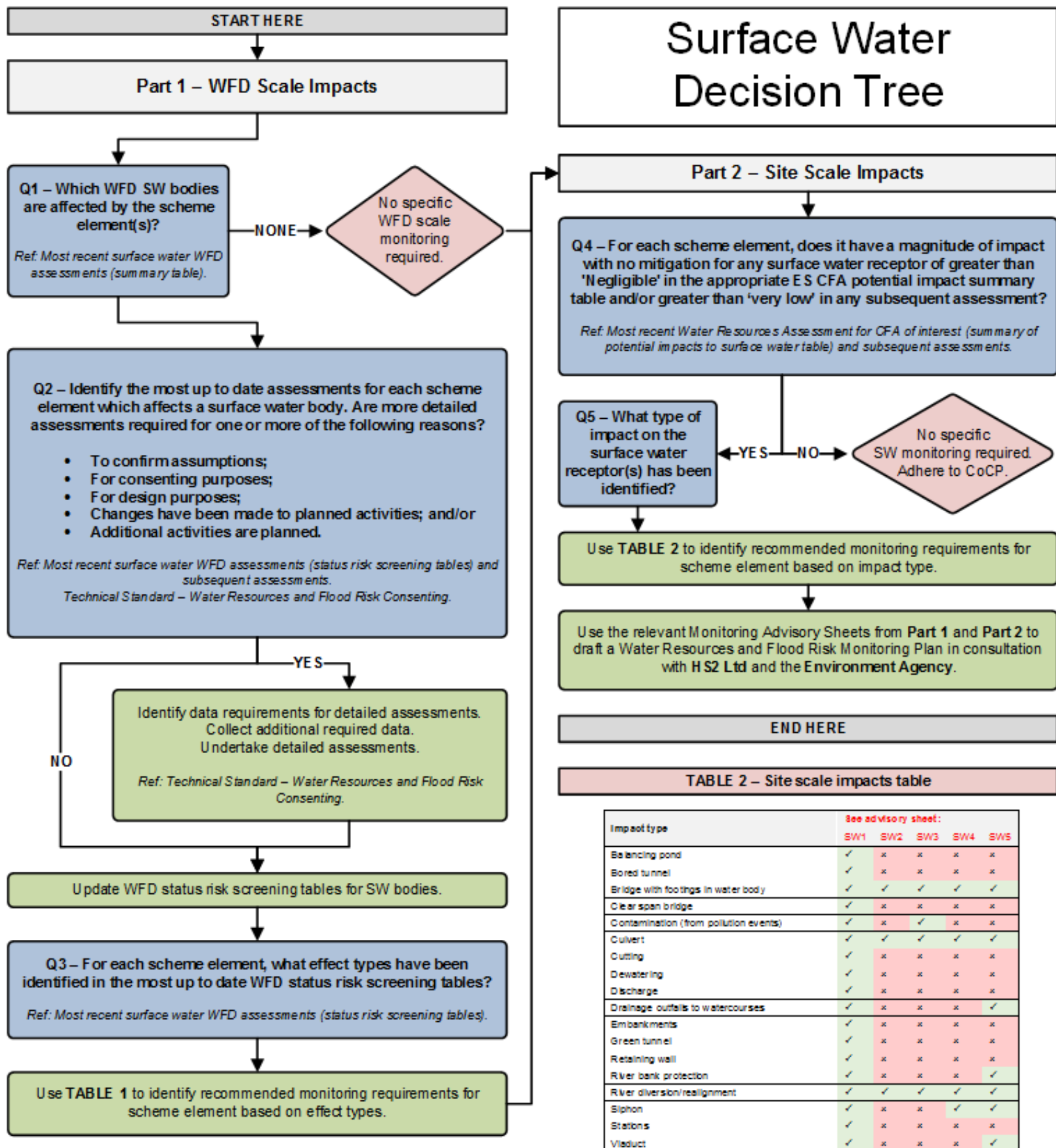
## Appendix A: Undertakings and Assurances

The following U&As have been identified as being applicable to this discipline topic and will be managed through the mitigations detailed in this monitoring plan.

| U&A Ref id | To Whom             | Detail   |
|------------|---------------------|--|
| 2220_29    | Canal & River Trust | Any Authorised Works that may adversely impact on the Trust's water supplies (short term or long term) from surface water feeders or groundwater pumps will be mitigated by the Promoter to the reasonable satisfaction of the Trust prior to commencement of such Authorised Works.   |
| 2783       | General             | Monitoring will be undertaken in consultation with the Environment Agency prior to and during construction, and if required post construction, to establish baseline conditions for surface water and groundwater and to confirm the effectiveness of temporary and permanent mitigation measures together with any remedial works deemed necessary. |

# Appendix B: Surface Water Monitoring Decision Tree and Surface Water Monitoring Advisory Sheets from Water Resources and Flood Risk Monitoring Technical Standard

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**TABLE 2 – Site scale impacts table**

| Impact type                           | See advisory sheet: |     |     |     |     |
|---------------------------------------|---------------------|-----|-----|-----|-----|
|                                       | SW1                 | SW2 | SW3 | SW4 | SW5 |
| Balancing pond                        | ✓                   | x   | x   | x   | x   |
| Bored tunnel                          | ✓                   | x   | x   | x   | x   |
| Bridge with footings in water body    | ✓                   | ✓   | ✓   | ✓   | ✓   |
| Clear span bridge                     | ✓                   | x   | x   | x   | x   |
| Contamination (from pollution events) | ✓                   | x   | ✓   | x   | x   |
| Culvert                               | ✓                   | ✓   | ✓   | ✓   | ✓   |
| Cutting                               | ✓                   | x   | x   | x   | x   |
| Dewatering                            | ✓                   | x   | x   | x   | x   |
| Discharge                             | ✓                   | x   | x   | x   | x   |
| Drainage outlets to watercourses      | ✓                   | x   | x   | x   | ✓   |
| Embankments                           | ✓                   | x   | x   | x   | x   |
| Green tunnel                          | ✓                   | x   | x   | x   | x   |
| Retaining wall                        | ✓                   | x   | x   | x   | x   |
| River bank protection                 | ✓                   | x   | x   | x   | ✓   |
| River diversion/realignment           | ✓                   | ✓   | ✓   | ✓   | ✓   |
| Siphon                                | ✓                   | x   | x   | ✓   | ✓   |
| Stations                              | ✓                   | x   | x   | x   | x   |
| Viaduct                               | ✓                   | x   | x   | x   | ✓   |

**TABLE 1 – WFD scale impacts table**

| 'WFD classification element' category               | Effect type                  |  |                    |       |                          |
|---|------------------------------|--|--------------------|-------|--------------------------|
|   | BLUE/LIGHT BLUE (Beneficial) | GREEN  | YELLOW             | AMBER | RED                      |
| Quality (physico-chemical) & Quantity (flow, level) | Advisory Sheet SW1           |  | Advisory Sheet SW1 |       |                          |
| Ecological  | Macrophytes/Diatoms          | No specific monitoring unless otherwise identified through Part 2. Adhere to CoCP.   | Advisory Sheet SW2 |       | Consult with EA directly |
|   | Macroinvertebrates           |  | Advisory Sheet SW3 |       |                          |
|   | Fish                         |  | Advisory Sheet SW4 |       |                          |
| Hydromorphological                                  | Advisory Sheet SW5           | No specific monitoring unless otherwise identified through Part 2, or scheme element being considered is a river diversion/realignment (in latter case refer to Advisory Sheet SW5). Adhere to CoCP. | Advisory Sheet SW5 |       |                          |

