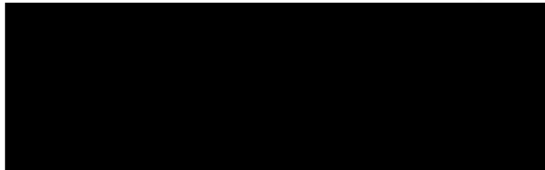


**Translocation of  
the little whirlpool  
ramshorn snail:  
Detailed surveys 2016/2017**







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# 1 Executive Summary

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An initial pilot translocation project of little whirlpool ramshorn snail *Anisus vorticulus* was conducted, under licence, at [REDACTED] in Norfolk in the summer of 2016. Initial monitoring of the newly established populations indicated that little whirlpool ramshorn snail has been successfully translocated and established in new locations for the first time. As a dispersal-limited species, this result could have wide-reaching implications for the conservation of little whirlpool ramshorn snail, as well as utility in the context of mitigation around development sites and areas where habitat is under threat, for example due to coastal erosion, saline incursion, and changing land use.

A wider translocation project is therefore planned, to determine whether little whirlpool ramshorn snail populations can thrive when moved over a larger distance and/or into a different drainage system, and to test whether certain populations respond more favourably to translocation than others. Initial scoping surveys of ten sites across the Broads identified habitat potentially suitable for little whirlpool ramshorn snail at eight sites (two were scoped out as unsuitable for the species - for full details see AECOM/Abrehart Ecology 2017). The results presented here are those from in-depth survey of mollusc and vegetation communities and abiotic ditch parameters at these eight sites.

Through the 2017 Scoping surveys, potential donor populations were identified at [REDACTED], and [REDACTED], while [REDACTED] was identified as a potential receptor site. Little whirlpool ramshorn snail was present at [REDACTED], but not in sufficient densities for translocation. While [REDACTED] and [REDACTED] appeared to contain good habitat during initial scoping surveys, the in-depth surveys revealed them to be unsuitable for little whirlpool ramshorn snail due to high levels of salinity from over-topping, seepage through dykes, or seepage through underlying peat. This highlights potential future challenges for the management of little whirlpool ramshorn snail, as storm surges and rising sea levels may increase the extent of saline incursion in the Norfolk Broads.

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## 2 Introduction

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Little whirlpool ramshorn snail *Anisus vorticulus* is a small, aquatic snail with a dorsoventrally flattened shell approximately 5 mm in diameter. It is a UK Biodiversity Action Plan Priority Species and the only British non-marine gastropod which is a European Protected Species. It is also listed in Annex II of the EU Habitats and Species Directive and therefore requires the designation of special areas for conservation (Annex II). In the UK, populations of little whirlpool ramshorn snail have been declining since the 1960s and although the precise cause is not clear, it is thought that drainage, over frequent dredging, and eutrophication are all likely to be contributing factors (JNCC, 2007; Van Damme, 2012).

In addition to direct threats from loss of suitable habitat, severe dispersal limitation may make little whirlpool ramshorn snail populations slow to recover even if habitat improves; the species may therefore be absent from suitable habitats simply because it lacks the means to access them. This may be exacerbated by strict control of water levels in many grazing marshes, preventing the natural flooding which may have historically transported little whirlpool ramshorn snail and other aquatic species between habitat patches. When considering the future conservation of little whirlpool ramshorn snail, it is therefore necessary to address not only the issues of habitat loss and management, but also the problems of limited dispersal - exploring the possibility of conservation translocations is therefore highly relevant. A discussion on the feasibility of the conservation translocation of the species is presented in AECOM, (2015a).

An initial pilot translocation study, in which 800 little whirlpool ramshorn snail were moved a short distance from [REDACTED] (see AECOM/Abrehart Ecology 2016b for details), has given early indications that the species can be successfully moved to a new site (Abrehart Ecology/AECOM 2016a). The translocations were made based on the output of multivariate analyses, which combined abiotic data with mollusc and vegetation community data to identify likely optimal sites for little whirlpool ramshorn snail (AECOM 2015c; AECOM/Abrehart Ecology 2016c). The findings from this body of previous work have been used to inform the in-depth surveys presented in this report, which aimed to identify suitable donor and receptor sites for a larger translocation (second phase) of little whirlpool ramshorn snail. It is hoped that additional translocations will determine:

- Whether little whirlpool ramshorn snail populations can survive and thrive when translocated over larger distances; and,
- Whether successful translocation is possible from different donor populations of little whirlpool ramshorn snail.

It is hoped that the results reported here can be combined with the data from previous work, and subsequently be used to further refine the knowledge of the habitat preferences of little whirlpool ramshorn snail and inform future management and conservation.

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## 3 Methods

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### 3.1 Licence Requirements

Natural England licences were required for each aspect of this project, including surveying (disturbing little whirlpool ramshorn snail) and collecting full aquatic invertebrate samples for laboratory analysis (killing little whirlpool ramshorn snail).

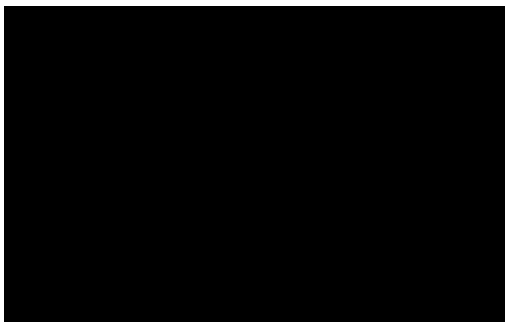
All surveys and sample collection were carried out in accordance with Survey Licence 25961-SCI-SCI. Pilot translocations of little whirlpool ramshorn snail were carried out in accordance with Translocation Licence 23292-SCI-SCI (see Appendix A). Due to surveys being conducted at sites known to support the fen raft spider *Dolomedes plantarius*, an additional licence was obtained in case of disturbance to this species (26279-SCI-SCI, see Appendix A).

### 3.2 Scoping Surveys

This report details the findings of initial in-depth surveys of the mollusc and vegetation communities at potential donor and receptor sites, selected based on the recommendations of initial non-intrusive scoping surveys conducted in September-October 2016 (see AECOM/Abrehart Ecology 2017 for full details).

The scoping surveys used a six-tiered scoring system (0=negligible potential, 5=very good potential – see Table 1) based on management, ditch profile, botanical diversity, and indicators of water quality, to identify grazing marsh ditches with apparently suitable habitat for little whirlpool ramshorn snail. Suitability was assessed based on the results of previous detailed surveys and multivariate analysis of habitat preferences of little whirlpool ramshorn snail (see AECOM 2015c; AECOM/Abrehart Ecology 2016c). A total of approx. 45km of ditch were assessed in this way across ten sites (see Table 2). Full results and details of scoping methods are presented in AECOM/Abrehart Ecology 2017.

Full, detailed surveys were subsequently conducted at:



**Table 1.** Definitions used to assess habitat suitability for little whirlpool ramshorn snail during scoping surveys.

Habitat Suitability Class (HSC)	Description	Example
5 – Very good potential	Ditch of very good potential for little whirlpool ramshorn snail	Ditch with diverse emergent and submerged vegetation, presence of extensive shallow marginal habitat, relatively late successional, with no sign of recent management and appropriate surrounding land use
4 – Good habitat	Ditch generally of good potential for little whirlpool ramshorn snail	Ditch with relatively diverse emergent and submerged vegetation, presence of limited shallow marginal habitat, with no sign of recent management and appropriate surrounding land use
3 – Good/moderate potential	Ditch generally of good potential for little whirlpool ramshorn snail, but with some potential limitations	Intermediate between HSC type 4 and HSC type 2
2 – Moderate potential	Ditch generally of moderate potential for little whirlpool ramshorn snail, but clear potential limitations	Ditch with some floating leaved and emergent plants steep sided, but with some shallow marginal habitat due to cattle poaching. Some evidence of eutrophication and recent management/dredging.
1 – Low potential	Ditch of poor potential for little whirlpool ramshorn snail	Ditch with few floating leaved plants, steep sided, presence of extensive algae, Enteromorpha etc. surrounding land use arable
0 – Negligible potential	Ditch of very little or no potential for little whirlpool ramshorn snail	Heavily shaded ditch or excessively eutrophic ditch.

**Table 2.** Area numbers correspond to those in the scoping report (AECOM/Abrehart Ecology 2017). Asterisks (\*) indicate sites which were not considered at all suitable for little whirlpool Ramshorn snail, and were therefore “scoped out” and not surveyed in detail.

Site Name	Area Number	Location (National Grid Reference)	Historic records of little whirlpool ramshorn snail	Approximate Total area of site (Ha)	Total length of ditches (m)
██████████	1	██████████	Yes, to the south of ██████████ only (in nearby habitats)	13.5	██████████
██████████	2	██████████	No	37.2	██████████
██████████	3	██████████	Yes, to the north of ██████████ only (in nearby habitats)	15.1	██████████
██████████	4	██████████	No	42.2	██████████
██████████	5	██████████	No	23.3	██████████
██████	6	██████████	Yes	21.6	██████████
██████	7	██████████	Yes	52.2	██████████
██████	8	██████████	Yes	15.7	██████████
██████████	9	██████████	No	8.7	██████████
██████	10	██████████	No	6.1	██████████

### 3.3 Detailed Surveys

Methods for the detailed surveys followed those from previous work (for example AECOM/Abrehart Ecology 2016b), assessing the mollusc and vegetation communities and ditch characteristics at each sample site as well as determining the presence/likely absence of little whirlpool ramshorn snail.

Ditches selected for detailed surveying were those that were classified as between Categories 2-4 (inclusive) in the initial scoping surveys (AECOM/Abrehart Ecology 2017). Based on these criteria (see Table 1), a total of 121 sample points were assessed across eight marshes (two marshes were scoped out of surveying as unsuitable for little whirlpool Ramshorn snail). The survey methods were consistent with those used for initial surveys and translocation work of little whirlpool ramshorn snail (AECOM/Abrehart Ecology 2016a, 2016b) Data and sample collection was conducted by a pair of surveyors, including an experienced on-site mollusc surveyor ██████████, Ecologist a National Mollusc Specialist) and a second team member responsible for recording ditch features, abiotic variables, and botanical diversity ██████████, Ecologist at Abrehart Ecology Ltd / ██████████, Ecologist at Abrehart Ecology Ltd). The ditch characteristic and botanical diversity recording sheets were adapted from Buglife’s manual for the survey and evaluation of grazing marsh ditch systems (Palmer et al., 2013); examples of the recording sheets used are presented in Appendix B.

