

# A358 Taunton to Southfields Dualling Scheme

## Ecological Baseline Report - River Corridor Survey (RCS) and Macrophytes

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## Executive summary

The A358 Taunton to Southfields Dualling scheme would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the M5 motorway to the A303 to the south.

River Corridor Surveys (RCS) and macrophyte surveys were part of the suite of habitat and protected species surveys commissioned in relation to the scheme. This report presents the results of the surveys undertaken throughout 2021 and aims to inform the ecology baseline for the scheme.

This report summarises the key findings of the RCS and macrophyte surveys that were undertaken at 17 watercourse crossings to inform the impact assessment for the scheme. RCS surveys were undertaken along a maximum 500m reach of any watercourses that were identified as being potentially impacted by the scheme 500 metres upstream and downstream of the point the scheme intersects with the watercourse).

The desk study revealed several records of black poplar (*Populus nigra ssp. Betulifolia*), a species of conservation interest, within 2 kilometres of the study area, as well as records of great horsetail (*Equisetum telmateia*), a county notable species, and bog pondweed (*Potamogeton polygonifolius*).

Out of the 17 watercourses identified for survey, it was only possible to undertake macrophyte surveys at nine crossing locations/river reaches. The remaining eight sites (17, 19b, 20, 24, 33, 34, 37, 51) were deemed unsuitable for macrophyte survey due to the absence of any significant macrophyte growth/coverage resulting from heavy shading (dense, overgrown bank zone vegetation) and high water turbidity.

An ecological quality ratio (EQR) was calculated for each surveyed watercourse using the LEAFPACS2 analysis tool. The macrophyte EQR values within the study area ranged from bad to high.

The majority of macrophyte species identified during the field surveys were common, widespread species typical of the habitats surveyed. No notable or protected species interest were recorded. Himalayan balsam (*Impatiens glandulifera*), an invasive non-native plant species listed on Schedule 9 Part 2 of the Wildlife and Countryside Act 1981 (as amended), was recorded at sites 15a, 19a, 30, 39, and 54. The RCS surveys identified a broadleaved semi-natural woodland of Bickenhall Wood at the downstream extent of site 31 (Meare Stream Tributary – south). The woodland contained some ancient woodland indicators (wild service tree *Sorbus torminalis*, bluebell *Hyacinthoides non-scripta* and European spindle *Euonymus europaeus*). Conservation of the woodland habitat in this area should be considered. In addition, black poplar was recorded at site 19a (Black Brook – south) which is of particular conservation interest and should be assessed/protected.

# 1 Introduction

## 1.1 Purpose and scope of this document

The A358 Taunton to Southfields Dualling scheme (hereafter referred to as ‘the scheme’) would provide a dual carriageway along the length of the A358 between Taunton and Ilminster in Somerset, connecting the M5 motorway to the A303 to the south. River Corridor Surveys (RCS) and macrophyte surveys were part of a suite of habitat and protected species surveys commissioned in relation to the scheme.

This report presents the results of the RCS and macrophyte surveys and aims to inform the ecology baseline for the scheme.

The objectives of this report are to:

- detail the results of the RCS and macrophyte surveys, including LEAFPACS2 classification tool analysis on the watercourses surveyed
- calculate ecological quality ratios (EQR) and site-specific Water Framework Directive (WFD) status of each watercourse
- highlight the presence of any species of conservation interest
- discuss potential mitigation measures

## 1.2 Scheme overview

- 1.2.1 The scheme is part of a programme of improvements planned along the A303/A358 corridor aimed at improving connectivity between London, the south-east and the south-west. The A303, alongside the A30, forms part of the strategic road network (SRN) and together with the A358, provides the link between London, the south-east and the south-west.
- 1.2.2 The programme of improvements, as set out in the Government’s *Road Investment Strategy* [1] made a commitment to, “...upgrade all remaining sections of the A303 between the M3 and the A358 to dual carriageway standard, together with creating a dual carriageway link from M5 at Taunton to the A303”.
- 1.2.3 The scheme directly addresses this long-term commitment and would provide a new rural all-purpose dual carriageway link from the M5 at Taunton to the A303 at Southfields roundabout. The new dual carriageway would comprise new and upgraded stretches of the existing A358 road. Full details of the scheme will be provided in Chapter 2 *The Project* of the Environmental Statement (ES). Please refer to Figure 1-1 for the scheme plan.

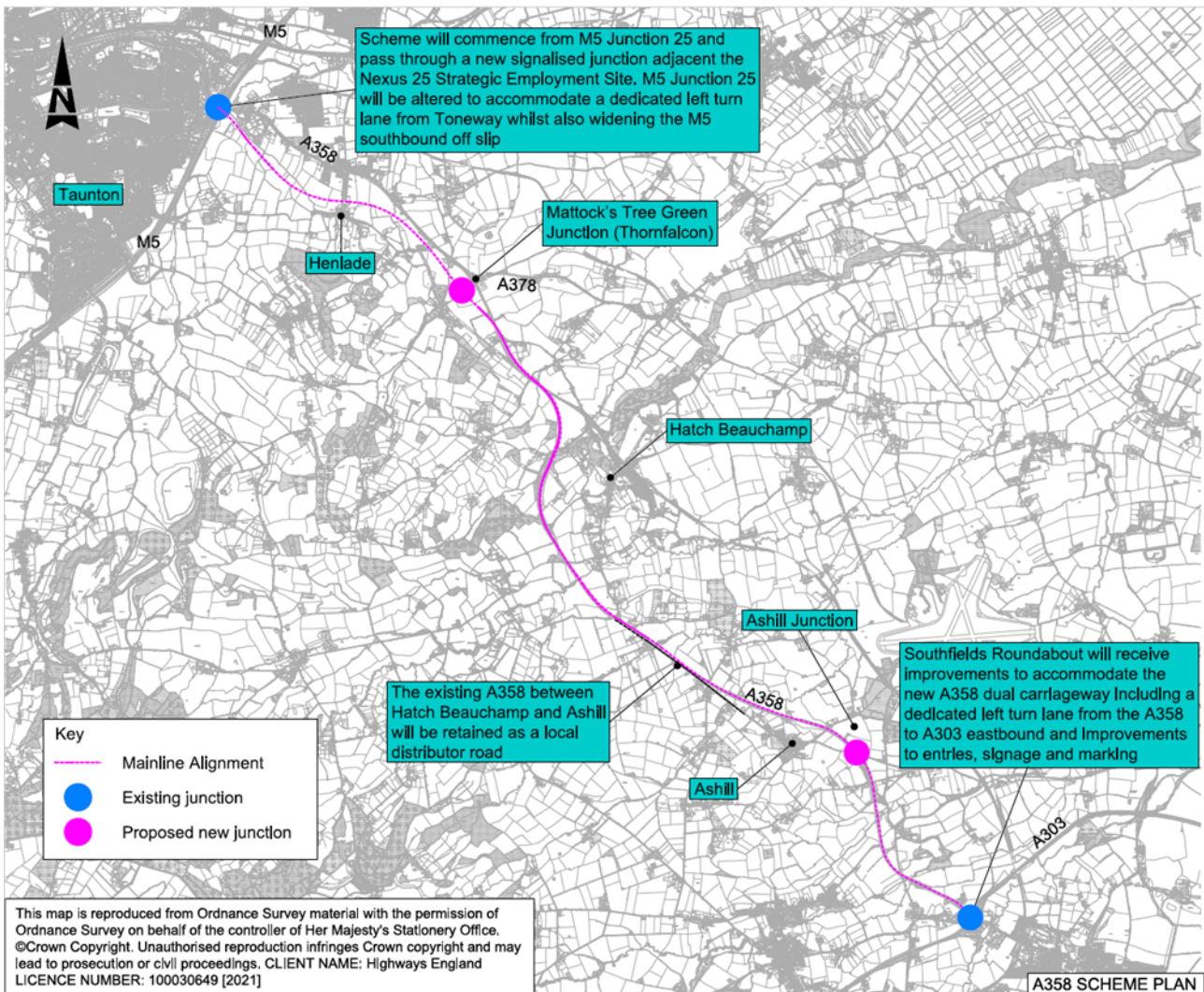


Figure 1-1 Scheme plan

## 1.3 Study area and zone of influence

1.3.1 The Chartered Institute for Ecology and Environmental Management (CIEEM) *Guidelines for Ecological Impact Assessment* [2] recommend that all potentially important ecological features that occur within the Zone of Influence (Zoi) for a scheme are investigated. The Zoi for RCS and macrophytes includes:

- areas to be directly within the land take for the scheme
- areas that would be temporarily affected during construction
- areas likely to be impacted by hydrological disruption
- areas where there is a risk of pollution and noise disturbance during construction and/or operation

1.3.2 The Zoi depends on the ecological features concerned. With regard to the watercourses likely to be affected by the scheme, in relation to the RCS and macrophytes the Zoi has been defined as all watercourses that cross the scheme and associated aquatic and riparian habitat 500 metres upstream and downstream of the crossing point, and therefore cover a total stretch of 1 kilometre of riverine habitat for each crossing point. This Zoi is hereby referred to as the study area.

## 1.4 Legislation

1.4.1 A framework of international, European, national and local legislation and planning policy guidance exists to protect and conserve wildlife and habitats. This legislation will be listed in full within Chapter 8 *Biodiversity* of the ES. Legislation relevant to this report are:

- The Conservation of Habitats and Species Regulations 2017 (the 'Habitat Regulations 2017')
- Wildlife and Countryside Act 1981
- Natural Environment and Rural Communities (NERC) Act 2006
- Invasive Alien Species (Enforcement and Permitting) Order 2019
- The Water Framework Directive 2000/60/EC

## 2 Methodology

### 2.1 Desk study

- 2.1.1 A detailed search for biological records was requested from the Somerset Environmental Records Centre (SERC) in February 2021. This was used to identify records of macrophytes and notable riparian trees, from the past 10 years, and from within a 2 kilometre radius of the scheme.
- 2.1.2 The Environment Agency's (EA) *Ecology & Fish Data Explorer* [3] was also used to search for macrophyte records within 2 kilometres of the study area within the past 10 years. Data from this resource is often not included within county species records.

### 2.2 Field survey

- 2.2.1 Field surveys were undertaken between 20 and 24 September 2021 and 27 and 30 September 2021, which is within the optimal survey season for RCS [4]. For aquatic macrophytes the optimal survey season is July to August, though surveys can typically be undertaken between 1 June and 30 September, with acknowledgement that conditions are considered to be sub-optimal in early June (due to the possibility of delayed growth) and late September [5].
- 2.2.2 The field surveys were led by Pete Flood and Dominic Stubbing. Pete has over five years consultancy experience as a botanist and specialises in the identification of vascular plants, bryophytes, fungi and lichens. Dominic is a highly experienced ecologist with over fourteen years' experience in environmental science and ecology.

#### River Corridor Survey

- 2.2.3 A total of 28 RCS surveys were undertaken across 17 sites, covering 8 watercourses, following the National River Authority RCS Handbook survey specification [4]. An approximately 500 metre section of river channel (aquatic, marginal and bank zones) was surveyed both upstream and downstream of the scheme crossing point at each site, extending up to 50 metres into the adjacent land zone on both banks. All visually dominant species were annotated onto field maps.

#### Macrophyte Survey

- 2.2.4 Macrophyte surveys were undertaken in addition to the RCS, as river macrophytes are a key biological indicator and reflect the impacts of nutrient enrichment and 'anthropogenic pressures', including alterations to river flows and modifications to morphological conditions which may act alone or in combination' [5]. The River LEAFPACS2 classification method tool enables the assessment of macrophytes in rivers according to the requirements of the Water Framework Directive (WFD), and thus provides a useful baseline indicator for the ecological status of a watercourse.
- 2.2.5 All field surveys were conducted by trained individuals using methodology that complies with those detailed in River Assessment Method Macrophytes and Phytobenthos, Macrophytes (River LEAFPACS2), Water Framework Directive [5] and the European Committee of Standardisation (EN 14184:2014) [6]. In accordance with these standards, survey sites were 100 metres in length and located so as to be representative of the watercourse/river reach. Sampling was



undertaken in September and was not undertaken during, or immediately following, periods of high flows. An experienced botanist identified macrophytes to species level where possible (and genus level or family level where positive species ID was not possible). A visual estimate of the percentage cover of the river channel for each species within the survey reach was recorded. Each species was then assigned a species cover value (SCV) according to the visual estimate of percentage cover, as summarised in Table 2-1.

**Table 2-1 River LEAFPACS2 cover values for macrophyte taxa**

| Percentage cover range (% of channel area) | Species cover value | Mid-point percentage |
|--------------------------------------------|---------------------|----------------------|
| < 0.1                                      | 1                   | 0.05                 |
| 0.1 < 1                                    | 2                   | 0.5                  |
| 1 < 2.5                                    | 3                   | 1.7                  |
| 2.5 < 5                                    | 4                   | 3.8                  |
| 5 < 10                                     | 5                   | 7.5                  |
| 10 < 25                                    | 6                   | 17.5                 |
| 25 < 50                                    | 7                   | 37.5                 |
| 50 < 75                                    | 8                   | 62.5                 |
| >75                                        | 9                   | 87.5                 |

2.2.6 Survey reaches and the scheme watercourse crossing points are presented in Table 2-2.

**Table 2-2 Summary table of RCS and macrophyte survey locations**

| Survey site ID | Watercourse                | Scheme crossing NGR | RCS survey extent     |              | Macrophyte survey extent |              |
|----------------|----------------------------|---------------------|-----------------------|--------------|--------------------------|--------------|
|                |                            |                     | Upstream              | Downstream   | Upstream                 | Downstream   |
| 15a North      | Broughton Brook            | ST2559324725        | ST 2561 2478          | ST 2577 2516 | ST 2566 2497             | ST 2571 2506 |
| 15a South      |                            |                     | ST 2532 2435          | ST 2561 2476 | ST 2539 2449             | ST 2544 2458 |
| 17             | Black Brook Tributary 1    | ST2600524230        | ST 2595 2379          | ST 2600 2423 | unsuitable for survey    | 17           |
| 19a North      | Black Brook                | ST2576924572        | ST 2562 2474          | ST 2575 2500 | ST 2570 2489             | ST 2574 2497 |
| 19a South      |                            |                     | ST 2603 2428          | ST 2579 2453 | ST 2592 2439             | ST 2584 2447 |
| 19b North      | Black Brook Tributary 3    | ST2652523807        | ST 2649 2385          | ST 2605 2427 | Unsuitable for survey    |              |
| 19b South      |                            |                     | ST 2686 2357          | ST 2650 2383 |                          |              |
| 20             | Black Brook Tributary 2/5  | ST2630623938        | ST 2656 2359          | ST 2632 2402 | Unsuitable for survey    |              |
| 24 North       | Thornwater Stream          | ST2754623555        | ST 2754 2355          | ST 2758 2383 | Unsuitable for survey    |              |
| 24 South       |                            |                     | ST 2768 2313          | ST 2754 2355 |                          |              |
| 30 North       | Meare Stream               | ST2924521573        | ST 2924 2157          | ST 2940 2179 | ST 2924 2158             | ST 2928 2172 |
| 30 South       |                            |                     | ST 2915 2114          | ST 2924 2157 | ST 2923 2155             | ST 2924 2146 |
| 31 North       | Meare Stream Tributary 1   | ST2945220806        | ST 2944 2081          | ST 2984 2106 | ST 2964 2089             | ST 2972 2095 |
| 31 South       |                            |                     | ST 2913 2039          | ST 2942 2079 | ST 2915 2040             | ST 2924 2046 |
| 33             | Fivehead River Tributary 1 | ST2971319286        | Unsuitable for survey |              | Unsuitable for survey    |              |

| Survey site ID | Watercourse                             | Scheme crossing NGR | RCS survey extent     |              | Macrophyte survey extent |              |
|----------------|-----------------------------------------|---------------------|-----------------------|--------------|--------------------------|--------------|
|                |                                         |                     | Upstream              | Downstream   | Upstream                 | Downstream   |
| 34 North       | Fivehead River main channel 1           | ST2972119292        | ST 2971 1929          | ST 3006 1948 | Unsuitable for survey    |              |
| 34 South       |                                         |                     | ST 2933 1910          | ST 2971 1929 |                          |              |
| 36 North       | Fivehead River main channel 2           | ST3062918516        | ST 3062 1851          | ST 3097 1863 | ST 3062 1851             | ST 3074 1857 |
| 36 South       |                                         |                     | ST 3021 1828          | ST 3060 1848 | ST 3034 1834             | ST 3041 1838 |
| 37 North       | Fivehead River Tributary 5              | ST3082718374        | ST 3082 1837          | ST 3099 1860 | Unsuitable for survey    |              |
| 37 South       |                                         |                     | ST 3073 1796          | ST 3082 1837 |                          |              |
| 39 North       | Venner's Water                          | ST3156617915        | ST 3133 1757          | ST 3156 1791 | ST 3157 1793             | ST 3161 1800 |
| 39 South       |                                         |                     | ST 3156 1791          | ST 3194 1800 | ST 3082 1829             | ST 3082 1816 |
| 51             | Cad Brook drainage network              | ST3321216561        | ST 3322 1646          | ST 3334 1659 | Unsuitable for survey    |              |
| 52 North       | Cad Brook                               | ST3322410467        | ST 3333 1666          | ST 3353 1678 | ST 3335 1668             | ST 3344 1671 |
| 52 South       |                                         |                     | Unsuitable for survey |              | Unsuitable for survey    |              |
| 54 North       | River Ding/River Ding drainage network  | ST3360915773        | ST 3376 1570          | ST 3405 1604 | ST 3361 1578             | ST 3367 1585 |
| 54 South       |                                         |                     | ST 3343 1548          | ST3376 1570  | ST 3359 1573             | ST 3357 1565 |
| 55 North       | Back Stream/River Ding drainage network | ST3376415708        | ST3376 1570           | ST 3420 1575 | ST 3377 1570             | ST 3393 1569 |
| 55 South       |                                         |                     | ST 3360 1573          | ST 3376 1570 | ST 3374 1567             | ST 3360 1573 |

## 2.3 LEAFPACS2 analysis

2.3.1 The River LEAFPACS2 tool was used, which enables the assessment of the macrophyte assemblage in rivers in accordance with the requirements of the WFD. Macrophytes can be defined as plants which can be easily seen with the naked eye, including all vascular plants, bryophytes, stoneworts and macro-algal growths [5]. The tool uses a '*species nutrient index*' and measures of species diversity and abundance [5] to calculate an ecological quality ratio (EQR) from the following metrics: nutrient indices, number of macrophyte taxa, number of functional groups, and cover of green filamentous algae for the macrophytes identified in river samples. In addition to these values, the mean measured alkalinity (as mg/l CaCO<sub>3</sub>) of the waterbody should be measured. Water sample data was collected by a third party as part of the suite of surveys associated with the scheme, including values for alkalinity at each sampling location. Average alkalinity values for each watercourse were calculated for the five-month monitoring period, May to September 2021. The alkalinity values were used to allow the data to be translated into WFD classifications of high, good, moderate, poor or bad.

2.3.2 The following metrics were calculated from the field data:

- River macrophyte nutrient index (RMNI).
- River macrophyte hydraulic index (RMHI).
- Number of taxa (NTAXA).
- Number of functional groups (NFG).

- Cover of green filamentous algae (ALG).

2.3.3 The results of each metric are then used to produce an EQR score (using the River LEAFPACS2 survey metrics calculator and the River LEAFPACS2 class calculator) and finally combined to produce a 'face value' WFD classification of the macrophyte biological quality element for each of the survey sites. The WFD classification generated in this instance is based on the LEAFPACS2 analysis alone and not in combination with a DARLEQ2 based assessment; however, in accordance with the UKTAG guidance, a LEAFPACS2 based assessment alone is adequate where CaCO<sub>3</sub> is >200 mg L<sup>-1</sup> [5]. A LEAFPACS2 assessment alone is therefore deemed adequate for all sites surveyed (see Table 3-3).

## 2.4 Assumptions and limitations

- 2.4.1 Survey conditions were considered optimal for RCS surveys, but due to the time of year (see section 2.1.1) they were considered sub-optimal for macrophyte survey. However, despite being later in the season, there was a reasonable presence of macrophytes and relatively little evidence of seasonal die back. It is, therefore, assumed that the species observed during surveys are representative of those that would be expected under optimal conditions during a typical growing season.
- 2.4.2 Water turbidity and dense vegetation made visual observations difficult for macrophyte surveys at numerous watercourse crossings (see section 3.3 for details of which watercourses were suitable for survey). Macrophyte growth was also inhibited across numerous watercourses as a result of dense, overgrown bank zone vegetation.
- 2.4.3 Average alkalinity values for each watercourse were calculated for the five-month monitoring period, May to September 2021. These alkalinity values are therefore considered to be representative of the annual mean in the absence of access to a full twelve-month dataset, which is recommended as a minimum for a WFD assessment [5].
- 2.4.4 The River LEAFPACS2 tool is less applicable to heavily modified water bodies [5]. Most watercourses surveyed were subject to some degree of modification and/or were classed as seasonal, with some sites being dry at the time of survey. The results of the LEAFPACS2 calculations and subsequent WFD classification may not, therefore, be entirely robust and should be analysed with caution; however, the data is still considered to present a useful indicator of ecosystem health.



## 3 Results

### 3.1 Desk study

- 3.1.1 Macrophyte survey data was available for Broughton Brook in 2013 from the EA Ecology and Fish Data Explorer (EA BIOSYS database, site ID 151596). No non-native or species of conservation concern were recorded [3].
- 3.1.2 The SERC data search returned multiple records for black poplar (*Populus nigra subsp. Betulifolia*), within 2 kilometres of the watercourse crossing of site 24 in close proximity to Presidents Court (to the south) and Lower Farm (to the north). Although not strictly an aquatic species, black poplar is a species of conservation interest, known to favour riversides and ditches. The data search also returned a record of great horsetail (*Equisetum telmateia*) from 2013, immediately south of Lower Farm.
- 3.1.3 Several records from SERC for great horsetail were also found within a 1 kilometre radius of sites 51 and 52 (Cad Brook), where bog pondweed (*Potamogeton polygonifolius*) was also recorded in 2014 at NGR: ST 3317, Every's Copse/Ashill Wood (SERC).