| Monitoring Advisory Sheet - GW1  |   |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
|--|---|--|--|---|--------------------|---|--|-------------------------------|---------------------------------|---------------------|---|---------------------------|
| <i>To be used for:</i>   |   |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| Monitoring type:   | Groundwater   |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| Impact type:   | Quantitative <sup>1</sup>   |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| Effect type:   | Amber <i>As reported in the WFD status risk screening tables</i>  |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| Impact magnitude:  | Any adverse <i>As reported in the CFA site specific 'potential impact on groundwater receptors' summary table</i> |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| RECEPTOR   | WHAT?   | PHASE  | Baseline (pre-construction)  |   |                    | Construction  |  |                               | Operational (post-construction) |                     |   | AGREED MONITORING WITH EA |
|  |   |  | HOW?<br>Method   | WHERE?<br>Locations   | WHEN?<br>Frequency | Duration  | WHERE?<br>Locations  | WHEN?<br>Frequency            | Duration                        | WHERE?<br>Locations | WHEN?<br>Frequency  |                           |
| Disturbed aquifer(s)<br>(i.e. dewatered, dammed, connected to other aquifers)              | GW level  | <i>Standard monitoring</i>   |  |   |                    |   |  |                               |                                 |                     |   |                           |
|  |   | Logger measurements<br>Dips  | Minimum of 3 x monitoring boreholes in each disturbed aquifer - one up and two down hydraulic gradient of the disturbance, including at least one between disturbed zone and each flagged receptor in the ES | Hourly<br>Monthly   | Minimum 12 months  | As baseline   | Hourly<br>Weekly during any active construction operations | Throughout construction phase | As baseline                     | Hourly<br>Monthly   | 2 years post construction unless agreed otherwise with EA |                           |
|  |   | <i>Additional monitoring if dewatering operations taking place</i> |  |   |                    |   |  |                               |                                 |                     |   |                           |
|  |   | Logger measurements<br>Dips  | At least 3 x monitoring boreholes per pumping well where dewatering taking place - one up and two down (background) hydraulic gradient of the pumping well at different radial distances                     | Hourly<br>Monthly   | Minimum 12 months  | As baseline   | Hourly<br>Weekly during any dewatering operations          | Throughout construction phase | As baseline                     | Hourly<br>Monthly   | 2 years post construction unless agreed otherwise with EA |                           |
|  | Abstraction rate  | Flow meter   | Pumping well   | Hourly  |                    |   | Hourly   |                               |                                 | Hourly              |   |                           |
| <i>Choose monitoring specification for other appropriate receptor(s) flagged in the ES</i> |   |  |  |   |                    |   |  |                               |                                 |                     |   |                           |
| SW body - watercourse  | SW flow   | Logger measurements  | Gauging stations (if already in situ) <sup>3</sup> upstream and downstream of the SW body reach down hydraulic GW gradient of disturbance  | Hourly  | Minimum 12 months  | As baseline   | Hourly   | Throughout construction phase | As baseline                     | Hourly              | 2 years post construction unless agreed otherwise with EA |                           |
|  |   | Current/flow meter   | 2 x spot flow locations, upstream and downstream of the SW body reach down hydraulic GW gradient of disturbance  | Monthly   |                    |   | Weekly during any dewatering operations                    |                               |                                 | Monthly             |   |                           |
|  | SW quality  | Field measurements   | hydraulic GW gradient of disturbance   | Monthly (temperature & conductivity) <sup>4</sup>   | Monthly            | Weekly during any dewatering operations (temperature & conductivity) <sup>4</sup> | Monthly (temperature & conductivity) <sup>4</sup>          |                               |                                 |                     |   |                           |
|  |   | SW level <sup>2</sup>  | Logger measurements<br>Dips  | 2 x stilling well locations, upstream and downstream of the SW body reach down hydraulic GW gradient of disturbance | Hourly<br>Monthly  | Hourly<br>Weekly during any dewatering operations                                 | Hourly<br>Monthly  |                               |                                 |                     |   |                           |
| SW body - reservoir, lake, pond  | SW level  | Logger measurements<br>Dips  | 1 x stilling well location   | Hourly<br>Monthly   | Minimum 12 months  | As baseline   | Hourly<br>Weekly during any dewatering operations          | Throughout construction phase | As baseline                     | Hourly<br>Monthly   | 2 years post construction unless agreed otherwise with EA |                           |
| Spring   | Flow  | Logger measurements<br>Various                                     | Spring gauging location (if already in situ) <sup>3</sup><br>Spring discharge point  | Hourly<br>Monthly   | Minimum 12 months  | As baseline   | Hourly<br>Weekly during any dewatering operations          | Throughout construction phase | As baseline                     | Hourly<br>Monthly   | 2 years post construction unless agreed otherwise with EA |                           |
| GW abstraction   | GW level  | Logger measurements<br>Dips  | Abstraction borehole & any observation borehole in close proximity to abstraction <sup>5</sup>   | Hourly<br>Monthly   | Minimum 12 months  | As baseline   | Hourly<br>Weekly during any dewatering operations          | Throughout construction phase | As baseline                     | Hourly<br>Monthly   | 2 years post construction unless agreed otherwise with EA |                           |
|  |   | Abstraction rate   | Flow meter   | Abstraction borehole  |                    |   | Hourly   |                               |                                 | Hourly              |   | Hourly                    |
| GWDTE  | GW level  | Logger measurements  | Minimum of 1 x monitoring borehole, located in the GWDTE, completed in each affected aquifer   | Hourly  | Minimum 12 months  | As baseline   | Hourly   | Throughout construction phase | As baseline                     | Hourly              | 2 years post construction unless agreed otherwise with EA |                           |
|  |   | Dips   | Minimum of 1 x monitoring borehole completed in any superficial deposits present in the GWDTE  | Monthly   |                    |   | Weekly during any dewatering operations                    |                               |                                 | Monthly             |   |                           |

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|--|
| <b>Monitoring Advisory Sheet - GW1</b>   |
| <b>Notes</b>   |
| <b>This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Groundwater Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.</b>   |
| <sup>1</sup> Quantitative groundwater impacts assessed in the WFD status risk screening tables are:<br><i>Lowering of GW levels and reduction of GW contributions to SW bodies, GWDTE or GW abstractions by temporary dewatering/permanent GW control</i><br><i>Damming of GW flow and reduction in GW contributions</i> |
| <sup>2</sup> In the absence of a gauging station, SW flows can be obtained from stilling well SW levels if sufficient current meter gaugings are available to define a stage-discharge relationship.   |
| <sup>3</sup> The installation of gauging stations may be required based on discussions with the Environment Agency.  |
| <sup>4</sup> Can be used as baseflow indicators.   |
| <sup>5</sup> If there are no appropriate observation boreholes in-situ, installation of new observation boreholes may be required in some circumstances.   |
| <sup>6</sup> A longer period of operational monitoring may be necessary to observe any Scheme impacts over a range of conditions (e.g. dry summer, wet winter).  |