At each sample location, ditch characteristics and a range of other environmental features were recorded (as in the 2015 survey; see AECOM 2015c for details). These included exposed and submerged bank profiles, channel width and depth, and levels of grazing, poaching and shelving. Abiotic parameters were recorded in the surface 10cm of water including pH and conductivity (measured using a HI98129 pH/Conductivity Tester; Hanna Instruments), dissolved oxygen and temperature (measured using a PDO-520 Dissolved Oxygen metre; Lutron). Each sample point was recorded as a 10-figure grid reference using a handheld GPS, and recorded on an Archer2 sub metre dGPS.

Mollusc community and botanical diversity were recorded at three points for each sample site, termed subsamples A, B, and C, where Subsample B formed the central point. Subsamples A and C were taken 15m on either side.



### 3.3.1 Molluscs

Mollusc community samples were collected at each of three subsampling points per sample location. The mollusc community was assessed and recorded separately for each subsample point (thus giving three sets of data for each sample location). This aimed to gauge the consistency of the mollusc community throughout the linear environment of the ditches. A copy of the recording sheet is presented in Appendix B.

Samples were collected using ten-second sweeps of a net with 0.5mm mesh. Sweeps were repeated three times for each subsample in different sections of the ditch profile, i.e. floating vegetation (where present), the benthic layer, and the submerged side of the near bank.

The material from the three sweeps was placed in a white gridded tray filled with water from the same ditch area. Molluscs were released from the collected vegetation by agitating the contents of the tray. Excess vegetation was then removed. The floating contents of the tray (chiefly vegetation and larger invertebrate species) were poured out into a 1mm mesh net, with molluscs retained in the bottom of the tray. It is accepted that a small proportion of molluscs may be lost at this stage, but previous tests of this method have shown such losses to be negligible (T. Abrehart, pers. obs.). The remaining material was then evenly distributed across the tray for assessment.

As inclement weather made identification in the field difficult, samples were removed from the sites and preserved in ethanol for later identification in the lab. All molluscs were identified to species level, and the relative abundance of each species was recorded. The abundance of notable and rare mollusc species was fully quantified, including little whirlpool ramshorn snail, shining ramshorn snail *Segmentina nitida*, slender amber snail *Oxyloma sarsi*, Desmoulin's whorl snail *Vertigo moulinsiana*, and the pea mussel species *Pisidium pseudosphaerium*.

### 3.3.2 Vegetation

The bankside, emergent, floating, and submerged flora of the ditch was recorded at each subsample point using the same methods as in previous surveys (see AECOM 2015c for full details). The relative abundance of each floral species occurring within 5m of the subsample point was quantified using a DAFOR scale (Table 3). This included vegetation on both the nearside and opposite bank and up to 1 m from the water's edge.

**Table 3.** DAFOR scale definitions used for quantifying botanical species abundance.

Value	Description	Percentage cover
D	Dominant	>75%
A	Abundant	51-75%
F	Frequent	26-50%
O	Occasional	11-25%
R	Rare	1-10%

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## 4 Results

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### 4.1 Site Descriptions

Appendix C presents maps showing sampling locations at each site, and the distribution of little whirlpool ramshorn snail at each site.

#### 4.1.1 [REDACTED] (Area 1 – surveyed Nov 2016)

[REDACTED] and is noted for its floristically diverse fen habitats, which are managed using low-intensity grazing. A total of 12 sampling points were assessed at the site as part of this survey. Prior to surveying, there were records of little whirlpool ramshorn snail in the surrounding area, but not on the site itself.

The structure of the surveyed ditches was fairly uniform - all were between 1-3m in width with shallow banks and a steep underwater profile, containing water between 0.75-1m deep. The sediment layer within the ditches was generally <0.5m across the site. Water quality was good with low turbidity overall, although turbidity at two sample points was slightly higher (potentially due to feeding activity of swans at those points). However, conductivity readings across the site were much higher than expected (900 $\mu$ S/S - >2800 $\mu$ S/S), strongly suggesting a saline influence across the site. This was confirmed through communications with the site warden (see Section 5.3 for more details).

The land adjacent to the sampled ditches was fen/swamp habitat, managed with moderate levels of grazing. There were low levels of poaching and shelf/block formation along the ditch margins, which had formed infrequent swampy areas.

#### **Vegetation**

There were frequent stands of hard rush *Juncus inflexus* and occasional stands of soft rush *Juncus effusus* and blunt-flowered *Juncus subnodulosus* across the site. Dense stands of greater pond sedge *Carex riparia* and lesser pond sedge *Carex acutiformis* were consistent along the margins of ditches, with occasional reed *Phragmites australis* scattered throughout. In areas that were poached by cattle, marginal vegetation occasionally extended into the water channel with branched bur-reed *Sparganium erectum* also very occasionally present. Whorl-leaf water milfoil *Myriophyllum verticillatum* was frequent within the water channels themselves, while star duckweed *Lemna trisulca* was present at all sample points, but not in high densities. Frogbit *Hydrocharis morsus-ranae* and water soldier *Stratiotes aloides* were present at the majority of sample points, but again not in high densities. Frogbit smut *Tracya hydrocharidis* was observed occasionally throughout the site. There were large areas of open water in all ditches sampled.

#### **Molluscs**

No little whirlpool ramshorn snail was found at [REDACTED], and the mollusc communities in general were species poor – this became much more pronounced towards the northern part of the site, where mollusc communities contained as few as seven different species. This may be explained by very high conductivity readings at all sample points, and subsequent information from the site warden indicating that salt water seeps into the ditches in the area from a number of sources.

The only species consistently found throughout the site was common Bithynia *Bithynia tentaculata* (a common species). A few shining ramshorn snail *Segmentina nitida* were found towards the south of the site, but no more than six individuals in a subsample. While little whirlpool ramshorn snail may frequently be associated with shining ramshorn snail (see AECOM/Abrehart Ecology 2016b), its strong intolerance of saline conditions (Boettger 1944; reviewed by Terrier et al. 2006) means that [REDACTED] is not a suitable habitat for little whirlpool ramshorn snail. Given the multiple sources of potential saline incursion to the site, this is not an issue that can be easily remedied by changes in management - the site is therefore unlikely to be suitable for little whirlpool ramshorn snail at any time in the near future (see Section 5.3 for more details).

#### 4.1.2 [REDACTED] (Area 3 – surveyed Nov 2016)

The survey site at [REDACTED] covered a large area approximately [REDACTED] Suffolk. A total of 17 sample points were surveyed across the area. The site [REDACTED] Prior to surveying, there were historic records of little whirlpool ramshorn snail in the surrounding area (Jackson & Howlett 1999), but not on the site itself.

The width of the surveyed ditches was mainly 2-3m, but this varied from <1m to >4m. Water depth was similarly varied, between 0.25m – 1m (although generally between 0.5m - 0.75m). Water quality appeared good, with little to no turbidity at the majority of sites – however, there was moderate turbidity in two ditches, and abundant filamentous algae in places. pH was slightly below neutral on average (6.33), while conductivity ranged from 695-972µS/S. The adjacent land at all sampling points was heavily-grazed, semi-improved grassland, and the edges of the ditches were subsequently heavily poached with moderate to high levels of block and shelf formation. This created swampy areas of submerged vegetation, and potentially micro-habitats suitable for little whirlpool ramshorn snail - at other sites the species has been observed to be more abundant in swampy marginal areas at the edges of ditches than in the open water (Killeen 1999; [REDACTED], pers. obs).

Signs of water vole (*Arvicola amphibious*) occupation, including feeding stations and a potential burrow, were frequently observed during the survey.

##### **Vegetation**

Bankside vegetation across the site was dominated by sedges (largely greater pond sedge with more occasional, dense areas of lesser pond-sedge) and grasses from the surrounding grazed areas including Yorkshire fog *Holcus lanatus* and creeping bent *Agrostis stolonifera*. Reed sweet grass *Glyceria maxima* was also present on the banks of ditches throughout the site at varying densities. Very occasional reed was scattered amongst the bankside vegetation at some sample points, and there were occasional patches of soft rush, hard rush, and blunt-flowered rush.

[REDACTED] contained ditches at varying levels of succession, which generally contained a diverse flora. In more mature ditches the bankside vegetation, including sedges, rushes, and reeds, frequently extended into the main ditch channels particularly in heavily poached areas. Lesser water parsnip *Berula erecta* and branched bur-reed were common along submerged, swampy margins and into the ditch channels. In more recently cleared ditches marginal vegetation was confined to the banks, and there was much less aquatic vegetation.

Common duckweed *Lemna minor* and star duckweed were present at all sample points, and Turion duckweed *Lemna turionifera* was very occasionally observed at low densities. Canadian waterweed *Elodea canadensis* was commonly found throughout the site, while frogbit was widely distributed but generally at very low density. Filamentous algae was observed in some areas, but was not common or abundant.

##### **Molluscs**

No little whirlpool ramshorn snail was found at any of the sample points visited, but records for the species are known from neighbouring areas of marsh across the river to the north. Mollusc communities were otherwise species-rich across the survey area, averaging 20 species per sample point (maximum 24, minimum 15 species). Shining ramshorn snail was frequently observed in high numbers (up to 438 total in a sample), and flat valve snail *Valvata cristata* was also common (up to 111 total in a sample) – both these species are associated with diverse mollusc communities, and have been suggested as indicator species for suitable little whirlpool ramshorn snail habitat (AECOM/Abrehart Ecology 2016b). Additional species of interest found at [REDACTED] were the bivalve *Pisidium pseudosphaerium*, which was found at several sample points but generally in low numbers, and moss valve snail *Aplexa hypnorum* which was found at a high density within two ditches but is more commonly associated with ponds (this may indicate a lack of water movement, and therefore a potential hindrance to dispersal of little whirlpool ramshorn snail). Other species frequently observed at the site included wandering pond snail *Radix balthica*, common bladder snail *Physa fontinalis*, Leach's Bithynia *Bithynia leachii*, common Bithynia, margined ramshorn snail *Planorbis planorbis*, and twisted ram's horn *Bathymophalus contortus*.

The diverse mollusc communities, presence of indicator species (shining ramshorn snail and flat valve snail), combined with the diverse vegetation communities observed at the site and the HLS management of the area, make [REDACTED] a good potential receptor site for a future translocation of little whirlpool ramshorn snail.



### 4.1.3 [REDACTED] (Area 5 – surveyed Nov 2016)

[REDACTED] is located approximately [REDACTED] Suffolk, on the [REDACTED]. Six sampling points were surveyed across the site, which is owned and managed by the Suffolk Wildlife Trust. There were no records of little whirlpool ramshorn snail on the site prior to surveying.

