Cyfoeth Naturiol Cymru
Natural Resources Wales

Aerial, Phase 1 and NVC Survey
Llyn Tegid Reservoir Safety Project
Bala, Gwynedd

Version 4

Report prepared for

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exegesis
SPATIAL DATA MANAGEMENT

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1 Introduction

Exegesis Spatial Data Management were commissioned by Natural Resources Wales (NRW) to conduct an aerial, Phase 1 and National Vegetation Classification (NVC) survey of the embankments and surrounding areas at Llyn Tegid (Bala lake) at Bala, Gwynedd. These surveys were conducted on the 22nd June 2018. This report concerns the ecological survey only; the aerial imagery captured informed the ecological work, but is reported separately.

NRW are currently appraising a project that will strengthen the reservoir embankments around the north shore of Llyn Tegid, and the nearby River Dee and Tryweryn embankments. A preliminary ecological appraisal on the full site was undertaken on the 3rd October 2017 and is reported in Yardley (2018), which provides an additional introduction and site description. Yardley (2018) aimed to gain baseline ecological data on the species and habitats present on the site and identify any ecological constraints on the proposed works. It included a desk study to identify existing species and habitat records for the site, a Phase 1 survey and protected species survey.

The work reported on here intends to supplement, rather than duplicate the previous study. It does not include further desk study and intends only to add to rather than replicate the protected species survey. It focuses on updating and improving the previous Phase 1 survey, which was limited by the time of year it was undertaken, and gathering more detailed NVC survey data in specific areas.

Plant names used in this report are those accepted by Botanical Society of Britain & Ireland (2007).

2 Methodology

2.1 Geographic scope

The overall site boundary used was the same as that used by Yardley (2018), but the survey was targeted to areas agreed with NRW.

The Phase 1 survey focussed on collecting detailed information on the part of the site between the embankment and the north shore of the lake, covering the mouth of the River Dee west of the road bridge. The Phase 1 survey also covered the remainder of the site, but the survey was briefer in this area as the existing survey data seemed to be adequate and NRW only required confirmation of the results of the previous survey. As before, the survey was limited by land access, meaning that some areas were viewed at a distance or on the aerial photography only.

The areas targeted for the NVC survey were identified by NRW staff and covered:

- The area around the car park on the northwest shore of the lake.
- The embankments
- A small area near to the part of the embankment known as the 'bandstand area', which may be impacted by a change to embankment alignment.
- A 5 m maintenance strip at the bottom of the lakeshore embankments.

2.2 Phase 1

The Phase 1 survey followed standard methodology (England Field Unit and Nature Conservancy Council 1990). Habitats were identified and roughly mapped in the field. Where appropriate, target notes were recorded containing details of habitat composition

and features of interest. Photographs were taken as a record of the plant communities seen and their visible extent, as well as other features of interest. The boundaries of the habitats identified were refined and accurately mapped in the office using the field maps, photographic record and high-resolution aerial imagery collected.

2.3 NVC

Due to time constraints, it was not possible to undertake a full NVC survey as described by Rodwell (2006). Instead, a briefer approach was adopted. Vegetation stands were identified in the field and their approximate boundaries mapped.

Where vegetation communities could readily be identified by the surveyor they were noted in the field, along with the key component vascular plant species in that stand and their estimated frequencies.

Where a greater level of detail was required to confirm the vegetation communities present five representative quadrats were placed within the stand. The presence of vascular plant species observed within each quadrat was recorded, providing overall frequencies that could be compared against the floristic tables for potential vegetation communities. Representative photographs were also taken of each stand that could be used both as a record and to allow species cover to be estimated.

NVC communities were identified from the field data collected using a combination of the keys, descriptions and floristic tables in Rodwell (1991b; 1991a; 1992; 1995), TableFit 2.0 (Hill 2015) and professional expertise.

Note that both approaches used for the NVC survey may mean that some of the more cryptic vascular plants were not recorded or their frequency or cover was underestimated. In addition, NVC communities were identified based only on vascular plants since bryophytes were not identified and recorded. This is not believed to have had an impact on the identification of NVC types, as the most similar type could be identified in every case, but is likely to have had a limited effect on the comparison and analysis of the recorded stands and standard NVC types.

The stand boundaries were refined in the office, using data and photographs collected in the field, and the high-resolution aerial imagery.

2.4 Data capture

All Phase 1 habitat and NVC stand boundaries were accurately captured against a high-resolution aerial background image, captured on the day of the habitat survey. Data were captured in QGIS to ESRI Shapefiles.

3 Results

3.1 Phase 1

Phase 1 habitat maps are provided in Appendix A. A summary of the Phase 1 habitats recorded is shown in Table 1. Note that full areas outside the survey boundary have not been included. Because of the high-resolution imagery available, dense scrub and woodland have been mapped at a much finer scale than in Yardley (2018) and individual scrub and tree specimens have been mapped as points.

Other significant differences between this survey and Yardley (2018) include:

- Reclassification of some poor semi-improved grassland as improved grassland
- Reclassification of large areas of amenity grassland as improved or semi-improved neutral grassland. Amenity grassland has been applied more strictly in this survey to the high footfall areas around the car park (see Section 3.2.1).
- A slight reduction in scrub in the area north of the lake. Discussions with a local member of the public suggested that scrub clearance had occurred in the winter of 2017/18, which was confirmed with the National Park Wardens.
- Reclassification of some scrub as woodland, mostly along the embankment and due to the presence of mature tree species.
- Identification of much larger areas of fen. This is mostly due to the availability of high resolution aerial imagery taken at an appropriate time of year to allow dense stands of Reed Canary-grass *Phalaris arundinacea* to be identified remotely. The fen in much of the site may be the same community as that in the car park area (Section 3.2.1)
- Reclassification of the river from standing to running water.
- The use of I141 natural rock exposure with an appropriate comment rather than H3 shingle/gravel above high tide mark to identify areas of lakeside shingle. This was felt to be less confusing than the use of a coastal habitat type.
- The use of I2 artificial rock exposure with an appropriate comment rather than H4 boulders/rocks above high tide mark to identify the exposed rock on the embankments. As above, this was felt to be less confusing than the use of a coastal habitat type.
- Conversion of one arable field to grass lay, leading to a reclassification as improved grassland.

Much of this is likely to be due to a combination of the timing of survey and the availability of high-resolution aerial imagery.

Table 1 – Phase 1 communities recorded during this survey, split into the area north of the lake (south of the bridge at the mouth of the River Dee) and along the river (north of the bridge). See Appendix A.

Phase 1		**Area m²**		
Habitat	**Code**	**Lake section**	**River section**	**Total**
Woodland: broadleaved, semi-natural	A1.1.1	7,003	10,531	17,534
Woodland: coniferous, plantation	A1.2.2	-	11,554	11,554
Scrub: dense/continuous	A2.1	1,156	470	1,626
Neutral grassland: unimproved	B2.1	12,168	82	12,250
Neutral grassland: semi-improved	B2.2	2,501	21,164	23,665
Improved grassland	B4	2,222	49,001	51,224
Poor semi-improved	B6	-	28,898	28,898
Other tall herb and fern: tall ruderal	C3.1	18,489	4,314	22,804
Fen: flood plain	E3.3	2,196	-	2,196
Swamp	F1	14,788	4,150	18,939
Marginal/inundation: marginal	F2.1	-	9,634	9,634
Marginal/inundation: inundation	F2.2	24,641	230	24,871
Standing water: eutrophic	G1.1	81,217	695	81,911
Running water: eutrophic	G2.1	-	47,721	47,721
Natural rock exposure: other exposure, acid/neutral	I1.4.1	1,264	-	1,264
Artificial rock exposure and waste	I2	3,677	-	3,677
Cultivated/disturbed land: amenity grassland	J1.2	7,475	179	7,654
Built-up areas	J3	-	169	169
Built-up areas: buildings	J3.6	372	20	392
Bare ground	J4	4,095	2,219	6,314

Phase 1		Area m²		
Habitat	**Code**	**Lake section**	**River section**	**Total**
Other habitat	J5	9,614	2,217	11,831

3.2 NVC

Vegetation communities on the embankment and the amenity areas around the car park could be accurately aligned with NVC types in the field. Data collected for these areas can be found in the appropriate Phase 1 target notes in Appendix A. More detailed information was collected on the bandstand area and other stands around the car park, which can be found in Appendix C.

3.2.1 Car park

The car park area comprised six NVC sub-communities, excluding the woodland along the north, which is covered under Section 3.2.2, and the areas of tarmac and bare ground. The extent of these is summarised in Table 2 and mapped in Figure 1.

Table 2 – The area of NVC communities found in the car park area.

NVC	Area m²
M27a *Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community	6,005
MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community	176
MG7f *Lolium perenne* leys and related grasslands, *Lolium perenne-Poa pratensis* grassland	6,273
MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community	4,032
S28a *Phalaris arundinacea* tall-herb fen, *Phalaris arundinacea* sub-community	437
W24b *Rubus fruticosus-Holcus lanatus* underscrub, *Arrhenatherum elatius-Heracleum sphondylium* sub-community	1,567

Figure 1 – National Vegetation Communities found in the car park area.

The largest area was covered by MG7f *Lolium perenne* leys and related grasslands, *Lolium perenne-Poa pratensis* grassland. This community covered the grassed areas around the car park. This is a community associated with amenity grassland and is of little conservation interest. In the middle of the car park area near the lake shore was an area that showed signs of heavily trampling and appeared to be transitioning to a more ruderal-rich OV NVC community (see Appendix C.2 0) but survey data suggested that this area was still closest to MG7f.