| Monitoring Advisory Sheet - GW2  |  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
|--|--|---------------------------------|---|--|-------------------|--------------|---|-------------------------------|---------------------------------|--|---|---------------------------|
| To be used for:  |  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| Monitoring type:   | Groundwater  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| Impact type:   | Chemical <sup>1</sup>  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| Effect type:   | Amber As reported in the WFD status risk screening tables  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| Impact magnitude:  | Any adverse As reported in the CFA site specific 'potential impact on groundwater receptors' summary table |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| RECEPTOR   | WHAT?  | PHASE                           | Baseline (pre-construction)   |  |                   | Construction |   |                               | Operational (post-construction) |  |   | AGREED MONITORING WITH EA |
|  |  | HOW?                            | WHERE?  | WHEN?  |                   | WHERE?       | WHEN?                                     |                               | WHERE?                          | WHEN?  |   |                           |
|  |  | Method                          | Locations   | Frequency                                    | Duration          | Locations    | Frequency                                 | Duration                      | Locations                       | Frequency                                    | Duration <sup>7</sup>                                     |                           |
| Disturbed aquifer(s)<br>(i.e. dewatered, dammed, connected to other aquifers, exposed to potential contaminants)   | Standard monitoring where exposure to potential contaminants during construction                           |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
|  | GW level   | Dips                            | Minimum of 3 x monitoring boreholes in each disturbed aquifer - one up and two down hydraulic gradient of the disturbance, including at least one between disturbance and each flagged receptor in the ES   | Monthly                                      | Minimum 12 months | As baseline  | Weekly                                    | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | GW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite), quarterly (full suite) |                   |              | Weekly (core suite), monthly (full suite) |                               |                                 | Monthly (core suite), quarterly (full suite) |   |                           |
|  |  | Samples (purged) <sup>3,4</sup> |   | Monthly                                      |                   |              | Weekly                                    |                               |                                 | Monthly                                      |   |                           |
|  | Visual (post purge)  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| Additional monitoring if there are known sources of pre-existing poor quality or contaminated groundwater (e.g. landfill site, or elevated nitrate concentrations) in the disturbed aquifer(s) |  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
|  | GW level   | Dips                            | At least 1 x monitoring borehole between poor quality / contaminated GW and disturbance<br>At least 1 x monitoring borehole between poor quality / contaminated GW and each receptor  | Monthly                                      | Minimum 12 months | As baseline  | Weekly                                    | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | GW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite), quarterly (full suite) |                   |              | Weekly (core suite), monthly (full suite) |                               |                                 | Monthly (core suite), quarterly (full suite) |   |                           |
|  |  | Samples (purged) <sup>3,4</sup> |   | Monthly                                      |                   |              | Weekly                                    |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual (post purge)             |   |  |                   |              |   |                               |                                 |  |   |                           |
| Choose monitoring specification for other appropriate receptor(s) flagged in the ES  |  |                                 |   |  |                   |              |   |                               |                                 |  |   |                           |
| SW body - watercourse  | SW flow  | Current/flow meter              | 2 x monitoring locations, upstream and downstream of the SW body reach down hydraulic GW gradient of disturbance <sup>5</sup>   | Monthly                                      | Minimum 12 months | As baseline  | Monthly                                   | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | SW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite)                         |                   |              | Weekly                                    |                               |                                 | Monthly (core suite)                         |   |                           |
|  |  | Samples <sup>3</sup>            |   | Monthly                                      |                   |              | Weekly (core suite)                       |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual                          |   |  |                   |              | Weekly                                    |                               |                                 |  |   |                           |
| SW body - lake   | SW level   | Dips                            | 1 x stilling well location<br>1 x sampling location   | Monthly                                      | Minimum 12 months | As baseline  | Monthly                                   | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | SW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite)                         |                   |              | Weekly                                    |                               |                                 | Monthly (core suite)                         |   |                           |
|  |  | Samples <sup>3</sup>            |   | Monthly                                      |                   |              | Weekly (core suite)                       |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual                          |   |  |                   |              | Weekly                                    |                               |                                 |  |   |                           |
| Spring   | Flow   | Various                         | Spring discharge point  | Monthly                                      | Minimum 12 months | As baseline  | Monthly                                   | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | Quality  | Field measurements <sup>2</sup> |   | Monthly (core suite)                         |                   |              | Weekly                                    |                               |                                 | Monthly (core suite)                         |   |                           |
|  |  | Samples <sup>3</sup>            |   | Monthly                                      |                   |              | Weekly (core suite)                       |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual                          |   |  |                   |              | Weekly                                    |                               |                                 |  |   |                           |
| GW abstraction   | GW level   | Dips                            | Abstraction borehole & any observation borehole in close proximity to abstraction <sup>5</sup>  | Monthly                                      | Minimum 12 months | As baseline  | Weekly                                    | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | GW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite)                         |                   |              | Weekly                                    |                               |                                 | Monthly (core suite)                         |   |                           |
|  |  | Samples (purged) <sup>3,4</sup> |   | Monthly                                      |                   |              | Weekly (core suite)                       |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual (post purge)             |   |  |                   |              | Weekly                                    |                               |                                 |  |   |                           |
| GWDTE  | GW level   | Dips                            | If disturbed aquifer outcrops in the GWDTE - 1 x monitoring borehole located in the GWDTE, completed in the affected aquifer<br>If the affected aquifer does not outcrop in the GWDTE - 2 x monitoring boreholes located in the GWDTE, one completed in the disturbed aquifer and the other completed in the superficial deposits | Monthly                                      | Minimum 12 months | As baseline  | Weekly                                    | Throughout construction phase | As baseline                     | Monthly                                      | 2 years post construction unless agreed otherwise with EA |                           |
|  | GW quality   | Field measurements <sup>2</sup> |   | Monthly (core suite)                         |                   |              | Weekly                                    |                               |                                 | Monthly (core suite)                         |   |                           |
|  |  | Samples (purged) <sup>3,4</sup> |   | Monthly                                      |                   |              | Weekly (core suite)                       |                               |                                 | Monthly                                      |   |                           |
|  |  | Visual (post purge)             |   |  |                   |              | Weekly                                    |                               |                                 | Monthly                                      |   |                           |

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| <b>Monitoring Advisory Sheet - GW2</b>  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>Notes</b>  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Groundwater Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.</b>  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>1</sup> Chemical groundwater impacts assessed in the WFD status risk screening tables are:<br><i>Creating or altering of pathways along which existing poor quality GW can migrate;</i><br><i>Disturbing or mobilising existing poor quality GW by temporary dewatering or depressurisation and permanent GW control.</i>  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| In addition the CFA site specific 'potential impact on groundwater receptors' summary tables highlight the impact caused by the introduction of contaminants during construction activities.  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>2</sup> Field measurements shall include T, pH, EC, DO and redox potential. For GW sampling these parameters shall be monitored throughout purging where appropriate to ensure stabilisation of water chemistry before sample is taken.  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>3</sup> Core suite shall include T, pH, EC, DO, nitrate, ammonium and a suite of major and trace ions and any other parameters agreed with EA to reflect local conditions.<br>During the construction phase, this suite shall be supplemented by TPH (total petroleum hydrocarbons) and other likely contaminants from construction materials.<br>Full suite shall be supplemented with determinands appropriate to detect impacts from known areas of pre-existing poor quality or contaminated groundwater and any contaminants related to construction activities, including speciated TPH. |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>4</sup> Low flow sampling methodology shall be used where non-aqueous phase liquid (NAPL), VOC/ SVOCs or significant contamination is suspected, or to reduce the volume of waste water with the agreement of the Environment Agency.  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>5</sup> A discharge monitoring point would also be required if dewatering effluent is being returned to the watercourse.   |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>6</sup> If there are no appropriate observation boreholes in-situ, installation of new observation boreholes may be required in some circumstances.  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <sup>7</sup> A longer period of operational monitoring maybe necessary to observe any Scheme impacts over a range of conditions (e.g. dry summer, wet winter).  |  |  |  |  |  |  |  |  |  |  |  |  |  |



| Monitoring Advisory Sheet - GW3  |            |                                 |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
|--|------------|---------------------------------|---|----------------------|-------------------|---------------------|--------------------------|-------------------------------|---------------------------------|----------------------|---|---------------------------|--|
| <i>To be used for:</i>   |            |                                 |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
| Monitoring type: Groundwater   |            |                                 |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
| Impact type: Quantitative <sup>1</sup> and chemical <sup>2</sup>   |            |                                 |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
| Effect type: Yellow As reported in the WFD status risk screening tables  |            |                                 |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
| RECEPTOR   | WHAT?      | PHASE<br>HOW?<br>Method         | Baseline (pre-construction)   |                      |                   | Construction        |                          |                               | Operational (post-construction) |                      |   | AGREED MONITORING WITH EA |  |
|  |            |                                 | WHERE?<br>Locations   | WHEN?<br>Frequency   | Duration          | WHERE?<br>Locations | WHEN?<br>Frequency       | Duration                      | WHERE?<br>Locations             | WHEN?<br>Frequency   | Duration <sup>5</sup>                                     |                           |  |
| Disturbed aquifer(s)<br>(i.e. dewatered,<br>dammed, connected<br>to other aquifers,<br>exposed to potential<br>contaminants) | GW level   | Logger measurements             | Minimum of 1 x monitoring borehole up hydraulic GW gradient and 1 x monitoring borehole down hydraulic GW gradient per 500 m of route, within aquifers potentially affected by the scheme | na                   | Minimum 12 months | As baseline         | na                       | Throughout construction phase | As baseline                     | na                   | 2 years post construction unless agreed otherwise with EA |                           |  |
|  |            | Dips                            |   | Monthly              |                   |                     | Fortnightly              |                               |                                 | Monthly              |   |                           |  |
|  | GW quality | Field measurements <sup>3</sup> |   | Monthly (core suite) |                   |                     | Fortnightly (core suite) |                               |                                 | Monthly (core suite) |   |                           |  |
|  |            | Samples (purged) <sup>4</sup>   |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |
|  |            | Visual (post purge)             |   |                      |                   |                     |                          |                               |                                 |                      |   |                           |  |

**Notes**

This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Groundwater Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.