### 3.2 Field survey - River Corridor Survey

- 3.2.1 The results of the RCS field assessment are summarised below. The survey extents for the RCS and macrophyte surveys are provided in Appendix A River Corridor Survey and macrophyte survey extent. The RCS survey maps, for all sites are provided in Appendix B River Corridor Survey maps. The adjacent land zones have been classified following the Joint Nature Conservation Committee (JNCC) *Handbook for Phase 1 habitat survey* (revised 2016) [7] standard definitions. These definitions have not been provided within this document but can be accessed via the JNCC weblink in the references. Details of adjacent land zones, along with all habitats across the scheme, are also provided in the Ecological Baseline Report – UK Habitats Classification, which will form Appendix 8.1 of the Environmental Statement.
- 3.2.2 The map logs should be viewed as a supporting document to illustrate the site characteristics (physical channel form and plant communities present) at the time of survey. A key to the standard symbols for use in RCS is provided in Appendix C Standard symbols for use in River Corridor Surveys. A list of abbreviated plant names is provided in Appendix D Abbreviated plant names. Survey photographs are provided in Appendix E RCS site photographs.
- 3.2.3 Any reference to north or east and south or west within this report relates to the cardinal direction of the survey reach in relation to the scheme. Furthermore, any reference to left bank or right bank refers to the perspective of the observer looking downstream. The direction of flow is clearly marked on the RCS maps for reference (Appendix B River Corridor Survey maps).

#### Site 15a – Broughton Brook – north

- 3.2.4 This downstream reach of Broughton Brook is an artificial channel of uniform width, running in a straight line alongside the M5. It is joined by an inflow pipe, probably carrying runoff from the adjacent road. Visibility was limited by dense vegetation, but channel flow appeared to be predominantly slack with occasional riffles and pools, which in some areas had been caused by erosion following

obstruction of the channel by fallen trees/boughs. Substrate was varied with areas of silt and gravel, and a concrete apron at the built-up area to the south.

- 3.2.5 Marginal vegetation was sparse due to ubiquitous overhanging vegetation from the bank zone on both sides. In open sections there were patches of reed sweet-grass (*Glyceria maxima*), fool's watercress (*Helosciadium nodiflorum*), common reed (*Phragmites australis*) and branched bur-reed (*Sparganium erectum*). Water chickweed (*Stellaria/Myosoton aquatica*) was occasionally present in the northern reach of the survey area. A few patches of curly-leaf pondweed (*Potamogeton crispus*) could be found near sections of riffle.
- 3.2.6 Bank zone habitat along the left bank was dominated by tall herbs and shrubs which were overhanging the river channel and outcompeting most aquatic and emergent vegetation. Himalayan balsam (*Impatiens glandulifera*) was abundant, interspersed with nettle (*Urtica dioica*) and great willowherb (*Epilobium hirsutum*). There were some patches of bramble (*Rubus fruticosus* agg.) and grey willow (*Salix cinerea*). Few trees were recorded, but those present included osier (*Salix viminalis*), ash (*Fraxinus excelsior*) and field maple (*Acer campestre*). Vegetation along the right bank included a thick belt of marginal scrub with occasional breaks overhanging the channel and outcompeting aquatic and emergent vegetation for most of its length. Bramble was especially common, with field maple, blackthorn (*Prunus spinosa*) and grey willow. Some sections were dominated by a more obviously riparian mix of alder (*Alnus glutinosa*) and grey willow. Breaks in the scrub were few and were vegetated with tall herbs, particularly nettle and Himalayan balsam.
- 3.2.7 Adjacent land use included the M5 motorway, arable land and a laydown area for motorway works to the north of the survey reach.
- 3.2.8 Dense scrub appeared to be a limiting factor for macrophyte growth.

#### **Site 15a – Broughton Brook – south**

- 3.2.9 This upstream reach of Broughton Brook is an artificial channel of uniform width, running in a straight line alongside the M5. It is joined in its progress by a drainage channel from the west at the top of the transect. Visibility was limited by dense vegetation, but channel flow appeared to be predominantly slack with occasional runs. Substrate was varied with areas of silt and gravel with a concrete apron at the built-up area to the north.
- 3.2.10 Macrophyte growth was sparse due to ubiquitous overhanging vegetation from the bank zone on both sides. In more open sections there were a few patches of watercress (*Nasturtium officinale*), fool's watercress, common reed and branched bur-reed. Algae, particularly *Ulva flexuosa*, was plentiful in places.
- 3.2.11 Bank zone habitat along the left bank was dominated by tall herbs and shrubs which were overhanging the river channel and outcompeting most aquatic and emergent vegetation. Himalayan balsam was abundant, interspersed with nettle and great willowherb. There were some patches of bramble and some bushes of grey willow. Few trees were present, including ash and field maple. Habitat along the right bank consisted of a thick belt of marginal scrub with occasional breaks overhanging the channel and outcompeting aquatic and emergent vegetation for most of the length of the channel. Bramble was especially common, with field maple, blackthorn and grey willow. Occasional breaks in the scrub were vegetated with a similar mix of species as the surrounding rough grassland, with

false oat-grass (*Arrhenatherum elatius*) and nettle frequent. There were a few trees present, mostly ash and field maple.

- 3.2.12 Adjacent land use along the left bank included the M5 motorway, with the conurbation of Taunton beyond. Right bank land use comprised semi-improved grassland, likely to have been previously cultivated but currently fallow.
- 3.2.13 Scrub invasion appeared to be limiting macrophyte growth.

#### **Site 17 – Black Brook Tributary 1**

- 3.2.14 This watercourse is a field drain system with straight reaches and abrupt corners at field margins. The channel is uniform in profile, likely a result of periodic dredging. The substrate was silt or clay and the flow at the time of survey was low, with some dry sections.
- 3.2.15 Some open sections of the watercourse were rich in macrophytes, particularly branched bur-reed, fool's watercress and watercress. Swollen duckweed (*Lemna gibba*) was frequent and there were some floating mats of common water-starwort (*Callitriche stagnalis*). Hemlock water-dropwort (*Oenanthe crocata*), water figwort (*Scrophularia auriculata*) and water chickweed were occasionally present on the banks. Many stretches were shaded by overhanging vegetation, resulting in negligible macrophyte growth.
- 3.2.16 Bank zone habitat along the upstream sections of the left bank were bordered with a thin belt of mown, semi-improved grassland, with cultivation occurring to the start of the riverbank. A thin English elm (*Ulmus procera*) hedge occurred on the bank of the eastern tributary. Midstream and downstream sections alongside semi-improved grassland had a range of grasses and tall herbs including nettle and great willowherb. Along the right bank, the stream bordered an area of thick scrub in its midstream segment, with overhanging shrubs of common dogwood (*Cornus sanguineus*), hawthorn (*Crataegus monogyna*) and bramble. The downstream segment was bordered by a line of crack willow (*Salix x fragilis*), with many fallen boughs obstructing the channel.
- 3.2.17 Adjacent land use included semi-improved grassland, scrub and arable (rapeseed [*Brassica napus*] and wheat [*Triticum aestivum*]).
- 3.2.18 Observed potential threats to conservation include crop spraying, dredging and cultivation to the stream margins.

#### **Site 19a – Black Brook – north**

- 3.2.19 The river channel at site 19a north comprises a plunging and u-shaped channel along the northern half of the reach where it traverses arable land, suggesting regular dredging. The bank profile has a gentler gradient south of the footbridge, which was observed towards the upstream extent of the survey reach (at NGR: ST 2603 2428). The channel was choked with vegetation and visibility was low, but it was appeared silty with little perceptible flow for its entire length. Where it crossed the road network, the watercourse had been extensively modified and straightened but the northern extent of the study area had a few small meanders. The river channel appeared to be ephemeral, despite its many tributaries.
- 3.2.20 Marginal vegetation was dominated to the north by fool's watercress, with substantial competition from bankside vegetation. Upstream of the recently constructed A358 road bridge, adjacent to the Taunton Gateway Park & Ride, the

channel was, for the most part, free of macrophytes due to overhanging vegetation and shading, but the southern end had patches of watercress and an abundant growth of swollen duckweed.

- 3.2.21 The left bank side at the northern extent was a marginal belt of grassland with abundant tall herbs including great willowherb and Himalayan balsam. Occasional trees included ash and field maple, and the laydown area near the A358 was fringed with bramble scrub, with frequent nettle. South of the existing A358 the bank was dominated by tall herbs, particularly bristly oxtongue (*Helminthotheca echioides*) and nettle, with shrub species including bramble and guelder rose (*Viburnum opulus*), and occasional hart's tongue fern (*Asplenium scolopendrium*) on the lower banks. At the downstream extent of the survey reach, the vegetation composition of the right bank was initially identical to the left bank, but the stream was soon bordered by riparian woodland consisting of crack willow and alder. South of the footbridge, towards the upstream extent of the survey reach, the stream was bordered by a hedgerow, with hawthorn, common dogwood, sycamore (*Acer pseudoplatanus*) and ash trees. Overhanging vegetation obscured the stream for most of its length.
- 3.2.22 Adjacent land use of the left bank included arable land with a stubble field and laydown area to the north and semi-improved *Arrhenatherum* grassland dominated by tall herbs to the south. Adjacent land use of the right bank included arable land, a stubble field and riparian woodland to the north and a thick hedge bordering private land to the south.
- 3.2.23 Recreation features included a public right of way (PRoW) and paved footpath along the left bank of the southern reach. Observed potential threats to conservation value include crop spraying and dredging.

#### **Site 19a – Black Brook – south**

- 3.2.24 The river channel at site 19a south varies significantly throughout the reach. The northern section has been extensively landscaped during recent infrastructure construction and braids into two channels. The western channel is a wide (8 metre) and silty 'watercress bed', perhaps in the site of a former borrow pit. To the east there is an island of spoil, with a narrow (60 centimetre) channel beyond. For the rest of its length the Black Brook is a straight channel averaging 1.5m wide, and with an average depth of 20cm. The water was slack throughout and the substrate uniformly silt/clay.
- 3.2.25 Marginal vegetation along the left bank of the northern section was dominated by watercress, with rare plants of cut-leaved water parsnip (*Berula erecta*). To the south, dense shading was preventing development of any macrophyte communities. The right bank was dominated by watercress, with occasional yellow flag iris (*Iris pseudacorus*).
- 3.2.26 Bank zone habitat along the left bank at the northern extent comprised a marginal belt of grassland with abundant tall herbs including great willowherb and Himalayan balsam. Occasional trees included ash and field maple, and the laydown area near the existing A358 was fringed with bramble scrub and frequent nettle. South of the existing A358 the bank was dominated by tall herbs, particularly bristly oxtongue and nettle with shrub species including bramble and guelder rose, and occasional hart's tongue fern on the lower banks. The right bank was largely similar to that of the left; however, the stream was soon bordered by riparian woodland consisting of crack willow and alder. South of the

footbridge, towards the upstream extent of the survey reach, the stream was bordered by a hedgerow, with hawthorn, common dogwood and sycamore and ash trees. Overhanging vegetation obscured the stream for most of its length.

- 3.2.27 Adjacent land use along the left bank comprised arable land with a stubble field and a laydown area to the north. Land to the south was semi-improved *Arrhenatherum* grassland dominated by tall herbs. The right bank consisted of arable land, a stubble field and riparian woodland to the north and a thick hedge bordering private land to the south.
- 3.2.28 No potential threats to conservation value were observed, however black poplar (*Populus nigra* ssp. *Betulifolia*) trees should be assessed and protected.

### **Site 19b – Black Brook Tributary 3 – north**

- 3.2.29 Site 19b north is essentially a field drain with uniform symmetrical channel profile, where visible (views were blocked by dense vegetation for much of its length). No evidence of recent dredging was observed.
- 3.2.30 Very few macrophytes were visible as the channel was densely shaded for 97% of the survey extent. Some fool's watercress was observed either side of the bridge near the inflow of site 20.
- 3.2.31 Bank zone habitat along the left bank was largely shaded by a dense hedgerow of blackthorn, with lesser quantities of common dogwood and hazel (*Corylus avellana*). The upstream end was bordered by a line of ash, crack willow and field maple with a dense understorey of shrubs. The upstream extent of the right bank was bordered by trees, principally crack willow, and a succession of scrubby hedgerows of blackthorn and brambles formed the margins along the middle section, while the upstream end was bordered by tall herbs such as great willowherb and common teasel (*Dipsacus fullonum*), with some patches of bramble.
- 3.2.32 Adjacent land use along the survey reach comprised entirely of semi-improved grassland.
- 3.2.33 Scrub encroachment was a notable problem across the survey reach.

### **Site 19b – Black Brook Tributary 3 – south**

- 3.2.34 Similar to the northern reach, site 19b south is another field drain, probably with intermittent flow. Channel visibility was severely hindered in places by vegetation on both banks and the low water levels made it impossible to confirm characteristics of flow. The upstream section is impounded on one side by Stoke Road, but below this point the river assumes a uniform profile.
- 3.2.35 Macrophytes were scarce due to overhanging vegetation from both sides (except for the section alongside Stoke Road). Some yellow flag iris specimens were apparent emerging above the thick vegetation in the upper section.
- 3.2.36 Bank zone habitat along the left bank was dominated by dense trees and shrubs for most of its length, with a field layer of tall herbs. Ash, field maple and pedunculate oak (*Quercus robur*) were common, with blackthorn, bramble and hawthorn in the understorey. The right bank was dominated by tall herbs for most of its length, with a few ash trees and both bramble and hawthorn present in the understorey. Nettle and false oat-grass were ubiquitous, with some hogweed (*Heracleum sphondylium*) and cocksfoot (*Dactylis glomerata*).

- 3.2.37 Land use along both banks included semi-improved grassland (cattle pasture), with the village of Henlade to the east.
- 3.2.38 No recent management of the watercourse was observed; however, scrub encroachment is a problem.

#### **Site 20 – Black Brook Tributary 2/5**

- 3.2.39 The river channel at site 20 is a notably uniform, shallow field drain. Low water levels were observed throughout and the channel was dry along the western tributary.
- 3.2.40 Very little vegetation was observed in the river channel due to shading from overhanging trees and scrub. Some small plants of fool's watercress were present and at the upstream end, in an area of low water, great willowherb was abundant.
- 3.2.41 Bank zone habitats along the left bank were lined with false oat-grass which dominated the field margins. Below this the drain ran through a length of dense hedgerow (hawthorn and bramble were abundant), along another arable margin in which mature trees of pedunculate oak were located in grassland and a semi-improved pasture, again with false oat-grass and nettle. The right bank was lined by a dense hedgerow with occasional trees. Hawthorn, blackthorn, wild privet (*Ligustrum vulgare*) and elder (*Sambucus nigra*) made up the principal shrubby species, with mature pedunculate oak, ash and field maple trees.
- 3.2.42 Adjacent land use was principally arable, currently stubble fields of wheat. No potential threats to conservation value were observed.

#### **Site 24 – Thornwater Stream – north**

- 3.2.43 This section of Thornwater Stream consists of a narrow channel with a predominantly clay bed and occasional shallow gravel riffles and infrequent pools. The river channel is predominantly straight and includes two small bridges. The existing A358 road bridge crosses the mid reach; where the river channel was surrounded predominantly by scrub, trees and shrubs. These had shaded ground cover mixed with patches of reed. The middle reach was open field along both banks.
- 3.2.44 Macrophytes were absent due to heavy shading as a result of overhanging vegetation on both sides.
- 3.2.45 Bank zone habitat along the lower left bank predominantly comprised bramble with areas of nettle and great willowherb. South of the existing A358 road bridge the vegetation was predominantly hazel with an understory of elder. Further upstream ash dominated, with ground cover of mostly ivy (*Hedera helix*). The right bank comprised ash trees along the downstream reach with nettle, great willowherb and spear thistle (*Cirsium vulgare*) ground cover in the more open areas. Common mallow (*Malva sylvestris*) was also present along with crack willow and ash trees. West of the existing A358, goat willow (*Salix caprea*) and hazel, with an understory of pendulous sedge (*Carex pendula*), were present. There was also abundance of hawthorn at the upstream extent and a covering of common hop (*Humulus lupulus*) amongst the trees.

- 3.2.46 Adjacent land use along both banks comprised extensively grazed grassland and scrub, with potential threats to conservation value from siltation as a direct result of extensive grazing.

#### **Site 24 – Thornwater Stream – south**

- 3.2.47 The reach to the south of the scheme was similar in nature to the northern reach, comprising a largely straight narrow channel with shallow gravel riffles.
- 3.2.48 Bank zone habitat along the left bank consisted of an ash treeline/hedge with an understory of elder and ivy. The vegetation then became open grassland with bramble and hawthorn dominating the bank. Redshank (*Persicaria maculosa*) and wild privet were also present. Along the right bank, there was a treeline/hedge of ash with an understory of elder and ivy covering the ground. The right bank also became open grassland, with the stream edge comprising mainly of bramble and hawthorn.
- 3.2.49 Adjacent land use mirrors that of the northern reach and comprises extensively grazed grassland and scrub with potential threats to conservation value from siltation as a direct result of extensive grazing.

#### **Site 30 – Meare Stream – north**

- 3.2.50 Meare Stream is a notably small, narrow waterbody with a predominantly silt bed and a few shallow gravel riffles and pools. It is largely straight with some meanders towards the upstream extent. There is a small road that runs alongside the downstream extent after which the stream is surrounded by scrub, trees and shrubs.
- 3.2.51 Left bank habitat comprised a narrow strip of nettle, great willowherb, spear thistle and cow parsley (*Anthriscus sylvestris*) as the road ran close to the stream. Hairy St John's-wort (*Hypericum hirsutum*) was also present. Further downstream pedunculate oak and ash lined the bank. A ground cover of ivy was also common. Along the right bank, there was a hedge of hawthorn and presence of field maple. Ground cover ivy was common with areas of pendulous sedge.
- 3.2.52 Adjacent land use included a small road to the west and arable fields, with a small area of grassland, scrub and woodland towards the upstream reach. There was also a small silt pond present at the upstream extent, alongside the A358. No significant potential threats to conservation value were observed, though it was noted the arable fields to the west may result in sediment runoff during periods of heavy rainfall.

#### **Site 30 – Meare Stream – south**

- 3.2.53 This section of Meare Stream is moderate in size and has a predominantly gravel bed with shallow riffles and pools present. It is surrounded by scrub, trees and shrubs.
- 3.2.54 Throughout the 100 metre reach identified as suitable for macrophyte survey, mosses and algae were observed, both of which occurred at low incidence (<5% total cover for moss and algae at <10%). Marginal vegetation comprised common liverwort (*Marchantia polymorpha*) and great scented liverwort (*Conocephalum conicum*).
- 3.2.55 Bank zone vegetation along the left bank included predominantly ash and pedunculate oak trees with an understory of holly (*Ilex aquifolium*). There was

ground cover of ground-elder (*Aegopodium podagraria*) and some primrose (*Primula vulgaris*). A small woodland was present towards the upstream extent of the survey reach and included ash, field maple and pedunculate oak. Right bank habitat included a hawthorn hedge with ivy covering to the ground. The right bank was also heavily tree-lined and included ash and pedunculate oak with an understory of holly. There was also ground cover of false-brome (*Brachypodium sylvaticum*) and some primrose.

- 3.2.56 Predominant land use adjacent to the watercourse was grassland, with a small woodland present at the upstream extent of the survey reach. Himalayan balsam, a potential threat to conservation value, was present throughout the survey reach.

### Site 31 – Meare Stream Tributary 1 – north

- 3.2.57 Site 31 north is a woodland stream with evidence of considerable erosive potential during spate in the upper reaches. Overhanging banks were common and where woody debris had blocked the channel there were some pools and areas of silt deposition. The stream was constrained in the downstream reach as it flowed alongside Griffin Lane. The channel was impounded on both sides as it debouched from the culvert under the existing A358 road bridge. Flow was reduced to a 'trickle' at the time of survey and as a result it was often not possible to identify flow characteristics.
- 3.2.58 Due to deep shade, aquatic and marginal vegetation was limited to the bryophytes long-beaked water feather-moss (*Platyhypnidium/Rhynchostegium riparoides*), *Pellea endiviifolia* and some fox-tail feather-moss (*Thamnobryum alopecurum*) occupying a marginal position in the wooded section. Below this, flow was low enough to allow pendulous sedge to become established in the watercourse. Macrophytes were absent in the lower reaches due to shading.
- 3.2.59 Bank zone habitat along the left bank of the upstream reach was lined by shrubby woodland, with holly, hazel, ivy and abundant ferns, particularly hart's tongue fern. Downstream from this the river narrowed between a garden and a road (NGR: ST 29586 20841) and the bank vegetation was limited to common roadside verge flora, principally nettle and false oat-grass. Right bank habitat along the upstream reach was bordered by woodland with hart's tongue fern, soft shield fern (*Polystichum setiferum*) and ivy, but also the shrubby species hazel and holly. Downstream cherry laurel (*Prunus laurocerasus*), in dense thickets, became an increasingly frequent constituent of the stream bank. As the stream became constrained, the marginal vegetation became more hedge-like, finally becoming a sculpted hedgerow of box (*Buxus sempervirens*) towards the upstream extent.
- 3.2.60 Adjacent land use along the left bank comprised of a small road (Griffin Lane) bordered by arable fields (maize [*Zea mays*]) and domestic gardens. The right bank land use comprised broadleaved semi-natural woodland and domestic gardens.
- 3.2.61 Mowing of the riverbanks and hedgerow management was observed towards the upstream extent of the reach, and the presence of cherry laurel was considered to be a threat to conservation value.



### Site 31 – Meare Stream Tributary 1 – south

- 3.2.62 The upstream reach of site 31 south is a dry field drain. Below this it becomes a woodland stream with evidence of considerable erosive potential during spate. Overhanging banks were common and where woody debris had blocked the channel there were some pools and areas of silt deposition. Some complex areas of meander towards the bottom of the reach were scoured down to the bedrock. The channel was impounded on both sides as it approached the culvert under the existing A358 road bridge at Griffin Lane. Flow was reduced to a trickle at the time of survey and it was not possible to identify flow characteristics.
- 3.2.63 Due to deep shade, aquatic and marginal vegetation was limited to the bryophytes long-beaked water feather-moss, *Pellea endiviifolia* and some fox-tail feather-moss occupying a marginal position.
- 3.2.64 Bank zone habitat along the upstream reach of the left bank comprised of a dry field ditch bordered by rough grassland, with frequent false oat-grass and nettle. Banks downstream had a varied vegetation. Hart's tongue fern and soft shield fern were common in shaded spots, while ivy, nettle and pendulous sedge were frequent near the tops of banks. Along the right bank, the upstream stretch was bordered by a dense, tall hedgerow with hazel, field maple, blackthorn and spindle (*Euonymus europaeus*). Woodland banks were largely similar to the left bank with ferns and ivy, but also the shrubby species hazel and holly.
- 3.2.65 Adjacent land use consisted of arable and semi-improved grassland along the left bank and broadleaved semi-natural woodland to the right, containing some ancient woodland indicators (wild service tree [*Sorbus torminalis*], bluebell [*Hyacinthoides non-scripta*] and spindle) although not designated as such in the Natural England Ancient Woodland Inventory [8]. No potential threats to conservation value were observed.