To the north of the car park and fringing the woodland along the embankment was a strip of scrubby grass that aligned closely with W24b *Rubus fruticosus-Holcus lanatus* underscrub, *Arrhenatherum elatius-Heracleum sphondylium* sub-community (see Appendix C.2 A). This was grassier than the described community and appeared to be an MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community in the latter stages of succession to W24b. This resulted in a higher frequency of Yorkshire-fog *Holcus lanatus*, lower frequency of Common Nettle *Urtica dioica* and the addition of Greater Bird's-foot-trefoil *Lotus pedunculatus*, Ribwort Plantain *Plantago lanceolata* and Common Sorrel *Rumex acetosa*. The presence of seedlings and saplings of Ash *Fraxinus excelsior*, Alder *Alnus glutinosa*, Sessile Oak *Quercus* cf. *petraea*, Downy Birch *Betula pubescens* and Goat Willow *Salix caprea* suggests that this area is likely to continue a successional path to woodland without intervention.

In the east of the car park area, south of the path leading east through the site, was a small area of MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community that had not started succeeding to woodland.

South of the eastern, unpaved part of the car park and the area surrounded by the dirt track was the third largest community that aligned most closely to MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community (see Appendix C.2 B). This wasn't a perfect match, due to a lower frequency of Tufted Hair-grass *Deschampsia cespitosa* than the described community and a higher proportion of fine rather than coarse grasses. Common Bent *Agrostis capillaris*, Red Fescue *Festuca rubra*, Ribwort Plantain *Plantago lanceolata* and Meadow Buttercup *Ranunculus acris* were all more frequent than in the described community.

Towards the south and east the MG9a community graded into a fen community. This aligned most closely to M27a *Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community (see Appendix C.2 C). This stand was much more open that the described community, with Meadowsweet *Filipendula ulmaria* abundant but at a relatively low cover. This led to higher frequencies of False Oat-grass *Arrhenatherum elatius*, Tufted Hair-grass *Deschampsia caespitosa*, Ragged-Robin *Lychnis flos-cuculi*, Reed Canary-grass *Phalaris arundinacea* and Sneezewort *Achillea ptarmica* than the described community. The unusually high frequency of Reed Canary-grass, more prominent towards the lake shore in this instance, is mentioned by Rodwell (Rodwell 1991a) as occurring rarely within M27a stands. Bladder Sedge *Carex vesicaria* was found within this stand close to the lake shore, but only a few culms in one location. To the east, along the ditch, the vegetation became less open as is more typical of this community.

To the south of the M27a stand, along the lake shore, was a thin strip of S28a *Phalaris arundinacea* tall-herb fen, *Phalaris arundinacea* sub-community. This was clearly visible as dense Reed Canary-grass on the detailed aerial imagery and has been mapped, but was too thin to be readily surveyed in the field.

3.2.2 Embankments

For reporting purposes, the embankments have been divided into the lake and river sections, defined by whether they occurred to the south or north of the bridge at the mouth of the River Dee. The embankments comprised three NVC sub-communities,

excluding the path and the largely unvegetated artificial rock exposures that often faced the south side of the lake section. The area of these is summarised in Table 3. These communities were all identified in the field and no species frequencies were recorded

Table 3 – The area of NVC communities found on the embankments. The area has been divided into those sections north of the lake (south of the bridge at the mouth of the River Dee) and along the river (north of the bridge).

NVC	Area m²	
	Lake section	River section
MG1 *Arrhenatherum elatius* grassland	2,454	
MG6 *Lolium perenne-Cynosurus cristatus* grassland		44,614[1]
W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Geranium robertianum* sub-community	6,839	616

The lake section of the embankments consisted of patches of secondary woodland and grassland, with woodland predominating in the west and grassland in the east (Figure 1 & Figure 2).

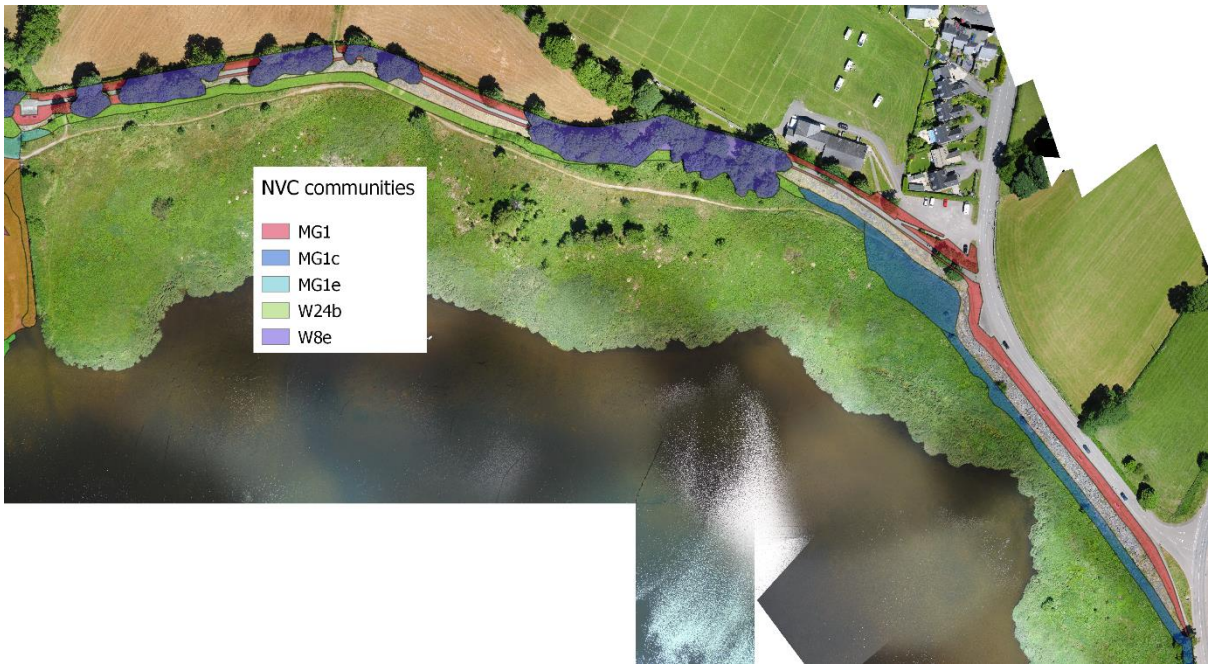

Figure 2 – National Vegetation Communities found in the lake section of the embankments and maintenance strip.

The woodland along the lake section of the embankments aligned with W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Geranium robertianum* sub-community (see Appendix A target note 10). Due to the small size and secondary nature of these stands, they contained an atypical ground flora that could more appropriately be referred to MG1 *Arrhenatherum elatius* grassland. East of the bench at SH923355 the ground flora had been largely mown.

[1] Covers the extent of this community as recorded, not just the area on top of the embankments.

The grassland along the lake section of the embankments had recently been mown, making determining an NVC community difficult. However, the arisings had been left in situ and based upon these remains and limited vegetative species identification it was felt likely that this grassland aligned with MG1 *Arrhenatherum elatius* grassland (see Appendix A target note 13).

Almost all of the river section of the embankments was grassland, with a small patch of woodland at SH932358 (Figure 3).

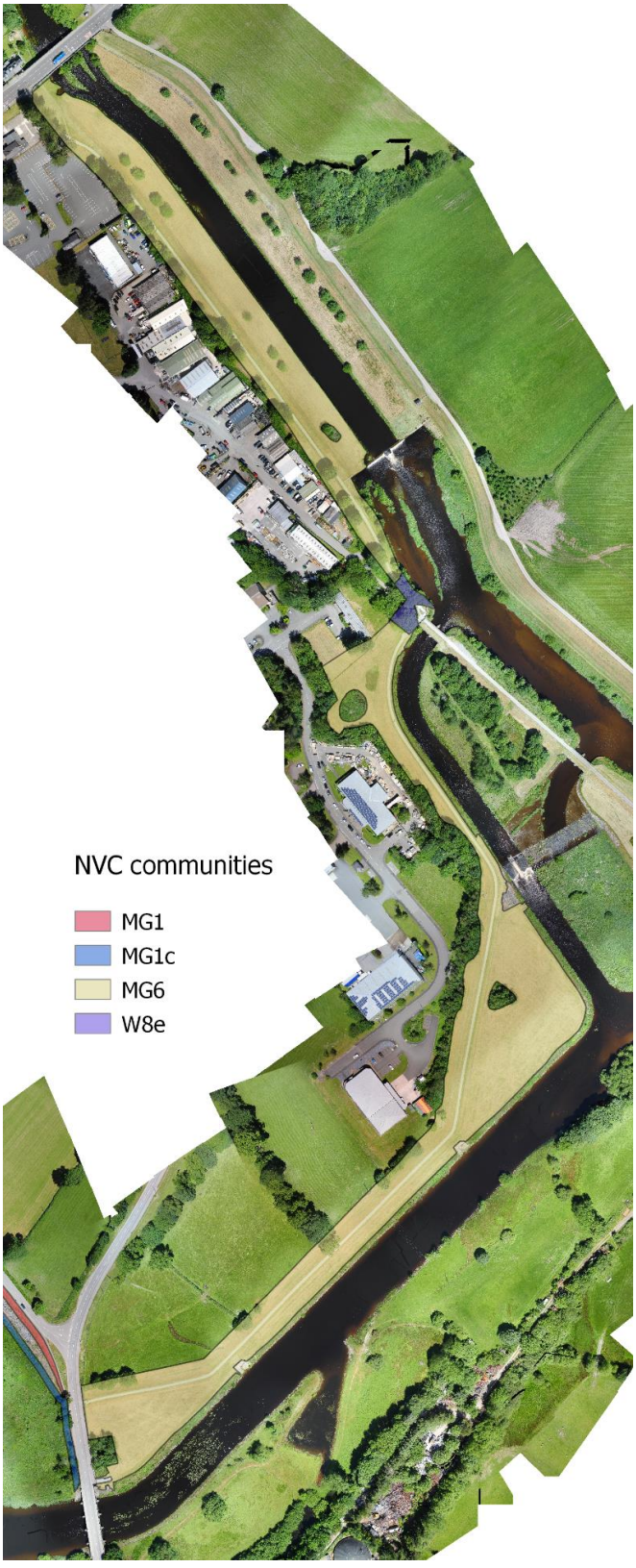

Figure 3 – National Vegetation Communities found in the river section of the embankments.