<sup>1</sup> Quantitative groundwater impacts assessed in the WFD status risk screening tables are:  
 Lowering of GW levels and reduction of GW contributions to SW bodies, GWDTE or GW abstractions by temporary dewatering/permanent GW control  
 Damming of GW flow and reduction in GW contributions

<sup>2</sup> Chemical groundwater impacts assessed in the WFD status risk screening tables are:  
 Creating or altering of pathways along which existing poor quality GW can migrate;  
 Disturbing or mobilising existing poor quality GW by temporary dewatering or depressurisation and permanent GW control.

In addition the CFA site specific 'potential impact on groundwater receptors' summary tables highlight the impact caused by the introduction of contaminants during construction activities.

<sup>3</sup> Field measurements shall include T, pH, EC, DO and redox potential - monitored throughout purging where appropriate to ensure stabilisation of water chemistry before sample is taken.

<sup>4</sup> Core suite shall include T, pH, EC, DO, nitrate, ammonium and a suite of major and trace ions and any other parameters agreed with EA to reflect local conditions.

During the construction phase, this suite shall be supplemented by TPH (total petroleum hydrocarbons) and other likely contaminants from construction materials.

Low flow sampling methodology shall be used where non-aqueous phase liquid (NAPL), VOC/ SVOCs or significant contamination is suspected, or to reduce the volume of waste water with the agreement of the Environment Agency.

<sup>5</sup> A longer period of operational monitoring maybe necessary to observe any Scheme impacts over a range of conditions (e.g. dry summer, wet winter).

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| Monitoring Advisory Sheet - SW1   |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
|---|--|---------------------------------|--|--|-------------------|--------------------------|---|-------------------------------|-------------------------------|--|---|-------------------------------|---------|--|
| To be used for:   |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Monitoring type:  | Surface water  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Impact type:  | Quality (physico-chemical) & Quantity  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Effect type:  | As reported in the WFD status risk screening tables  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
|   | Amber  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
|   | Yellow   |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
|   | Blue   |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Impact magnitude:   | Any adverse As reported in the CFA site specific 'potential impact on surface water receptors' summary table |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| RECEPTOR  | WHAT?  | PHASE                           | Baseline (pre-construction)  |  |                   | Construction             |   |                               | Operation (post-construction) |  |   | AGREED MONITORING WITH THE EA |         |  |
|   |  | HOW?                            | WHERE?   | WHEN?  | Duration          | WHERE?                   | WHEN?                                     | Duration                      | WHERE?                        | WHEN?  | Duration  |                               |         |  |
|   |  | Method                          | Locations <sup>4</sup>   | Frequency                                    |                   | Locations                | Frequency                                 |                               | Locations                     | Frequency                                    |   |                               |         |  |
| SW body - watercourse   | Quality  | Spot sampling <sup>2</sup>      | Upstream and downstream control sites typically within 50m of the construction zone                              | Monthly (core suite), quarterly (full suite) | Minimum 12 months | As baseline <sup>6</sup> | Weekly (core suite), monthly (full suite) | Throughout construction phase | As baseline                   | Monthly (core suite), quarterly (full suite) | 2 years post construction unless agreed otherwise with EA |                               |         |  |
|   |  | Visual inspection               |  | Monthly                                      |                   |                          | Additional construction monitoring sites  |                               | Daily                         |  |   | na                            | Monthly |  |
|   |  | Field measurements <sup>3</sup> |  |  |                   |                          | Construction site office                  |                               | Weekly                        |  |   | As baseline                   | Hourly  |  |
|   |  | Meteorology                     | na   | na   |                   |                          |   |                               | Daily summary                 |  |   |                               | Monthly |  |
|   | Flow   | Logger measurements             | Upstream and downstream gauging stations in proximity to the construction zone (if already in-situ) <sup>5</sup> | Hourly                                       |                   |                          |   |                               | Hourly                        |  |   |                               | Monthly |  |
|   |  | Current/flow meter              | Upstream and downstream control sites typically within 50m of the construction zone                              | Monthly                                      |                   |                          |   |                               | Monthly                       |  |   |                               | Hourly  |  |
|   | Level <sup>1</sup>   | Logger measurements             | Upstream and downstream stilling well control sites typically within 50m of the construction zone                | Hourly                                       |                   | As baseline              | Hourly                                    |                               |                               | Monthly                                      |   |                               |         |  |
|   |  | Dips                            |  | Monthly                                      |                   |                          | Monthly                                   |                               |                               | Monthly                                      |   |                               |         |  |
| SW body - reservoir, lake, pond   | Quality  | Spot sampling <sup>2</sup>      | 1 x sampling location  | Monthly (core suite), quarterly (full suite) | Minimum 12 months | As baseline              | Weekly (core suite), monthly (full suite) | Throughout construction phase | As baseline                   | Monthly (core suite), quarterly (full suite) | 2 years post construction unless agreed otherwise with EA |                               |         |  |
|   |  | Visual inspection               |  | Monthly                                      |                   |                          | Additional construction monitoring sites  |                               | Daily                         |  |   | na                            | Monthly |  |
|   |  | Field measurements <sup>3</sup> |  |  |                   |                          | Construction site office                  |                               | Weekly                        |  |   | As baseline                   | Hourly  |  |
|   |  | Meteorology                     | na   | na   |                   |                          |   |                               | Daily summary                 |  |   |                               | Monthly |  |
|   | Level  | Logger measurements             | 1 x stilling well location   | Hourly                                       |                   |                          |   |                               | Hourly                        |  |   |                               | Monthly |  |
|   |  | Dips                            |  | Monthly                                      |                   |                          |   |                               | Monthly                       |  |   |                               | Monthly |  |
| <b>Notes</b>  |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Surface Water Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans. |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>1</sup> In the absence of a gauging station, SW flows can be obtained from stilling well SW levels if sufficient current meter gaugings are available to define a stage-discharge relationship.  |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>2</sup> The use of automatic water quality sampling equipment rather than spot sampling may be appropriate at some locations based on discussions with the EA - for example, those highlighted as amber risk for water quality.                          |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Core suite shall include T, pH, EC, DO, BOD, COD, suspended solids, nitrate, ammonium, chlorophyll a, hardness, copper, zinc and a suite of major and trace ions and any other parameters agreed with the EA to reflect local conditions.                     |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| During the construction phase, this suite shall be supplemented by TPH (total petroleum hydrocarbons) and other likely contaminants from construction materials during the construction phase.  |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| Full suite shall be supplemented with a wide range of possible contaminants, particularly those related to construction activities, including speciated TPH.  |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>3</sup> Field measurements shall include T, pH, EC, DO and redox potential.  |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>4</sup> Information on existing monitoring sites (e.g. EA routine monitoring sites), discharge consents, abstractions, control structures etc. shall be collated in order to best determine monitoring site locations. See Appendix C.                   |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>5</sup> A discharge monitoring point would also be required if dewatering effluent is being returned to the watercourse.   |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |
| <sup>6</sup> The installation of gauging stations may be required based on discussions with the Environment Agency.   |  |                                 |  |  |                   |                          |   |                               |                               |  |   |                               |         |  |