### Site 34 – Fivehead River main channel 1 – north

- 3.2.66 This section of Fivehead River is medium in size and is predominantly shallow gravel riffle and glide, becoming more pool at the upstream reach. It bends near 90 degrees at the downstream reach where it flows alongside Village Road, then back 90 degrees. The banks were predominantly tree-lined with shrubs, becoming more open towards the downstream extent.
- 3.2.67 Bank zone habitat comprised alder along the upstream reach of the left bank with nettle and bramble. Alder, pedunculate oak and ash lined the bank downstream of Village Road with an understory of pendulous sedge. Great willowherb and some hemp-agrimony (*Eupatorium cannabinum*) was also identified. The right bank comprised alder with nettle and bramble. Goat willow and sycamore are also present, with ivy covering to the ground. There was also a wide strip of nettle and great willowherb, around a soft revetment.
- 3.2.68 Adjacent land use was predominantly arable and grassland, with a bus depot present at the downstream extent. Potential contaminants to the watercourse included sediment run-off from the arable fields during heavy downpours and potential petrochemical pollutants from the bus depot.

**Site 33 and 34 – Fivehead River main channel 1 – south and Fivehead River Tributary 1**

- 3.2.69 This section of Fivehead River is similar in nature to that of the northern reach and is heavily tree lined with shrubs. There is a small tree lined tributary that flows into the river and forms part of site 33.
- 3.2.70 Bank zone habitat along the left bank was primarily alder and pedunculate oak along the downstream reach, along with goat willow and sycamore and ivy ground cover. Further upstream, a small tributary flowed into the watercourse, where habitat became a high tree-lined bank of pedunculate oak and ash with some bramble and giant rhubarb (*Gunnera manicata*). Bank zone habitat along the right bank included ash, alder and pedunculate oak. Goat willow and sycamore were also present with ivy ground cover. Adjacent land use was largely arable with areas of grassland on the right bank towards the upstream reach. No potential threats to conservation value were observed.

**Site 36 – Fivehead River main channel 2 – north**

- 3.2.71 Site 36 north is a variable watercourse with a few shallow gravel riffles and pools. Along the survey reach, there are a number of notably sharp meanders towards the downstream extent. The channel in this reach is surrounded by scrub, trees and shrubs.
- 3.2.72 Fool's watercress was observed, which occurred at low incidence (<3% total cover), at the margins of the channel. Common liverwort and great scented liverwort were also present along the reach.
- 3.2.73 Trees, mainly crack willow, ash and blackthorn, with patches of bramble, were dominant along the downstream extent of the left bank. A small, wooded area of mostly ash and alder with an understory of hart's tongue fern was noted at the upstream extent of the survey reach. Habitat along the right bank was similar to that of the left with traveller's joy (*Clematis vitalba*) and nettle also present.
- 3.2.74 Adjacent land use of both the left and right bank was largely improved grassland, becoming arable towards the downstream reach with a small woodland alongside the A358 at the upstream reach.
- 3.2.75 No evidence of significant management was observed, however some strimming to the bank had been undertaken at various locations along the reach.

**Site 36 – Fivehead River main channel 2 – south**

- 3.2.76 The watercourse at site 36 south is a very variable channel, clearly prone to seasonal flooding, with cliffs and overhangs caused by tree roots and the undercutting of banks due to the blocking of the channel by debris. The riverbed had incised down to the bedrock at the upstream end of the transect. Elsewhere the river had exposed cobbles and gravels in the alluvium of the banks. River flow was extremely low on the day of the survey, but some large pools were present.
- 3.2.77 Few macrophytes were recorded, but bryophytes were well-represented. *Pellea endiviifolia* and great scented liverwort were fairly common, with some *Fissidens bryoides*, Portuguese feather-moss (*Platyhypnidium/Rhynchostegium alopecuroides*) and *Cratoneuron filicinum*. In pools of stagnant water swollen duckweed was also occasionally present.

- 3.2.78 The river ran through a belt of shrubby riparian woodland. The left-hand bank contained mainly mature ash with some pedunculate oak and crack willow. There was an understorey of hazel and common dogwood and the ground layer commonly comprised soft shield fern and hart's tongue fern. Along the right bank, close to the upstream extent of the survey reach there was a small area of woodland with mature pedunculate oak and ash. Downstream of this point the vegetation became 'shrubbier' and dominated by blackthorn, with some field maple and crack willow.
- 3.2.79 Adjacent land use comprised semi-improved grassland along both banks. No potential threats to conservation value were observed.

#### **Site 37 – Fivehead River Tributary 5 – north**

- 3.2.80 A notably small tributary of Fivehead River with a predominantly clay bed and abundance of shallow gravel riffles. The channel is largely uniform in nature and is surrounded otherwise by scrub and trees/hedge.
- 3.2.81 Fool's watercress was observed instream, which occurred at low incidence (<9% total cover) in the channel.
- 3.2.82 The upstream extent of the left bank was lined with trees, mostly crack willow, and an understory of ivy. The watercourse then opened up as it flowed downstream where bank zone vegetation comprised bramble, blackthorn, elder and hawthorn. Right bank vegetation included nettle, great willowherb and bramble.
- 3.2.83 Adjacent land use was predominantly improved grassland, with some mowing observed along the banks of the downstream reach. No potential threats to conservation value were observed.

#### **Site 37 – Fivehead River Tributary 5 – south**

- 3.2.84 Site 37 south is similar in nature to that of the northern reach. Some previous strimming of the bankside vegetation was observed and the channel was otherwise surrounded by scrub and lined with trees towards the upstream extent.
- 3.2.85 Fool's watercress was observed in the river channel, alongside hemlock water-dropwort.
- 3.2.86 Bank zone habitat along the downstream extent of both the left and right bank comprised a tree-lined hedge of hawthorn. The watercourse then crossed under Folly Drove Road, where it opened into another hawthorn hedge.
- 3.2.87 Adjacent land use was predominantly improved grassland, with some notable strimming to the water's edge. No potential threats to conservation value were observed.

#### **Site 39 – Venner's Water – north**

- 3.2.88 This section of Venner's Water has a predominantly silt/clay bed, with a few shallow gravel riffles and the occasional pool. The river channel was predominantly surrounded by scrub, trees and shrubs.
- 3.2.89 Lesser duckweed (*Lemna minor*) was observed throughout the survey reach at low incidence (<4% total cover).

- 3.2.90 Bank zone vegetation along the left bank consisted largely of crack willow, with areas of bramble and nettle. Alder, ash and goat willow were also recorded along the reach with patches of pendulous sedge and some purple loosestrife (*Lythrum salicaria*). Right bank habitat was similar in nature to that of the left, with goat willow, ash and field maple. There was a small ash woodland at the upstream extent of the reach.
- 3.2.91 Semi-improved grassland bordered the channel, with Himalayan balsam, a potential threat to conservation value, a notable concern throughout the survey reach.

### **Site 39 – Venner’s Water – south**

- 3.2.92 Site 39 south is similar in nature to that of the north, with bank vegetation comprising largely of scrub, trees and shrubs. The river channel through this section flows through residential gardens and includes some areas of artificial bank, and a small road crossing.
- 3.2.93 Duckweed (*Lemna minor*) was observed throughout the survey reach, with fool’s watercress, both of which occurred at low incidence (<3% total cover). Common liverwort and great scented liverwort were also present throughout the reach.
- 3.2.94 Pendulous sedge was dominant along the downstream reach of the left bank, before the small road bridge for Ashill Road, around which marsh marigold (*Calitha palustris*) and hedge woundwort (*Stachys sylvatica*) existed. Upstream of the road bridge, there was an artificial bank supporting cherry laurel. Further upstream, the residential gardens comprised mainly of mown lawn/grasses. Trees included field maple, alder, sycamore and ash. The right bank habitat was similar in nature to that of the left bank, with alder, goat willow and ash and ivy hedge.
- 3.2.95 To the left bank, semi-improved grassland, housing and residential gardens bordered the river channel, with arable field along the right bank. Some mowing, a potential threat to conservation value, was observed close to the riverbanks.

### **Site 51 – Cad Brook drainage network – north**

- 3.2.96 The watercourse comprises a ‘field drain’ of uniform profile. The channel arises a little southwest of the A358 carriageway, but with no visible culvert to link it to drainage systems on the other side of the road (which were dry and ephemeral).
- 3.2.97 Marginal vegetation included hemlock water-dropwort and reed canary-grass (*Phalaris arundinaceus*) which were abundant for most of the channel length with occasional fool’s watercress. Where the channel turned south-east it became choked with a dense assemblage of nettle.
- 3.2.98 Bank zone habitat along the left bank of the upstream section bordered the margin to an arable field, with false oat-grass and nettle. The channel then crossed under the hedge and from there on it was bordered by the hedgerow, which comprised hawthorn, blackthorn, and field maple with some hart’s tongue fern and soft shield fern at the base. The upstream right bank bordered the hedge with blackthorn, hazel and English elm, then moved into an area of semi-improved grassland dominated by couch (*Elymus repens*) and false oat-grass.
- 3.2.99 Arable land and semi-improved grassland bordered the channel along its reach.
- 3.2.100 Existing management included mowing of the arable border and crop spraying was noted as a potential threat to conservation value.

### **Site 51 – Cad Brook drainage network – south**

3.2.101 Site 51 appears to terminate to the north of the existing A358 road crossing. The culvert beneath the A358 was not visible due to dense vegetation. There were dry 'ditches' to the south side and presumably the water soaks through. Observations of the vegetation suggested that the flow was ephemeral. No wetland plants were present, and vegetation comprised largely nettle and thistles. The site was therefore deemed unsuitable for a formal RCS and/or macrophyte survey.

### **Site 52 – Cad Brook – north**

3.2.102 This watercourse was potentially once a dependable channel of Cad Brook but is now diminished by drainage of the surrounding land and was dry in sections. The channel is uniform, except in constricted areas of woodland where there are some signs of high-water erosion, particularly the undercutting of tree roots. Some dry sections had a gravelly substrate but for the most part the river was silty and choked with vegetation.

3.2.103 Marginal vegetation was largely absent, as the watercourse channel was substantially choked with an overgrowth of bank zone vegetation at the time of survey. A pool at the upstream footbridge (ST 33238 16469), adjacent to the A358, has a rich growth of small pondweed (*Potamogeton berchtoldii*) with lesser duckweed. Thereafter emergent species dominated, including reed canary-grass, hemlock water-dropwort, fool's watercress and floating sweet-grass. Wooded sections had a much-reduced flora, with some fool's watercress and water mint (*Mentha aquatica*).

3.2.104 Bank zone habitat of the left bank was dominated by rank grasses and tall herbs including couch, nettle, great willowherb and mugwort (*Artemisia vulgaris*). Lower positions on the bank had a more recognisably riparian vegetation with some meadowsweet (*Filipendula ulmaria*), common fleabane (*Pulicaria dysenterica*) and purple loosestrife. Downstream sections were wooded, with mature pedunculate oak, ash and shrubs including blackthorn and bramble. The right bank was also largely dominated by rank grasses and tall herbs. Downstream sections were bordered by semi-improved grassland but maintained a woodland flora with hart's tongue fern and pendulous sedge.

3.2.105 Adjacent land use across both banks was dominated by semi-improved grassland, with a notable stretch of arable land (wheat) present towards the upstream reach of the left bank.

3.2.106 The watercourse was mostly unmanaged, but the downstream stretch had been mown and shrubs flailed. It also looked as if spoil had been deposited into the river at a dry downstream section to create a passage between neighbouring fields, with no culvert evident.

### **Site 52 – Cad Brook – south**

3.2.107 Site 52, to the south of the A358 crossing, was a dry channel/field drain lacking any macrophyte growth. This site was therefore deemed unsuitable for survey.

### **Site 54 – River Ding/River Ding drainage network – north**

3.2.108 This section of the River Ding has a predominantly clay bed with a few shallow gravel riffles and a weir pool. The river flows through concrete hatches and widens into a silty pool for a short section. There are a number of small 'drains'

that form part of the 'drainage network' along this reach, some of which were dry. The watercourse was lined primarily with trees and shrubs.

- 3.2.109 Common water starwort (*Callitriche stagnalis*) and lesser duckweed were observed throughout the river channel and occurred at low incidence (<2% total cover).
- 3.2.110 Left bank zone habitat comprised alder at the upstream reach with nettle and bramble, then goat willow and sycamore with an understory of ivy. Further downstream, there was crack willow and sycamore. There were many mature trees here of interest including yew (*Taxus baccata*) with an understory of pendulous sedge. Right bank vegetation included alder, with nettle and bramble, then goat willow and sycamore with an ivy covering to the ground and lesser periwinkle (*Vinca minor*). Horse chestnut (*Aesculus hippocastanum*) and cherry laurel were also present along the reach. There were many mature trees of interest including poplar sp. and Scot's pine (*Pinus sylvestris*).
- 3.2.111 Adjacent land use across both banks throughout the reach was primarily grassland at the upstream extent, with a small woodland area dominating the middle of the reach. Further downstream, adjacent land use became arable.
- 3.2.112 Some 'ditching' was observed throughout the survey reach, along with hedgerow management. Himalayan balsam, a potential threat to conservation value, was also identified.

#### **Site 54 – River Ding/River Ding drainage network – south**

- 3.2.113 This section of the River Ding is predominantly glide, followed by gravel riffles and an occasional pool at the upstream extent. The river channel is principally uniform and straight along the downstream reach, with a sharp meander at the upstream extent. A small field drain flows into the channel in the vicinity of the meander at the upstream extent. The channel was largely surrounded by scrub, trees and shrubs.
- 3.2.114 Common water starwort and lesser duckweed were observed in the channel at low incidence (<10% total cover). The presence of fool's watercress was also recorded.
- 3.2.115 Nettle and great willowherb dominated the left bank zone vegetation at the downstream reach. Further upstream, as the river passed under a small road bridge, field maple, hawthorn, ash and blackthorn lined the riverbanks with patches of bramble and spear thistle. Elder was observed under the trees. Right bank vegetation largely mirrored that of the left, with ash and blackthorn and patches of bramble.
- 3.2.116 Adjacent land use was largely grassland to the right bank, with some arable on the left bank towards the downstream reach. Some strimming of the bankside vegetation was noted and Himalayan balsam, a potential threat to conservation value, was identified throughout the reach.

#### **Site 55 – Back Stream/ River Ding drainage network – north**

- 3.2.117 This section of Back Stream has a predominantly gravel substrate with area of glide, riffle and occasional pools. The channel is relatively uniform in nature, with some bank buffer strip present and areas of scrub, trees and shrubs.

- 3.2.118 Fool's watercress and reed canary-grass were recorded in the river channel within the downstream reach. Willow moss (*Fontinalis antipyretica*) was also recorded and occurred at low incidence (<1% total cover). Common liverwort and great scented liverwort were present in some areas.
- 3.2.119 The left bank zone vegetation comprised a covering of false-brome with a tree-line/hedge comprising mainly ash and alder, with ivy ground cover. Further downstream, the tree canopy opened and was largely dominated by reed canary-grass and sycamore. Right bank habitat largely mirrored that of the left and included horse chestnut with patches of bramble and nettle.
- 3.2.120 Adjacent land use was predominantly arable on both the left and right sides, with some areas of grassland. Himalayan balsam, a potential threat to conservation value, was recorded throughout the reach.

### Site 55 – Back Stream/River Ding drainage network – south

- 3.2.121 This section of Back stream runs parallel to the A358 and comprises a gravel substrate with glide, riffle and pools present. The riverbanks throughout the reach were largely dominated by scrub, trees and shrubs.
- 3.2.122 The macrophytes common water starwort, willow Moss, fool's watercress and duckweed sp. were all present throughout the survey reach at low incidence (<9% total cover).
- 3.2.123 The left bank zone habitat towards the downstream extent comprised garlic mustard (*Alliaria petiolate*) and brooklime (*Veronica beccabunga*) with a tree-line/hedge of mostly ash and alder, with ivy ground cover. Further upstream, to the south of the A358 road crossing, the stream edge comprised mainly reed canary-grass and bramble. To the right bank, south of the A358 road crossing, bank zone vegetation comprised mainly bramble and elder, with ash, field maple and pedunculate oak trees and hawthorn.
- 3.2.124 Adjacent land use was largely grassland and the A358 road crossing, with arable fields to the right bank, north of the A358 road crossing. Himalayan balsam, a potential threat to conservation value, was recorded throughout the reach.

## 3.3 Field survey - macrophytes

- 3.3.1 A total of fifteen 100m macrophyte surveys were undertaken, following EN 14184:2014 [6] guidance, covering nine watercourse crossings across seven watercourses (Table 3-1). The remaining eight watercourse crossings (17, 19b, 20, 24, 33, 34, 37, 51) were deemed unsuitable for macrophyte survey as a result of the absence of any significant macrophyte growth/coverage largely due to heavy shading. Macrophyte survey reaches are summarised in Table 2-2. Macrophyte survey data can be provided upon request (the River LEAFPACS2 survey metrics calculator and the River LEAFPACS2 class calculator). Survey constraints and limitations are discussed in section 4.1. An ecological description of each watercourse, including any notable macrophyte species is provided in section 3.2.

**Table 3-1 Macrophyte survey sites**

| Site ID | Cardinal direction in relation to the scheme crossing | Watercourse     |
|---------|-------------------------------------------------------|-----------------|
| 15a     | North                                                 | Broughton Brook |

| Site ID | Cardinal direction in relation to the scheme crossing | Watercourse                             |
|---------|-------------------------------------------------------|-----------------------------------------|
| 15a     | South                                                 |                                         |
| 19a     | North                                                 | Black Brook                             |
| 19a     | South                                                 |                                         |
| 30      | N/A                                                   | Meare Stream                            |
| 31      | North                                                 | Meare Stream Tributary 1                |
| 31      | South                                                 |                                         |
| 36      | N/A                                                   | Fivehead River main channel 2           |
| 39      | North                                                 | Venner's Water                          |
| 39      | South                                                 |                                         |
| 52      | N/A                                                   | Cad Brook                               |
| 54      | North                                                 | River Ding/River Ding drainage network  |
| 54      | South                                                 |                                         |
| 55      | North                                                 | Back Stream/River Ding drainage network |
| 55      | South                                                 |                                         |

### 3.4 LEAFPACS2 WFD classification

- 3.4.1 Water Framework Directive (WFD) UK Technical Advisory Group (UKTAG) guidance recommends that WFD classification of a waterbody using a macrophyte based assessment alone is adequate where alkalinity is >200 mg L<sup>-1</sup> CaCO<sub>3</sub>. Alkalinity data was obtained from the schemes' water quality monitoring programme. Note, water quality sampling was not undertaken at all sites/waterbodies. Where this was the case (Cad Brook and Venner's Water), the alkalinity data for the nearest connecting water body was used based on the nearby location and therefore assumed similar environmental parameters.
- 3.4.2 The alkalinity data is presented in Table 3-2. Average alkalinity values for each watercourse were calculated for the monitoring period May to September 2021. Alkalinity values were appropriate for a macrophyte-based WFD classification at all sites.

**Table 3-2 Alkalinity results**

| Site ID | Watercourse                             | Mean alkalinity (mg/L CaCO <sub>3</sub> ) |
|---------|-----------------------------------------|-------------------------------------------|
| 15a     | Broughton Brook                         | 490                                       |
| 19a     | Black Brook                             | 490                                       |
| 30      | Meare Stream                            | 436                                       |
| 31      | Meare Stream Tributary 1                | 436                                       |
| 36      | Fivehead River                          | 395                                       |
| 39      | Venner's Water                          | 395                                       |
| 52      | Cad Brook                               | 242                                       |
| 54      | River Ding/River Ding drainage network  | 242                                       |
| 55      | Back Stream/River Ding drainage network | 242                                       |

- 3.4.3 Table 3-3 shows the EQR score and WFD classification for macrophytes at each of the survey sites and associated watercourses. Scores were calculated using



the WFD LEAFPACS2 tool. Survey limitations and constraints of the LEAFPACS2 analysis are discussed in section 4.1.

**Table 3-3 WFD macrophyte classification**

| Site ID | Cardinal direction in relation to the scheme crossing | Watercourse                             | EQR   | WFD macrophyte classification |
|---------|-------------------------------------------------------|-----------------------------------------|-------|-------------------------------|
| 15a     | North                                                 | Broughton Brook                         | 0.621 | Good                          |
| 15a     | South                                                 |                                         | 0.572 | Moderate                      |
| 19a     | East                                                  | Black Brook                             | 0.113 | Bad                           |
| 19a     | West                                                  |                                         | 0.277 | Poor                          |
| 30      | South                                                 | Meare Stream                            | 0.638 | Good                          |
| 31      | North                                                 | Meare Stream Tributary 1                | 0.965 | High                          |
| 31      | South                                                 |                                         | 1.087 | High                          |
| 36      | North                                                 | Fivehead River main channel 2           | 0.162 | Bad                           |
| 39      | North                                                 | Venner's Water                          | 0.177 | Bad                           |
| 39      | South                                                 |                                         | 0.190 | Bad                           |
| 52      | North                                                 | Cad brook                               | 0.766 | Good                          |
| 54      | North                                                 | River Ding/River Ding drainage network  | 0.466 | Moderate                      |
| 54      | South                                                 |                                         | 0.388 | Poor                          |
| 55      | North                                                 | Back Stream/River Ding drainage network | 0.834 | High                          |
| 55      | South                                                 |                                         | 0.663 | Good                          |

3.4.4 For those watercourses where it was possible to complete more than one macrophyte survey, a water body confidence class was calculated (Table 3-4). The water body confidence class calculation provides a statistical confidence of the overall EQR being in any of the five status classes. This calculation is particularly useful in order to determine the robustness of the LEAFPACS2 analysis and subsequent WFD classification for each waterbody.