The surveyed ditches varied from 1m to >4m in width. Water in the ditches was generally clear, and approximately 0.5-0.7m in depth (although depth was <25cm at one sampling point). The adjacent land was largely improved grassland with low levels of grazing, and the banks showed only low levels of poaching by cattle and no block formation – however, there was some moderate submerged shelf formation in two of the ditches surveyed. Water vole signs, including runs and feeding stations, were frequently seen across the site. Higher than expected conductivity readings (>800µS/S) at some sample points (particularly points 4 and 5) suggested saline incursion in places.

#### **Vegetation**

In the areas of improved, cattle-grazed grassland, dominant species included creeping bent and Yorkshire fog, while hard rush formed occasional dense stands at points across the site. These species extended occasionally into the margins of the surveyed ditches, which were dominated by reed and greater and lesser pond sedge. Lesser water parsnip was frequent along the submerged margins of the ditches, with occasional scattered branched bur-reed also present. Star duckweed was present in the water channels of all surveyed ditches, although not at a high density. Species of interest at the site included Gibbous duckweed *Lemna gibba*, Turion duckweed, and frogbit smut.

#### **Molluscs**

No little whirlpool ramshorn snail were found at any sample points. This may be due to the potential salinity of the water. Little whirlpool ramshorn snail is known to be highly intolerant of saline conditions (Boettger 1944; reviewed by Terrier et al. 2006), so this site is not suitable as part of any future translocation program (see section 5.3). More general mollusc communities at the site were relatively species-poor, comprising between four and twenty species. This was not expected, but may also be explained by the unexpected salinity of the ditch habitats. The most abundant species included margined ramshorn snail, flat ram's horn *Hippeutis complanatus*, and common Bithynia, which are all reasonably common and generalist in their habitat requirements. The first sample site visited contained a much richer mollusc community with higher abundances of each species than other points. These included Nautilus ram's horn *Gyraulus crista*, which is generally associated with higher quality aquatic habitats.

### 4.1.4 [REDACTED] (Area 6 – surveyed Nov 2016)

[REDACTED] is located approximately [REDACTED] Suffolk, and is [REDACTED]. Little whirlpool ramshorn snail was previously known to occur at the site, which is under the management of the Suffolk Wildlife Trust. The ditches and marshland are managed with a focus on conservation and biodiversity, which has included a relatively recent (2011-2012) reintroduction of the fen raft spider *Dolomedes plantarius*. Low-intensity cattle grazing is used to manage vegetation heights across the site. Samples were collected at 14 points throughout the marsh.

The ditches surveyed were relatively uniform in width and depth, averaging between 2-4m wide and 0.5-1m deep with a steep underwater profile. The silt layer was typically 0.5-0.75m, but was shallower in ditches with deeper water due to more recent ditch maintenance. Water quality was good with very low turbidity across the site as a whole, but submerged filamentous algae was occasionally observed and turbidity was slightly higher in two of the ditches surveyed. The land adjacent to the ditches was semi-improved, cattle-grazed grassland. The grass appeared relatively intensely grazed, but there were only low-moderate levels of poaching and shelf formation across the site.

Water vole signs including latrines, feeding stations, runs, and burrows were found across the site. Fen raft spiders and their discarded exuviae were found towards the southern end of the site.

#### **Vegetation**

Bankside vegetation varied between ditches, with communities including common reed, dense stands of rush (chiefly soft rush and more sporadic stands of hard rush and blunt flowered rush) and sedges (mainly greater pond sedge). Some bramble *Rubus fruticosus* agg. and scrub was present when ditches were close to the main access road. Some grass species form the adjacent land, including creeping bent and Yorkshire fog, occasionally extended into the ditch margins, and there were some small, sporadic patches of marsh horsetail *Equisetum fluviatile*. Some more mature ditches had dense areas of lesser water parsnip and very occasional branched bur-

reed, but emergent vegetation was otherwise limited to very small stands of sedges and reed extending from the bank. Within the main ditch channels there were dense patches of star duckweed, which was highlighted as an indicator of habitat suitability for little whirlpool ramshorn snail in previous analyses (AECOM/Abrehart Ecology 2016b). Some more mature ditches also contained abundant water soldier, and frogbit. Other species of interest included frogbit smut.

#### **Molluscs**

Little whirlpool ramshorn snail was found at all but one of the sample points visited, with densities varying from 13-180 individuals in total per sample site. The site is therefore considered a good option as a donor site for future translocation.

Mollusc communities across the site were species-rich, averaging 19 species in total per sample point (maximum 25 species, minimum 14 species). Species of conservation interest included shining ramshorn snail, which is often associated with little whirlpool ramshorn snail, *Pisidium pseudosphaerium*, and Desmoulin's whorl snail. Other species commonly found included lake limpet *Acroloxus lacustris*, common *Bithynia*, *Leach's Bithynia*, and whirlpool ramshorn *Anisus vortex*. The diversity of the mollusc communities, combined with the presence of several notable species including little whirlpool ramshorn snail, indicates that the aquatic habitat at the site is of high quality.

### 4.1.5 [REDACTED] (Area 7 – surveyed Oct/Nov 2016)

[REDACTED] is located approximately [REDACTED] Suffolk, on the [REDACTED]. It is one of the largest sites sampled during this survey, with 31 sampling points visited in total. The site is owned and managed by the Suffolk Wildlife Trust, and has been the location of a reintroduction of the fen raft spider (2010-2011). There were records of little whirlpool ramshorn snail occupying the site prior to surveying (Jackson & Howlett 1999).

The surveyed ditches at the site were between 2-4m wide, although some had narrowed to slightly less than 2m due to encroachment of vegetation into the channel. The site contained ditches at varying stages of succession, and this was reflected in the variable structure of the ditches. Water depth was between 0.25m and >1m, with more recently cleared ditches being deeper and having a steeper underwater profile. Silt depth ranged from <0.25m to 0.75m, with more recently cleared ditches having a shallower sediment layer. Water quality was very good, with very low turbidity across the site.

The land adjacent to all the ditches was semi-improved, cattle-grazed grassland. Grazing levels were moderate to high, and had resulted in moderate levels of poaching, shelf formation, and block formation across the survey area. In places the submerged shelves had become significantly undercut.

Water vole signs including latrines and runs were found at the site, and on one occasion a water vole was heard entering the ditch. Fen raft spiders were very frequently found across the southern half of the survey area, and great silver water beetles *Hydrophilus piceus* were also frequently observed.

#### **Vegetation**

Bankside vegetation was dominated by dense areas of greater and lesser pond sedge and rush (mainly soft rush with hard rush present but less abundant). Grasses from the adjacent grazed areas were also present, including creeping bent and Yorkshire fog. Branched bur-reed and great water dock *Rumex hydrolapathum* were abundant in places, and extended into the channels from the banks on occasion. In more mature ditches there were swampy margins dominated by tussocks of sedge and dense areas of lesser water parsnip. Those due for clearance in the next few years were heavily choked in places by water soldier which was unable to sink due to being so densely packed. Species including marsh horsetail and tubular water-dropwort *Oenanthe fistulosa* were sporadically present in the marginal vegetation throughout the site. Star duckweed was present at all sampling points and was often very abundant, forming dense floating mats in the water channels. Frogbit was frequently observed and occasionally supported frogbit smut. Common duckweed was present at the majority of sampling points, and Turion duckweed was found more occasionally.

#### **Molluscs**

Little whirlpool ramshorn snail was found at the majority of sample points visited (20 out of 31). Densities varied considerably, with total numbers between 1-240 individuals in a sample. The highest densities were found in ditches towards the north of the site, particularly in ditches which are due for clearance in the near future. These would therefore be ideal as donor sites for a translocation.

Mollusc communities across the site were very species-rich, averaging 22 species per sampling point (maximum 26, minimum 18). Several species of conservation interest were observed in addition to little whirlpool ramshorn snail, including shining ramshorn snail, slender amber-snail *Oxyloma sarsi*, *Pisidium pseudosphaerium*, and flat valve snail. Other more common species at the site included

wandering pond snail, *Sphaerium corneum*, Leach's Bithynia, lake limpit, and whirlpool ramshorn. The level of mollusc diversity at the site shows that the aquatic habitats present are of very high quality, particularly combined with the presence of other sensitive invertebrate species such as great silver water beetle.

#### 4.1.6 [REDACTED] (Area 8 – surveyed Nov 2016/Feb 2017)

[REDACTED] is located [REDACTED] Suffolk, to the [REDACTED]. It is also immediately adjacent to the Suffolk Wildlife Trust site known as [REDACTED] which lies to the west. [REDACTED]. Samples were collected at 18 points over a two-day period (one in November 2016, one in February 2017) across the southern half of the marsh. There were historical records of little whirlpool ramshorn snail on the site prior to surveying (Jackson & Howlett 1999).

The ditches at [REDACTED] were all between 2-3m in width. The water in the ditches was generally shallow, at less than 0.5m at all sample points. At one point the water was <0.25m deep. By contrast, sediment depth was considerable, being >0.5m deep at all sample points. The surrounding land use at all sample points was semi-improved grassland with high-intensity grazing. There were indications of some eutrophication in the ditches, evidenced by the turbidity of the water (which ranged from slight on the eastern side of the site to moderate on the western side) and an abundance of filamentous algae in places. Conductivity readings were very high, particularly in the western half of the site (1000-1300µS/S in the west compared to 800-1276µS/S in the east) - this can indicate the presence of nitrates, although further chemical testing would be required to confirm this. Eutrophication can be linked to runoff from intensively grazed land - if this is the case, the habitat may be at risk of further damage – while little whirlpool ramshorn snail prefers mesotrophic conditions (Glöer & Groh 2007), significant eutrophication is a risk to aquatic flora and fauna.

Water vole feeding signs were occasionally found across the site, and Chinese water deer *Hydropotes inermis* were seen using the area. Other species observed included marsh tits *Poecile palustris* and peregrine falcon *Falco peregrinus*.

##### **Vegetation**

The bankside vegetation across the site was dominated by dense stands of greater and lesser pond sedge and rushes (mainly soft rush with some hard rush), with occasional reed. Grasses from the surrounding grazed land, including creeping bent and Yorkshire fog were also present on the banks. The amount of emergent vegetation varied significantly between ditches. Some had very open water channels with little to no vegetation, while others were heavily choked with species such as water soldier, lesser water parsnip, reed sweet grass, and floating sweet-grass. There were patches of dense star duckweed in some more mature ditches, while common duckweed was present at all sample points in varying densities. Frogbit, frogbit smut, Turion duckweed, and greater duckweed *Spirodela polyrhiza* were also occasionally observed. Filamentous algae was present in some ditches, occasionally with an oily film on the surface of the water, indicating possible eutrophication.