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| <b>Monitoring Advisory Sheet - SW2</b> |  |
| To be used for:                        |  |
| Monitoring type:                       | Surface water  |
| Impact type:                           | Aquatic Ecology - Aquatic Macrophytes and Phytobenthos   |
| Effect type:                           | Amber<br>Yellow<br>Blue  |
| Impact magnitude:                      | Any adverse As reported in the CFA site specific 'potential impact on surface water receptors' summary table |

| RECEPTOR | WHAT?   | PHASE<br>HOW?<br>Method   | Baseline (pre-construction)  |   |               | Construction                            |   |  | Operation (post-construction)   |  |          | AGREED MONITORING WITH THE EA |
|----------|---|---|--|---|---------------|---|---|--|---|--|----------|-------------------------------|
|          |   |   | WHERE?<br>Locations  | WHEN?<br>Season   | Duration      | WHERE?<br>Locations                     | WHEN?<br>Season   | Duration   | WHERE?<br>Locations   | WHEN?<br>Season  | Duration |                               |
| SW body  | Aquatic macrophyte community abundance, species richness and distribution.  | Standard LEAFPACS2 aquatic macrophyte survey method (see Appendix E for further details). | The location of monitoring will be dependant on the nature of the design element.  |   |               | No surveys required during construction |   |  | The location of monitoring will be dependant on the nature of the design element.                             |  |          |                               |
|          |   |   | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | Summer (June-August)                                    | Single Survey |   |   | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | Summer (June-August)  | Single Surveys (one year post-construction and five-year post construction)  |          |                               |
|          | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing channel that will be affected by the design element. This shall be undertaken at a minimum of one location, or at a rate of one location per km of channel affected, whichever is the highest. |   | Summer (June-August)   | Single Survey   |               |   | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing or newly created channel associated with the design element. | Summer (June-August)   | Single Surveys (one year post-construction and five-year post construction)                                   |  |          |                               |
|          |   |   |  |   |               |   |   |  |   |  |          |                               |
| SW body  | Aquatic phytobenthos community abundance and species richness.  | Standard DARLEQ2 aquatic phytobenthos survey method (see Appendix E for further details). | The location of monitoring will be dependant on the nature of the design element.  |   |               | No surveys required during construction |   |  | The location of monitoring will be dependant on the nature of the design element.                             |  |          |                               |
|          |   |   | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | Spring (March-May)<br>OR<br>Autumn (September-November) | Single Survey |   |   | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | To be consistent with Baseline survey i.e. either:<br>Spring (March-May)<br>OR<br>Autumn (September-November) | Single Surveys (one year post-construction and three-year post construction) |          |                               |
|          | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing channel that will be affected by the design element. This shall be undertaken at a minimum of one location, or at a rate of one location per km of channel affected, whichever is the highest. |   | Spring (March-May)<br>OR<br>Autumn (September-November)  | Single Survey   |               |   | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing or newly created channel associated with the design element. | To be consistent with Baseline survey i.e. either:<br>Spring (March-May)<br>OR<br>Autumn (September-November)  | Single Surveys (one year post-construction and three-year post construction)                                  |  |          |                               |
|          |   |   |  |   |               |   |   |  |   |  |          |                               |

**Notes**  
 This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Surface Water Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.  
 Aquatic macrophytes are good biological indicators of medium to long term functional changes in river water quality and habitat provision (through, for example, changes in chemical composition, flow and sediment dynamics). Where monitoring is required, pre-construction baseline and post-construction monitoring can help ensure that design elements have met their ecological and WFD objectives in respect to the riverine environment.  
 Aquatic phytobenthos are good biological indicators of short to medium term functional changes in river water quality and habitat provision (through, for example, changes in chemical composition, flow and sediment dynamics). Where monitoring is required, pre-construction baseline and post-construction monitoring can help ensure that design elements have met their ecological and WFD objectives in respect to the riverine environment.  
 This advisory sheet provides overarching principles of how, where and when aquatic macrophyte or phytobenthos sampling is advisable. However, the decision to implement aquatic macrophyte or phytobenthos sampling shall take account of the nature of the local system affected by the design.  
 For phytobenthos where possible do not collect spring samples before mid spring (before mid-April).  
 For further details of the methods described for aquatic macrophyte and phytobenthos surveying, please refer to Appendix E Monitoring Activity requirements.  
 Data held by HS2 and the Environment Agency shall be reviewed spatially and temporally to determine if existing information provides an appropriate proxy that negates the need for baseline monitoring.

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| Monitoring Advisory Sheet - SW3  |   |   |   |   |               |   |  |  |   |   |  |                               |
|--|---|---|---|---|---------------|---|--|--|---|---|--|-------------------------------|
| To be used for:  |   |   |   |   |               |   |  |  |   |   |  |                               |
| Monitoring type: Surface water   |   |   |   |   |               |   |  |  |   |   |  |                               |
| Impact type: Aquatic Ecology - Aquatic Macroinvertebrates  |   |   |   |   |               |   |  |  |   |   |  |                               |
| Effect type: Amber As reported in the WFD status risk screening tables   |   |   |   |   |               |   |  |  |   |   |  |                               |
| Yellow   |   |   |   |   |               |   |  |  |   |   |  |                               |
| Blue   |   |   |   |   |               |   |  |  |   |   |  |                               |
| Impact magnitude: Any adverse As reported in the CFA site specific 'potential impact on surface water receptors' summary table   |   |   |   |   |               |   |  |  |   |   |  |                               |
| RECEPTOR   | WHAT?   | PHASE   | Baseline (pre-construction)   |   |               | Construction  |  |  | Operation (post-construction)   |   |  | AGREED MONITORING WITH THE EA |
|  |   | HOW?<br>Method  | WHERE?<br>Locations   | WHEN?<br>Season   | Duration      | WHERE?<br>Locations   | WHEN?<br>Season  | Duration   | WHERE?<br>Locations   | WHEN?<br>Season   | Duration   |                               |
| SW body  | Aquatic macroinvertebrate community abundance and species richness. | Standard RIVPACS aquatic macroinvertebrate survey (see Appendix E for further details). | The location of monitoring will be dependant on the nature of the design element.   |   |               | Construction monitoring will only be required in response to a specific contamination event of the surface water body, with reference to the ongoing water quality monitoring.  |  |  | The location of monitoring will be dependant on the nature of the design element.   |   |  |                               |
|  |   |   | Where habitat loss/severance occurs (e.g. culvert/bridge/road placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element.   | Spring (March-May)<br>OR<br>Autumn (September-November) | Single Survey | Monitoring shall be undertaken at one site upstream and at a minimum of one site downstream of the contamination source (assuming point source contamination event). Additional downstream sites may be required depending on the propagation of the event. | Non-seasonal. Sample to be collected as soon after the specific pollution event as practically possible. | Dependant on the severity of the event. Advice shall be sought from the regulator. | Where habitat loss/severance occurs (e.g. culvert/bridge/road placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | To be consistent with Baseline survey i.e. either:<br>Spring (March-May)<br>OR<br>Autumn (September-November) | Single Surveys (one year post-construction and three-year post construction) |                               |
|  |   |   | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing channel that will be affected by the design element. This shall be undertaken at a minimum of one location, or at a rate of one location per km of channel affected, whichever is the highest. | Spring (March-May)<br>OR<br>Autumn (September-November) | Single Survey |   |  |  | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing or newly created channel associated with the design element.                             | To be consistent with Baseline survey i.e. either:<br>Spring (March-May)<br>OR<br>Autumn (September-November) | Single Surveys (one year post-construction and three-year post construction) |                               |
| <b>Notes</b>   |   |   |   |   |               |   |  |  |   |   |  |                               |
| This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Surface Water Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.  |   |   |   |   |               |   |  |  |   |   |  |                               |
| Aquatic macroinvertebrates are excellent biological indicators of short to long term functional changes in river water quality and habitat provision (through, for example, changes in chemical composition, flow and sediment dynamics). Where monitoring is required, pre-construction baseline and post-construction monitoring can help ensure that design elements have met their ecological and WFD objectives in respect to the riverine environment. |   |   |   |   |               |   |  |  |   |   |  |                               |
| This advisory sheet provides overarching principles of how, where and when aquatic macroinvertebrate sampling is advisable. However, the decision to implement aquatic macroinvertebrate sampling shall take account of the nature of the local system affected by the design element. For example, aquatic macroinvertebrate sampling on ephemeral ditches may not be advisable regardless of the nature of the modification.                               |   |   |   |   |               |   |  |  |   |   |  |                               |
| For further details of the methods described for each of the techniques, please refer to Appendix E Monitoring Activity requirements.  |   |   |   |   |               |   |  |  |   |   |  |                               |
| Data held by HS2 and the Environment Agency shall be reviewed spatially and temporally to determine if existing information provides an appropriate proxy that negates the need for baseline monitoring.   |   |   |   |   |               |   |  |  |   |   |  |                               |