**Table 3-4 Waterbody confidence**

| Site ID | Watercourse                             | Mean EQR | Confidence of class |      |          |      |       | WFD macrophyte classification |
|---------|-----------------------------------------|----------|---------------------|------|----------|------|-------|-------------------------------|
|         |                                         |          | Bad                 | Poor | Moderate | Good | High  |                               |
| 15a     | Broughton Brook                         | 0.597    | 0.0                 | 0.0  | 52.5     | 47.5 | 0.0   | Moderate                      |
| 19a     | Black Brook                             | 0.195    | 53.6                | 46.0 | 0.4      | 0.0  | 0.0   | Bad                           |
| 31      | Meare Stream Tributary 1                | 1.026    | 0.0                 | 0.0  | 0.0      | 0.0  | 100.0 | High                          |
| 39      | Venner's Water                          | 0.184    | 60.5                | 39.2 | 0.3      | 0.0  | 0.0   | Bad                           |
| 54      | River Ding/River Ding drainage network  | 0.427    | 0.0                 | 32.9 | 66.9     | 0.3  | 0.0   | Moderate                      |
| 55      | Back Stream/River Ding drainage network | 0.748    | 0.0                 | 0.0  | 0.1      | 91.4 | 8.5   | Good                          |

## 4 Conclusions

### 4.1 Survey constraints and limitations

- 4.1.1 A number of constraints impeded comprehensive macrophyte surveys at numerous watercourse crossings, including water turbidity and dense vegetation/hedgerow, thus making visual observations difficult. In addition to the aforementioned survey constraints, macrophyte growth was also notably inhibited across numerous watercourses as a result of dense, overgrown bank zone vegetation.
- 4.1.2 The River LEAFPACS2 tool was developed to be appropriate for use on all rivers in the UK, however there are a number of notable limitations. The model is sensitive to anthropogenic pressures including modification to river morphology and flow. The assessment is also notably less applicable to heavily modified water bodies and “should not be used to assess canals, marsh ditch systems or strongly seasonal watercourses” [5]. The majority of watercourses surveyed were subject to some degree of modification and/or were notably “seasonal”, with some sites being dry at the time of survey. The results of the LEAFPACS2 calculations and subsequent WFD classification may therefore not be entirely robust and should be treated with caution. Nevertheless, they are considered to present a useful indicator of ecosystem health.
- 4.1.3 The majority of macrophyte species identified during the surveys were common, widespread species typical of the habitats surveyed. In summary, macrophyte diversity and abundance/SCV were low for the majority of species encountered, due largely to the constraints detailed in section 4.1.1. No notable protected species or species of particular conservation interest were recorded. Himalayan balsam, an invasive non-native plant species listed on Schedule 9 Part 2 of the Wildlife and Countryside Act 1981 (as amended) was recorded at sites 15a, 19a, 30, 39, and 54.

### 4.2 Mitigation and enhancement recommendations

- 4.2.1 The results of the RCS and macrophyte surveys highlight a need for the management of bank zone vegetation at a number of watercourse crossings. Specific recommendations include the following:
- Site 15a Broughton Brook south: some scrub clearance would be beneficial to improve biodiversity.
  - Site 19a Black Brook south: further planting of black poplar, perhaps in the northern area would help maintain continuity of this species which is scarce in the area.
  - Site 19b Black Brook Tributary 3 north: some thinning of scrub may improve the habitat conservation value of the site.
  - Site 30 Meare Stream south: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).
  - Site 31 Meare Stream Tributary 1 north: removal of cherry laurel.
  - Site 31 Meare Stream Tributary 1 south: conservation of the woodland.
  - Site 39 Venner’s Water north: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).
  - Site 51 Cad Brook drainage network north: late summer mowing to reduce rank grasses and tall herb dominance.

- Site 54 River Ding/River Ding drainage network north: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).
- Site 54 River Ding/River Ding drainage network south: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).
- Site 55 Back Stream/River Ding drainage network north: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).
- Site 55 Back Stream/River Ding drainage network south: Himalayan balsam present and site would benefit from management through seasonal pulling (April/May).

4.2.2 General management recommendations include the seasonal management of hedgerows along with thinning of scrub and bank vegetation to reduce the shading of the watercourses and improve habitat and macrophyte assemblage.

4.2.3 It is an offence to plant or otherwise cause to grow Himalayan balsam in the wild. A specific invasive species survey at an appropriate time of year, to map the extent of these species has been identified as necessary if any works are predicted to impact on the watercourses or their banks where Himalayan balsam has been recorded. Precautionary working measures would be outlined in a management plan to prevent the spread of these species if works are planned to be undertaken within 6m of any infestation of these species.

Although not designated as such in the Ancient Woodland Inventory [8], the broadleaved semi-natural woodland of Bickenhall Wood at the upstream extent of site 31 south contains some ancient woodland indicators (wild service tree, bluebell and spindle). Conservation of the woodland habitat in this area should be considered. In addition, black poplar was recorded at site 19a south and is of particular conservation interest and should be assessed/protected.

## Abbreviations List

*Please refer to ES Chapter 17 Abbreviations*

## Glossary

*Please refer to ES Chapter 18 Glossary*

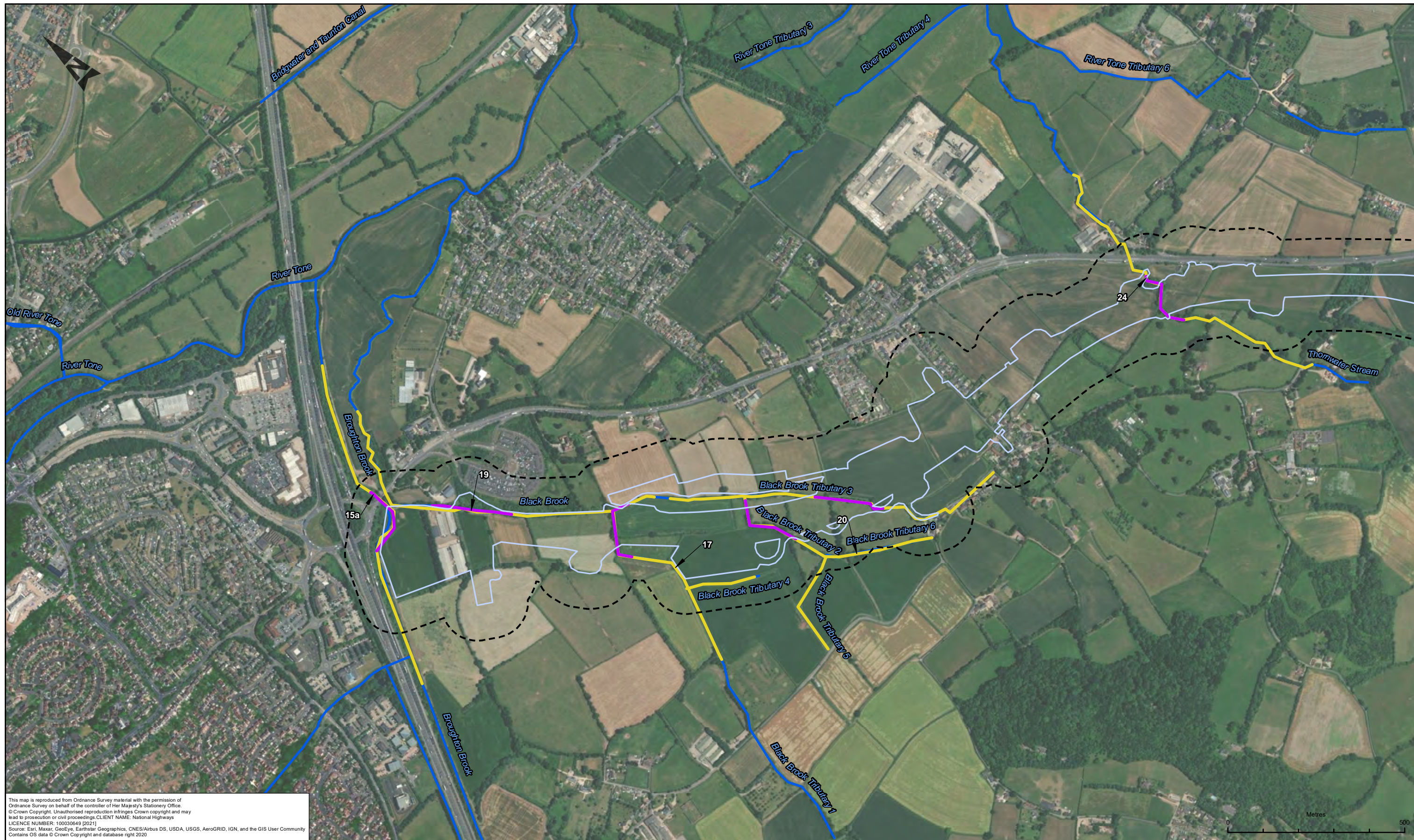
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# Appendix A River Corridor Survey (RCS) and macrophytes survey extent



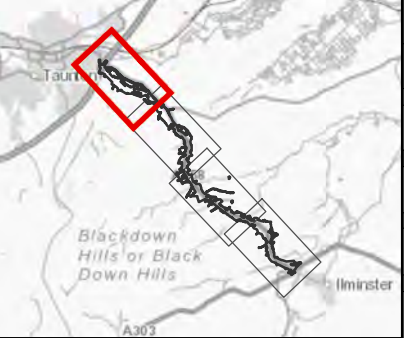


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**LEGEND**

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 100M
- WATERCOURSES
- RIVER CORRIDOR SURVEY EXTENT (500M EITHER SIDE OF SCHEME CROSSING POINT)
- MACROPHYTE SURVEY EXTENT (100M EITHER SIDE OF SCHEME CROSSING POINT)

*LABELS SHOW SURVEY LOCATION ID*



**SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

|                              |      |
|------------------------------|------|
| CONSTRUCTION                 | NONE |
| MAINTENANCE / CLEANING       | NONE |
| USE                          | NONE |
| DECOMMISSIONING / DEMOLITION | NONE |

|      |      |             |    |       |       |        |
|------|------|-------------|----|-------|-------|--------|
| Rev. | Date | Description | By | Chk'd | App'd | Auth'd |
|      |      |             |    |       |       |        |

Suitability: S2  
Drawing Status: SUITABLE FOR INFORMATION

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|---------------------------------------------------------------------------------------|-----------------|---------------------------|----------------|----------------|----------------|
| Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME                            |                 |                           |                |                |                |
| Drawing Title: RIVER CORRIDOR SURVEY (RCS) AND MACROPHYTES SURVEY EXTENT SHEET 1 OF 4 |                 |                           |                |                |                |
| Scale: 1:10,000                                                                       | By: LL          | Checked: MA               | Approved: JS   | Authorised: SV |                |
| Original Size: A3                                                                     | Date: 05/05/22  | Date: 05/05/22            | Date: 05/05/22 | Date: 05/05/22 | Date: 05/05/22 |
| Drawing Number: HE551508 - ZZ                                                         | Originator: ARP | Volume: -DR - LE - 000291 | Revision: P02  |                |                |
| Location                                                                              | Type            | Role                      | Number         |                |                |







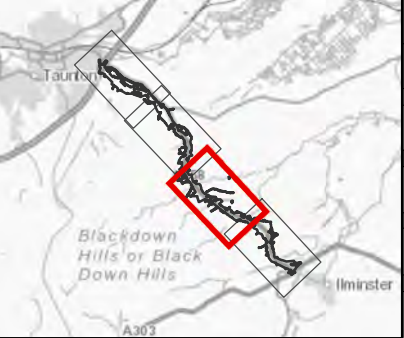


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**LEGEND**

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 100M
- WATERCOURSES
- RIVER CORRIDOR SURVEY EXTENT (500M EITHER SIDE OF SCHEME CROSSING POINT)
- MACROPHYTE SURVEY EXTENT (100M EITHER SIDE OF SCHEME CROSSING POINT)

*LABELS SHOW SURVEY LOCATION ID*



**SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

|                              |      |
|------------------------------|------|
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| MAINTENANCE / CLEANING       | NONE |
| USE                          | NONE |
| DECOMMISSIONING / DEMOLITION | NONE |

|      |      |             |    |       |       |        |
|------|------|-------------|----|-------|-------|--------|
| Rev. | Date | Description | By | Chk'd | App'd | Auth'd |
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Suitability: S2 Drawing Status: SUITABLE FOR INFORMATION

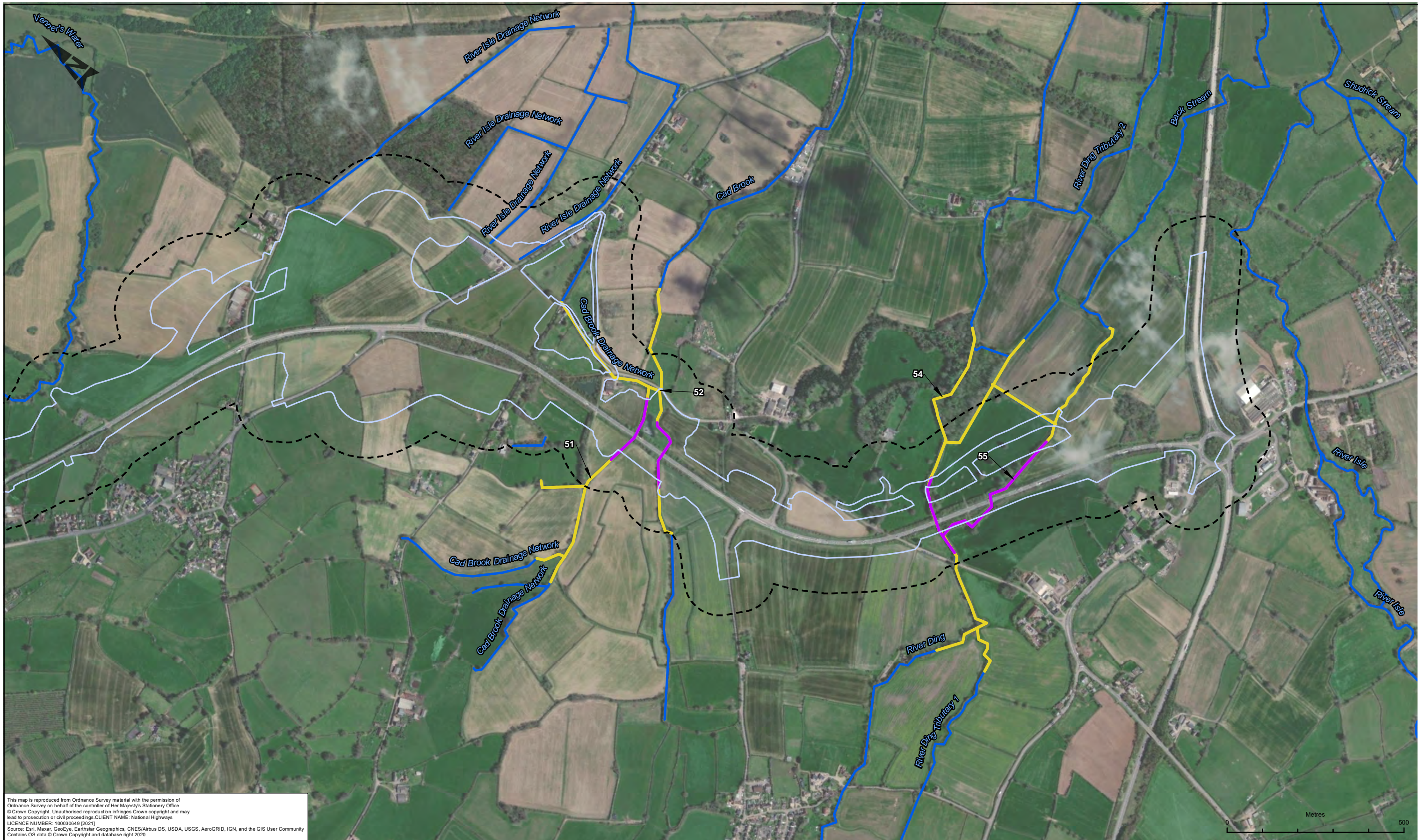
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|                                                                                       |                 |                            |                |                |                |
|---------------------------------------------------------------------------------------|-----------------|----------------------------|----------------|----------------|----------------|
| Project Title: A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME                            |                 |                            |                |                |                |
| Drawing Title: RIVER CORRIDOR SURVEY (RCS) AND MACROPHYTES SURVEY EXTENT SHEET 3 OF 4 |                 |                            |                |                |                |
| Scale: 1:10,000                                                                       | By: LL          | Checked: MA                | Approved: JS   | Authorised: SV |                |
| Original Size: A3                                                                     | Date: 05/05/22  | Date: 05/05/22             | Date: 05/05/22 | Date: 05/05/22 | Date: 05/05/22 |
| Drawing Number: HE551508 - ZZ                                                         | Originator: ARP | Volume: - DR - LE - 000293 | Revision: P02  |                |                |
| Location                                                                              | Type            | Role                       | Number         |                |                |



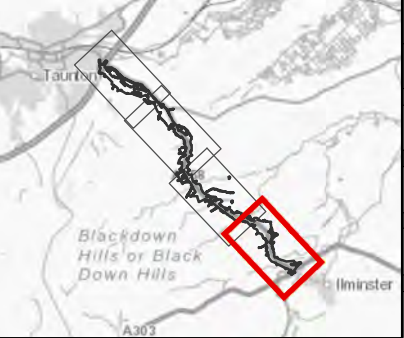


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**LEGEND**

- ECOLOGY SURVEY ZONE
- ECOLOGY SURVEY ZONE BUFFER - 100M
- WATERCOURSES
- RIVER CORRIDOR SURVEY EXTENT (500M EITHER SIDE OF SCHEME CROSSING POINT)
- MACROPHYTE SURVEY EXTENT (100M EITHER SIDE OF SCHEME CROSSING POINT)

*LABELS SHOW SURVEY LOCATION ID*



**SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION**

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING SIGNIFICANT RESIDUAL RISKS (REFERENCE SHALL ALSO BE MADE IN THE DESIGN HAZARD LOG)

|                              |      |
|------------------------------|------|
| CONSTRUCTION                 | NONE |
| MAINTENANCE / CLEANING       | NONE |
| USE                          | NONE |
| DECOMMISSIONING / DEMOLITION | NONE |

|      |      |             |    |       |       |        |
|------|------|-------------|----|-------|-------|--------|
| Rev. | Date | Description | By | Chk'd | App'd | Auth'd |
|      |      |             |    |       |       |        |

Client: **national highways**

Subsidiary: **TAYLOR WOODROW** together @ VINCI **ARUP** **RAMBOLL**

Drawing Status: **S2** SUITABLE FOR INFORMATION

|                                                                                              |                |                 |                |                |                |
|----------------------------------------------------------------------------------------------|----------------|-----------------|----------------|----------------|----------------|
| Project Title: <b>A358 TAUNTON TO SOUTHFIELDS DUALLING SCHEME</b>                            |                |                 |                |                |                |
| Drawing Title: <b>RIVER CORRIDOR SURVEY (RCS) AND MACROPHYTES SURVEY EXTENT SHEET 4 OF 4</b> |                |                 |                |                |                |
| Scale: 1:10,000                                                                              | By: LL         | Checked: MA     | Approved: JS   | Authorised: SV |                |
| Original Size: A3                                                                            | Date: 05/05/22 | Date: 05/05/22  | Date: 05/05/22 | Date: 05/05/22 | Date: 05/05/22 |
| Drawing Number: HE551508 - ZZ                                                                | HE PIN: ZZ     | Originator: ARP | Volume: - VES  | Revision: P02  |                |
| Location                                                                                     |                | Type            | Role           | Number         |                |



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# Appendix B River Corridor Survey maps







### B.3 Site 19a – Black Brook

WEATHER: DRY/SUNNY  
 RIVER: BLACK BROOK  
 SITE: 19a SOUTH  
 SURVEYOR: P FLOOD  
 DATE: 23/9/21

FLOW/LEVEL: Low  
 CLARITY: CLEAR  
 TOTAL MACROPHYTE: 30%, Lt < 1%  
 upst-ream of ST2581 2451