As with the lake section, the grassland had been recently mown, though most of the arisings had been removed. Based upon the floristic diversity and the cut remains that

were left it was thought that this stand corresponded with MG6 *Lolium perenne-Cynosurus cristatus* grassland.

The small patch of woodland along the river section corresponded well with W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Geranium robertianum* sub-community (see Appendix A target note 19).

3.2.3 Bandstand area

The bandstand area comprised a single stand that corresponded most closely with MG1c *Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community. This stand was species poor compared with the described community, with Meadowsweet *Filipendula ulmaria* less frequent and Hogweed *Heracleum sphondylium* absent. In contrast, Hedge Bindweed *Calystegia sepium* was more prominent than the described community. The presence of Yellow Iris *Iris pseudacorus*, Reed Canary-grass *Phalaris arundinacea*, Marsh Woundwort *Stachys palustris* and Common Valerian *Valeriana officinalis* most likely reflected the composition of the nearby fen community. This stand extended beyond the area targeted for survey.

Figure 4 – National Vegetation Communities found in the bandstand area.

3.2.4 Maintenance strip

For the purposes of reporting, the 5 m maintenance strip at the bottom of the lakeshore embankments excludes those parts in the car park area (Section 3.2.1) and bandstand area (Section 3.2.3).

The maintenance strip was predominantly MG1c *Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community and W24b *Rubus fruticosus-Holcus lanatus* underscrub, *Arrhenatherum elatius-Heracleum sphondylium* sub-community, similar to those communities described above. The proportions varied along the length of the strip, being almost exclusively W24b in the west and more MG1c dominant in the east, though in some areas in the east these communities formed a fine-scale mosaic.

At the far western end of the maintenance strip was an extension of the MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community from the same community in the car park area.

4 Discussion

One of the main features of this survey is the much finer resolution mapping of habitats due to the presence of such high-resolution aerial photography. This also allowed habitats and features to be mapped accurately where they could not be accessed in the

field. For example, based upon field survey notes and photographs, it was possible to identify a small patch of Japanese Knotweed *Fallopia japonica* on the aerial imagery (Phase 1 target note 4), even though perhaps no more than six stems were present in an area of tall ruderal that could not be accessed on the ground.

4.1 Car park

The car park area contained a range of vegetation communities from those with little conservation value to those with a greater value. The largest area, the amenity grassland area surrounding the car parks corresponding with MG7f *Lolium perenne* leys and related grasslands, *Lolium perenne-Poa pratensis* grassland, is of little conservation value.

The areas of W24b *Rubus fruticosus-Holcus lanatus* underscrub, *Arrhenatherum elatius-Heracleum sphondylium* sub-community and MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community were of greater value, but both communities are very common and can be found in a range of situations. However, these communities can still provide valuable resources for wildlife, such as nesting and foraging habitat for small mammals and invertebrates. It's possible that these areas are valuable for important species that were not identified during this survey or Yardley (2018), but larger extents of similar stands are found elsewhere on site.

The reasons for the differences between the recorded MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community stand and the described community were not immediately clear. One possibility is that the proximity to the car park and associated increased human trampling was helping to keep the coarser grasses in check. Another suggestion is that the community was more akin to MG5a *Cynosurus cristatus-Centaurea nigra* grassland, *Lathyrus pratensis* sub-community but had been taken over by coarser grasses. The latter hypothesis is supported by Rodwell et al (1992): 'the sward between the [*D. cespitosa*] tussocks is frequently a reflection of the type of grassland in which *D. cespitosa* has become established'.

Regardless of the history of the MG9a stand, the presence of finer grasses suggests that this stand could become more floristically diverse with appropriate management, especially if other herbaceous species present nearby invaded this area. However, reduction of Tufted Hair-grass cover may be challenging. Tufted Hair-grass is preferentially avoided by most grazers. Winter grazing by cattle may reduce Tufted Hair-grass if there is little else to eat and when trampling on the wet ground may break up the rhizomes. Greater success may be achieved by selective mowing of the Tufted Hair-grass and breaking up or removal of tussocks by mechanical means. Alternatively, raising the water levels in this area may increase diversity through the invasion of fen and swamp species, though this alone may not reduce the cover of Tufted Hair-grass.

M27a *Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community is typical of areas with a high water table where grazing is limited or absent, leading to very dense, tall fen vegetation. The differences between the M27a stand recorded and the described community may again be due to human trampling caused by the proximity of the car park, leading to a more open structure. This has led to the penetration of Tufted Hair-grass into the sward, especially adjacent to the MG9a stand described above.

It may be possible to increase the conservation importance of the M27a stand through management. Taking a hay crop from this stand could increase diversity, though it may also lead to an increase in the abundance of Soft Rush *Juncus effusus* and other less desirable species. Alternatively, deeper winter flooding would probably lead to the development of other communities. The presence of Bladder Sedge *Carex vesicaria* in

this stand and S11b *Carex vesicaria* swamp, *Mentha aquatica* sub-community nearby suggests that this community could develop here, given the appropriate conditions.

4.2 Embankments

The habitat with the highest conservation value on the embankments is likely to be the broadleaved woodland, although this was a relatively poor example of W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Geranium robertianum* sub-community. An assessment of this woodland is included in Yardley (2018), but the woodland areas may contain biodiversity value not recorded during either survey.

Of particular interest was the borderline veteran Ash *Fraxinus excelsior* (Appendix A target note 11). Though this showed few features of veteran trees, such as rot and hollows, it was large and if left is likely to increase in value to saproxylic species, leading to the development of hollows within which bats and birds may roost.

The grassland on the embankments were of limited conservation value. The MG1 *Arrhenatherum elatius* grassland is similar to that found on many road verges and typically develops where arisings are left following mowing, as in this situation. Whilst these plant communities can be valuable to small mammals and as overwintering sites for invertebrates, the narrowness of the stands and high levels of disturbance along the embankment was likely to limit the value here.

The MG6 *Lolium perenne-Cynosurus cristatus* grassland recorded during this survey is typical of agriculturally improved grassland and is of little conservation value.

4.3 Bandstand area

As with the grassland on the river section of the embankment, the bandstand area and surrounds is of limited conservation value. MG1c *Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community is a widespread community, in this instance expressed as a species poor variant. It is not clear whether any management occurred in this area, but based on the presence of scrub in similar stands nearby it is assumed that this area was unmanaged. Over time it is likely to develop to scrub and then woodland.

4.4 Maintenance strip

As with the equivalent communities in the car park and bandstand areas, the scrub and grassland along the 5 m maintenance strip at the bottom of the lakeshore embankments is of limited conservation value. They may provide resources for wildlife, such as nesting and foraging habitat for small mammals and invertebrates, but significant areas of these communities exist elsewhere on the site.

5 Recommendations

5.1 Car park

The W24b *Rubus fruticosus-Holcus lanatus* underscrub, *Arrhenatherum elatius-Heracleum sphondylium* sub-community and MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community stands in the car park area are small, so no specific management is recommended. There is unlikely to be significant impact if they are affected by the proposed works in the car park, especially if habitat improvements can be made alongside the other stands around the car park.

No specific recommendations are made regarding the MG7f *Lolium perenne* leys and related grasslands, *Lolium perenne-Poa pratensis* grassland around the car park. This amenity grassland has little nature conservation value, but is of value to visitors to the site. Development affecting this grassland would have little nature conservation impact and may even be beneficial.

Mechanical removal of Tufted Hair-grass *Deschampsia cespitosa* is recommended within the MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community and M27a *Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community stands. This is an aggressive plant species that could come to dominate these stands if not kept in check.

5.2 Embankments

The areas of woodland on the embankment were poor examples of W8e *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Geranium robertianum* sub-community. Whilst they add to the diversity of the whole site and may be greatly valued by those who use the site regularly, they are likely to be of limited ecological value and there are probably many similar areas of woodland nearby.

However, no trees suspected of being, or being close to attaining, veteran status should be affected by the proposed works. This is especially relevant to the near veteran Ash *Fraxinus excelsior* (Appendix A target note 11). Mature trees suspected of supporting protected species such as bats should similarly not be affected by the works.

Works affecting the grassland communities on the embankments are likely to have a limited nature conservation impact, especially if they could be replaced or offset by other higher quality habitats.

Better management of the MG1 *Arrhenatherum elatius* grassland through mowing in mid-July after flowers have set seed and removal of the arisings could lead to a richer plant community. Given the presence of Lady's Bedstraw *Galium verum* and other species, such management could allow this community to develop into something more akin to lowland meadow, a priority habitat included in Section 7 of the Environment (Wales) Act 2016.

Meadow management could also improve the diversity of the MG6 *Lolium perenne-Cynosurus cristatus* grassland, leading to the development of lowland meadow. Given the state of this stand at the time of the survey, it is not clear what meadow species are already present. Further survey before the stand is mown would be required to determine whether application of meadow seeds may be the most appropriate way to achieve this goal. Management should involve a hay cut no earlier than mid-July, followed by a further cut in September, as suggested by NRW's grassland ecologist in August 2018.

5.3 Bandstand area

The MG1c *Arrhenatherum elatius* grassland, *Filipendula ulmaria* sub-community stands in the bandstand area is of limited biodiversity value. There is unlikely to be significant impact if this area is affected by the proposed works in the car park. However, destruction of this area through the proposed works should be offset through making habitat improvements in other parts of the site.

5.4 Maintenance strip

As discussed above, there is unlikely to be significant impact if the communities along the 5 m maintenance strip at the bottom of the lakeshore embankments are affected by the proposed works in the car park, especially if habitat improvements can be made alongside the other lakeshore stands.

5.5 Increasing the water table

Increasing the floristic diversity of other communities around the car park would be beneficial. Section 4.1 suggests that this could best be achieved in the MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community and M27a *Filipendula ulmaria-Angelica sylvestris* mire, *Valeriana officinalis-Rumex acetosa* sub-community stands through increasing the water table. Other suggestions, such as winter grazing, are unlikely to be viable in this area.