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| Monitoring Advisory Sheet - SW4  |  |   |   |   |               |  |   |  |  |   |  |                               |
|--|--|---|---|---|---------------|--|---|--|--|---|--|-------------------------------|
| To be used for:  |  |   |   |   |               |  |   |  |  |   |  |                               |
| Monitoring type: Surface water   |  |   |   |   |               |  |   |  |  |   |  |                               |
| Impact type: Aquatic Ecology - Fish  |  |   |   |   |               |  |   |  |  |   |  |                               |
| Effect type: Amber As reported in the WFD status risk screening tables   |  |   |   |   |               |  |   |  |  |   |  |                               |
| Yellow   |  |   |   |   |               |  |   |  |  |   |  |                               |
| Blue   |  |   |   |   |               |  |   |  |  |   |  |                               |
| Impact magnitude: Any adverse As reported in the CFA site specific 'potential impact on surface water receptors' summary table   |  |   |   |   |               |  |   |  |  |   |  |                               |
| RECEPTOR   | WHAT?  | PHASE   | Baseline (pre-construction)   |   |               | Construction   |   |  | Operation (post-construction)  |   |  | AGREED MONITORING WITH THE EA |
|  |  | HOW?<br>Method  | WHERE?<br>Locations   | WHEN?<br>Season   | Duration      | WHERE?<br>Locations  | WHEN?<br>Season   | Duration   | WHERE?<br>Locations  | WHEN?<br>Season   | Duration   |                               |
| SW body  | Fish community species richness, density and standing crop (weight per unit area). | Electric fishing survey (see Appendix E for further details). | The location of monitoring will be dependant on the nature of the design element.   |   |               | Construction monitoring will only be required in response to a specific contamination event of the surface water body, with reference to the ongoing water quality monitoring.   |   |  | The location of monitoring will be dependant on the nature of the design element.  |   |  |                               |
|  |  |   | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element.  | March to October. Optimal period within this range will be partly informed by the structure of the fish assemblage and will need to be agreed with the regulator as part of licensing requirements. | Single Survey | Following a pollution event there may be a requirement to implement an ecological watching brief to target signs of fish stress. This watching brief may trigger the need for a fish rescue, depending on the severity of the event. | Non-seasonal.   | Watching brief to be instated as soon as the specific pollution event has occurred. Dependant on the severity of the event. Advice shall be sought from the regulator. | Where habitat loss/severance occurs (e.g. culvert/bridge/viaduct placement), monitoring shall be undertaken at 2 sites; one upstream and one downstream within, as far as practically possible, 50m of the design element. | March to October. Optimal period within this range will be partly informed by the structure of the fish assemblage and will need to be agreed with the regulator as part of licensing requirements. | Single Surveys (one year post-construction and three-year post construction) |                               |
|  |  |   | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing channel that will be affected by the design element. This shall be undertaken at a minimum of one location, or at a rate of one location per km of channel affected, whichever is the highest. | March to October. Optimal period within this range will be partly informed by the structure of the fish assemblage and will need to be agreed with the regulator as part of licensing requirements. | Single Survey | Where habitat severance does not occur (e.g. river diversions/enhancements) monitoring shall be undertaken within the existing or newly created channel associated with the design element.  | March to October. Optimal period within this range will be partly informed by the structure of the fish assemblage and will need to be agreed with the regulator as part of licensing requirements. | Single Surveys (one year post-construction and three-year post construction)   |  |   |  |                               |
| <b>Notes</b>   |  |   |   |   |               |  |   |  |  |   |  |                               |
| This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Surface Water Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.  |  |   |   |   |               |  |   |  |  |   |  |                               |
| Fish are good biological indicators of short to long term changes in river water quality and habitat provision (through, for example, changes in chemical composition, flow and sediment dynamics). Fish kills, observational signs of fish stress, and population displacement are all indicators of localised deterioration in water quality. Where monitoring is required, pre-construction baseline and post-construction monitoring can help ensure that design elements have met their ecological and WFD objectives in respect to the riverine environment. |  |   |   |   |               |  |   |  |  |   |  |                               |
| This advisory sheet provides an overarching guide to the principles of how, where and when fish sampling is advisable. However, the decision to implement fish sampling shall take account of the nature of the local system affected by the design element. It shall also take account of the functional ecology of the populations present (i.e. if the assemblage dominated by fish with a low tolerance to environmental disturbance it will be a better indicator of local change).   |  |   |   |   |               |  |   |  |  |   |  |                               |
| For further details of the methods described for each of the techniques, please refer to Appendix C Monitoring Activity requirements.  |  |   |   |   |               |  |   |  |  |   |  |                               |
| Data held by HS2 and the Environment Agency shall be reviewed spatially and temporally to determine if existing information provides an appropriate proxy that negates the need for baseline monitoring.   |  |   |   |   |               |  |   |  |  |   |  |                               |
| This advisory sheet does not include requirements for any fish captures or translocations that may be required as part of a specific design element, e.g. coffer damming or river channel realignment work. It is assumed these will be covered in the workpackages produced for individual design element   |  |   |   |   |               |  |   |  |  |   |  |                               |