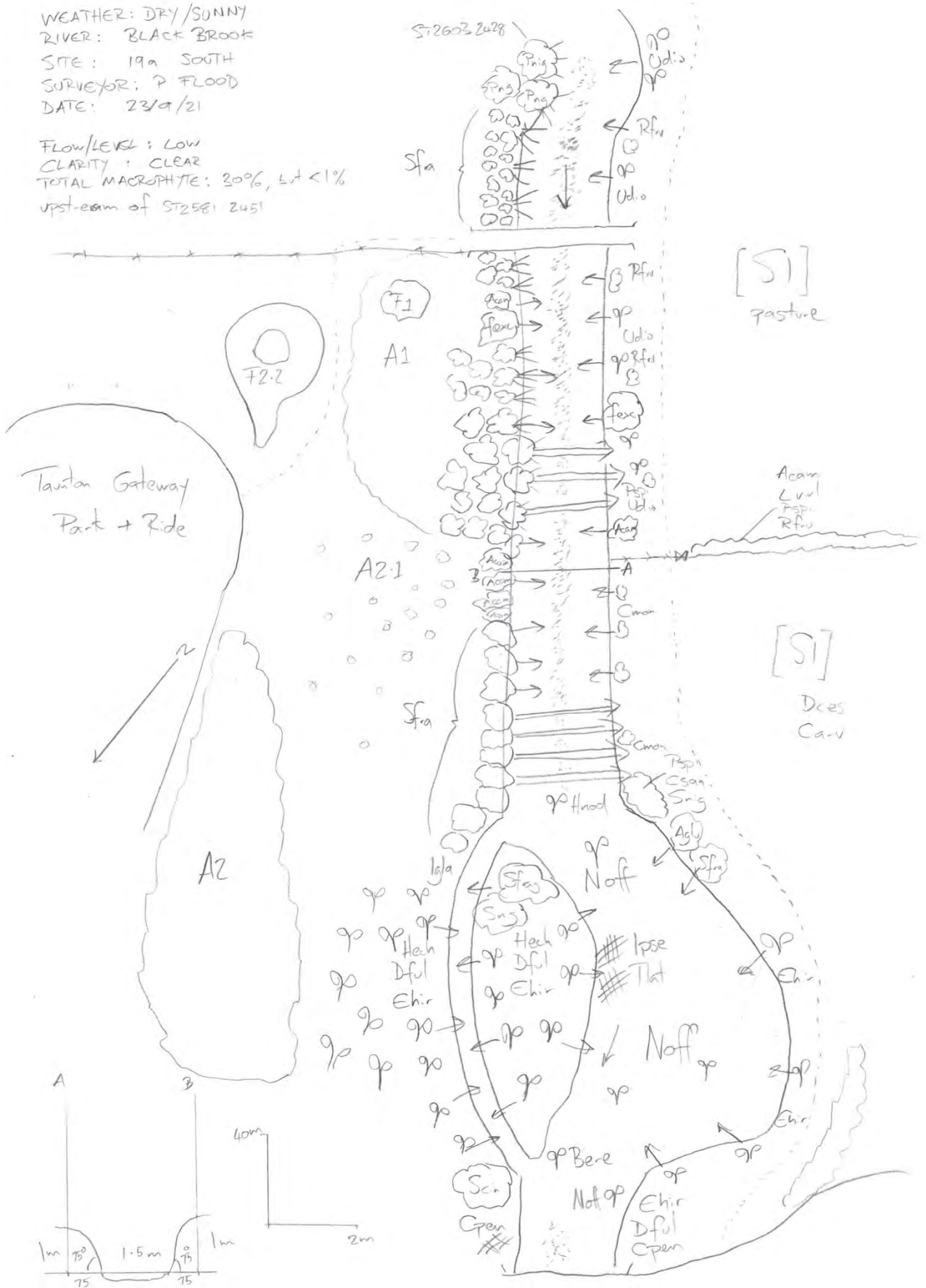


Figure B-4 RCS map - Site 19a - South of A358 scheme crossing



WEATHER: DRY/SUNNY  
 RIVER BLACK BROOK  
 SITE 19a NORTH  
 SURVEYOR P FLOOD  
 DATE: 23/9/21

FLOW/LEVEL: LOW  
 CLARITY: CLEAR  
 TOTAL MACROPHYTE  
 COVER: 30%



Figure B-5 RCS map - Site 19a - North of A358 scheme crossing



### B.4 Site 19b – Black Brook Tributary 3

WEATHER: OVERCAST/DRY  
 RIVER: BLACK BROOK TRIBUTARY 3  
 SITE: 19b SOUTHEAST  
 SURVEYOR: P FLOOD  
 DATE: 24/9/21

FLOW/LEVEL: LOW  
 CLARITY: CLEAR  
 TOTAL MACROPHYTE COVER: < 5%

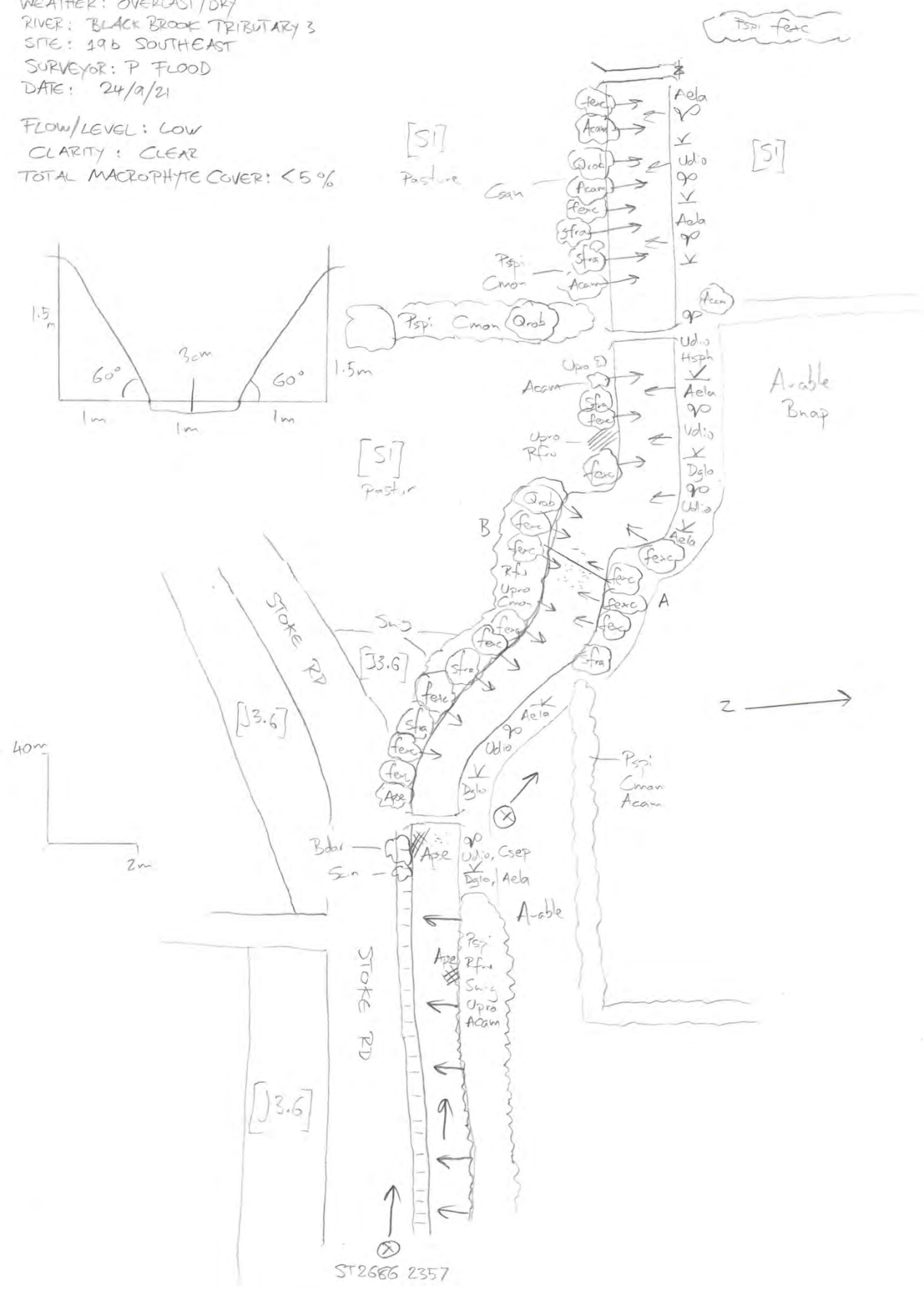


Figure B-6 RCS map - Site 19b - South of A358 scheme crossing

WEATHER: OVERCAST / DRY  
 RIVER: BLACK BROOK TRIBUTARY 3  
 SITE: 19 b NORTHWEST  
 SURVEYOR: P FLOOD  
 DATE: 24/9/21

FLOW/LEVEL: LOW  
 CLARITY: CLEAR  
 TOTAL MACROSPHYTE COVER: < 5%

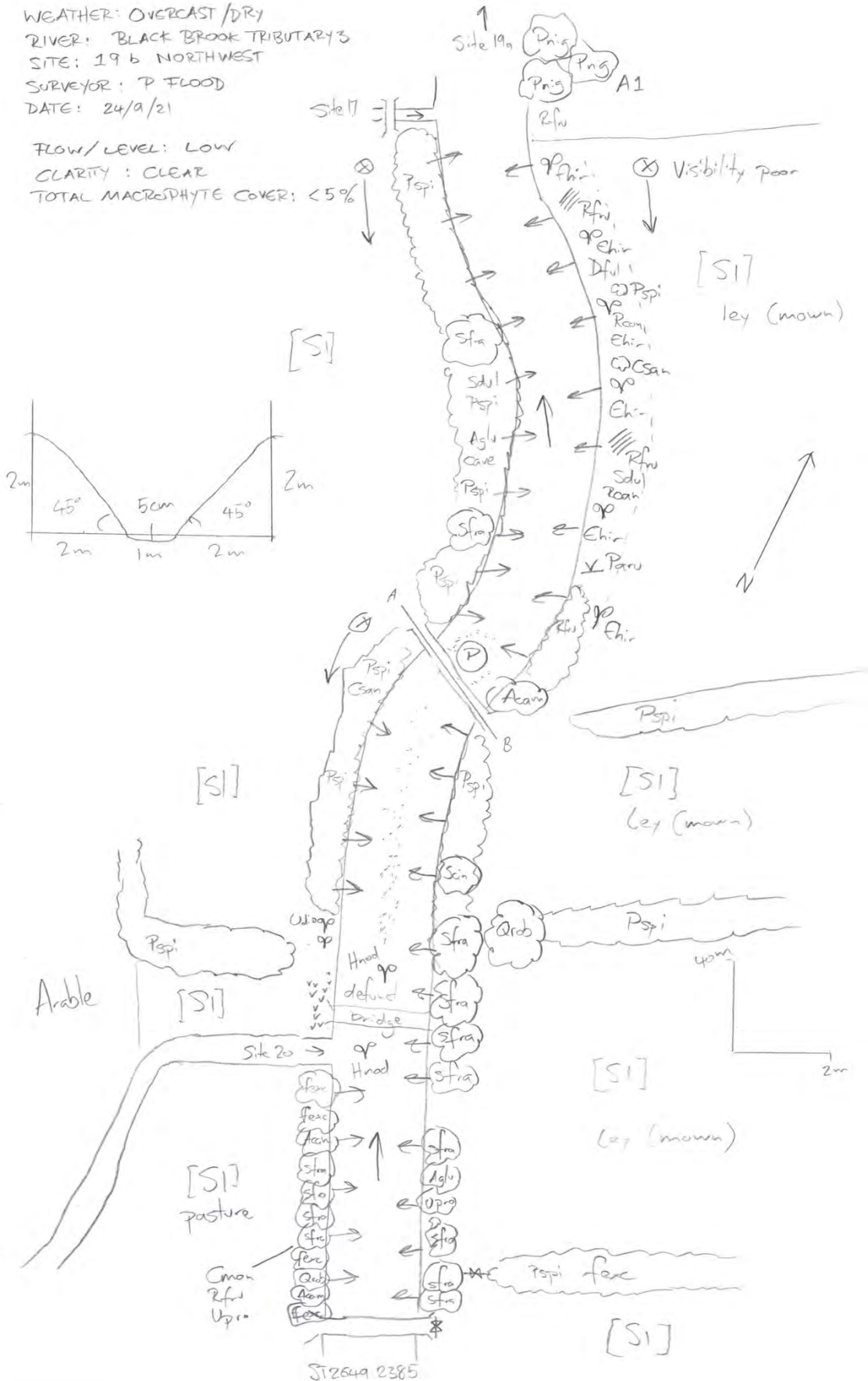


Figure B-7 RCS map - Site 19b - North of A358 scheme crossing

## B.5 Site 20 – Black Brook Tributary 2/5

WEATHER: OVERCAST/DRY  
 RIVER: BLACK BROOK TRIBUTARY 2  
 SITE: 20  
 SURVEYOR: P. FLOOD  
 DATE: 24/9/21

Flow/LEVEL: Low/DRY  
 CLARITY: CLEAR  
 TOTAL MACROPHYTE COVER: < 5%

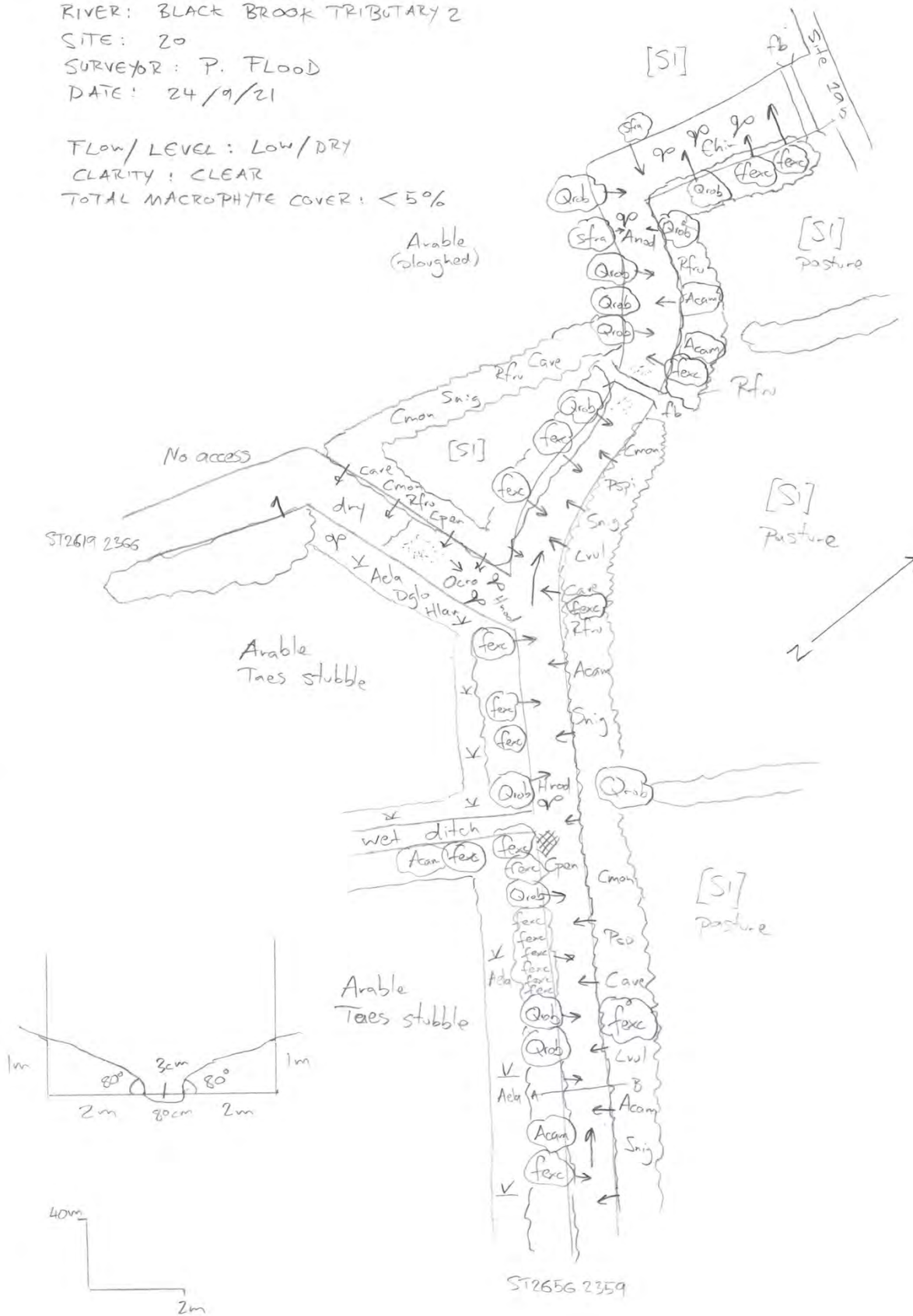


Figure B-8 RCS map - Site 20

### B.6 Site 24 – Thornwater Stream

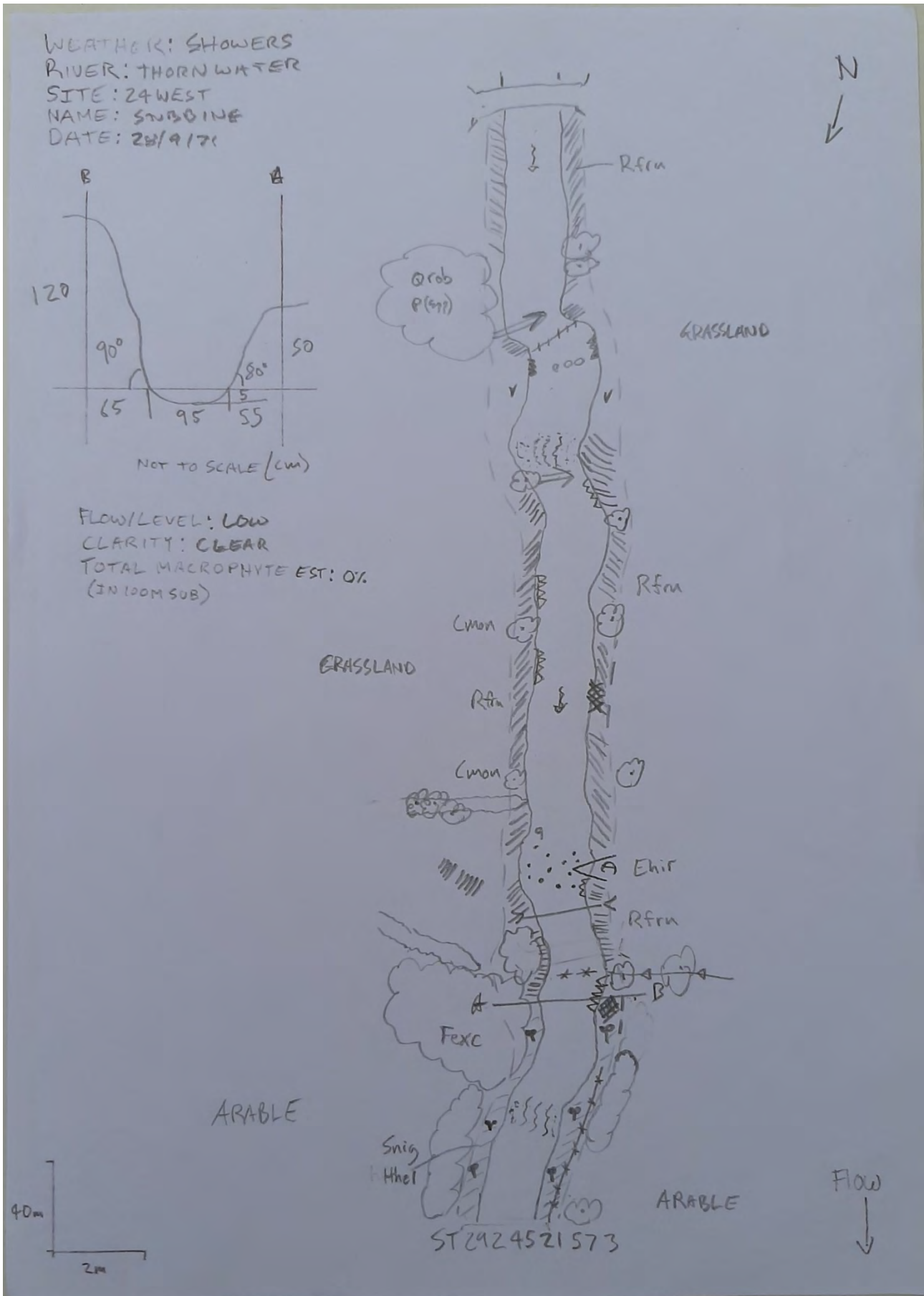


Figure B-9 RCS map - Site 24 - South of A358 scheme crossing





### B.7 Site 30 – Meare Stream

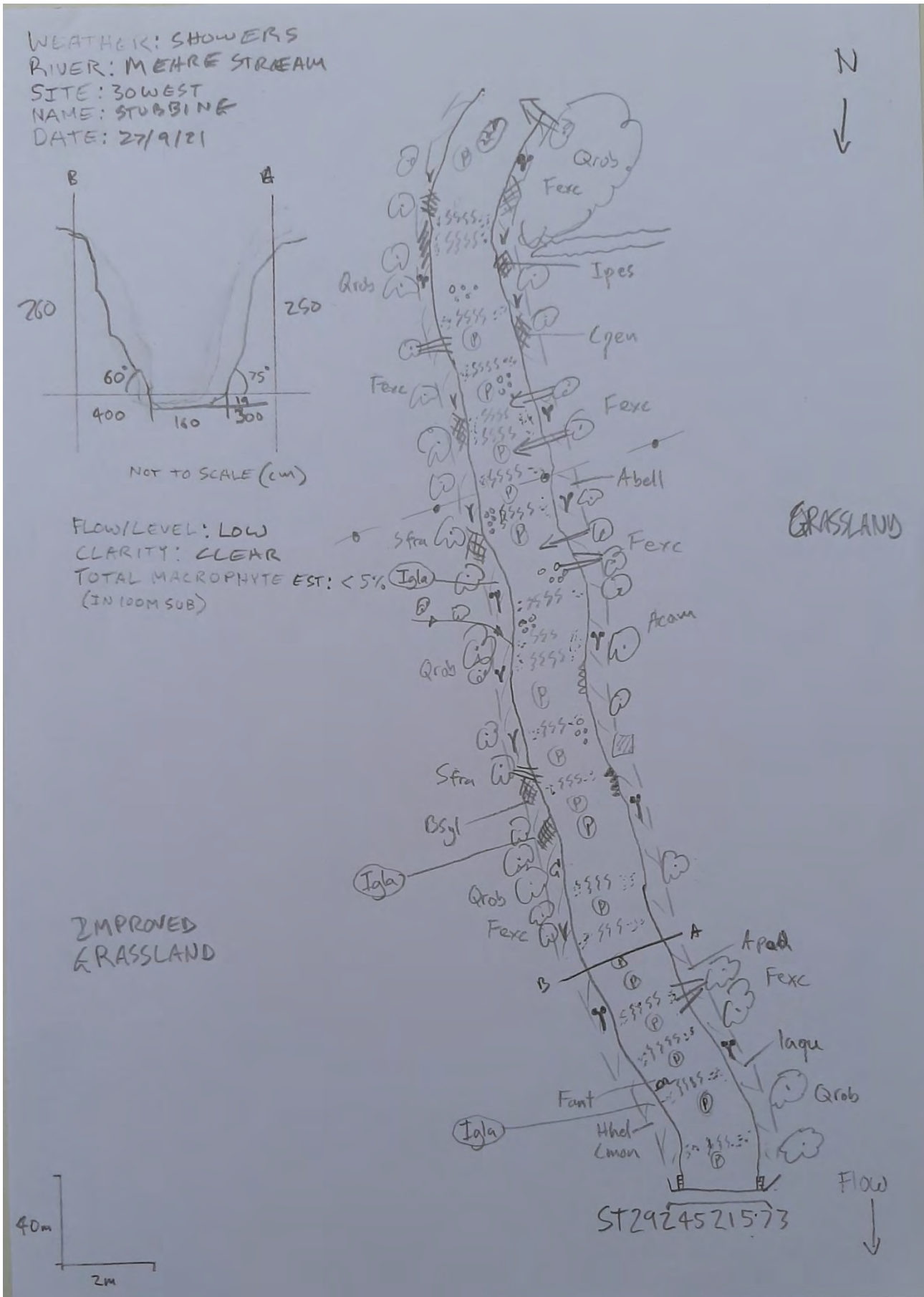


Figure B-11 RCS map - Site 30 - South of A358 scheme crossing

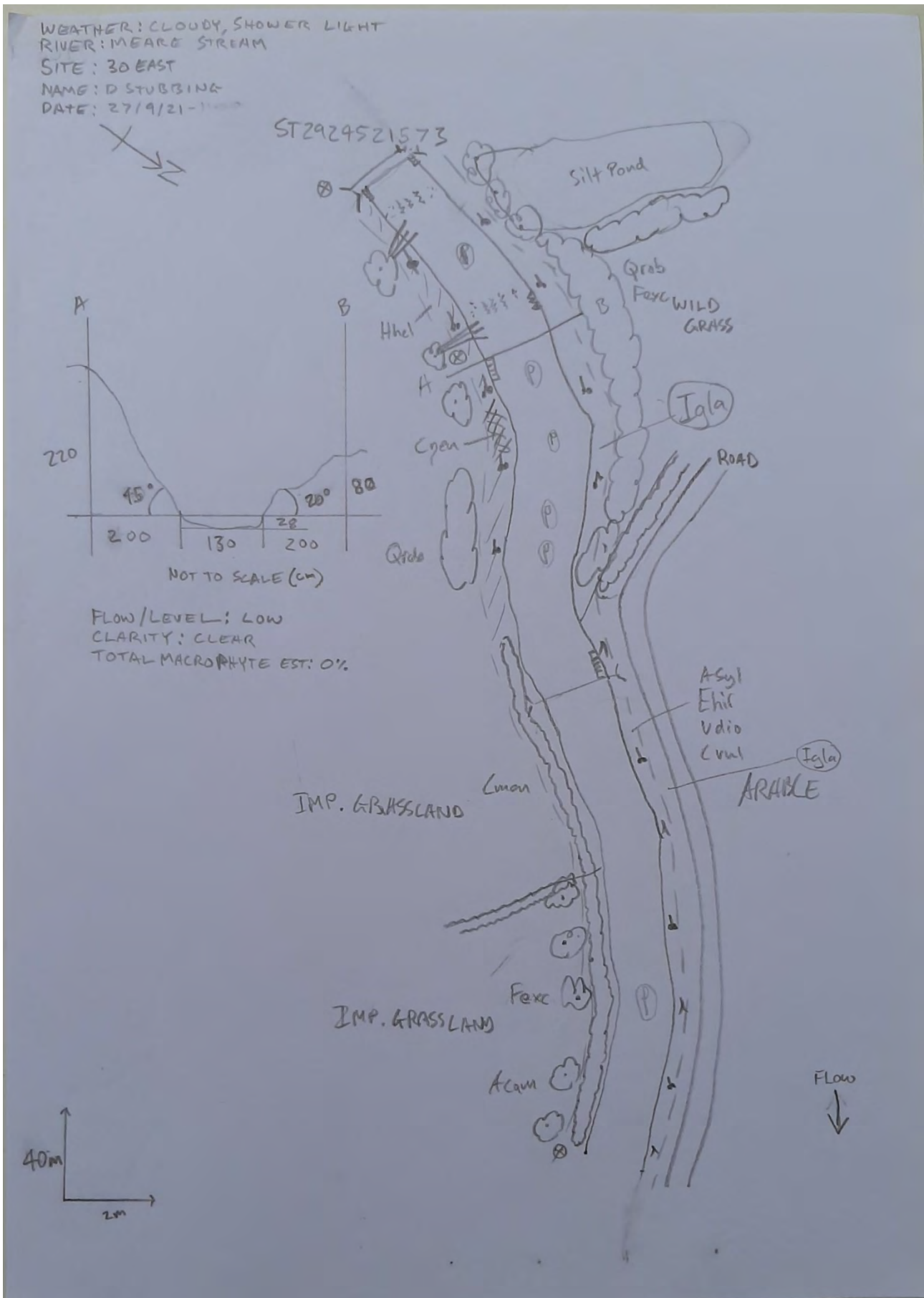


Figure B-12 RCS map - Site 30 - North of A358 scheme crossing



### B.8 Site 31 – Meare Stream Tributary 1

WEATHER: SUNNY/DRY  
 RIVER: MEARE STREAM TRIBUTARY 1  
 SITE: 31 WEST  
 SURVEYOR: P FLOOD  
 DATE: 21/9/21  
 FLOW/LEVEL: DRY/POOLS, trickling flow  
 CLARITY: CLEAR  
 TOTAL MACROPHYTE COVER: < 5%