In addition, the presence of fen species in the tall ruderal areas north of the lake, including the bandstand area, suggests that the water table was high. Increasing the water table further may lead to the development of a more species rich fen community. This may be a way to offset works affecting the bandstand area.

Increasing the water table is also likely to inhibit the development of scrub in these areas.

Increasing the water table may be difficult or impossible, but removing the top level of substrate would reduce the ground height. It is likely that some fen species would be present in the exposed seed bank, but otherwise the exposed areas are likely to be quickly colonised by fen species if suitable conditions are provided. The removed substrate could be redistributed elsewhere on the site, away from areas of conservation value, or removed from the site.

One possible solution may be to deposit removed substrate at the lake edge, increasing the area of valuable lakeside habitat just above or below the water table. However, a more detailed assessment of the impact on the lake habitat itself would be needed before implementing this recommendation, as doing this would mean small decreases in potentially valuable aquatic habitat.

5.6 General recommendations

The following recommendations are made more generally:

- Works should not increase the ground heights in the areas containing swamp species, either through direct impacts or subsequent accretion of material.
- Works affecting areas not covered by the NVC survey should be surveyed at NVC level before works are carried out on them. This applies particularly to the swamp and inundation vegetation communities identified by the Phase 1 survey.
- Survey to determine the extent of S11b and comparison with the survey undertaken ten years ago (Garrett 2007) would help to identify change and recommend habitat management to increase the extent of this rare stand.

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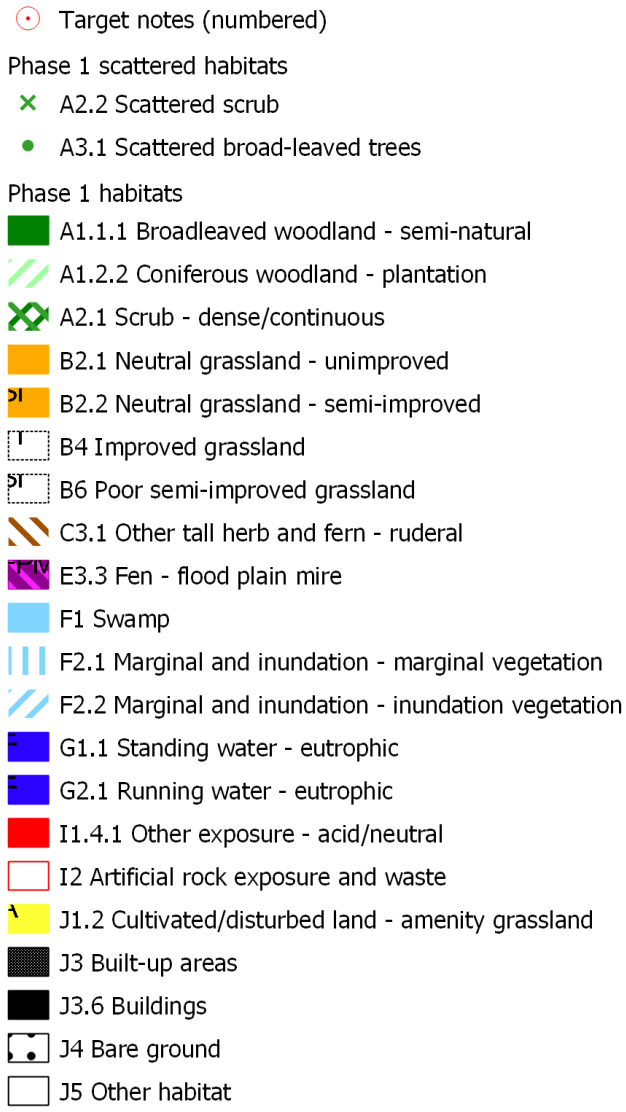
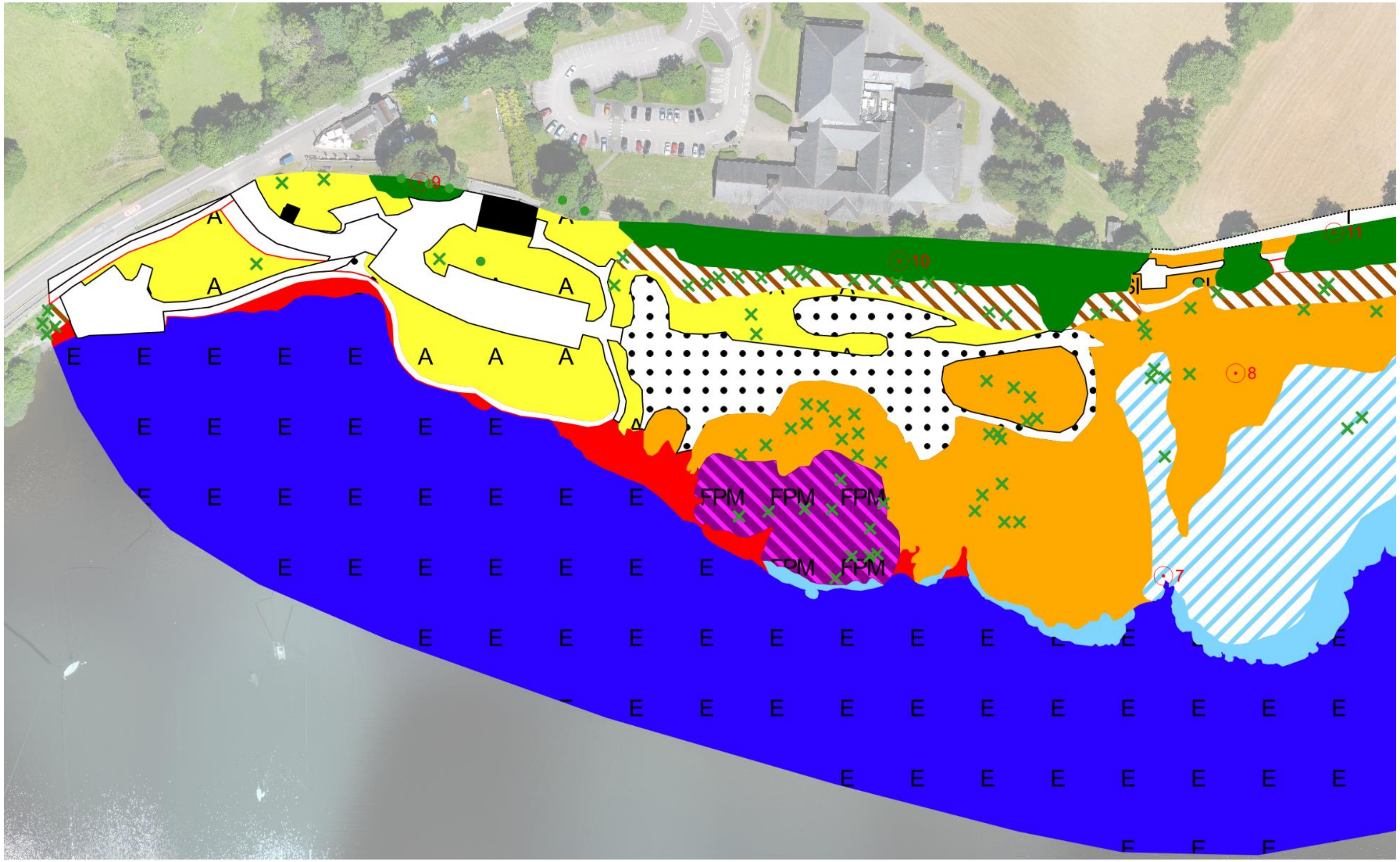
Appendix A Phase 1 map

Legend to Phase 1 map (relevant habitats only)