| Monitoring Advisory Sheet - SW5  |   |   |   |  |  |  |  |   |  |  |               |                               |
|--|---|---|---|--|--|--|--|---|--|--|---------------|-------------------------------|
| To be used for:  |   |   |   |  |  |  |  |   |  |  |               |                               |
| Monitoring type:   | Surface water   |   |   |  |  |  |  |   |  |  |               |                               |
| Impact type:   | Hydromorphology   |   |   |  |  |  |  |   |  |  |               |                               |
| Effect type:   | Amber<br>Yellow<br>Blue   |   |   |  |  |  |  |   |  |  |               |                               |
| As reported in the WFD status risk screening tables  |   |   |   |  |  |  |  |   |  |  |               |                               |
| Impact magnitude:  | Any adverse   |   |   |  |  |  |  |   |  |  |               |                               |
| As reported in the CFA site specific 'potential impact on surface water receptors' summary table |   |   |   |  |  |  |  |   |  |  |               |                               |
| RECEPTOR   | WHAT?   | PHASE<br>HOW?<br>Method   | Baseline (pre-construction)<br>WHERE?<br>Locations  | WHEN?<br>Season  | Duration   | Construction<br>WHERE?<br>Locations  | WHEN?<br>Season  | Duration  | Operation (post-construction)<br>WHERE?<br>Locations                         | WHEN?<br>Season  | Duration      | AGREED MONITORING WITH THE EA |
| Watercourse reach or SW body depending on use of hydromorphological data                         | Hydromorphology<br>Required monitoring for the following (large impact) scheme elements:<br>River diversion/realignment, Culvert  | Reconnaissance (walkover) survey<br><br>It would involve a fairly detailed assessment of the changes in geomorphological form and function using geo-referenced photos and mobile mappers at 1-2m resolution. The principal objective is to monitor channel change and monitor changes to habitat form as it evolves. | Scheme impact location plus upstream and downstream up to approximately 100m within site boundary. This could be extended up to 500m for sites that are impacted over a longer distance.  | Not season specific but preferably at the same time as ecological surveys are carried out.                     | Single survey  | Point photography is recommended during construction   |  |   | Repeat survey approximately 3 months, 1, 3 and 5 years post construction.    | Not season specific but preferably at the same time as ecological surveys are carried out.   | Single survey |                               |
|  |   | Fixed point photography<br><br>Photographs taken at a set of identical locations before, during, just after and several years after the works.  | Scheme impact location where changes will occur e.g. river diversions/realignments. It shall be carried out in conjunction with the reconnaissance survey.  | Not season specific but preferably at the same time as ecological surveys are carried out.                     | Single survey  |  |  |   | Repeat of survey approximately 3 months, 1, 3 and 5 years post construction. | Not season specific but preferably at the same time as ecological surveys are carried out.   | Single survey |                               |
|  |   | Hydromorphology<br>Required monitoring for the following scheme elements:<br>Viaduct/Bridge with footing in the water body, Siphon, Drainage outfalls to watercourses, River bank protection  | Reconnaissance (walkover) survey<br><br>It would involve an assessment of the changes in geomorphological form and function using geo-referenced photos and mobile mappers at 1-2m resolution. The resolution of monitoring could be less detailed than for large elements such as a river diversion/realignment and the length of the reach monitored could be less i.e. only at the scheme impact location and not up and downstream. | Scheme impact location   | Not season specific but preferably at the same time as ecological surveys are carried out.   |  |  |   | Single survey  | Repeat survey approximately 3 months after construction. Further surveys unlikely to be required, unless perhaps a large hydrological event leads to concerns about channel stability. | NA            |                               |
|  | Detailed River datasets<br>Additional monitoring may also be required for the following scheme elements especially where there are hydromorphological risks that could affect an asset:<br>River diversion/realignment, Culvert, Siphon | Topographic Surveys<br><br>Scheme location incorporating channel and surrounding floodplain.  | NA  | Single survey  | Unlikely to need to be repeated post construction unless perhaps a large hydrological event leads to concerns about channel stability.   | NA   | Isolated surveys as required   |   |  |  |               |                               |
|  |   | Repeat Cross sections<br><br>Scheme location. The number of cross sections required will be dependent on length of river reach affected and how active the channel is at that point.  | NA  | Single survey  | May be required where there are hydromorphological concerns. Frequency and locations of surveys will depend on site specific details.  | Not season specific but preferably at the same time as ecological surveys are carried out.   | Isolated surveys as required   |   |  |  |               |                               |
|  | Habitats<br>Additional monitoring may also be required for the following scheme elements:<br>River diversion/realignment  | Habitat Mapping (RCS)<br><br>Mapping vegetation structures along a watercourse and includes a map of physical habitat and a botanical survey.   | Scheme impact location plus upstream and downstream up to approximately 250m within site boundary. This could be extended over 500m reaches for sites that are impacted over a longer distance.   | Not season specific but preferably at the same time as hydromorphology reconnaissance surveys are carried out. | Single survey  | Repeat survey approximately 3 months, 1, 3 and 5 years post construction.  | Not season specific but preferably at the same time as hydromorphology reconnaissance surveys are carried out. | Single survey   |  |  |               |                               |
|  |   | River habitats survey (RHS)   |   | Single survey  |  |  |  |   |  |  |               |                               |
|  | Sediment<br>Additional monitoring may also be required for the following scheme elements:<br>Culvert<br>Drainage outfalls to watercourses   | Sediment analysis could include: bed substrate analysis<br><br>Scheme impact location   | Not season specific but preferably at the same time as other surveys are carried out.   | Single survey  | Repeat survey approximately 3 months after construction. Further surveys unlikely to be required, unless perhaps a large hydrological event leads to concerns about channel stability. | NA   | Single survey at 3 months and then isolated surveys as required  |   |  |  |               |                               |
|  |   | Extended Reach studies<br>Additional monitoring may also be required for the following scheme elements:<br>Several river diversions/realignments (or other scheme elements) occurring within close proximity and affect the same river reach/water bodies.  | Larger reconnaissance survey<br><br>Extended reach including all scheme impact locations plus upstream and downstream to appropriate reach boundaries.  | Not season specific but preferably at the same time as ecological surveys are carried out.                     | Single survey  | Repeat survey approximately 3 months after construction. Further surveys unlikely to be required, unless perhaps a large hydrological event leads to concerns about channel stability. | NA   | Single survey at 3 months and then isolated surveys as required |  |  |               |                               |

|  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|
| <b>Monitoring Advisory Sheet - SW5</b>   |  |  |  |  |  |  |  |  |  |  |
| <b>Notes</b>   |  |  |  |  |  |  |  |  |  |  |
| This Monitoring Advisory Sheet is part of the Water Resources and Flood Risk Monitoring Strategy and is intended to be used in conjunction with the Surface Water Decision Tree to inform the development of Water Resources and Flood Risk Monitoring Plans.  |  |  |  |  |  |  |  |  |  |  |
| Hydromorphological monitoring is required to assess, manage and mitigate any hydromorphological risks associated with the scheme, as well as being useful to monitor scheme channel diversions to ensure appropriate habitat recovery, and also to check for WFD compliance.   |  |  |  |  |  |  |  |  |  |  |
| Each hydromorphological study per Scheme location will need to be bespoke taking into account site specific objectives, targets, local hydromorphological parameters (such as given the location, the geology, gradient, planform, sediment, scale, land use) and risks and uncertainties associated with the scheme. Below is a generic guide to inform the type of monitoring that is likely to be required per scheme element type: |  |  |  |  |  |  |  |  |  |  |
| For all scheme elements hydromorphological monitoring will require a form of reconnaissance survey combined with fixed point photography; however the resolution and frequency of survey can be tailored to the likely impact and site specific data.  |  |  |  |  |  |  |  |  |  |  |
| For some scheme elements additional hydromorphological monitoring may also be useful, especially in terms of assessing ongoing risks during the operational phase.   |  |  |  |  |  |  |  |  |  |  |
| For river diversions habitat data could be collected at the same time as reconnaissance surveys to support analysis of whether appropriate hydroecological targets have been met.  |  |  |  |  |  |  |  |  |  |  |
| For further details on method descriptions for each of the techniques please refer to Appendix C Monitoring Activity requirements where references can be found. Additional surveys may be required post significant channel forming events.   |  |  |  |  |  |  |  |  |  |  |

# Appendix C: Detail of WFD drivers for each proposed monitoring point for Aquatic Ecology



| N° | ES (as amended) ID | WFD ID         | Location   | Potential anticipated risk to WFD Ecological Status | Macrophytes | Phytobenthos | Macroinvertebrates | Fish |
|----|--------------------|----------------|--|---|-------------|--------------|--------------------|------|
|    |                    |                |  |   |             |              |                    |      |
| 1  | SWC-CFA03-01       | GB70610078     | Grand Union Canal at Gloucester Avenue (near Euston Approach)  | Compound and construction activities impacts.       | ✓           | ✓            | ✓                  | *6   |
|    |                    |                |  | Noise and vibration impact                          |             |              |                    | ✓    |
| 2  | SWC-CFA04-01       | GB70610078     | Grand Union Canal at South of Saint Mary's Catholic Cemetery (east Old Oak Common Station)             | Noise and vibration impact                          |             |              |                    | ✓    |
| 3  | SWC-CFA05-04       | GB70610078     | Grand Union Canal south west of Mandeville Road Ventilation Shaft at East Mandeville Ventilation Shaft | Compound and construction activities impacts.       | ✓           | ✓            | ✓                  | ✓    |
|    |                    |                |  | Dewatering impacts                                  | ✓           | ✓            | ✓                  | ✓    |
|    |                    |                |  | Noise and vibration impact                          |             |              |                    | ✓    |
| 4  | SWC-CFA05-01       | GB106039023590 | River Brent  | Compound and construction activities impacts.       | ✓           | ✓            | ✓                  | ✓    |
|    |                    |                |  | Noise and vibration impact                          |             |              |                    | ✓    |
| 5  | SWC-CFA06-01       | GB106039023050 | Yeading Brook East   | Noise and vibration impact                          |             |              |                    | ✓    |
| 6  | SWC-CFA06-04       | GB106039023060 | Yeading Brook West (upstream)  | Dewatering impacts                                  | ✓           | ✓            | ✓                  | ✓    |
|    |                    |                |  | Noise and vibration impact                          |             |              |                    | ✓    |
| 7  | SWC-CFA06-05       | GB106039023060 | Yeading Brook West (downstream)  | Noise and vibration impact                          |             |              |                    | ✓    |
| 8  | SWC-CFA06-02 (1)   | GB106039023070 | River Pinn (upstream bridge)   | Shading impacts                                     | ✓           | ✓            |                    |      |
|    |                    |                |  | Land take and new habitat creation impacts          | ✓           | ✓            | ✓                  | ✓    |
|    |                    |                |  | Noise and vibration impact                          |             |              |                    | ✓    |