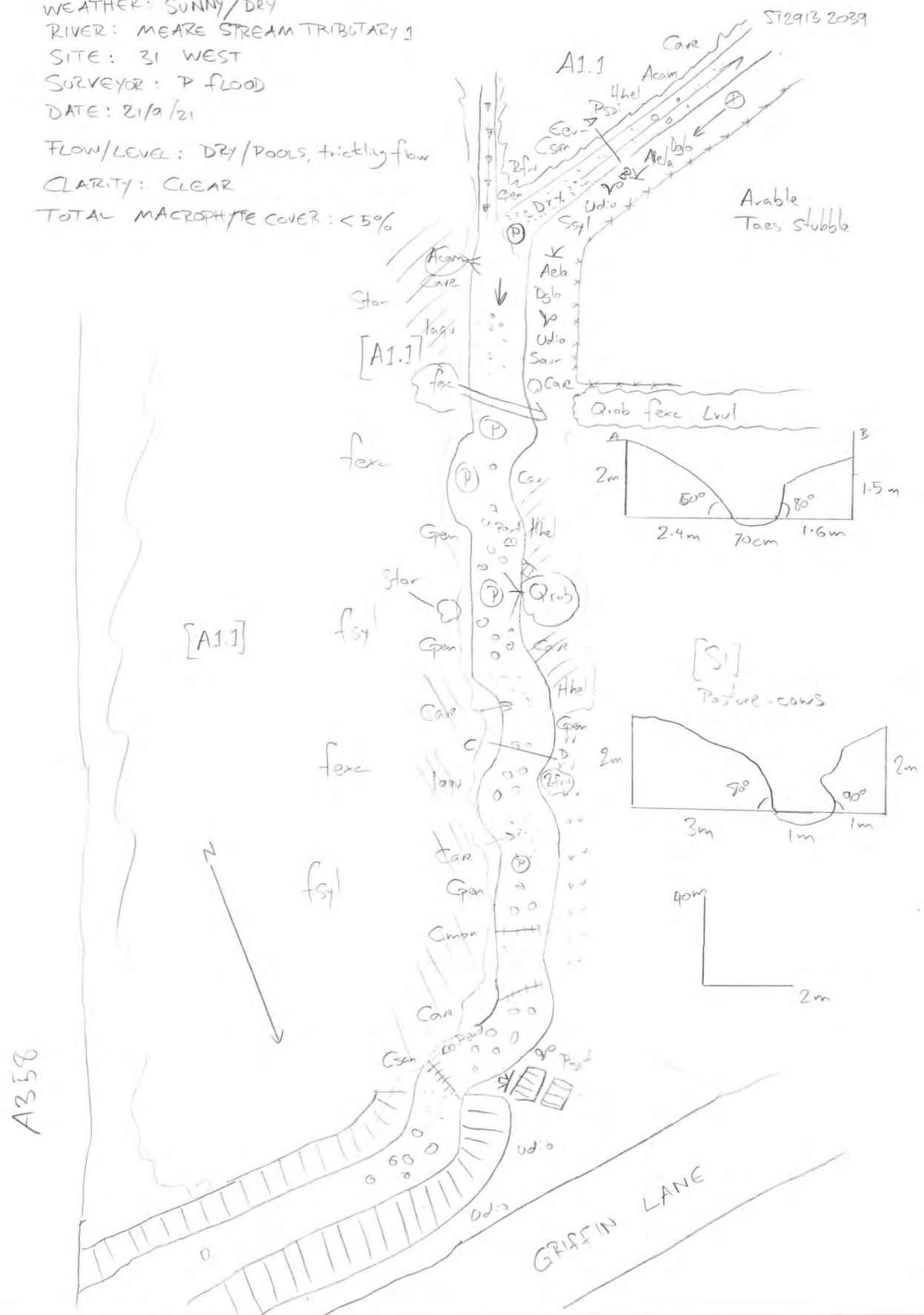


Figure B-13 RCS map - Site 31 - South of A358 scheme crossing





### B.9 Site 34 and 33 – Fivehead River main channel 1 and Fivehead River Tributary 1

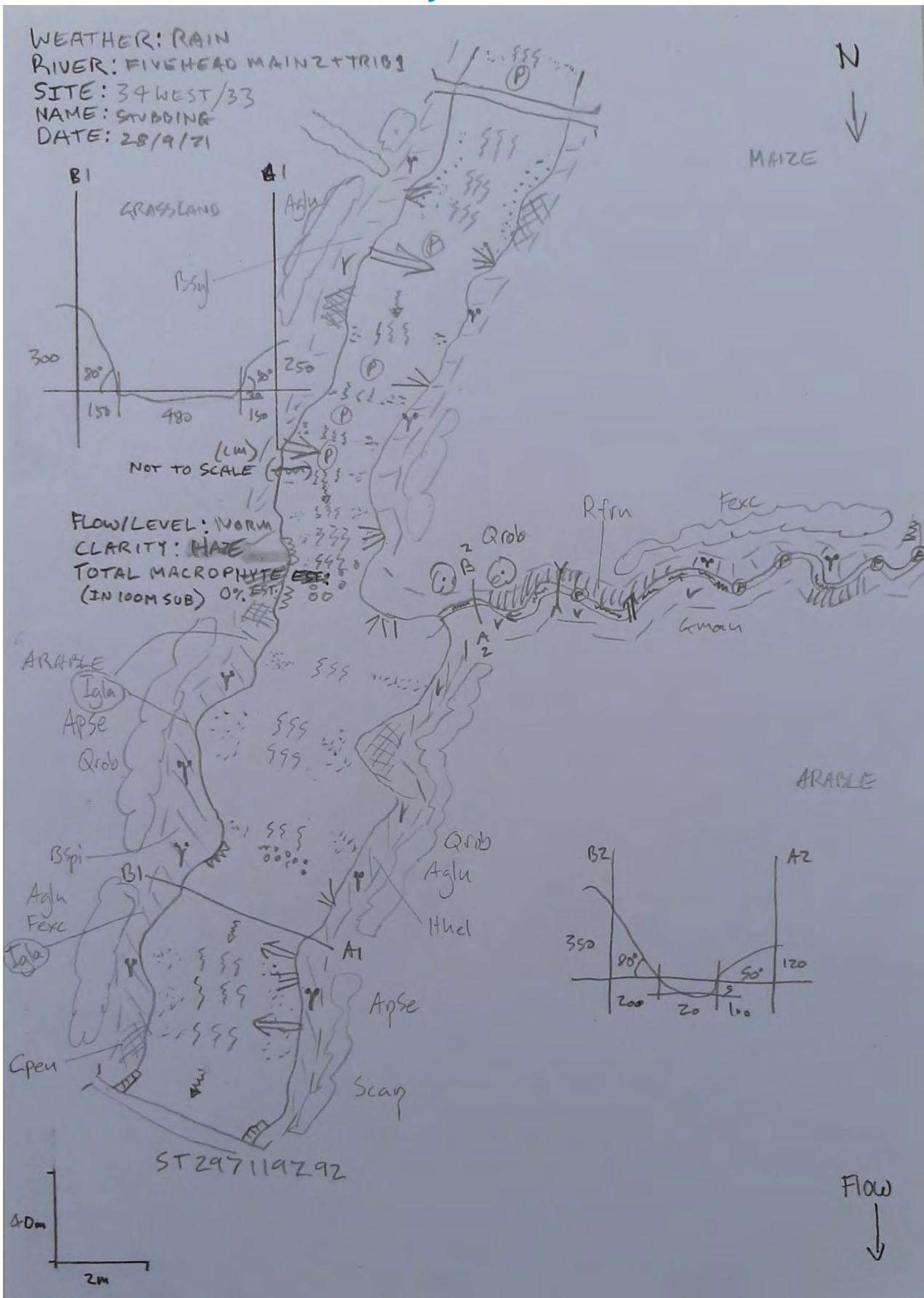


Figure B-15 RCS map - Site 34 and 33 - South of A358 scheme crossing







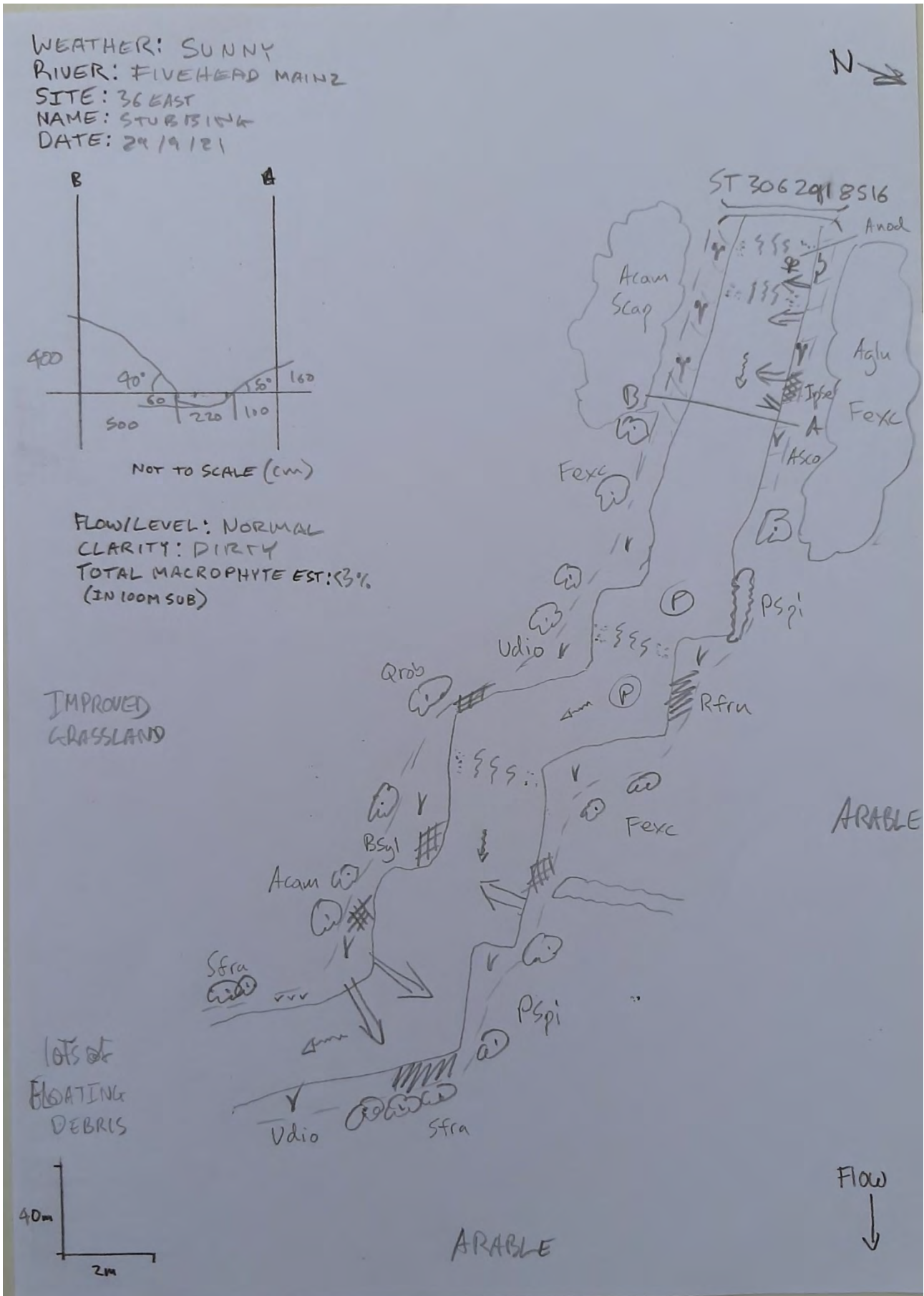


Figure B-18 RCS map – Site 36 – North of A358 scheme crossing

### B.11 Site 37 – Fivehead River Tributary 5

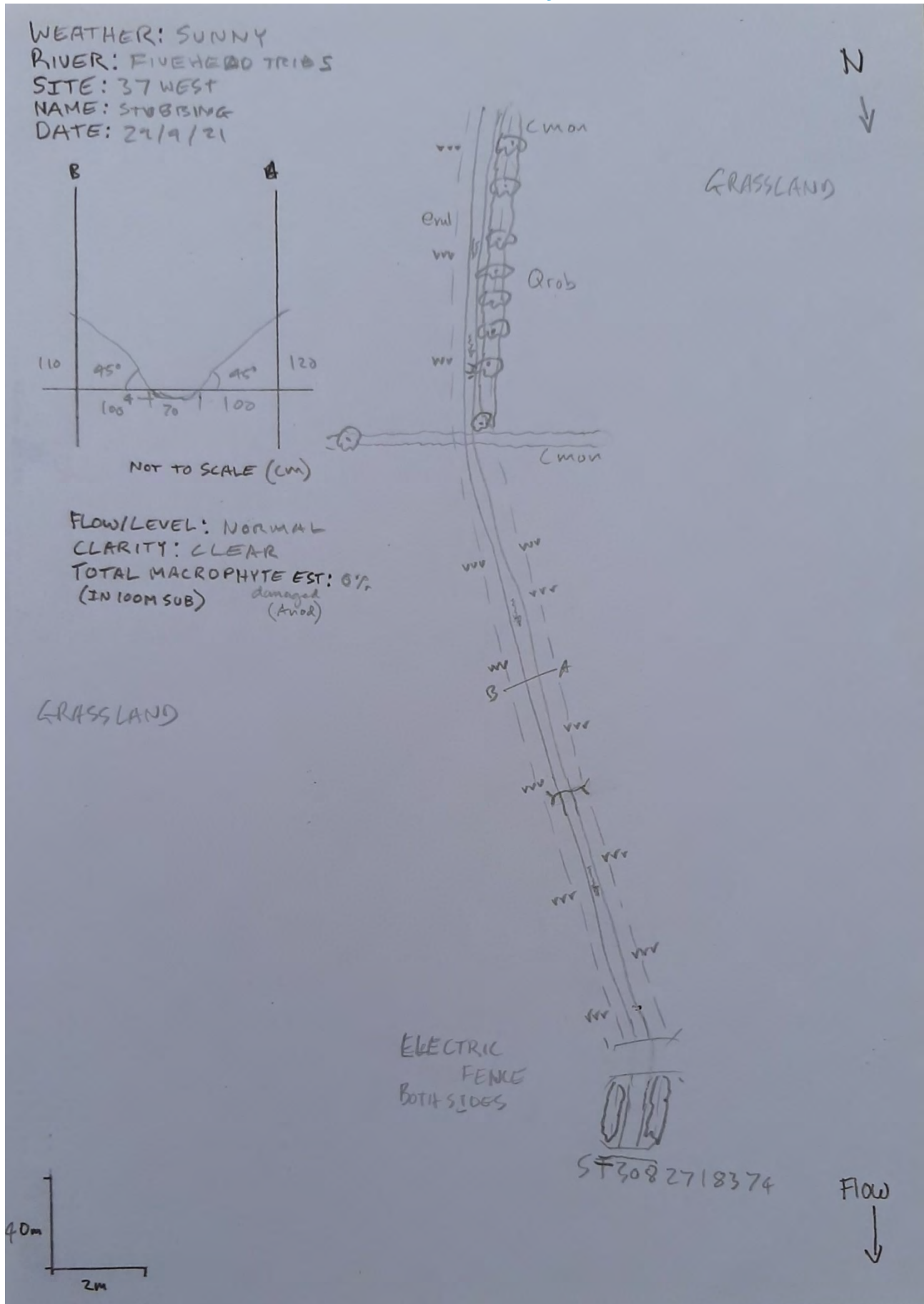


Figure B-19 RCS map – Site 37 – South of A358 scheme crossing



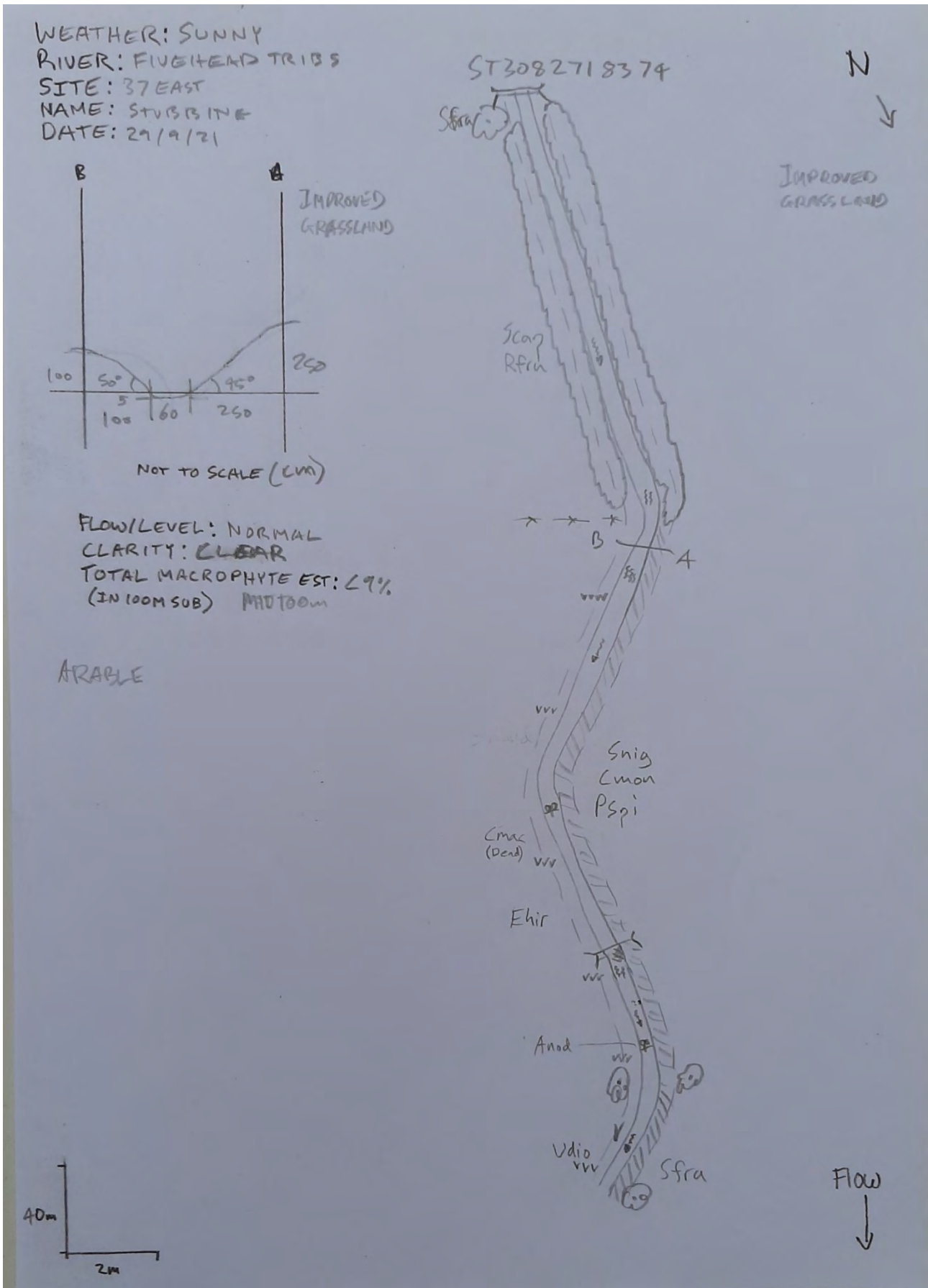
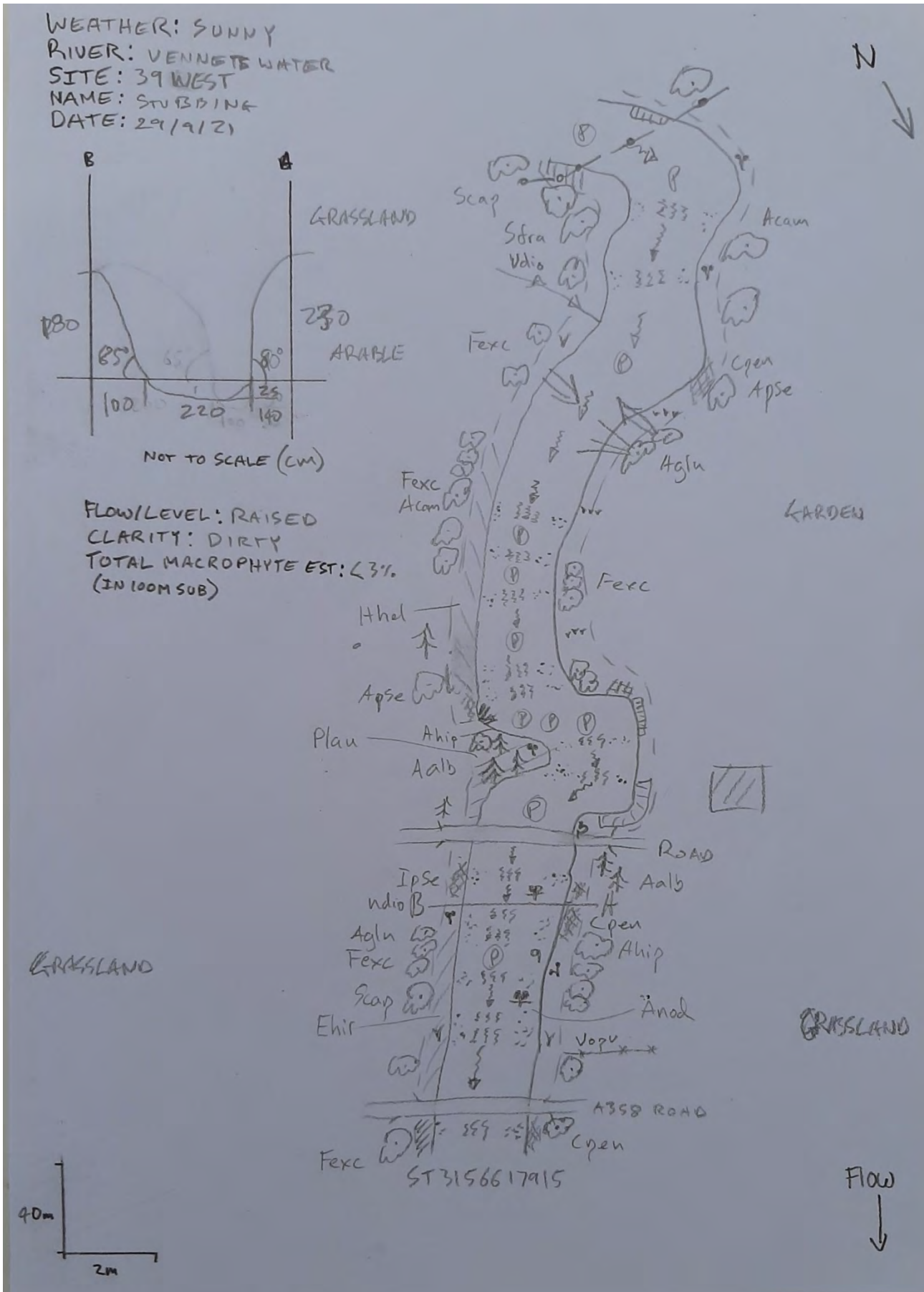