##### **Molluscs**

Little whirlpool ramshorn snail was found at eight sampling points at the eastern side of the site, and at four sampling points in ditches immediately adjacent to the neighbouring [REDACTED] (although it should be noted that the ditches are not connected between the sites). However, no Little whirlpool ramshorn snail was found in the ditches between the eastern side and the ditches abutting [REDACTED] to the west. Densities were generally low (<10 snails total per sample), but in three ditches in the eastern half of the survey area much higher numbers were present (between 30-110 animals total per sample). These three ditches may be suitable donor sites for a future translocation, as sufficient numbers of animals could be gathered quickly; however, other ditches on the site are less suitable due to the low numbers of little whirlpool ramshorn snail recorded. Moving animals from this site may also be beneficial if the habitat is at risk from eutrophication. Subjectively, little whirlpool ramshorn snail was more abundant at sample points with lower turbidity and conductivity, suggesting a preference for cleaner, higher quality habitat. Translocation may therefore offer an opportunity to protect this population if the current site continues to deteriorate.

The divide between the western and eastern halves of the site was also reflected in general mollusc community richness. Sample sites in the east, where little whirlpool ramshorn snail was routinely present and turbidity was lower, averaged communities of 20 different mollusc species with a maximum of 25 species and a minimum of 12 species. By contrast communities from the western side of the site, where turbidity was higher and little whirlpool ramshorn snail was generally absent, averaged 10 species with a maximum of 18 and a minimum of just four species. It should be noted that little whirlpool ramshorn snail was only found in the western half of the survey area in the ditches with the most diverse mollusc communities (18, 13 and 11 species) – this again indicates the preference of the species for higher quality habitats. Previous mollusc surveys at the site found communities with species richness routinely reaching 30-35 species per sample [REDACTED] pers. obs.), suggesting that diversity at the site has generally declined.



Other molluscs routinely found across the western side of the survey area included common species such as margined ramshorn snail, wandering pond-snail, whirlpool ramshorn, and common Bithynia. A few shining ramshorn snail (<10 total per sample) were found in the ditches which also contained little ramshorn whirlpool snail, but otherwise no species of conservation interest were found. By contrast, ditches in the eastern half of the survey area contained species such as flat valve snail, shining ramshorn snail (in high numbers), *Pisidium pseudosphaerium*, and slender amber-snail, in addition to little whirlpool ramshorn snail. This again indicates that the habitat quality is significantly higher in the eastern half of the site.

#### 4.1.7 [REDACTED] (Area 9 – surveyed Feb 2017)

The marsh surveyed at [REDACTED] is located approximately [REDACTED]. [REDACTED] Ten sample points were assessed at this site. There were no records of little whirlpool ramshorn snail on the site prior to surveying.

The surveyed ditches at the site were all between 2-4m wide, and contained water >50cm deep. There was a thick silt layer throughout the ditches, which was >1m in depth at all but one sample point. Water quality was good with very low turbidity throughout the site. Conductivity varied between 600-940µS/S. The surrounding land was generally swamp/fen, with occasional unimproved grassland tracks. There was no evidence of livestock grazing around the sampled points, and consequently no poaching or block/shelf formation along ditch margins. However, highland cows were being kept at very low densities in other parts of the site, and may graze the sampled area in the future.

Some occasional water vole signs were observed at the site, and an otter *Lutra lutra* spraint was found on top of an old mink raft. Droppings from Chinese water deer were frequently found throughout the site. Birds of prey, including marsh harrier *Circus aeruginosus*, were seen in the area, and barn owl *Tyto alba* pellets were found occasionally beneath trees within the site.

##### **Vegetation**

The bankside vegetation across the site was dominated by common reed with some occasional stands of lesser pond sedge, and scattered great water dock and hemp-agrimony *Eupatorium cannabinum*. While the ditches were generally open and not shaded, some occasional small trees were found close to the ditches, including alder *Alnus glutinosa*, oak *Quercus robur*, and silver birch *Betula pendula* – a small wooded area ran along one side of the first ditch visited, so this sample point was significantly more shaded than the others.

While the flora within the ditches had died back over the winter, the early growth stages and remnants of plants suggested that it is species-rich during summer. Star duckweed was present at low densities in all the ditches surveyed, and frogbit was present in the majority. Species of interest included Turion duckweed, water moss *Fontinalis antipyretica*, and royal fern *Osmunda regalis*.

##### **Molluscs**

Little whirlpool ramshorn snail was found at nine of the ten sampling points at [REDACTED] although generally in low numbers (typically <10 total per sample, but >30 total at two points) - the population is not therefore considered robust enough to support the removal of individuals for translocation. Finding little whirlpool ramshorn snail at [REDACTED] was significant however, as the species had not previously been recorded at the site. Additionally, [REDACTED] is a naturally-flooding and tidal system and could therefore give information regarding the dispersal of the little whirlpool ramshorn snail under natural conditions. It is therefore recommended that population levels are carefully monitored at this site.

Mollusc communities in general were species-rich, averaging 20 species per sample point. The most abundant species recorded was flat valve snail, a species with a strong preference for well-oxygenated, well-vegetated sites, and which has been associated with little whirlpool ramshorn snail at other sites in Norfolk (AECOM/Abrehart Ecology 2016b). A number of species of conservation interest were also observed, including *Pisidium pseudosphaerium*, shining ramshorn snail, and *Valvata macrostomata* - these are all species which prefer clean, well-oxygenated water and good levels of aquatic vegetation, indicating that the habitat is very favourable at the site overall.

A high density of zebra mussel *Dreissena polymorpha* shells was found on the bank of one ditch on the site. This invasive species is found in the nearby river channel, but was not found in any of the mollusc samples collected during the survey. It is possible that the shells are debris from predatory behavior from otters or birds in the area, but the precise source could not be determined.

#### 4.1.8 [REDACTED] (Area 10 – surveyed Feb 2017)

The survey site at [REDACTED] is [REDACTED], Norfolk. The marsh had previously been an extremely wet habitat with extensive areas of swampy and floating vegetation [REDACTED] pers. obs.). Seven sample points were visited across the site. There were no records of little whirlpool ramshorn snail on the site prior to surveying.

Ditches at the site were generally narrow (<2m) and shallower than at other sites (generally <0.5m and frequently <0.25m deep). The ditches were varied in character. Some appeared relatively recently cleared, with little vegetation in the channels and short vegetation along the margins, while others were almost totally choked with dense vegetation including tussocks of sedge and rush. While the water was clear throughout the site, there was some suggestion of eutrophication as large patches of ochre were evident on some banks.

The surrounding land was swamp/fen and was noticeably dryer than historically described, with swampy areas much reduced and very little standing water between ditches. While levels of grazing appeared low, there was some moderate poaching and shelf formation along ditch margins, suggesting that grazing is more intensive at times.

##### **Vegetation**

Bankside vegetation was dominated by sedges, largely lesser pond-sedge with greater pond sedge often present but less abundant. There were some dense areas of blunt flowered rush along ditches and in the surrounding fen, and some very occasional stands of hard rush along ditch margins. Marginal vegetation was dense and frequently extended into the channels of mature ditches, narrowing the open water. In the more overgrown ditches, lesser water parsnip formed dense mats in those areas not occupied by sedges or rushes. Fen pondweed *Potamogeton coloratus* was occasionally observed, and star duckweed was found in one of the ditches assessed. Aquatic vegetation was otherwise sparse and species-poor.

##### **Molluscs**

No little whirlpool ramshorn snail was found at [REDACTED], and the habitat did not appear to be suitable for the species as aquatic vegetation was limited. Mollusc communities overall were species-poor, containing ten species on average and consisting only of common species such as common Bithynia, great pond snail *Lymnaea stagnalis*, wandering pond snail, and common bladder snail. No species of conservation interest were found. Desmoulins whorl snail, which had previously been abundant [REDACTED], pers. obs.), was much more difficult to find even in the remaining wet areas of the site.



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## 5 Discussion & Recommended Future Work

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### 5.1 Extension of Original Translocation

Initial results have suggested that a local translocation of little whirlpool ramshorn snail from Acle has been, in the short term, successful (AECOM/Abrehart Ecology 2016a). Using additional individuals from Acle for a second round of translocations would enable an additional test of whether populations which respond well to short-distance movement also thrive when the receptor site is more distant. This may give an indication as to the level of plasticity of the species i.e. whether it is able to tolerate a larger change in its environment (as is likely to be the case over a larger distance). Moving little whirlpool ramshorn snail from several different populations will help to test whether the species as a whole responds well to translocation as a management strategy, or whether certain populations are better suited than others. It should be noted that individuals from different populations should not be combined at this stage, as the potential risks of outbreeding depression have not been adequately quantified. Translocations would therefore consist of individuals from separate populations, introduced into sites where little whirlpool ramshorn snails do not currently occur.

This work would help to determine whether the results of the pilot translocation are generally applicable to little whirlpool ramshorn snail as a species, or applicable only in one isolated population. This is highly relevant for the future conservation and management of the species, as it will determine whether translocation is a technique that can be more generally applied, or whether the method is only applicable in certain, local situations.

### 5.2 Potential Donor and Receptor Sites

#### 5.2.1 Donor Sites

Several potential donor populations of little whirlpool ramshorn snail were identified at the sites surveyed. These included populations at [REDACTED].

[REDACTED] would be particularly suitable as a donor site. The site is under the management of the Suffolk Wildlife Trust, and the grazing marsh ditches are therefore routinely maintained. The ditches containing the highest densities of little whirlpool ramshorn snail at this site are due to be cleared in the coming months as part of this maintenance. This therefore provides an opportunity to remove and protect individual molluscs that would otherwise be destroyed, and to test whether a successful reintroduction of little whirlpool ramshorn snail can be achieved post-maintenance under a CL14 licence, using bulk material removed from ditches. If successful, this would improve the ability of land managers to conserve existing populations of little whirlpool ramshorn snail without drastic changes to current management practices. It is possible that this approach could also be applied to translocations of little whirlpool ramshorn snail between sites, as such an approach would reduce the manpower required (compared to recent translocation methods e.g. AECOM/Abrehart Ecology 2016b) and therefore make it more feasible for populations to be moved and established in new locations. However, the impacts of moving ditch material between sites on a larger scale would need to be assessed, as this method would introduce other species in addition to little whirlpool ramshorn snail into the receptor system. While this may not be a problem if translocation is happening within one marsh (as mollusc communities at this scale are reasonably consistent), it may cause shifts in mollusc communities and subsequent environmental changes if translocations are conducted over a larger distance. There is also the potential for novel pathogens and/or parasites to be moved along with the molluscs; this is a risk that would need to be carefully assessed prior to translocation to new sites using bulk material.

#### 5.2.2 Receptor Sites

As in the pilot study (AECOM/Abrehart Ecology 2016b), it was more difficult than expected to locate suitable receptor locations. Whilst areas of suitably managed late successional ditches without little whirlpool ramshorn snail previously proved difficult to locate, in the current study, many sites had been affected by issues such as saline incursion as well as inappropriate management for the species.