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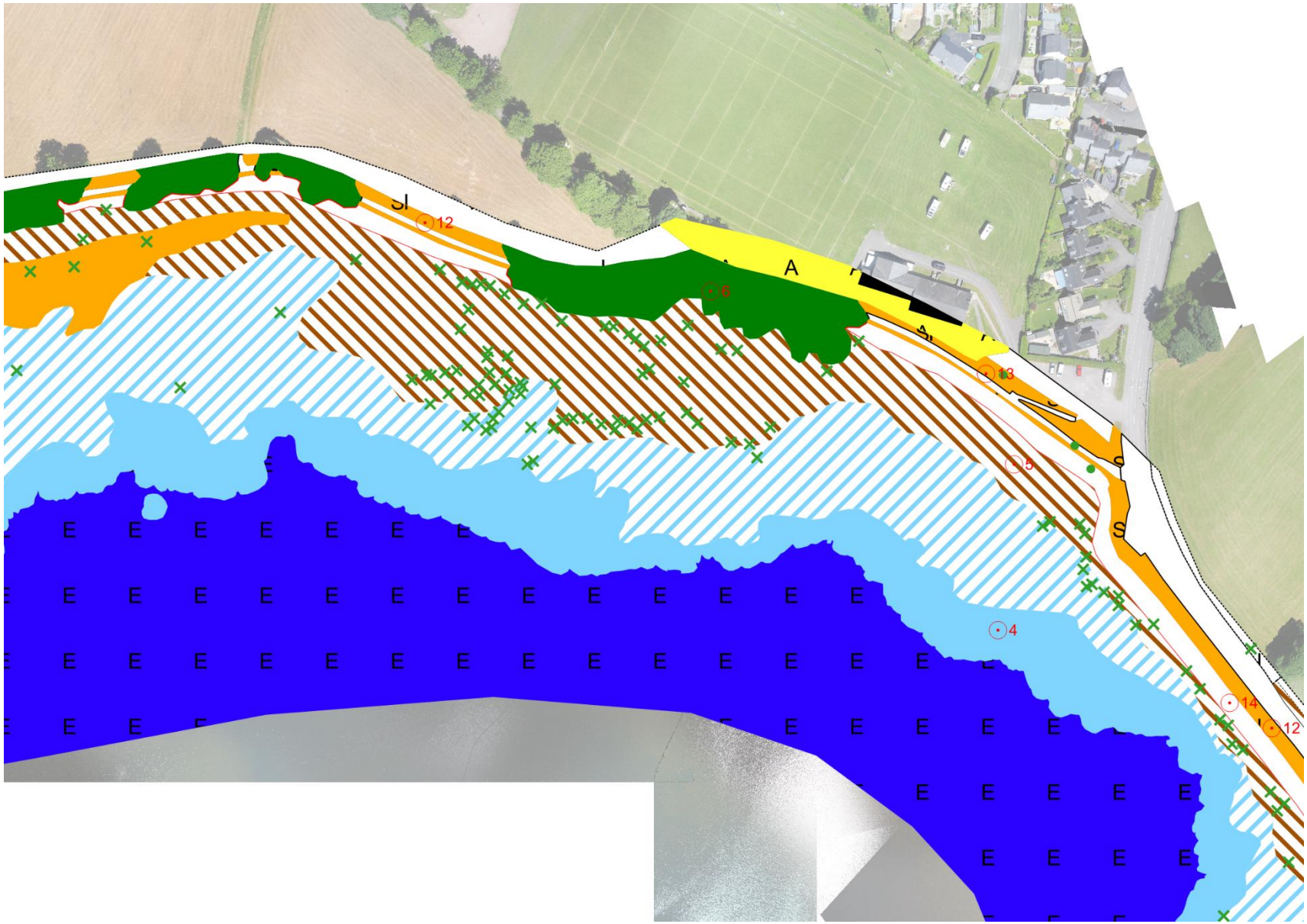
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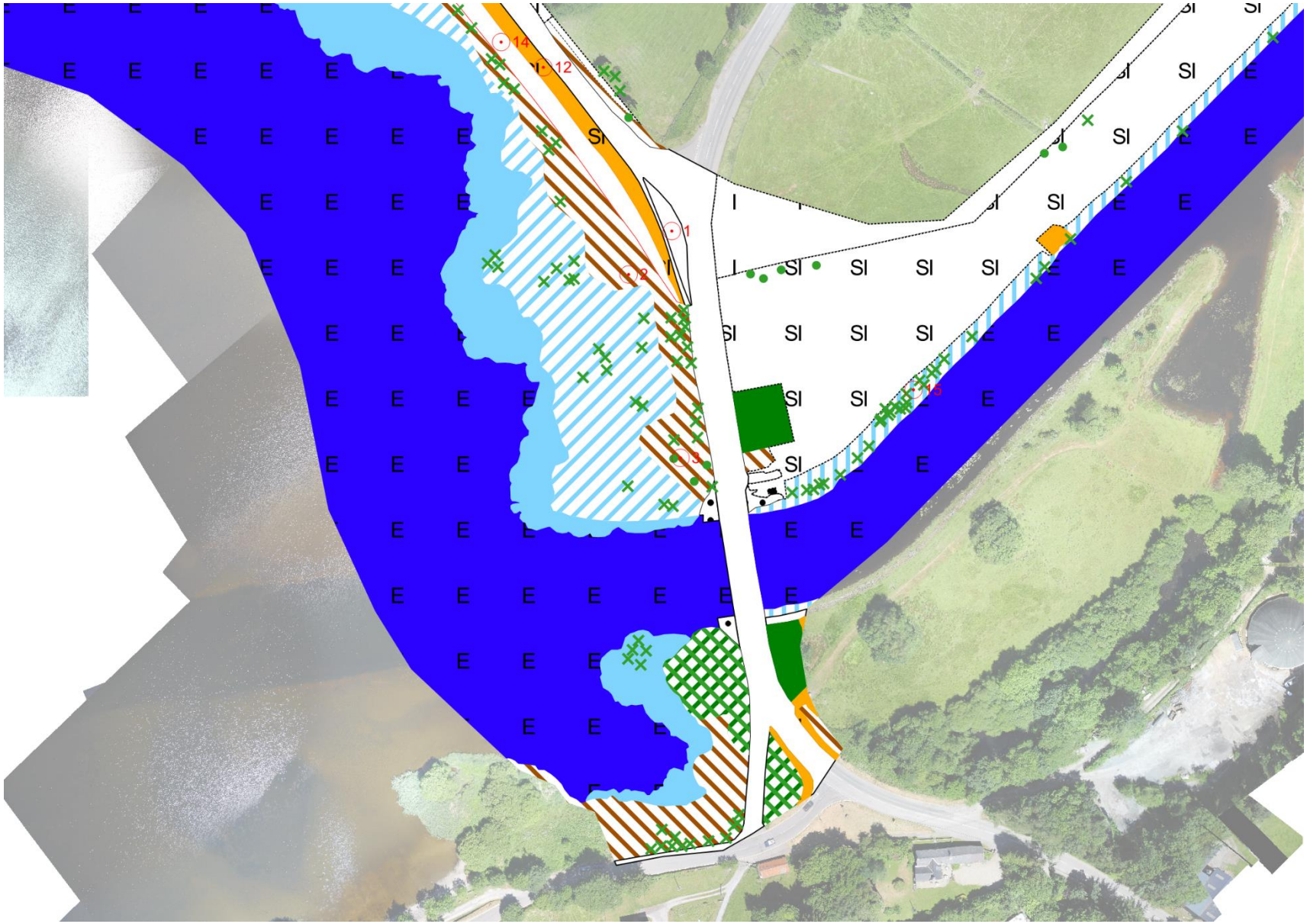
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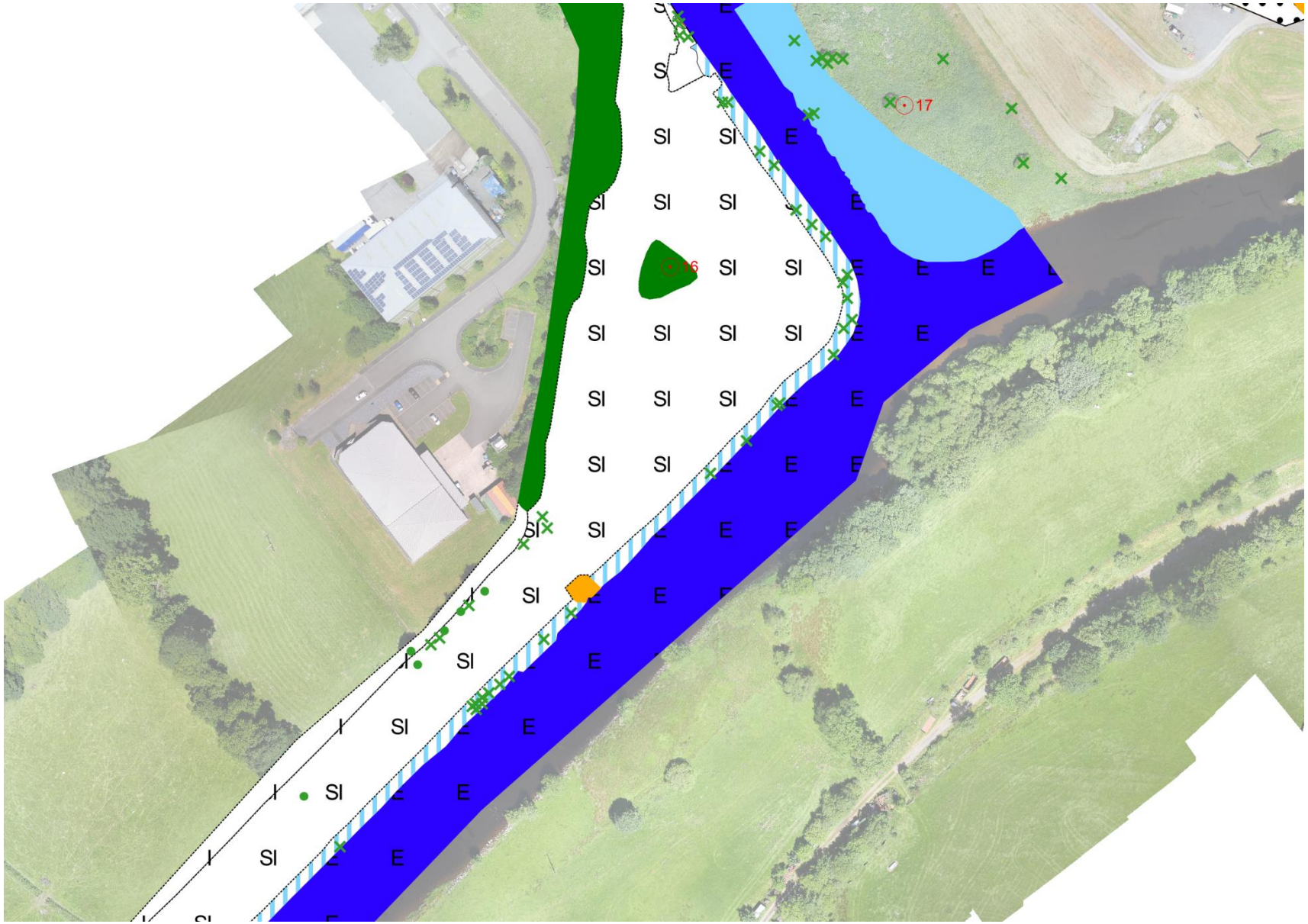