Figure B-20 RCS map – Site 37 – North of A358 scheme crossing

**B.12 Site 39 – Venner’s Water**



**Figure B-21 RCS map - Site 39 – South of A358 scheme crossing**



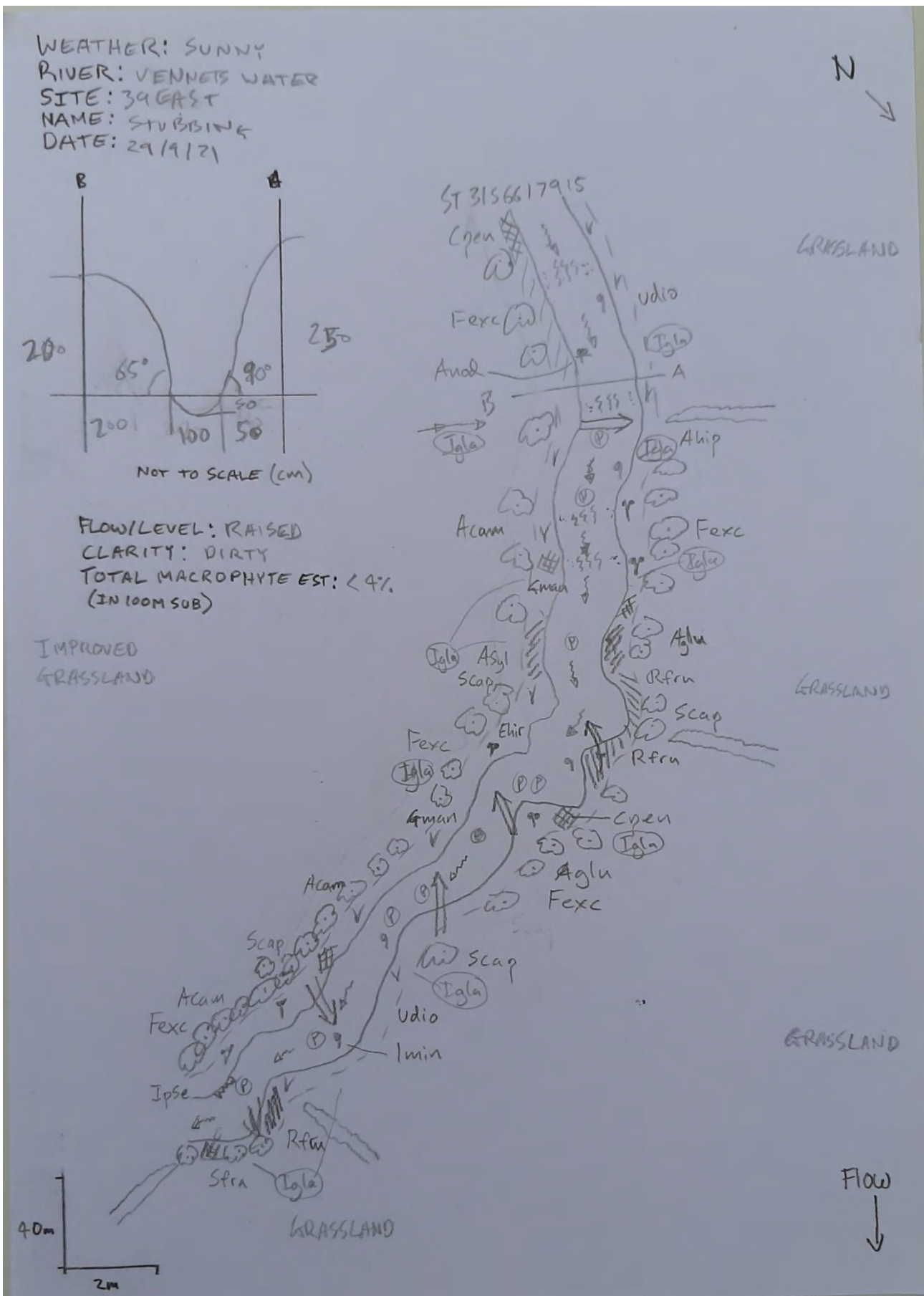


Figure B-22 RCS map – Site 39 – North of A358 scheme crossing

### B.13 Site 51 – Cad Brook drainage network

WEATHER: SUNNY/DRY  
 RIVER: CAD BROOK DRAINAGE NETWORK  
 SITE: 51 EAST  
 SURVEYOR: P. FLOOD  
 DATE: 21/9/21  
 FLOW/LEVEL: LOW/DRY  
 CLARITY: CLEAR  
 MACROPHYTE COVER: 50%

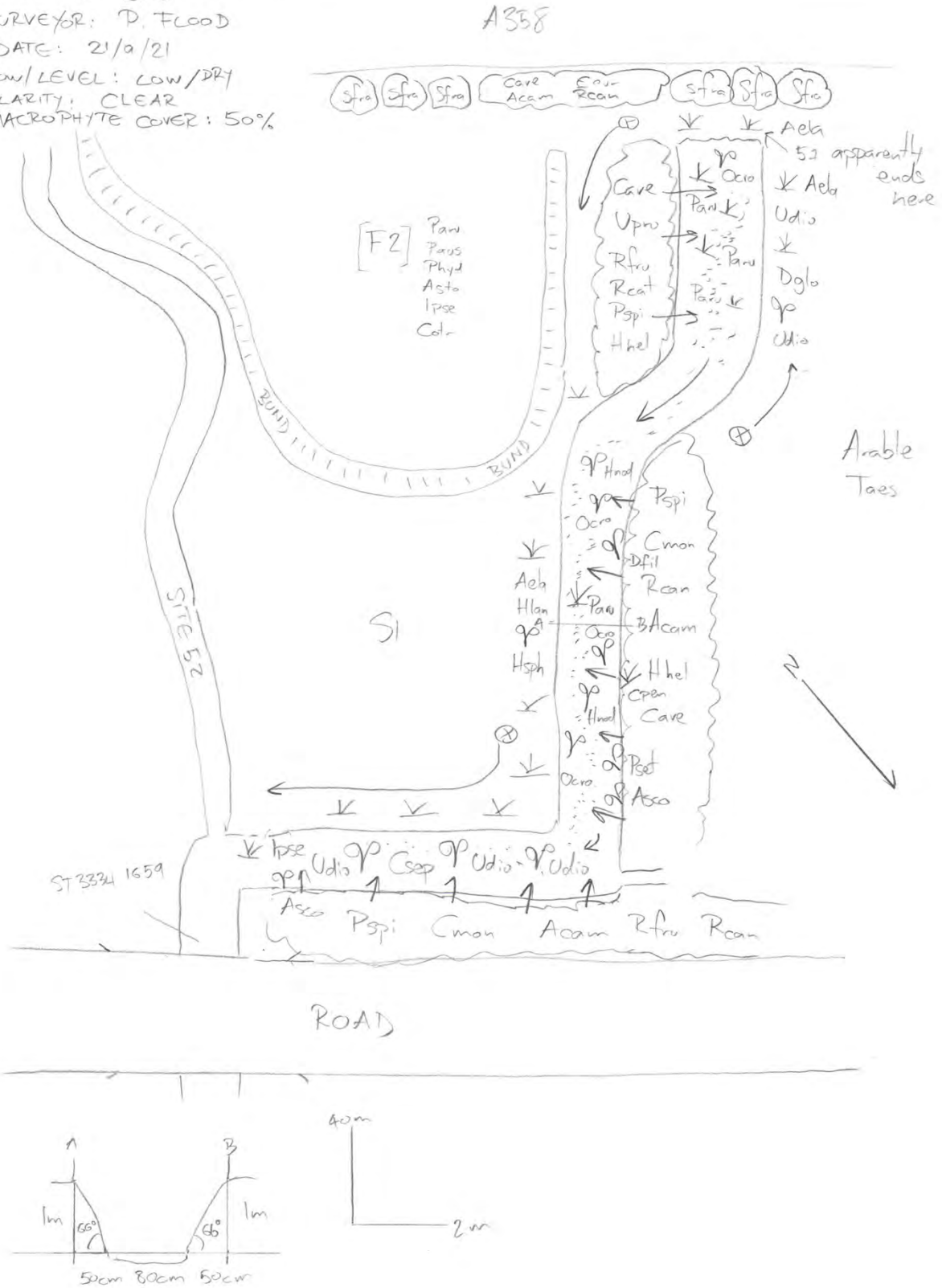


Figure B-23 RCS map - Site 51 - North of A358 scheme crossing

### B.14 Site 52 – Cad Brook

WEATHER: SUNNY/DRY  
 RIVER: CAD BROOK DRAINAGE  
 SITE: 52 EAST  
 SURVEYOR: P FLOOD  
 DATE 21/9/21  
 FLOW/LEVEL: LOW/DRY  
 CLARITY: STAGNANT  
 MACROPHYTE COVER: 40%