However, [REDACTED] was identified as a suitable receptor site. The grazing marsh ditches are in good condition (as evidenced by diverse vegetation and mollusc communities), there are records of little whirlpool ramshorn snail in neighbouring marshes, suggesting that there are no issues with saline incursion or other pollutants in the catchment area. However, no little whirlpool ramshorn snail were found in [REDACTED] itself.

In contrast to the [REDACTED] used previously for translocation work, and with the other marshes surveyed for this report, [REDACTED] is a naturally flooding system. Little whirlpool ramshorn snail has previously been shown to be highly dispersal limited (Niggebrugge et al. 2007), and this may be exacerbated by the strict management of water levels in many grazing marshes to prevent flooding. Using [REDACTED] as a receptor site may therefore provide an opportunity to study the dispersal potential of little whirlpool ramshorn snail under a different management strategy; comparisons can then be made between [REDACTED] and other translocation sites regarding the rate of spread of little whirlpool ramshorn snail from the initial translocation points.

Given the difficulty finding appropriate receptor sites within the original search area, it is proposed that ditches at [REDACTED] are included as an additional receptor site option. While not initially considered as part of this project, the marshes at [REDACTED] are within the Broads and in the Waveney catchment area. Abrehart Ecology completed full invertebrate and vegetation surveys of the area on behalf of the Broads Authority in July 2016 (for full details see Abrehart Ecology 2016). During these surveys the habitat was found to be potentially suitable for little whirlpool ramshorn snail, but the species was not found to be occupying the site. The condition of the site has markedly improved in recent years, and supports more diverse invertebrate communities with more species of conservation interest (see Abrehart Ecology 2016 for details).

## 5.3 Saline Incursion

Saline incursion is a significant threat to habitats in the Norfolk Broads, and will continue to be so when rising sea levels resulting from climate change are considered. The increasing height and frequency of storm surges expected is likely to increase the frequency of saline inundation of large areas, particularly as large parts of the Broads are below sea level. In addition, consistently higher sea levels may in future increase low-level seepage of salt water through flood defences.

Some evidence for this was found during surveys at [REDACTED] and [REDACTED]. During the scoping surveys both sites appeared to contain ditches at suitable stages of succession and under suitable management for supporting little whirlpool ramshorn snail, and held a generally diverse mollusc fauna. [REDACTED] appeared particularly suitable for little whirlpool ramshorn snail, as the ditches at the site are already managed for conservation and cattle grazing on the marsh is at a low intensity. The fen grassland adjacent to the ditches surveyed was very species rich botanically, as was the marginal vegetation within the ditches themselves.

However, at both sites conductivity readings were significantly higher than was expected, despite the distance from the sea [REDACTED]. This was particularly marked at [REDACTED] where conductivity readings steadily increased towards the north of the site, corresponding with a decrease in mollusc diversity to a fauna of just seven species at some sample points. Data provided by the site warden also suggested that, rather than salinity resulting from leakage through damaged sea walls, the salt water is likely to be percolating through the peat beneath the marsh. This is not something which could be easily controlled by a simple change in management and repair of existing dykes/sea walls.

Little whirlpool ramshorn snail has been shown to be highly intolerant of saline conditions (Boettger 1944; reviewed by Terrier et al. 2006), and seawater flooding may therefore render large areas of currently suitable habitat useless for the species in the future. This highlights the need for identifying suitable areas of habitat for little whirlpool ramshorn snail further inland and above the current sea level, as such sites may be more resilient to future environmental change.

## 5.4 Future work summary

1. As per the translocation licence, monitoring of the pilot donor and receptor sites at [REDACTED] and [REDACTED] needs to continue. This will provide more evidence as to the efficacy of locally translocating little whirlpool ramshorn snail.
  2. Prior to any further translocation work, a re-survey of all proposed donor and receptor sites to ensure:
    - i. That little whirlpool ramshorn snail is still absent at receptor sites.
    - ii. That densities of little whirlpool ramshorn snail are high enough at proposed donor sites to support removal of individuals for translocation.
  3. In agreement with Natural England, translocation of additional little whirlpool ramshorn snail from [REDACTED] [REDACTED]. This will test:
    - a. Whether the species responds similarly to movement over larger distances; and
    - b. Whether some populations perform better than others post-translocation (as detailed in Section 5.1).
- Based on the current data, eight translocations are planned:
- i. Translocation would involve the movement of 1000 snails from each donor site (4000 snails in total).
  - ii. The snails would be moved to two receptor sites (2000 snails delivered to each receptor site in total, 500 from each donor population.)
  - iii. A total of four receptor ditches would be located at each receptor site. Therefore 500 snails would be moved into each receptor ditch.
  - iv. Each receptor ditch would receive snails from *one* donor site, to avoid any potential for inter-breeding and potential outbreeding depression (which could in theory occur if populations have undergone significant local adaptation to different conditions).
  - v. Snails would be seeded into receptor ditches in groups of 100 individuals, spaced evenly along the length of the ditch. Each point of release would be marked with a cane and flag, and recorded using dGPS for future monitoring.

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## 6 Acknowledgements

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## 7 References

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***This report to be cited as: AECOM/Abrehart Ecology, 2017. Translocation of the little whirlpool ramshorn snail – detailed surveys 2016-2017. Report to Highways England.***

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## **Appendix A – Survey licences**

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**Conservation of Habitats and Species Regulations  
2010 (as amended) and Wildlife and Countryside Act  
1981 (as amended)**



Customer Services  
Wildlife Licensing  
First Floor  
Temple Quay House  
2 The Square  
Bristol  
BS1 6DG  
T: 0300 060 3900  
F: 0845 601 3438

**LICENCE - Schedule 5 for survey, science,  
education or conservation**

This licence authorises acts that would otherwise be offences under the above legislation

Any request for information in this licence will be considered under the Environmental Information Regulations 2004 and the Freedom of Information Act 2000 as appropriate.

**Natural England Ref:** 2016-25961-SCI-SCI-1

Under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended) Natural England has granted this licence for Schedule 5 (Wildlife and Countryside Act) - Animals except bats, dormice and great crested newts for the purpose of:

**Science or education, under section 53(2)(a) and/or section 16(3)(a)**

to:

<b>Name (in full):</b>	<span style="background-color: black; color: black;">[REDACTED]</span>
<b>Company Name:</b>	Abrehart Ecology
<b>Address:</b>	Pound Farm, Low Road Great Glemham Saxmundham
<b>County:</b>	Suffolk
<b>Postcode:</b>	IP17 2DQ

**Between the dates of:**

26 October 2016	and	31 August 2017	inclusive
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**At (locations):**

Site/Location Name	County	OS Grid Reference
<span style="background-color: black; color: black;">[REDACTED]</span>	Suffolk	<span style="background-color: black; color: black;">[REDACTED]</span>
<span style="background-color: black; color: black;">[REDACTED]</span>	Norfolk	<span style="background-color: black; color: black;">[REDACTED]</span>

For the following species:

Species Common Name (Taxonomic Name)	Number	Activity	Method	Detailed Location	OS Grid Reference
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Disturb	As appropriate	As detailed above	████████
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Take	As appropriate	Se detailed above	████████

This licence is granted subject to the licensee, including servants and named agents, adhering to the conditions and notes specified below.

Signature:

██████████

Date:

25 October 2016

(for and on behalf of Natural England)

## WARNING

- This licence authorises acts that would otherwise be offences under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended). Any departure from the conditions relating to this licence may be an offence under that legislation;
- This licence conveys no authority for actions prohibited by any other legislation;
- This licence can be modified or revoked at any time by Natural England, but this will not be done unless there are good reasons for doing so. The licence is likely to be revoked immediately if it is discovered that false information had been provided which resulted in the issue of the licence.

## LICENCE CONDITIONS

1. These conditions apply to the licensee and any additional authorised person. The licensee and any additional authorised person(s) are responsible for ensuring that any licensed operations/activities comply with all terms and conditions of the licence.
2. The licensee and any additional authorised person(s), shown on the licence, may act under the authority of this licence. The licensee or any additional authorised person(s) may also employ assistants provided they work under the direct personal supervision of the licensee or authorised person.
3. Whilst engaged in activities permitted by this licence, the licensee and/or any additional authorised person(s), must have access to a copy of this licence and produce it to any police officer or any Natural England officer on demand.



## LICENCE CONDITIONS

4. The Licensee and any additional authorised person(s) shall permit an officer of Natural England, accompanied by such persons as he/she considers necessary for the purpose, on production of his/her identification on demand, reasonable access to the site for monitoring purposes and to be present during any operations carried out under the authority of this licence for the purpose of ascertaining whether the conditions of this licence are being, or have been, complied with. The Licensee shall give all reasonable assistance to an officer of Natural England and any persons accompanying him/her.
5. This licence does not convey any right of entry upon land, and the landowner's/occupier's prior permission must be obtained, as necessary, before the licence is used.
6. No licensed activity shall be carried out under this licence on a National Nature Reserve or Marine Nature Reserve except with the prior written permission of Natural England.
7. A person authorised by the licensee shall provide him/her with such information as is within his/her knowledge and is necessary for the Report, which the licensee is required to make to Natural England.
8. The 'Report by licensee of action taken under licence' must be completed, even if no licensed action is taken. It must be submitted on line or sent to the Natural England office at the address shown on this licence, to arrive no later than 14 days (two weeks) after the expiry of the licence. Failure to make a report may result in the licence being revoked and/or any future applications being refused.

Additional condition(s):

This licence may be modified or revoked at any time by Natural England.

There is no limit to the number of Little Whirlpool Ramshorn snail that may be disturbed or taken under this licence provided all conditions and notes are adhered to.

## NOTES

1. Please read the details of your licence carefully to ensure that you comply with it paying particular attention to the number and species licensed as this may differ to what was requested in your application.
2. Under Regulation 58(1) of the Conservation of Habitats and Species Regulations 2010 (as amended), it is an offence to contravene or fail to comply with a licence condition. This includes all persons authorised to act under this licence.
3. An additional authorised person is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the licensee. To carry out licensed activities their name will be on the licence. To comply with the licence conditions, additional licensed persons should have a copy of the licence accessible when acting under the licence.

## NOTES

4. An assistant is a person assisting the licensee or the additional authorised person(s). Assistants are only authorised to act under a licence whilst they are under the direct supervision of either the licensee or the additional authorised person(s).
5. Please note the information of the 'Report by licensee of action taken under licence' may have changed from previous years. The data required in your report and the required format can be viewed on the Natural England website. Alternatively you can request a copy from the Natural England address shown on your licence.