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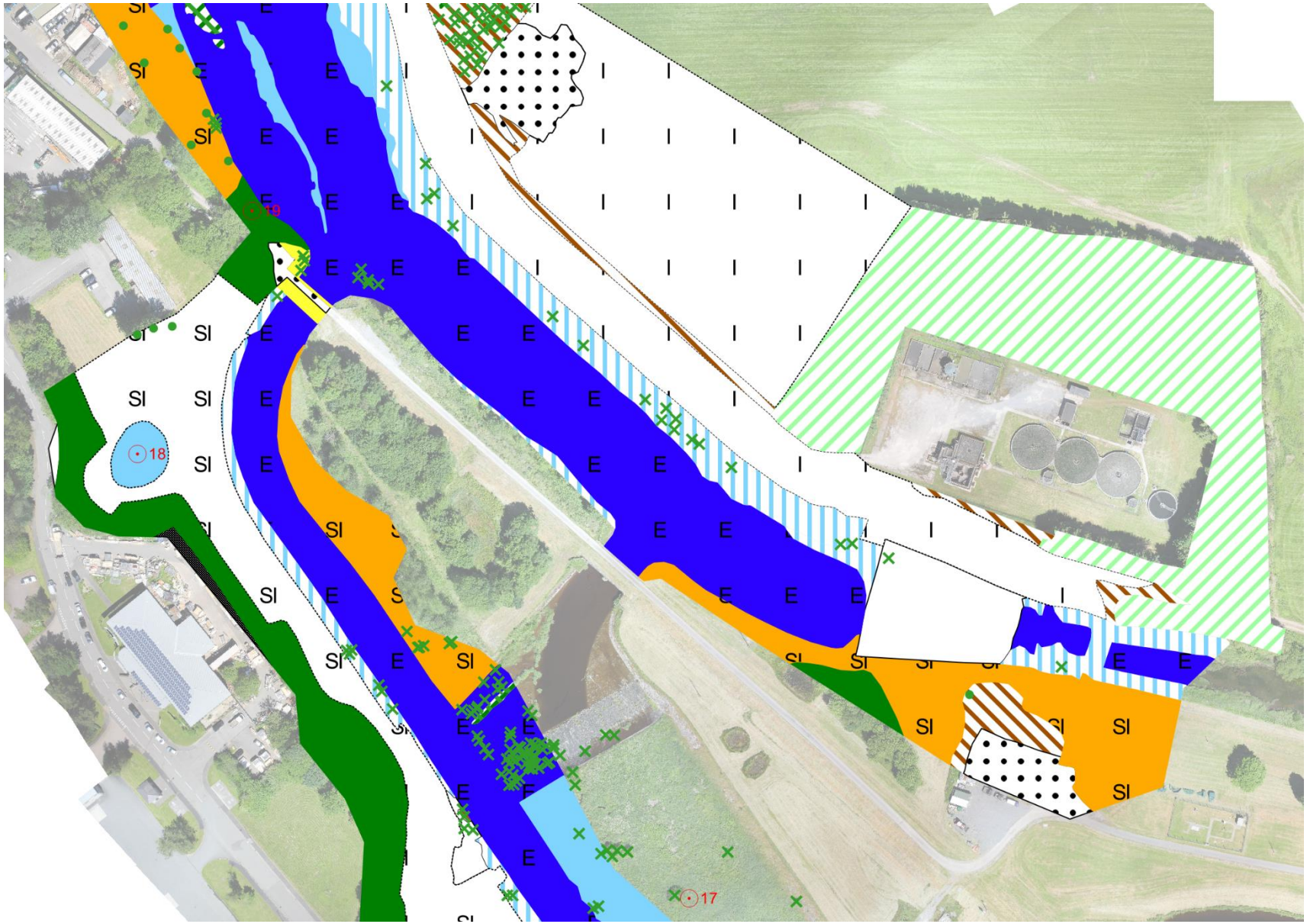
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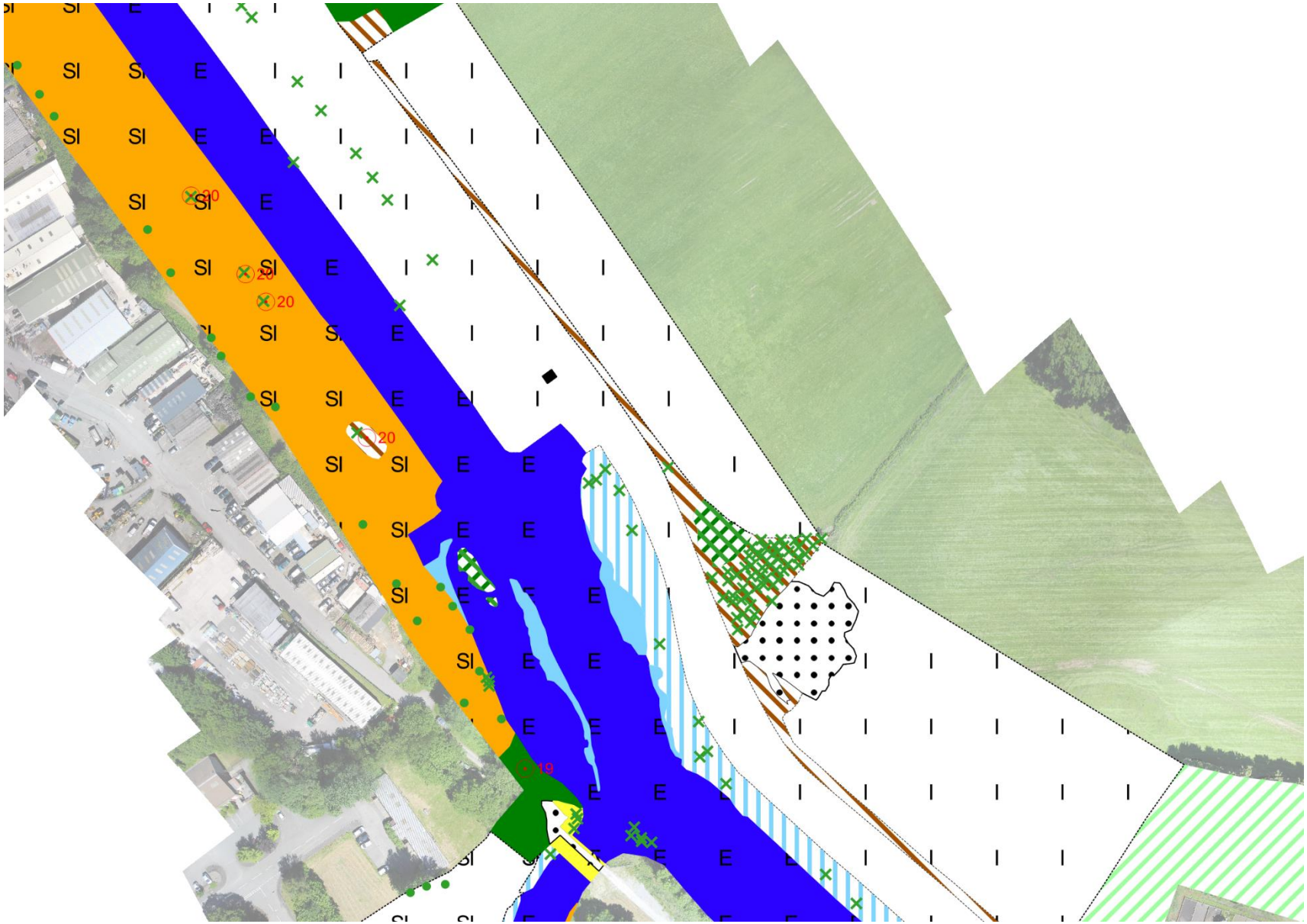
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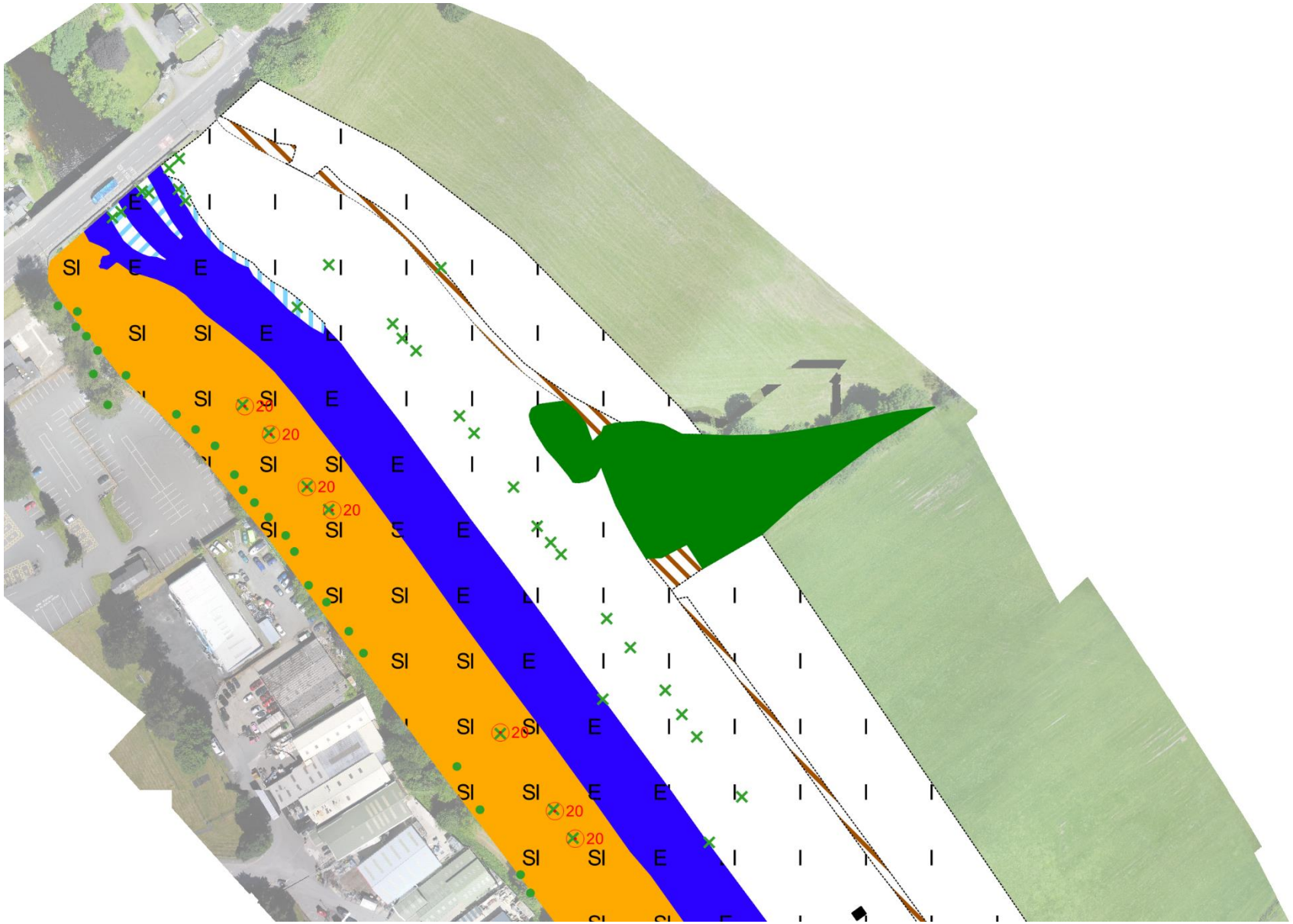
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Appendix B Phase 1 target notes