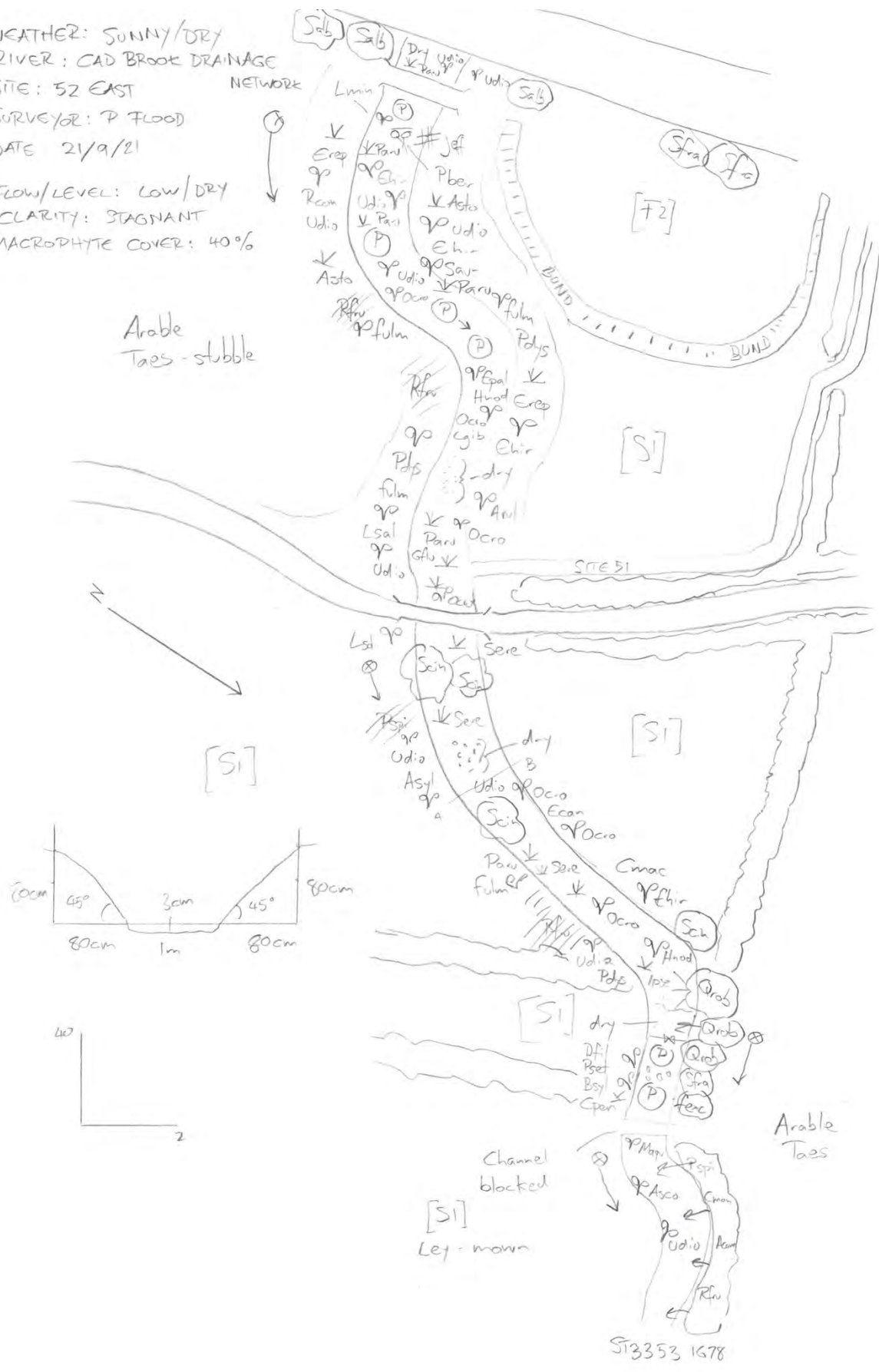


Figure B-24 RCS map - Site 52 - North of A358 scheme crossing



### B.15 Site 54 – River Ding / River Ding drainage network

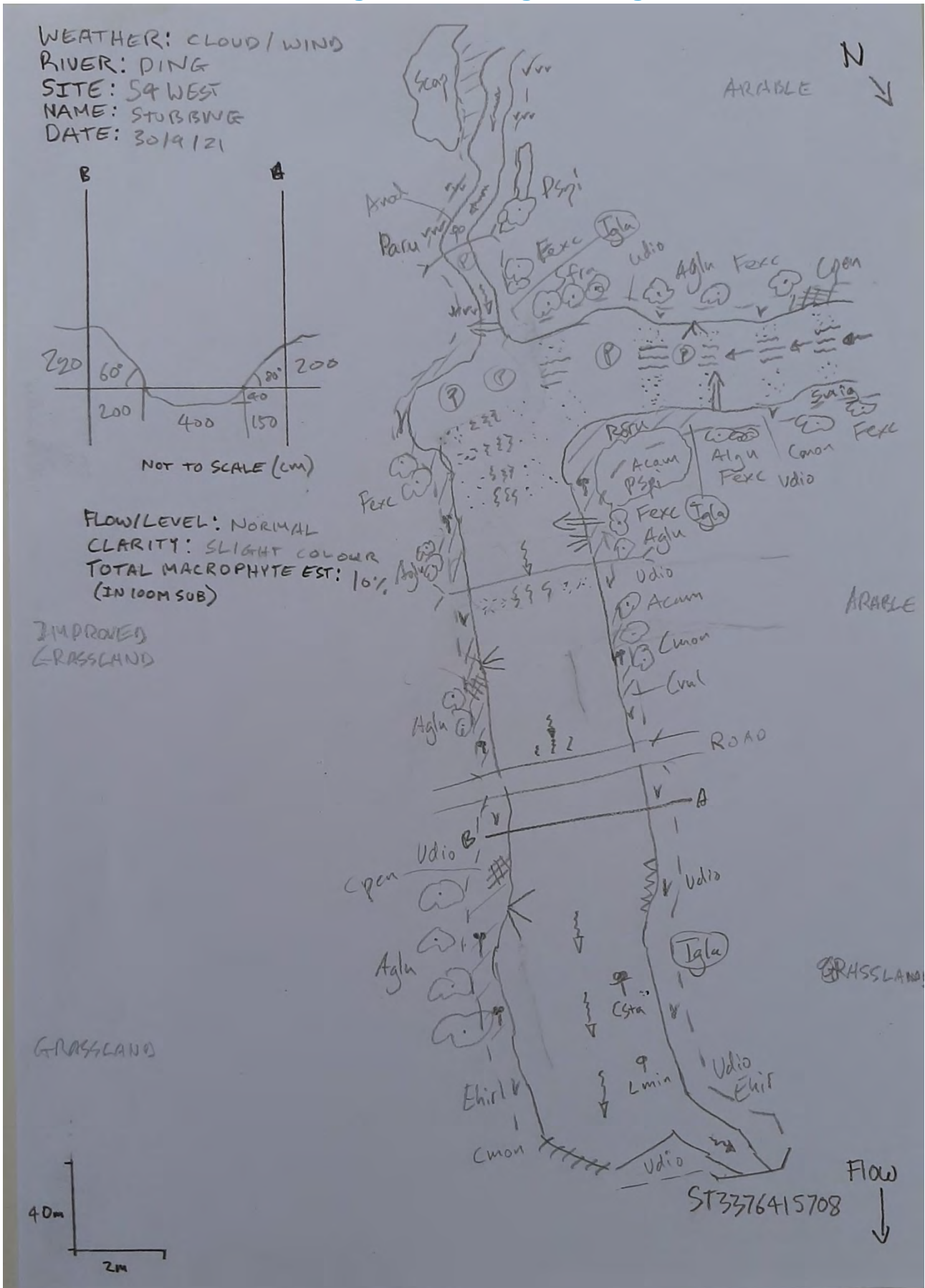


Figure B-25 RCS map – Site 54 - South of A358 scheme crossing

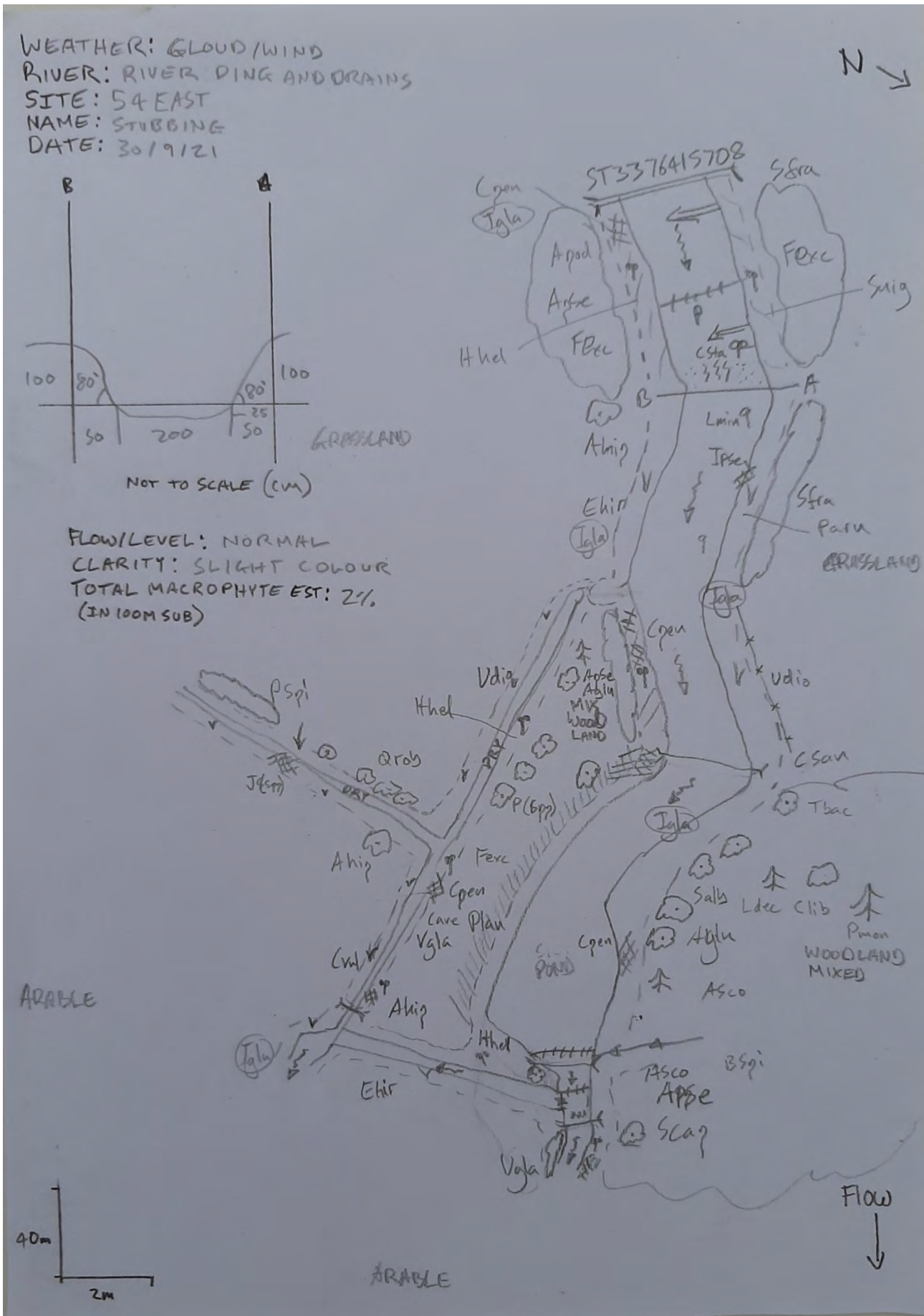


Figure B-26 RCS map – Site 54 – North of A358 scheme crossing





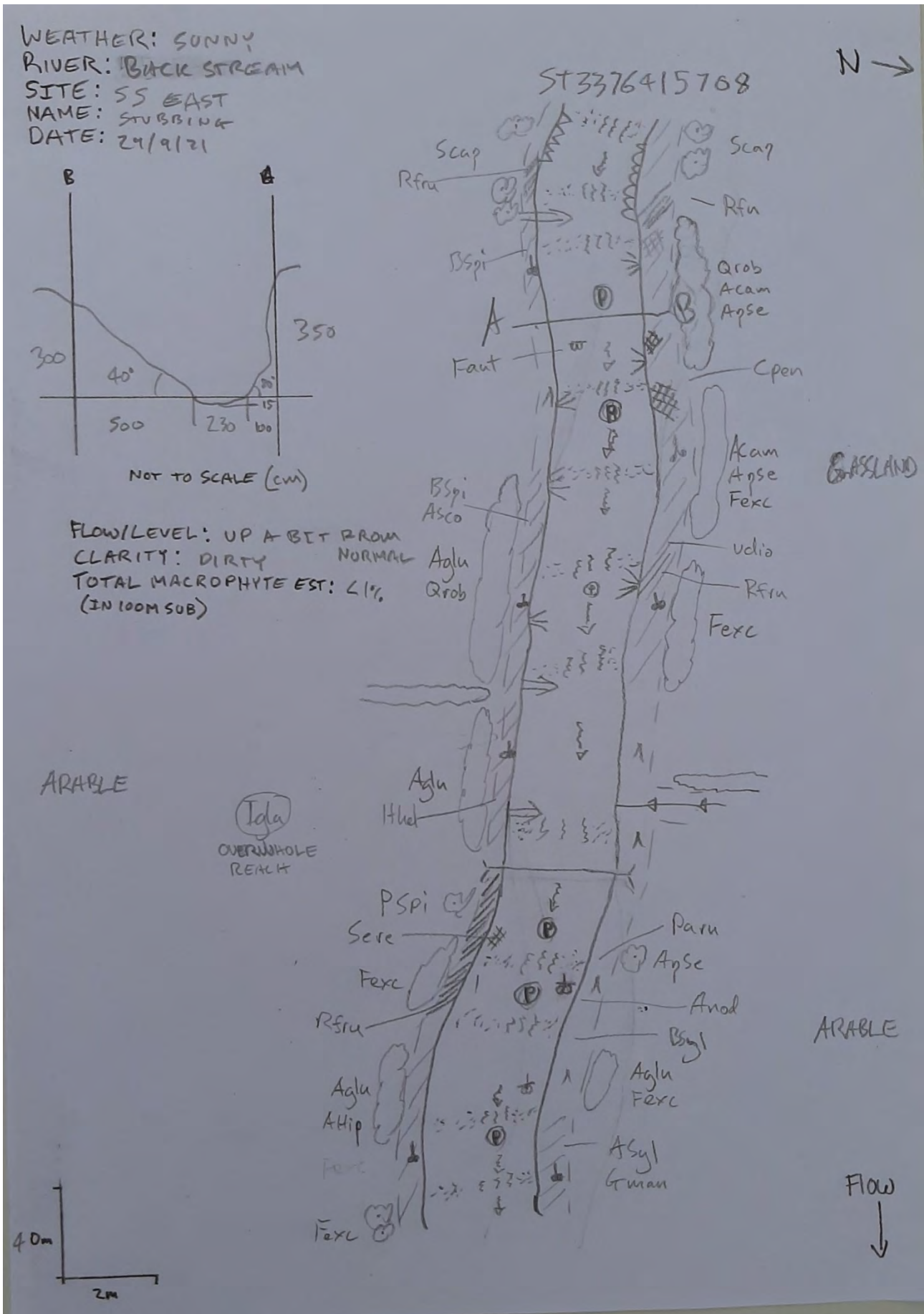


Figure B-28 RCS map – Site 55 – North of A358 scheme crossing

# Appendix C Standard symbols for use in River Corridor Survey

## APPENDIX 2

### Standard Symbols for use in River Corridor Surveys

#### AQUATIC AND MARGINAL ZONES

##### CHANNEL FEATURES

|  |                          |
|--|--------------------------|
|  | Bridge (road/track)      |
|  | Footbridge               |
|  | Lock                     |
|  | Inlet                    |
|  | Weir                     |
|  | Pool                     |
|  | Riffle                   |
|  | Rapids                   |
|  | Run                      |
|  | Waterfall                |
|  | Protruding rock          |
|  | Island (with vegetation) |
|  | Direction of flow        |

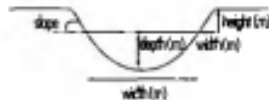
##### SUBSTRATE

|  |                          |
|--|--------------------------|
|  | Mud                      |
|  | Sand                     |
|  | Bare gravel/shingle      |
|  | Vegetated gravel/shingle |
|  | Cobbles                  |
|  | Boulders                 |

##### CHANNEL VEGETATION

|  |                    |
|--|--------------------|
|  | Emergent Monocots  |
|  | Emergent Dicots    |
|  | Submerged Monocots |
|  | Submerged Dicots   |
|  | Bryophytes         |
|  | Floating leaves    |

##### CHANNEL CROSS-SECTION



##### SURVEY INFORMATION

|  |                               |
|--|-------------------------------|
|  | Direction of survey/bank used |
|  | Photograph                    |

#### BANK AND ADJACENT LAND ZONES

##### BANK FEATURES

|  |                            |
|--|----------------------------|
|  | Base of bank               |
|  | Top of bank                |
|  | Slump                      |
|  | Stable earth cliff         |
|  | Eroding earth cliff        |
|  | Rock cliff                 |
|  | Artificial bank protection |
|  | Cattle drink               |
|  | Shelf / berm               |
|  | Spring / flush             |
|  | Inflow stream              |
|  | Outfall                    |
|  | Dredgings/spoil            |

##### ADJACENT LAND FEATURES

|  |                                                  |
|--|--------------------------------------------------|
|  | Fence                                            |
|  | Gate                                             |
|  | Road / track                                     |
|  | Railway                                          |
|  | Footpath                                         |
|  | Power lines                                      |
|  | Building                                         |
|  | Sewage works                                     |
|  | Flood bank                                       |
|  | Land use category<br>Defined name / Phase 1 code |

##### VEGETATION

|              |                            |
|--------------|----------------------------|
| <b>Trees</b> |                            |
|              | Conifer                    |
|              | Broadleaf                  |
|              | - overhanging              |
|              | - fallen                   |
|              | - exposed roots            |
|              | Woodland + symbol for type |
|              | Pollarded tree             |
|              | Tree needs pollarding      |
|              | Coppiced tree              |
|              | Sapling                    |

##### Shrubs/hedgerows

|  |                     |
|--|---------------------|
|  | Shrub (single)      |
|  | Dense shrubs        |
|  | Sparse shrubs       |
|  | Hedgerow            |
|  | Hedgerow with trees |

##### Grasses and herbs

|  |                       |
|--|-----------------------|
|  | Reed / sedge          |
|  | Tall grass            |
|  | Tall herb / ruderal   |
|  | Tall grass with herbs |
|  | Short grass           |
|  | Mown                  |



# Appendix D Abbreviated plant names

## APPENDIX 4

### ABBREVIATED PLANT NAMES

All plants should be recorded using an abbreviated version of their scientific name. The following list is indicative; additions should be abbreviated using the convention of the first letter name (i.e. the first letter of the generic name and the first three letters of the specific name). Duplicate abbreviations thus created should be clarified by using the BSBI abbreviation or code number. Plants not identified to species should be recorded using initial of generic name and (sp) in brackets. Nomenclature follows Stace (1991).

#### DICOTYLEDONS

##### Herbs

|      |                                |                                  |
|------|--------------------------------|----------------------------------|
| Anod | <i>Apium nodiflorum</i>        | Fool's Water-cress               |
| Asyl | <i>Angelica sylvestris</i>     | Wild Angelica                    |
| Bere | <i>Berula erecta</i>           | Lesser Water-parsnip             |
| Bcer | <i>Bidens cernua</i>           | Nodding Bur-marigold             |
| Btri | <i>B. tripartita</i>           | Trifid Bur-marigold              |
| Cobt | <i>Callitriche obtusangula</i> | Blunt-fruited Water-starwort     |
| Csta | <del><i>C. stagnalis</i></del> | <del>Common Water-starwort</del> |
| Cpal | <i>Caltha palustris</i>        | Marsh-marigold                   |
| Cpra | <i>Cardamine pratensis</i>     | Cuckooflower                     |
| Cdem | <i>Ceratophyllum demersum</i>  | Rigid Hornwort                   |
| Cmac | <i>Conium maculatum</i>        | Hemlock                          |
| Dful | <i>Dipsacus fullonum</i>       | Wild Teasel                      |
| Dpil | <i>D. pilosus</i>              | Small Teasel                     |
| Ehir | <i>Epilobium hirsutum</i>      | Great Willowherb                 |
| Ecan | <i>Eupatorium cannabinum</i>   | Hemp-agrimony                    |
| Fulm | <i>Filipendula ulmaria</i>     | Meadowsweet                      |
| Lped | <i>Lotus pedunculatus</i>      | Greater Bird's-foot-trefoil      |
| Lfcu | <i>Lycnis flos-cuculi</i>      | Ragged-Robin                     |
| Leur | <i>Lycopus europaeus</i>       | Gipsywort                        |
| Lvul | <i>Lysimachia vulgaris</i>     | Yellow Loosestrife               |
| Lsal | <i>Lythrum salicaria</i>       | Purple-loosestrife               |
| Maqu | <i>Mentha aquatica</i>         | Water Mint                       |
| Mscs | <i>Myosotis scorpioides</i>    | Water Forget-me-not              |
| Mspi | <i>Myriophyllum spicatum</i>   | Spiked Water-milfoil             |
| Nalb | <i>Nymphaea alba</i>           | White Water-lily                 |
| Nlut | <i>Nuphar lutea</i>            | Yellow Water-lily                |
| Ocro | <i>Oenanthe crocata</i>        | Hemlock Water-dropwort           |
| Oflu | <del><i>O. fluvialis</i></del> | <del>River Water-dropwort</del>  |
| Phyb | <i>Petasites hybridus</i>      | Butterbur                        |
| Pamp | <i>Polygonum amphibium</i>     | Amphibious Bistort               |
| Phyd | <i>P. hydropiper</i>           | Water-pepper                     |
| Pdys | <i>Pulicaria dysenterica</i>   | Common Fleabane                  |
| Raqu | <i>Ranunculus aquatilis</i>    | Common Water-crowfoot            |
| Rcir | <i>R. circinatus</i>           | Fan-leaved Water-crowfoot        |
| Rfla | <i>R. flammula</i>             | Lesser Spearwort                 |
| Rflu | <i>R. fluitans</i>             | River Water-crowfoot             |
| Rpel | <i>R. peltatus</i>             | Pond Water-crowfoot              |

|      |                                     |                          |
|------|-------------------------------------|--------------------------|
| Rpen | <i>R. penicillatus</i>              | Stream Water-crowfoot    |
| Rsce | <i>R. sceleratus</i>                | Celery-leaved Buttercup  |
| Rnaq | <i>Rorippa nasturtium-aquaticum</i> | Water-cress              |
| Rhyd | <i>Rumex hydrolapathum</i>          | Water Dock               |
| Saur | <i>Scrophularia auriculata</i>      | Water Figwort            |
| Sgal | <i>Scutellaria galericulata</i>     | Skullcap                 |
| Sdul | <i>Solanum dulcamara</i>            | Bittersweet              |
| Soff | <i>Symphytum officinale</i>         | Common Comfrey           |
| Tfla | <i>Thalictrum flavum</i>            | Common Meadow-rue        |
| Udio | <del><i>Urtica dioica</i></del>     | <del>Common Nettle</del> |
| Voff | <i>Valeriana officinalis</i>        | Common Valerian          |
| Vaaq | <i>Veronica anagallis-aquatica</i>  | Blue Water-Speedwell     |
| Vbec | <i>V. beccabunga</i>                | Brooklime                |
| Vcat | <i>V. catenata</i>                  | Pink Water-Speedwell     |

#### MONOCOTYLEDONS

##### Grasses

|      |                              |                      |
|------|------------------------------|----------------------|
| Aela | <i>Arrhenatherum elatius</i> | False Oat-grass      |
| Asto | <i>Agrostis stolonifera</i>  | Creeping Bent        |
| Caqu | <i>Catabrosa aquatica</i>    | Whorl-grass          |
| Dces | <i>Deschampsia cespitosa</i> | Tufted Hair-grass    |
| Gdec | <i>Glyceria declinata</i>    | Small Sweet-grass    |
| Gflu | <i>G. fluitans</i>           | Floating Sweet-grass |
| Gmax | <i>G. maxima</i>             | Reed Sweet-grass     |
| Gnot | <i>G. notata</i>             | Plicate Sweet-grass  |
| Paru | <i>Phalaris arundinacea</i>  | Reed Canary-grass    |
| Paus | <i>Phragmites australis</i>  | Common Reed          |

##### Sedges & rushes

|               |                             |                       |
|---------------|-----------------------------|-----------------------|
| Cacu BSBI 340 | <i>Carex acuta</i>          | Slender Tufted-sedge  |
| Cacu BSBI 341 | <i>C. acutiformis</i>       | Lesser Pond-sedge     |
| Cfla          | <i>C. flacca</i>            | Glaucous Sedge        |
| Chir          | <i>C. hirta</i>             | Hairy Sedge           |
| Cnig          | <i>C. nigra</i>             | Common Sedge          |
| Cobt          | <i>C. obtusae</i>           | False Fox-sedge       |
| Cpan          | <i>C. paniculata</i>        | Greater Tussock-sedge |
| Cpen          | <i>C. pendula</i>           | Pendulous Sedge       |
| Crip          | <i>C. riparia</i>           | Greater Pond-sedge    |
| Epal          | <i>Eleocharis palustris</i> | Common Spike-rush     |



|      |                                 |                     |      |                         |                 |
|------|---------------------------------|---------------------|------|-------------------------|-----------------|
| Jacu | <i>Juncus acutiflorus</i>       | Sharp-flowered Rush | Qrob | <i>Quercus robur</i>    | Pedunculate Oak |
| Jart | <i>J. articulatus</i>           | Jointed Rush        | Rfru | <i>Rubus fruticosus</i> | Bramble         |
| Jeff | <i>J. effusus</i>               | Soft-rush           | Salb | <i>Salix alba</i>       | White Willow    |
| Jinf | <i>J. inflexus</i>              | Hard Rush           | Scap | <i>S. caprea</i>        | Goat Willow     |
| Slac | <i>Schoenoplectus lacustris</i> | Common Club-rush    | Scin | <i>S. cinerea</i>       | Grey Willow     |
| Ssyl | <i>Scirpus sylvaticus</i>       | Wood Club-rush      | Sfra | <i>S. fragilis</i>      | Crack-willow    |
|      |                                 |                     | Snig | <i>Sambucus nigra</i>   | Elder           |
|      |                                 |                     | Ugla | <i>Ulmus glabra</i>     | Wych Elm        |
|      |                                 |                     | Vopu | <i>Viburnum opulus</i>  | Guelder-rose    |

**Other monocotyledons**

|      |                                 |                              |
|------|---------------------------------|------------------------------|
| Apaq | <i>Alisma plantago-aquatica</i> | Water-plantain               |
| Alan | <i>A. lanceolatum</i>           | Narrow-Leaved Water-plantain |
| Bumb | <i>Butomus umbellatus</i>       | Flowering-rush               |
| Ecan | <i>Elodea canadensis</i>        | Canadian Waterweed           |
| Hmra | <i>Hydrocharis morsus-ranae</i> | Frogbit                      |
| Ipsc | <i>Iris pseudacorus</i>         | Yellow Iris                  |
| Lgib | <i>Lemna gibba</i>              | Fat Duckweed                 |
| Lmin | <i>L. minor</i>                 | Common Duckweed              |
| Ltri | <i>L. trisulca</i>              | Ivy-leaved Duckweed          |
| Pcri | <i>Potamogeton crispus</i>      | Curled Pondweed              |
| Pluc | <i>P. lucens</i>                | Shining Pondweed             |
| Pnat | <i>P. natans</i>                | Broad-leaved Pondweed        |
| Ppec | <i>P. pectinatus</i>            | Fennel Pondweed              |
| Pper | <i>P. perfoliatus</i>           | Perfoliate Pondweed          |
| Ssag | <i>Sagittaria sagittifolia</i>  | Arrowhead                    |
| Seme | <i>Sparganium emersum</i>       | Unbranched Bur-reed          |
| Sere | <i>S. erectum</i>               | Branched Bur-reed            |
| Spoi | <i>Spirodela polyrrhiza</i>     | Greater Duckweed             |
| Tlat | <i>Typha latifolia</i>          | Bulrush                      |
| Warr | <i>Wolffia arrhiza</i>          | Rootless Duckweed            |
| Zpal | <i>Zannichellia palustris</i>   | Horned Pondweed              |

**TREES & SHRUBS**

|      |                               |                |
|------|-------------------------------|----------------|
| Acam | <i>Acer campestre</i>         | Field Maple    |
| Apse | <i>A. pseudoplatanus</i>      | Sycamore       |
| Aglu | <i>Alnus glutinosa</i>        | Alder          |
| Ahip | <i>Aesculus hippocastanum</i> | Horse-chestnut |
| Cave | <i>Corylus avellana</i>       | Hazel          |
| Cbet | <i>Carpinus betulus</i>       | Hornbeam       |
| Csan | <i>Cornus sanguinea</i>       | Dogwood        |
| Cmon | <i>Crataegus monogyna</i>     | Hawthorn       |
| Feur | <i>Euonymus europaeus</i>     | Spindle        |
| Fexc | <i>Fraxinus excelsior</i>     | Ash            |
| Fsyl | <i>Fagus sylvatica</i>        | Beech          |
| Iaqu | <i>Ilex aquifolium</i>        | Holly          |
| Palb | <i>Populus alba</i>           | White Poplar   |
| Pcan | <i>P. canescens</i>           | Grey Poplar    |
| Pnig | <i>P. nigra</i>               | Black-poplar   |
| Ptre | <i>P. tremula</i>             | Aspen          |
| Pspi | <i>Prunus spinosa</i>         | Blackthorn     |
| Psyl | <i>Pinus sylvestris</i>       | Scots Pine     |

**FERNS**

|      |                             |                 |
|------|-----------------------------|-----------------|
| Eflu | <i>Equisetum fluviatile</i> | Water Horsetail |
|------|-----------------------------|-----------------|

**SELECTED ALIEN PLANTS**

|      |                                 |                       |
|------|---------------------------------|-----------------------|
| Afil | <i>Azolla filiculoides</i>      | Water Fern            |
| Chel | <i>Crassula helmsii</i>         | New Zealand Pigmyweed |
| Fjap | <i>Fallopia japonica</i>        | Japanese Knotweed     |
| Hman | <i>Heracleum mantegazzianum</i> | Giant Hogweed         |
| Icap | <i>Impatiens capensis</i>       | Orange Balsam         |
| Igla | <i>I. glandulifera</i>          | Indian Balsam         |
| Mgut | <i>Mimulus guttatus</i>         | Monkeyflower          |

# Appendix E RCS site photographs

## E.1 Site 15a – Broughton Brook



**Figure E-1 Site 15a upstream reach**



**Figure E-2 Site 15a mid reach**



**Figure E-3 Site 15a downstream reach**



## E.2 Site 17 - Black Brook Tributary 1



**Figure E-4 Site 17 upstream reach**



**Figure E-5 Site 17 mid reach**



**Figure E-6 Site 17 downstream reach**



### E.3 Site 19a – Black Brook



Figure E-7 Site 19a upstream reach



Figure E-8 Site 19a mid reach



Figure E-9 Site 19a downstream reach



## E.4 Site 19b – Black Brook Tributary 3



**Figure E-10 Site 19b upstream reach**



**Figure E-11 Site 19b downstream reach**



**Figure E-12 site 19b mid reach**



## E.5 Site 20 – Black Brook Tributary 2/5



**Figure E-13 Site 20 upstream reach**



**Figure E-14 Site 20 mid reach**



**Figure E-15 Site 20 downstream reach**



## E.6 Site 24 – Thornwater Stream



Figure E-16 Site 24 upstream reach



Figure E-17 Site 24 mid reach



Figure E-18 Site 24 downstream reach



## E.7 Site 30 – Meare Stream



**Figure E-19 Site 30 upstream reach**



**Figure E-20 Site 30 mid reach**



**Figure E-21 Site 30 downstream reach**



## E.8 Site 31 - Meare Stream Tributary 1



Figure E-22 Site 31 upstream reach



Figure E-23 Site 31 mid reach



Figure E-24 Site 31 downstream reach



## E.9 Site 34 – Fivehead River main channel 1



**Figure E-25 Site 34 upstream reach**



**Figure E-26 Site 34 mid reach**



**Figure E-27 Site 34 downstream reach**



## E.10 Site 36 – Fivehead River main channel 2



Figure E-28 Site 36 upstream reach



Figure E-29 Site 36 mid reach



Figure E-30 Site 36 downstream reach



## E.11 Site 37 – Fivehead River Tributary 5



Figure E-31 Site 37 upstream reach



Figure E-32 Site 37 mid reach



Figure E-33 Site 37 downstream reach



## E.12 Site 39 – Venner’s Water



**Figure E-34 Site 39 upstream reach**



**Figure E-35 Site 39 mid reach**



**Figure E-36 Site 39 downstream reach**



## E.13 Site 51 – Cad Brook drainage network



**Figure E-37 Site 51 upstream reach**



**Figure E-38 Site 51 mid reach**



**Figure E-39 Site 51 downstream reach**



## E.14 Site 52 – Cad Brook



Figure E-40 Site 52 upstream reach



Figure E-41 Site 52 mid reach



Figure E-42 Site 52 downstream reach



## E.15 Site 54 – River Ding / River Ding drainage network



**Figure E-43 Site 54 upstream reach**



**Figure E-44 Site 54 mid reach**



**Figure E-45 Site 54 downstream reach**



## E.16 Site 55 - Back Stream/River Ding drainage network



Figure E-46 Site 55 upstream reach



Figure E-47 Site 55 mid reach



Figure E-48 Site 55 downstream reach

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