Additional note(s):

All equipment used for the purposes of this licence shall be so constructed and maintained as to avoid cruelty and distress to the species named on this licence.

## Additional Authorised Individuals

The additional authorised individuals listed below are also authorised to act under the terms and conditions of this licence:

Title	First Name	Surname	Address Line 1	Postcode
Doctor	██████	██████	AECOM	██████
Doctor	██████	██████	South Maundin	██████
Mr	██████	██████	Chepstow Road	██████

**Conservation of Habitats and Species Regulations  
2010 (as amended) and Wildlife and Countryside Act  
1981 (as amended)**



Customer Services  
Wildlife Licensing  
First Floor  
Temple Quay House  
2 The Square  
Bristol  
BS1 6DG  
T: 0300 060 3900  
F: 0845 601 3438

**LICENCE - Schedule 5 for survey, science,  
education or conservation**

This licence authorises acts that would otherwise be offences under the above legislation

Any request for information in this licence will be considered under the Environmental Information Regulations 2004 and the Freedom of Information Act 2000 as appropriate.

**Natural England Ref:** 2016-23292-SCI-SCI

Under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended) Natural England has granted this licence for Schedule 5 (Wildlife and Countryside Act) - Animals except bats, dormice and great crested newts for the purpose of:

**Science or education, under section 53(2)(a) and/or section 16(3)(a)**

to:

<b>Name (in full):</b>	<span style="background-color: black; color: black;">[REDACTED]</span>
<b>Company Name:</b>	Abrehart Ecology
<b>Address:</b>	Pound Farm, Low Road Great Glemham Saxmundham
<b>County:</b>	Suffolk
<b>Postcode:</b>	IP17 2DQ

**Between the dates of:**

21 April 2016	and	20 May 2016	inclusive
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**At (locations):**

Site/Location Name	County	OS Grid Reference
<span style="background-color: black; color: black;">[REDACTED]</span>	Norfolk	<span style="background-color: black; color: black;">[REDACTED]</span>
<span style="background-color: black; color: black;">[REDACTED]</span>	Norfolk	<span style="background-color: black; color: black;">[REDACTED]</span>

For the following species:

Species Common Name (Taxonomic Name)	Number	Activity	Method	Detailed Location	OS Grid Reference
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Disturb	Net	[REDACTED]	[REDACTED]
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Take	Net	[REDACTED]	[REDACTED]

This licence is granted subject to the licensee, including servants and named agents, adhering to the conditions and notes specified below.

Signature:

[REDACTED]

Date:

18 April 2016

(for and on behalf of Natural England)

## WARNING

- This licence authorises acts that would otherwise be offences under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended). Any departure from the conditions relating to this licence may be an offence under that legislation;
- This licence conveys no authority for actions prohibited by any other legislation;
- This licence can be modified or revoked at any time by Natural England, but this will not be done unless there are good reasons for doing so. The licence is likely to be revoked immediately if it is discovered that false information had been provided which resulted in the issue of the licence.

## LICENCE CONDITIONS

1. These conditions apply to the licensee and any additional authorised person. The licensee and any additional authorised person(s) are responsible for ensuring that any licensed operations/ activities comply with all terms and conditions of the licence.
2. The licensee and any additional authorised person(s), shown on the licence, may act under the authority of this licence. The licensee or any additional authorised person(s) may also employ assistants provided they work under the direct personal supervision of the licensee or authorised person.
3. Whilst engaged in activities permitted by this licence, the licensee and/or any additional authorised person(s), must have access to a copy of this licence and produce it to any police officer or any Natural England officer on demand.

## LICENCE CONDITIONS

4. The Licensee and any additional authorised person(s) shall permit an officer of Natural England, accompanied by such persons as he/she considers necessary for the purpose, on production of his/her identification on demand, reasonable access to the site for monitoring purposes and to be present during any operations carried out under the authority of this licence for the purpose of ascertaining whether the conditions of this licence are being, or have been, complied with. The Licensee shall give all reasonable assistance to an officer of Natural England and any persons accompanying him/her.
5. This licence does not convey any right of entry upon land, and the landowner's/occupier's prior permission must be obtained, as necessary, before the licence is used.
6. No licensed activity shall be carried out under this licence on a National Nature Reserve or Marine Nature Reserve except with the prior written permission of Natural England.
7. A person authorised by the licensee shall provide him/her with such information as is within his/her knowledge and is necessary for the Report, which the licensee is required to make to Natural England.
8. The 'Report by licensee of action taken under licence' must be completed, even if no licensed action is taken. It must be submitted on line or sent to the Natural England office at the address shown on this licence, to arrive no later than 14 days (two weeks) after the expiry of the licence. Failure to make a report may result in the licence being revoked and/or any future applications being refused.

Additional condition(s):

This licence may be modified or revoked at any time by Natural England.

There is no limit to the number of Little whirlpool ramshorn snail (*Anisus vorticulus*) that may be disturbed or taken under this licence provided all conditions and notes are adhered to.

## NOTES

1. Please read the details of your licence carefully to ensure that you comply with it paying particular attention to the number and species licensed as this may differ to what was requested in your application.
2. Under Regulation 58(1) of the Conservation of Habitats and Species Regulations 2010 (as amended), it is an offence to contravene or fail to comply with a licence condition. This includes all persons authorised to act under this licence.
3. An additional authorised person is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the licensee. To carry out licensed activities their name will be on the licence. To comply with the licence conditions, additional licenced persons should have a copy of the licence accessible when acting under the licence.

## NOTES

4. An assistant is a person assisting the licensee or the additional authorised person(s). Assistants are only authorised to act under a licence whilst they are under the direct supervision of either the licensee or the additional authorised person(s).
5. Please note the information of the 'Report by licensee of action taken under licence' may have changed from previous years. The data required in your report and the required format can be viewed on the Natural England website. Alternatively you can request a copy from the Natural England address shown on your licence.

Additional note(s):

## Additional Authorised Individuals

The additional authorised individuals listed below are also authorised to act under the terms and conditions of this licence:

Title	First Name	Surname	Address Line 1	Postcode
Doctor	██████	██████	AECOM	██████
Doctor	██████	██████	South Maundin	██████

**Conservation of Habitats and Species Regulations  
2010 (as amended) and Wildlife and Countryside Act  
1981 (as amended)**



Customer Services  
Wildlife Licensing  
First Floor  
Temple Quay House  
2 The Square  
Bristol  
BS1 6EB  
T: 0845 601 4523  
F: 0845 601 3438

**LICENCE - Schedule 5 for survey, science,  
education or conservation**

This licence authorises acts that would otherwise be offences under the above legislation

Any request for information in this licence will be considered under the Environmental Information Regulations 2004 and the Freedom of Information Act 2000 as appropriate.

**Natural England Ref:** 2015-14705-SCI-SCI

Under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended) Natural England has granted this licence for Schedule 5 (Wildlife and Countryside Act) - Animals except bats, dormice and great crested newts for the purpose of:

**Science or education, under section 53(2)(a) and/or section 16(3)(a)**

to:

<b>Name (in full):</b>	<span style="background-color: black; color: black;">[REDACTED]</span>
<b>Company Name:</b>	Abrehart Ecology
<b>Address:</b>	Pound Farm, Low Road Great Glemham Saxmundham
<b>County:</b>	Suffolk
<b>Postcode:</b>	IP17 2DQ

**Between the dates of:**

31 October 2015	and	31 October 2016	inclusive
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**At (locations):**

Site/Location Name	County	OS Grid Reference
<span style="background-color: black; color: black;">[REDACTED]</span>	Norfolk	<span style="background-color: black; color: black;">[REDACTED]</span>
<span style="background-color: black; color: black;">[REDACTED]</span>	Norfolk	<span style="background-color: black; color: black;">[REDACTED]</span>

For the following species:

Species Common Name (Taxonomic Name)	Number	Activity	Method	Detailed Location	OS Grid Reference
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Take	Hand Net	[REDACTED]	[REDACTED]
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Possess	As appropriate	[REDACTED]	[REDACTED]
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Disturb	Hand Net	[REDACTED]	[REDACTED]
Little whirlpool ram's-horn snail ( <i>Anisus vorticulus</i> )	0	Kill	Hand Net	[REDACTED]	[REDACTED]

This licence is granted subject to the licensee, including servants and named agents, adhering to the conditions and notes specified below.

Signature:

[REDACTED]

Date:

29 October 2015

(for and on behalf of Natural England)

## WARNING

- This licence authorises acts that would otherwise be offences under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended). Any departure from the conditions relating to this licence may be an offence under that legislation;
- This licence conveys no authority for actions prohibited by any other legislation;
- This licence can be modified or revoked at any time by Natural England, but this will not be done unless there are good reasons for doing so. The licence is likely to be revoked immediately if it is discovered that false information had been provided which resulted in the issue of the licence.

## LICENCE CONDITIONS

1. These conditions apply to the licensee and any additional authorised person. The licensee and any additional authorised person(s) are responsible for ensuring that any licensed operations/ activities comply with all terms and conditions of the licence.



## LICENCE CONDITIONS

2. The licensee and any additional authorised person(s), shown on the licence, may act under the authority of this licence. The licensee or any additional authorised person(s) may also employ assistants provided they work under the direct personal supervision of the licensee or authorised person.
3. Whilst engaged in activities permitted by this licence, the licensee and/or any additional authorised person(s), must have access to a copy of this licence and produce it to any police officer or any Natural England officer on demand.
4. The Licensee and any additional authorised person(s) shall permit an officer of Natural England, accompanied by such persons as he/she considers necessary for the purpose, on production of his/her identification on demand, reasonable access to the site for monitoring purposes and to be present during any operations carried out under the authority of this licence for the purpose of ascertaining whether the conditions of this licence are being, or have been, complied with. The Licensee shall give all reasonable assistance to an officer of Natural England and any persons accompanying him/her.
5. This licence does not convey any right of entry upon land, and the landowner's/occupier's prior permission must be obtained, as necessary, before the licence is used.
6. No licensed activity shall be carried out under this licence on a National Nature Reserve or Marine Nature Reserve except with the prior written permission of Natural England.
7. A person authorised by the licensee shall provide him/her with such information as is within his/her knowledge and is necessary for the Report, which the licensee is required to make to Natural England.
8. The 'Report by licensee of action taken under licence' must be completed, even if no licensed action is taken. It must be submitted on line or sent to the Natural England office at the address shown on this licence, to arrive no later than 14 days (two weeks) after the expiry of the licence. Failure to make a report may result in the licence being revoked and/or any future applications being refused.

Additional condition(s):

There is no limit to the number of Little whirlpool ramshorn snail that can be disturbed, taken, killed or possessed under this licence provided all conditions and notes are adhered to.