<sup>6</sup> following a site visit to the survey point (SWC-CFA03-01) by the contractor undertaking the aquatic ecology monitoring, fish surveys at this location were removed from the monitoring plan based on the H&S risks posed by the general public and boat traffic.

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|    |                  |                    |   |  |    |    |    |    |    |
|----|------------------|--------------------|---|--|----|----|----|----|----|
|    | SWC-CFA06-02 (2) |                    | River Pinn (downstream bridge)                | Shading impacts                                    |    | ✓  |    |    |    |
|    |                  |                    |   | Land take and new habitat creation impacts         | ✓  | ✓  | ✓  | ✓  | ✓  |
|    |                  |                    |   | Noise and vibration impact                         |    |    |    |    | ✓  |
| 9  | SWC-CFA06-03 (1) | GB106039023<br>070 | Ickenham Stream (upstream diversion proposed) | Land take and new habitat creation impacts         | ✓  | ✓  | ✓  | ✓  | ✓  |
|    |                  |                    |   | Noise and vibration impact                         |    |    |    |    | ✓  |
|    | SWC-CFA06-03 (2) |                    | Ickenham Stream (downstream bridge)           | Land take and new habitat creation impacts         | ✓  | ✓  | ✓  | ✓  | ✓  |
|    |                  |                    |   | Noise and vibration impact                         |    |    |    |    | ✓  |
| 10 | SWC-CFA06-07     | GB106039023<br>070 | Ickenham East Tributary                       | Land take and new habitat creation impacts         | ✓  | ✓  | ✓  | ✓  | ✓  |
|    |                  |                    |   | Noise and vibration impact                         |    |    |    |    | ✓  |
| 11 | CFA06-P05 (1)    | GB106039023<br>070 | Existing Pond 1 West Ruislip Golf Course      | Pond lost to scheme – no monitoring proposed.      | -  | -  | -  | -  | -  |
|    | CFA06-P05 (2)    |                    | Existing Pond 2 West Ruislip Golf Course      | Pond lost to scheme – no monitoring proposed.      | -  | -  | -  | -  | -  |
|    | CFA06-P05 (3)    |                    | Existing Pond 3 West Ruislip Golf Course      | Pond lost to scheme – no monitoring proposed.      | -  | -  | -  | -  | -  |
|    | NP-1 (1)         |                    | New Pond 1 West Ruislip Golf Course           | Pond created to compensate for pond lost to scheme | SG | SG | SG | SG | SG |
|    | NP-1 (2)         |                    | New Pond 1 West Ruislip Golf Course           | Pond created to compensate for pond lost to scheme | SG | SG | SG | SG | SG |
|    | NP-1 (3)         |                    | New Pond 1 West Ruislip Golf Course           | Pond created to compensate for pond lost to scheme | SG | SG | SG | SG | SG |
| 12 | SWC-CFA06-06     | GB106039023<br>070 | West Ruislip Golf Drains                      | Land take and new habitat creation impacts         | ✓  | ✓  | ✓  | ✓  | ✓  |
|    |                  |                    |   | Noise and vibration impact                         |    |    |    |    | ✓  |
| 13 | SWC-CFA06-08 (1) | N/A                | Brackenbury Farm north pond 1                 | Adjacent earthworks: minimal impact likely.        | SG | SG | SG | SG | SG |
|    | SWC-CFA06-08 (2) |                    | Brackenbury Farm north pond 2                 | Adjacent earthworks: minimal impact likely.        | SG | SG | SG | SG | SG |
|    | SWC-CFA06-08 (3) |                    | Moat in Brackenbury Farm                      | Adjacent earthworks: minimal impact likely.        | SG | SG | SG | SG | SG |

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|                            |                                   |            |  |   |    |    |    |    |
|----------------------------|-----------------------------------|------------|--|---|----|----|----|----|
| 14                         | SWC-CFA06-09                      | N/A        | South-east of Newyears Green Covert pond   | Adjacent earthworks: minimal impact likely. | SG | SG | SG | SG |
| 15                         | SWC-CFA06-10 (1)                  | N/A        | Newyears Green Bourne (upstream bridge)  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
| 15                         | SWC-CFA06-10 (2)                  | N/A        | Newyears Green Bourne (downstream bridge)  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
| 16                         | SWN-A                             | GB70610078 | Grand Union Canal at Atlas Road Logistics Tunnel and Willesden Euro Terminal Compounds | Adjacent works impacts                      | ✓  | ✓  | ✓  | ✓  |
|                            |                                   |            |  | Noise and vibration impact                  |    |    |    | ✓  |
| 17                         | SWN-B                             | GB70610078 | Grand Union Canal at North of Greenpark Way Ventilation Shaft                          | Dewatering impacts                          | ✓  | ✓  | ✓  | ✓  |
|                            |                                   |            |  | Noise and vibration impact                  |    |    |    | ✓  |
| 18                         | SWN-C                             | N/A        | Sustainable Placement Areas  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
|                            | SWN-D                             |            |  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
|                            | SWN-E                             |            |  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
|                            | SWN-F                             |            |  | Earthworks impacts                          | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
|                            | SWN-G                             |            |  | Earthworks and culverting impacts           | ✓  | ✓  | ✓  | ✓  |
|                            | Noise and vibration impact        |            |  |   |    |    | ✓  |    |
| SWN-H                      | Earthworks and culverting impacts | ✓          | ✓  | ✓   | ✓  |    |    |    |
| Noise and vibration impact |                                   |            |  | ✓   |    |    |    |    |
| SWN-I                      | Earthworks and culverting impacts | ✓          | ✓  | ✓   | ✓  |    |    |    |
| Noise and vibration impact |                                   |            |  | ✓   |    |    |    |    |

Notes:

SG – SCS Self-governance for success of new habitat creation and evidence of no effect from construction.

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## Appendix D: Recommended Format of Water Quality Data (in Excel)

| Location_Coc | Sampled_Date_Tim | Monitoring_Rour | ChemName             | Prefix | Concen | Output | Matrix_Typ |
|--------------|------------------|-----------------|----------------------|--------|--------|--------|------------|
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Ethylbenzene         | <      | 5      | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Xylene (m & p)       | <      | 5      | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Toluene              | <      | 5      | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Xylene Total         | <      | 10     | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Nitrate (as NO3-)    |        | 6.4    | mg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Nitrate (as N)       |        | 1.45   | mg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Nitrite (as N)       |        | 0.063  | mg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Sulphate             |        | 78.8   | mg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Chromium (Trivalent) | <      | 6      | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | MTBE                 | <      | 5      | µg/L   | water      |
| ML023-SW200  | 12/07/2019 00:00 | 2_July 2019     | Chloride             |        | 80.3   | mg/L   | water      |