1. Recently mown amenity grassland. Arisings left.

Species	English name	Recorded frequency
Holcus lanatus	Yorkshire-fog	A
Lolium perenne	Perennial Rye-grass	A
Arrhenatherum elatius	False Oat-grass	F
Dactylis glomerata	Cock's-foot	F
Trifolium repens	White Clover	F
Plantago lanceolata	Ribwort Plantain	O
Ranunculus repens	Creeping Buttercup	O
Rumex obtusifolius	Broad-leaved Dock	O
Taraxacum officinale agg.	Dandelion	O
Anthoxanthum odoratum	Sweet Vernal-grass	O LF
Achillea millefolium	Yarrow	R
Vicia sepium	Bush Vetch	R

2. Small patch of Japanese Knotweed *Fallopia japonica*.
3. Tall ruderal vegetation with scattered trees and scrub. The interface between this and the swamp community is indistinct in the north.

Species	English name	Recorded frequency
Oenanthe crocata	Hemlock Water-dropwort	A
Acer pseudoplatanus	Sycamore	F
Arrhenatherum elatius	False Oat-grass	F
Crataegus monogyna	Hawthorn	F
Fraxinus excelsior	Ash	F
Rubus fruticosus agg.	Bramble	F
Silene dioica	Red Campion	F
Alnus glutinosa	Alder	O
Chamerion angustifolium	Rosebay Willowherb	O
Hedera helix	Common Ivy	O
Heracleum sphondylium	Hogweed	O
Lathyrus pratensis	Meadow Vetchling	O
Rosa sp.	Rose	O
Rumex obtusifolius	Broad-leaved Dock	O
Valeriana officinalis	Common Valerian	O
Rumex acetosa	Common Sorrel	R
Salix caprea	Goat Willow	R

4. Swamp community, mostly not accessed due to nesting bird and therefore viewed from a distance, but accessible towards the west. Species present included Reed Canary-grass *Phalaris arundinacea*, Common Valerian *Valeriana officinalis*, Hemlock Water-dropwort *Oenanthe crocata*, Common Reed *Phragmites australis*, Yellow Iris *Iris pseudacorus*, Ragged-Robin *Lychnis flos-cuculi*, Marsh-marigold *Caltha palustris*, Marsh-bedstraw *Galium palustre* and Common Spike-rush *Eleocharis palustris*.
5. Tall ruderal vegetation.

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	D
Holcus lanatus	Yorkshire-fog	D
Dactylis glomerata	Cock's-foot	A
Galium aparine	Cleavers	A
Lolium perenne	Perennial Rye-grass	A
Poa pratensis	Smooth Meadow-grass	A

Urtica dioica	Common Nettle	A
Calystegia sepium	Hedge Bindweed	F
Filipendula ulmaria	Meadowsweet	F
Heracleum sphondylium	Hogweed	F
Lathyrus pratensis	Meadow Vetchling	F
Plantago lanceolata	Ribwort Plantain	F
Rubus fruticosus agg.	Bramble	F
Rumex obtusifolius	Broad-leaved Dock	F
Valeriana officinalis	Common Valerian	F
Chamerion angustifolium	Rosebay Willowherb	O
Silene dioica	Red Campion	O
Digitalis purpurea	Foxglove	R
Epilobium hirsutum	Great Willowherb	R
Potentilla anserina	Silverweed	R

6. Scattered trees and scrub, including, Ash *Fraxinus excelsior*, Hawthorn *Crataegus monogyna*, Alder *Alnus glutinosa*, Sycamore *Acer pseudoplatanus*, Downy Birch *Betula pubescens*, Oak *Quercus* sp. and Gorse *Ulex europaeus*.
7. Monkeyflower *Mimulus* sp. in ditch.
8. Unimproved neutral grassland, becoming very dry furthest from the lake. Species found furthest from the lake at marked with an *.

Species	**English name**	**Recorded frequency**
Agrostis capillaris	Common Bent	D
Angelica sylvestris	Wild Angelica	A
Festuca rubra	Red Fescue	A
Holcus lanatus	Yorkshire-fog	A
Lolium perenne	Perennial Rye-grass	A
Plantago lanceolata	Ribwort Plantain	A
Poa pratensis	Smooth Meadow-grass	A
Ranunculus acris	Meadow Buttercup	A
Achillea millefolium	Yarrow	F
Anthoxanthum odoratum	Sweet Vernal-grass	F
Dactylis glomerata	Cock's-foot	F
Juncus effusus	Soft-rush	F
Lotus pedunculatus	Greater Bird's-foot-trefoil	F
Ranunculus repens	Creeping Buttercup	F
Rumex acetosa	Common Sorrel	F
Trifolium pratense	Red Clover	F
Achillea millefolium	Yarrow	O
Alopecurus pratensis	Meadow Foxtail	O
Centaurea nigra	Common Knapweed	O
Cynosurus cristatus	Crested Dog's-tail	O
Deschampsia cespitosa	Tufted Hair-grass	O
Galium palustre	Marsh-bedstraw	O
Hypochaeris radicata	Cat's-ear	O
Lathyrus pratensis	Meadow Vetchling	O
Trifolium repens	White Clover	O
Phalaris arundinacea	Reed Canary-grass	O LA
Cardamine pratensis	Cuckooflower	R
Juncus tenuis	Slender Rush	R
Leontodon autumnalis	Autumn Hawkbit	R
Linaria sp.*	Toadflax	R
*Rumex acetosella**	Sheep's Sorrel	R
*Senecio jacobaea**	Common Ragwort	R
Senecio vulgaris	Groundsel	R

*Vicia cracca**	Tufted Vetch	R

9. Mature Beech *Fagus sylvatica*, Ash *Fraxinus excelsior* and Horse-chestnut *Aesculus hippocastanum*.
10. Broadleaved woodland on the embankment. Aligns with W8e *Fraxinus excelsior – Acer campestre – Mercurialis perennis* woodland *Geranium robertianum* sub-community, though owing to its small size and secondary nature the ground flora does is not typical. The ground flora is more appropriately referred to MG1 grassland. Ground flora mown east of the bench.

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	D
Dactylis glomerata	Cock's-foot	D
Fraxinus excelsior	Ash	D
Poa trivialis	Rough Meadow-grass	A
Acer pseudoplatanus	Sycamore	F
Allium ursinum	Ramsons	F
Geranium robertianum	Herb-Robert	F
Heracleum sphondylium	Hogweed	F
Rumex obtusifolius	Broad-leaved Dock	F
Aesculus hippocastanum	Horse-chestnut	O
Alnus glutinosa	Alder	O
Fagus sylvatica	Beech	O
Hedera helix	Common Ivy	O
Quercus cf. *petraea*	Sessile Oak	O
Rubus fruticosus agg.	Bramble	O
Urtica dioica	Common Nettle	O
Deschampsia cespitosa	Tufted Hair-grass	R
Epilobium ciliatum	American Willowherb	R
Geum urbanum	Wood Avens	R
Rumex sanguineus	Wood Dock	R
Silene dioica	Red Campion	R
Trifolium repens	White Clover	R

11. Possible veteran Ash *Fraxinus excelsior*.
12. Mown grassland on the embankment. Arisings left in situ. Difficult to NVC accurately; species identified partly vegetatively and from dried remains.

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	D
Rubus fruticosus agg.	Bramble	D
Dactylis glomerata	Cock's-foot	A
Holcus lanatus	Yorkshire-fog	A
Lolium perenne	Perennial Rye-grass	A
Festuca rubra	Red Fescue	F
Galium verum	Lady's Bedstraw	R
Lotus corniculatus	Common Bird's-foot-trefoil	R
Rumex obtusifolius	Broad-leaved Dock	R
Taraxacum officinale agg.	Dandelion	R

13. Mown grassland on the embankment. Arisings left in situ. Difficult to NVC accurately; species identified partly vegetatively and from dried remains. Aligns with MG1. Crack-willow *Salix fragilis* in the hedge along this section. * next to path only.