This licence may be modified or revoked at any time by Natural England.

## NOTES

1. Please read the details of your licence carefully to ensure that you comply with it paying particular attention to the number and species licensed as this may differ to what was requested in your application.

## NOTES

2. Under Regulation 58(1) of the Conservation of Habitats and Species Regulations 2010 (as amended), it is an offence to contravene or fail to comply with a licence condition. This includes all persons authorised to act under this licence.
3. An additional authorised person is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the licensee. To carry out licensed activities their name will be on the licence. To comply with the licence conditions, additional licenced persons should have a copy of the licence accessible when acting under the licence.
4. An assistant is a person assisting the licensee or the additional authorised person(s). Assistants are only authorised to act under a licence whilst they are under the direct supervision of either the licensee or the additional authorised person(s).
5. Please note the information of the 'Report by licensee of action taken under licence' may have changed from previous years. The data required in your report and the required format can be viewed on the Natural England website. Alternatively you can request a copy from the Natural England address shown on your licence.

Additional note(s):

## Additional Authorised Individuals

The additional authorised individuals listed below are also authorised to act under the terms and conditions of this licence:

Title	First Name	Surname	Address Line 1	Postcode
Miss	██████	██████	97	██████

**Conservation of Habitats and Species Regulations  
2010 (as amended) and Wildlife and Countryside Act  
1981 (as amended)**



Customer Services  
Wildlife Licensing  
First Floor  
Temple Quay House  
2 The Square  
Bristol  
BS1 6DG  
T: 0300 060 3900  
F: 0845 601 3438

**LICENCE - Schedule 5 for survey, science,  
education or conservation**

This licence authorises acts that would otherwise be offences under the above legislation

Any request for information in this licence will be considered under the Environmental Information Regulations 2004 and the Freedom of Information Act 2000 as appropriate.

**Natural England Ref:** 2016-26279-SCI-SCI

Under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended) Natural England has granted this licence for Schedule 5 (Wildlife and Countryside Act) - Animals except bats, dormice and great crested newts for the purpose of:

**Science or education, under section 53(2)(a) and/or section 16(3)(a)**

to:

<b>Name (in full):</b>	[REDACTED]
<b>Company Name:</b>	Abrehart Ecology
<b>Address:</b>	Pound Farm, Low Road Great Glemham Saxmundham
<b>County:</b>	Suffolk
<b>Postcode:</b>	IP17 2DQ

**Between the dates of:**

26 October 2016	and	31 August 2021	inclusive
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**At (locations):**

Site/Location Name	County	OS Grid Reference
[REDACTED]	Suffolk	[REDACTED]
[REDACTED]	Suffolk	[REDACTED]

For the following species:

Species Common Name (Taxonomic Name)	Number	Activity	Method	Detailed Location	OS Grid Reference
Fen raft spider ( <i>Dolomedes plantarius</i> )	0	Take	Hand	As detailed above	██████
Fen raft spider ( <i>Dolomedes plantarius</i> )	0	Disturb	Hand	As detailed above	██████
Fen raft spider ( <i>Dolomedes plantarius</i> )	0	Take	Net	As detailed above	██████
Fen raft spider ( <i>Dolomedes plantarius</i> )	0	Disturb	Net	As detailed above	██████

**This licence is granted subject to the licensee, including servants and named agents, adhering to the conditions and notes specified below.**

Signature:

████████████████████

Date:

25 October 2016

(for and on behalf of Natural England)

## WARNING

- This licence authorises acts that would otherwise be offences under the Conservation of Habitats and Species Regulations 2010 (as amended) and Wildlife and Countryside Act 1981 (as amended). Any departure from the conditions relating to this licence may be an offence under that legislation;
- This licence conveys no authority for actions prohibited by any other legislation;
- This licence can be modified or revoked at any time by Natural England, but this will not be done unless there are good reasons for doing so. The licence is likely to be revoked immediately if it is discovered that false information had been provided which resulted in the issue of the licence.

## LICENCE CONDITIONS

1. These conditions apply to the licensee and any additional authorised person. The licensee and any additional authorised person(s) are responsible for ensuring that any licensed operations/ activities comply with all terms and conditions of the licence.
2. The licensee and any additional authorised person(s), shown on the licence, may act under the authority of this licence. The licensee or any additional authorised person(s) may also employ assistants provided they work under the direct personal supervision of the licensee or authorised person.
3. Whilst engaged in activities permitted by this licence, the licensee and/or any additional authorised person(s), must have access to a copy of this licence and produce it to any police officer or any Natural England officer on demand.

## LICENCE CONDITIONS

4. The Licensee and any additional authorised person(s) shall permit an officer of Natural England, accompanied by such persons as he/she considers necessary for the purpose, on production of his/her identification on demand, reasonable access to the site for monitoring purposes and to be present during any operations carried out under the authority of this licence for the purpose of ascertaining whether the conditions of this licence are being, or have been, complied with. The Licensee shall give all reasonable assistance to an officer of Natural England and any persons accompanying him/her.
5. This licence does not convey any right of entry upon land, and the landowner's/occupier's prior permission must be obtained, as necessary, before the licence is used.
6. No licensed activity shall be carried out under this licence on a National Nature Reserve or Marine Nature Reserve except with the prior written permission of Natural England.
7. A person authorised by the licensee shall provide him/her with such information as is within his/her knowledge and is necessary for the Report, which the licensee is required to make to Natural England.
8. The 'Report by licensee of action taken under licence' must be completed, even if no licensed action is taken. It must be submitted on line or sent to the Natural England office at the address shown on this licence, to arrive no later than 14 days (two weeks) after the expiry of the licence. Failure to make a report may result in the licence being revoked and/or any future applications being refused.

Additional condition(s):

This licence may be modified or revoked at any time by Natural England.

There is no limit to the number of Fen Raft spiders that may be disturbed and taken under this licence provided all conditions and notes are met.

Any wild animal taken under this licence shall be liberated at the site of capture immediately after examination.

## NOTES

1. Please read the details of your licence carefully to ensure that you comply with it paying particular attention to the number and species licensed as this may differ to what was requested in your application.
2. Under Regulation 58(1) of the Conservation of Habitats and Species Regulations 2010 (as amended), it is an offence to contravene or fail to comply with a licence condition. This includes all persons authorised to act under this licence.
3. An additional authorised person is a suitably trained and experienced person who is able to carry out work under a licence without the personal supervision of the licensee. To carry out licensed activities their name will be on the licence. To comply with the licence conditions, additional licensed persons should have a copy of the licence accessible when acting under the licence.

## NOTES

4. An assistant is a person assisting the licensee or the additional authorised person(s). Assistants are only authorised to act under a licence whilst they are under the direct supervision of either the licensee or the additional authorised person(s).
5. Please note the information of the 'Report by licensee of action taken under licence' may have changed from previous years. The data required in your report and the required format can be viewed on the Natural England website. Alternatively you can request a copy from the Natural England address shown on your licence.

Additional note(s):

All equipment used for the purposes of this licence shall be so constructed and maintained as to avoid cruelty and distress to the species named on this licence.

## Additional Authorised Individuals

The additional authorised individuals listed below are also authorised to act under the terms and conditions of this licence:

Title	First Name	Surname	Address Line 1	Postcode
Mr	████	████	Chepstow Road	██████
Doctor	██████	██████	AECOM	██████
Doctor	████	██████	South Maundin	██████

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## **Appendix B – Survey forms**

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# Abiotic Data Recording Sheet

Date	
Site ID	
Ditch no.	
Photo(s)	
Grid ref.	
Side A	
Side B	

Water features	
pH	
Conductivity (mS)	
D.O.	
Temp	
Water colour	

	Adjacent Land use	
	A	B
Improved grassland		
Semi-improved grassland		
Unimproved grassland		
Arable		
Swamp/Fen		
Drove		
Cattle/horse grazed		
Sheep grazed		
Hay/Silage		
Stockproof boundary		
Temporary fencing		
Spoil on bank		

	Bank vegetation (DAFOR)	
	A	B
Tall grass/reed		
Short grass		
Bare ground		
Tall herbs		
Overhanging vegetation		
Scrub <1.5m		
Fen		
Woodland ground flora		
Shaded (%)		

	Vegetation cover	
	DAFOR	Absent
Open water surface		
Floating Lemna/Azolla		
Other floating aquatics		
Floating algae		
Lemna trisulca		
Other submerged plants		
Submerged algae		
Open substrate		
Emergent		
Low swamp/Floating mat		
Exposed vegetation		
Exposed mud		
Litter / detritus		
Shaded		
Emergents/floating mat in channel %		

Ditch Features										
Water width (m)	Bank top width (m)	Freeboard (cm)	Water depth (cm)	Silt depth (cm)	Slope - bank A	Slope - bank B	Profile under water A	Profile under water B	Substrate	Turbidity
0-1	0-2	0-25	0-25	0-25	0-15	0-15	0-15	0-15	Clay	Clear
1-2	2-4	26-50	25-50	25-50	16-30	16-30	16-30	16-30	Alluvial	Slight
2-3	4-6	51-100	51-75	51-75	31-55	31-55	31-55	31-55	Peat	Mod
3-4	6-8	100-200	76-100	76-100	56-70	56-70	56-70	56-70	Sand	Heavy
4+	>10	>200	>100	>100	71-90	71-90	71-90	71-90	Gravel	

	Grazing/vegetation structure							
	None		Low		Med		High	
	A	B	A	B	A	B	A	B
Grazing								
Poaching								
Block formation								
Shelf formation								
Tangledness								
Grassy margin								

Management					
Years since last cleared	Not known	1	2-3	4-10	>10
Water relative to normal (cm)	Not known	+	-	Normal?	
Cleared to side	A	B			
Benched profile	A	B			
Cleared by					

**NOTES**



## AECOM Mollusc Data Recording Sheet - Phase 4

Site:

Date:

Sample ID:

Mollusc species	Sample (counts)		
	A	B	C
Acroloxus lacustris			
Anisus leucostoma			
Anisus vortex			
<b>Anisus vorticulus</b>			
Bathyomphalus contortus			
Bithynia leachii			
Bithynia tentaculata			
Galba truncatula			
Gyraulus albus			
Gyraulus crista			
Hippeutis complanatus			
Lymnaea fuscus			
Lymnaea palustris			
Lymnaea stagnalis			
Musculum lacustris			
Oxyloma pfeiferi			
<b>Oxyloma sarsi</b>			
Physa acuta			
Physa fontinalis			
Pisidium milium			
Pisidium nitidum			
Pisidium personatum			
<b>Pisidium pseudosphaerium</b>			
Pisidium sp			
Planorbarius corneus			
Planorbis carinatus			
Planorbis planorbis			
Potamopyrgus antipodarum			
Radix auricula			
Radix balthica			
<b>Segmentina nitida</b>			
Sphaerium corneus			
Sphaerium nucleus			
Succinea putris			
Valvata cristata			
<b>Valvata macrostoma</b>			
Valvata piscinalis			
<b>Vertigo moulinsiana</b>			
Viviparous sp.			
Viviparus connectus			
Zonitoides nitidula			