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	D
Holcus lanatus	Yorkshire-fog	D

Lolium perenne	Perennial Rye-grass	D
Poa pratensis	Smooth Meadow-grass	A
Dactylis glomerata	Cock's-foot	F
Ranunculus repens	Creeping Buttercup	F
Heracleum sphondylium	Hogweed	O
Taraxacum officinale agg.	Dandelion	O
Urtica dioica	Common Nettle	O
Calystegia sepium	Hedge Bindweed	R
Geum urbanum	Wood Avens	R
Hedera helix	Common Ivy	R
Lapsana communis	Nipplewort	R
Potentilla reptans	Creeping Cinquefoil	R
Rubus fruticosus agg.	Bramble	R
Trifolium repens *	White Clover	R

14. Artificial rock embankment. Plants in crevices in the rocks, including Common Valerian *Valeriana officinalis*, American Willowherb *Epilobium ciliatum*, Enchanter's-nightshade *Circaea lutetiana*, Bramble *Rubus fruticosus* agg., seedling Ash *Fraxinus excelsior*, Curled Dock *Rumex crispus*, Yorkshire-fog *Holcus lanatus*, False Oat-grass *Arrhenatherum elatius*, Herb-Robert *Geranium robertianum*, Cleavers *Galium aparine*, Common Nettle *Urtica dioica* and Rough Meadow-grass *Poa trivialis*.
15. Tall ruderal on steep river bank, most likely closely aligned with MG1.
16. Small copse, containing:

Species	English name	Recorded frequency
Holcus lanatus	Yorkshire-fog	D
Rubus fruticosus agg.	Bramble	A
Salix caprea	Goat Willow	A
Alnus glutinosa	Alder	F
Ranunculus repens	Creeping Buttercup	F
Salix viminalis	Osier	F
Juncus effusus	Soft-rush	O
Lathyrus pratensis	Meadow Vetchling	O
Rumex obtusifolius	Broad-leaved Dock	O
Digitalis purpurea	Foxglove	R
Dryopteris felis-mas	Male-fern	R
Rosa sp.	Rose	R
Salix cinerea	Grey Willow	R
Sambucus nigra	Elder	R

17. Area of swamp. Not accessed, but species identifiable from the other side of the river include Reed Canary-grass *Phalaris arundinacea*, Hemlock Water-dropwort *Oenanthe crocata* and Common Reed *Phragmites australis*.
18. Small, overgrown pond. No evidence of water at the time of survey.

Species	English name	Recorded frequency
Phalaris arundinacea	Reed Canary-grass	D
Galium aparine	Cleavers	A
Poa trivialis	Rough Meadow-grass	A
Urtica dioica	Common Nettle	A
Epilobium hirsutum	Great Willowherb	F
Ranunculus repens	Creeping Buttercup	F
Juncus sp.	Rush	O
Rumex sanguineus	Wood Dock	O
Stachys palustris	Marsh Woundwort	O
Digitalis purpurea	Foxglove	R

Epilobium ciliatum	American Willowherb	R
Heracleum sphondylium	Hogweed	R
Typha sp.	Bulrush	R

19. Broadleaved woodland, aligning with W8. Probably closest to W8e, but ground flora species poor.

Species	English name	Recorded frequency
Fraxinus excelsior	Ash	A
Salix caprea	Goat Willow	A
Poa trivialis	Rough Meadow-grass	A
Crataegus monogyna	Hawthorn	F
Alnus glutinosa	Alder	F
Dactylis glomerata	Cock's-foot	F
Ranunculus repens	Creeping Buttercup	F
Rumex obtusifolius	Broad-leaved Dock	O
Arrhenatherum elatius	False Oat-grass	O
Rubus fruticosus agg.	Bramble	O
Galium aparine	Cleavers	O
Digitalis purpurea	Foxglove	R
Impatiens glandulifera	Indian Balsam	R
Anthriscus sylvestris	Cow Parsley	R
Silene dioica	Red Campion	R
Rosa sp.	Rose	R
Hedera helix	Common Ivy	R
Chamerion angustifolium	Rosebay Willowherb	R

20. Small patches of Osier *Salix viminalis*. Largest in the south, containing Reed Canary-grass *Phalaris arundinacea*, Common Nettle *Urtica dioica*, Yorkshire-fog *Holcus lanatus*, Soft-rush *Juncus effusus*, Broad-leaved Dock *Rumex obtusifolius*, Creeping Buttercup *Ranunculus repens*, Rough Meadow-grass *Poa trivialis* and Meadowsweet *Filipendula ulmaria*.

Appendix C NVC survey data

C.1 Bandstand area

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	5
Galium aparine	Cleavers	5
Calystegia sepium	Hedge Bindweed	4
Filipendula ulmaria	Meadowsweet	3
Holcus lanatus	Yorkshire-fog	3
Lathyrus pratensis	Meadow Vetchling	3
Urtica dioica	Common Nettle	3
Rubus fruticosus agg.	Bramble	2
Rumex obtusifolius	Broad-leaved Dock	2
Valeriana officinalis	Common Valerian	2
Cerastium fontanum	Common Mouse-ear	1
Chamerion angustifolium	Rosebay Willowherb	1
Dactylis glomerata	Cock's-foot	1
Epilobium ciliatum	American Willowherb	1
Epilobium hirsutum	Great Willowherb	1
Iris pseudacorus	Yellow Iris	1
Oenanthe crocata	Hemlock Water-dropwort	1
Phalaris arundinacea	Reed Canary-grass	1
Plantago lanceolata	Ribwort Plantain	1
Salix caprea	Goat Willow	1
Silene dioica	Red Campion	1
Stachys palustris	Marsh Woundwort	1

C.2 Car park area

A. Rank grass and bramble dominated area with occasional scrub.

Species	English name	Recorded frequency
Dactylis glomerata	Cock's-foot	5
Holcus lanatus	Yorkshire-fog	5
Poa trivialis	Rough Meadow-grass	5
Rubus fruticosus agg.	Bramble	5
Galium aparine	Cleavers	4
Ranunculus repens	Creeping Buttercup	4
Rumex obtusifolius	Broad-leaved Dock	4
Arrhenatherum elatius	False Oat-grass	3
Centaurea nigra	Common Knapweed	3
Heracleum sphondylium	Hogweed	3
Plantago lanceolata	Ribwort Plantain	3
Taraxacum officinale agg.	Dandelion	3
Cirsium arvense	Creeping Thistle	2
Elytrigia repens	Common Couch	2
Filipendula ulmaria	Meadowsweet	2
Hypericum maculatum	Imperforate St John's-wort	2
Lathyrus pratensis	Meadow Vetchling	2
Ranunculus acris	Meadow Buttercup	2
Rumex acetosa	Common Sorrel	2
Silene dioica	Red Campion	2
Achillea millefolium	Yarrow	1

Anthoxanthum odoratum	Sweet Vernal-grass	1
Chamerion angustifolium	Rosebay Willowherb	1
Epilobium ciliatum	American Willowherb	1
Festuca rubra	Red Fescue	1
Lotus pedunculatus	Greater Bird's-foot-trefoil	1
Stachys palustris	Marsh Woundwort	1
Stachys sylvatica	Hedge Woundwort	1
Stellaria graminea	Lesser Stitchwort	1
Symphytum officinale	Common Comfrey	1
Urtica dioica	Common Nettle	1
Alnus glutinosa	Alder	N/A
Betula pubescens	Downy Birch	N/A
Fraxinus excelsior	Ash	N/A
Quercus cf. *petraea*	Sessile Oak	N/A
Rosa sp.	Rose	N/A
Salix caprea	Goat Willow	N/A
Ulex europaeus	Gorse	N/A

B. Grassland.

Species	English name	Recorded frequency
Agrostis capillaris	Common Bent	5
Festuca rubra	Red Fescue	5
Plantago lanceolata	Ribwort Plantain	5
Holcus lanatus	Yorkshire-fog	4
Ranunculus acris	Meadow Buttercup	4
Deschampsia cespitosa	Tufted Hair-grass	3
Anthoxanthum odoratum	Sweet Vernal-grass	2
Centaurea nigra	Common Knapweed	2
Poa humilis[2]	Spreading Meadow-grass	2
Ranunculus repens	Creeping Buttercup	2
Carex ovalis	Oval Sedge	1
Crepis sp.[3]	Hawk's-beard	1
Dactylis glomerata	Cock's-foot	1
Juncus effusus	Soft-rush	1
Leontodon autumnalis	Autumn Hawkbit	1
Lotus pedunculatus	Greater Bird's-foot-trefoil	1
Trifolium pratense	Red Clover	1

C. Wet neutral grassland/fen.

Species	English name	Recorded frequency
Arrhenatherum elatius	False Oat-grass	5
Deschampsia cespitosa	Tufted Hair-grass	5
Lychnis flos-cuculi	Ragged-Robin	5
Phalaris arundinacea	Reed Canary-grass	5
Poa trivialis	Rough Meadow-grass	5
Rumex acetosa	Common Sorrel	5
Achillea ptarmica	Sneezewort	4

[2] *Poa humilis* was treated as Smooth Meadow-grass *Poa pratensis* agg. for the purposes of NVC classification. *P. humilis* is not included in any floristic table included in the NVC and it is likely that it was recorded as *P. pratensis* agg. by Rodwell et al (1992).

[3] This could not be reliably identified to species level, but for the purposes of NVC classification was assumed to be Smooth Hawk's-beard *Crepis capillaris*.

Agrostis stolonifera	Creeping Bent	4
Angelica sylvestris	Wild Angelica	4
Filipendula ulmaria	Meadowsweet	4
Galium palustre	Marsh-bedstraw	4
Juncus effusus	Soft-rush	4
Lotus pedunculatus	Greater Bird's-foot-trefoil	4
Plantago lanceolata	Ribwort Plantain	4
Anthoxanthum odoratum	Sweet Vernal-grass	3
Ranunculus repens	Creeping Buttercup	3
Carex nigra	Common Sedge	2
Crepis paludosa	Marsh Hawk's-beard	1
Hypericum maculatum	Imperforate St John's-wort	1
Oenanthe crocata	Hemlock Water-dropwort	1
Ranunculus flammula	Lesser Spearwort	1
Senecio aquaticus	Marsh Ragwort	1
Stachys palustris	Marsh Woundwort	1
Trifolium repens	White Clover	1
Carex vesicaria	Bladder-sedge	N/A

D. Small patch of heavily trampled grass/ruderals.

Species	**English name**	**Recorded frequency**
Rumex obtusifolius	Broad-leaved Dock	5
Agrostis capillaris	Common Bent	5
Ranunculus acris	Meadow Buttercup	5
Poa pratensis	Smooth Meadow-grass	5
Plantago lanceolata	Ribwort Plantain	4
Taraxacum officinale agg.	Dandelion	2
Galium palustre	Marsh-bedstraw	2
Crepis sp.	Hawk's-beard	1
Juncus effusus	Soft-rush	1