## AECOM Vegetation Data Recording Sheet

### Emergent plants

Site:

Date:

Species	Subsample (DAFOR)			Species	Subsample (DAFOR)		
	A	B	C		A	B	C
Agrost stol				Thal flav			
Alisma lance				Trifol prat			
Alisma plant				Trifol rep			
Alopec genic				Typha ang			
Angelic sylv				Typha lati			
Apium nodif				Urtica dioica			
Apium rep				Veron caten			
Berula erect				Vicia cracca			
Butom umbel							
Carex acutif							
Carex otrub							
Carex pseud							
Carex ripar							
Cirsium pal							
Dactyl glom							
Eleoch pal							
Elytrig repen							
Epilob hirsut							
Epilob parvi							
Equiset fluv							
Eupator can							
Festuc rub							
Filipend ulm							
Galium palus							
Glycer fluit							
Glycer max							
Holcus lanat							
Iris pseudac							
Juncus artic							
Juncus bufo							
Juncus effus							
Juncus inflex							
Lathyr prat							
Lolium pere							
Lotus pedun							
Lycop europ							
Lythrum sali							
Mentha aqua							
Myosot laxa							
Myosot scor							
Oenan aqu							
Oenan fist							
Phragm aust							
Plant lanceo							
Poa trivialis							
Potentil ans							
Ran acris							
Ran flammu							
Ran sceler							
Rorip nas ag							
Rumex hydol							
Rumedx obtus							
Salix ciner							
Salix fragi							
Salix sp.							
Samolus val							
Schoen tab							
Scroph aur							
Scutel galer							
Solan dulca							
Sparg erect							
Stachys pal							

### Aquatic plants (submerged-leaves)

Species	Subsample (DAFOR)		
	A	B	C
Callit brut			
Callit obtus			
Callit platy			
Callit stag			
Cerat dem			
Cerat subm			
Chara vulg			
Elodea can			
Elodea nutt			
Filam alg			
Front anti			
Hottonia pal			
Myriop spic			
Myriop vert			
Potam berch			
Potam crisp			
Potam natan			
Potam pect			
Potam pus			
Potam trich			
Ran aqu agg			
Ran circ			
Sagit sag			
Sparg emers			
Sparg erect			
Zannic palus			

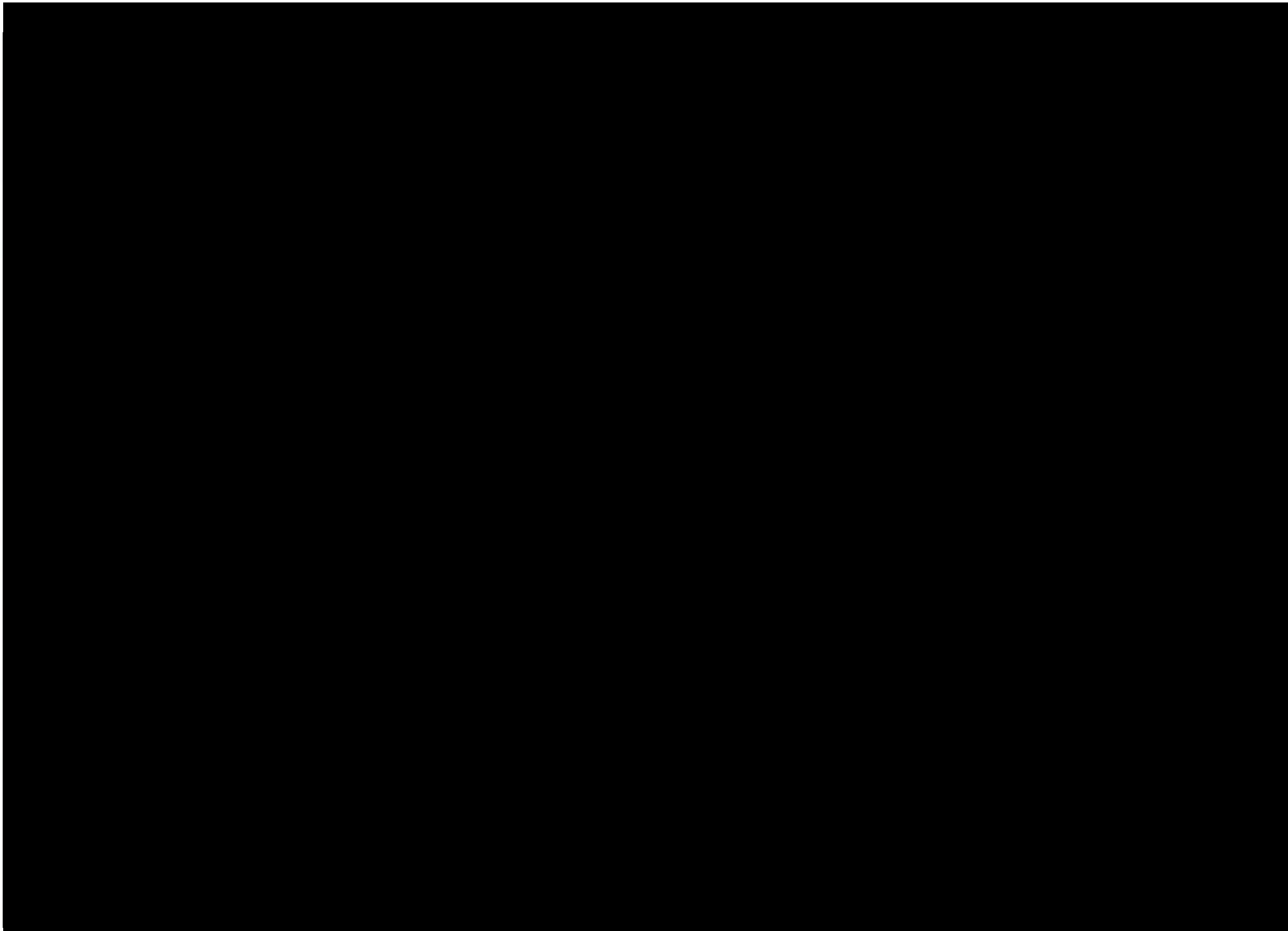
### Floating leaved plants

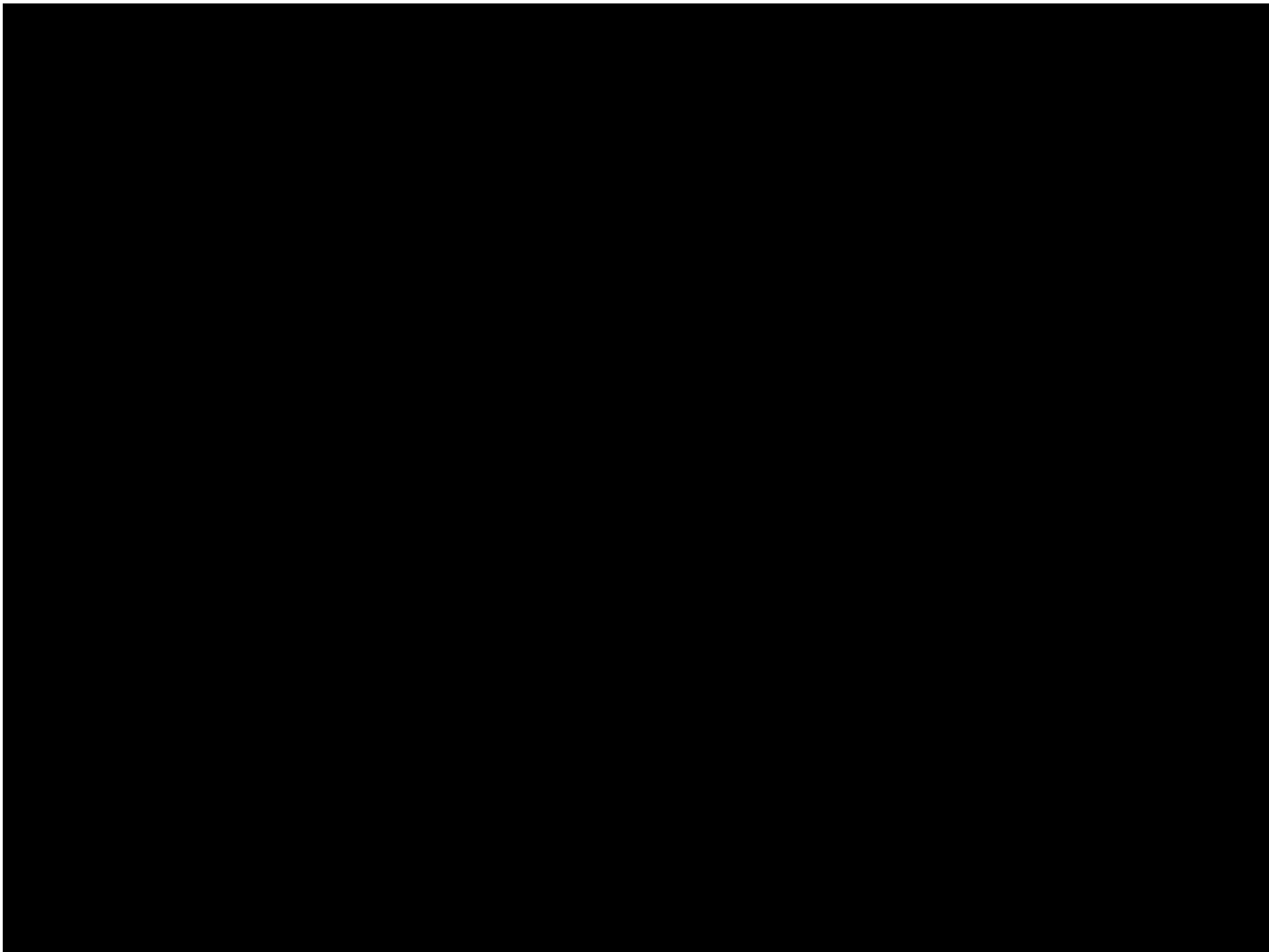
Species	Subsample (DAFOR)		
	A	B	C
Azolla filicu			
Hydroch mor			
Hydroco ran			
Hydroco vul			
Lemna gibba			
Lemna minor			
Lemna minut			
Lemna trisul			
Nuphar lut			
Nymph alba			
Persic amph			
Spiro polyr			
Stratio alo			
Wolff arrh			

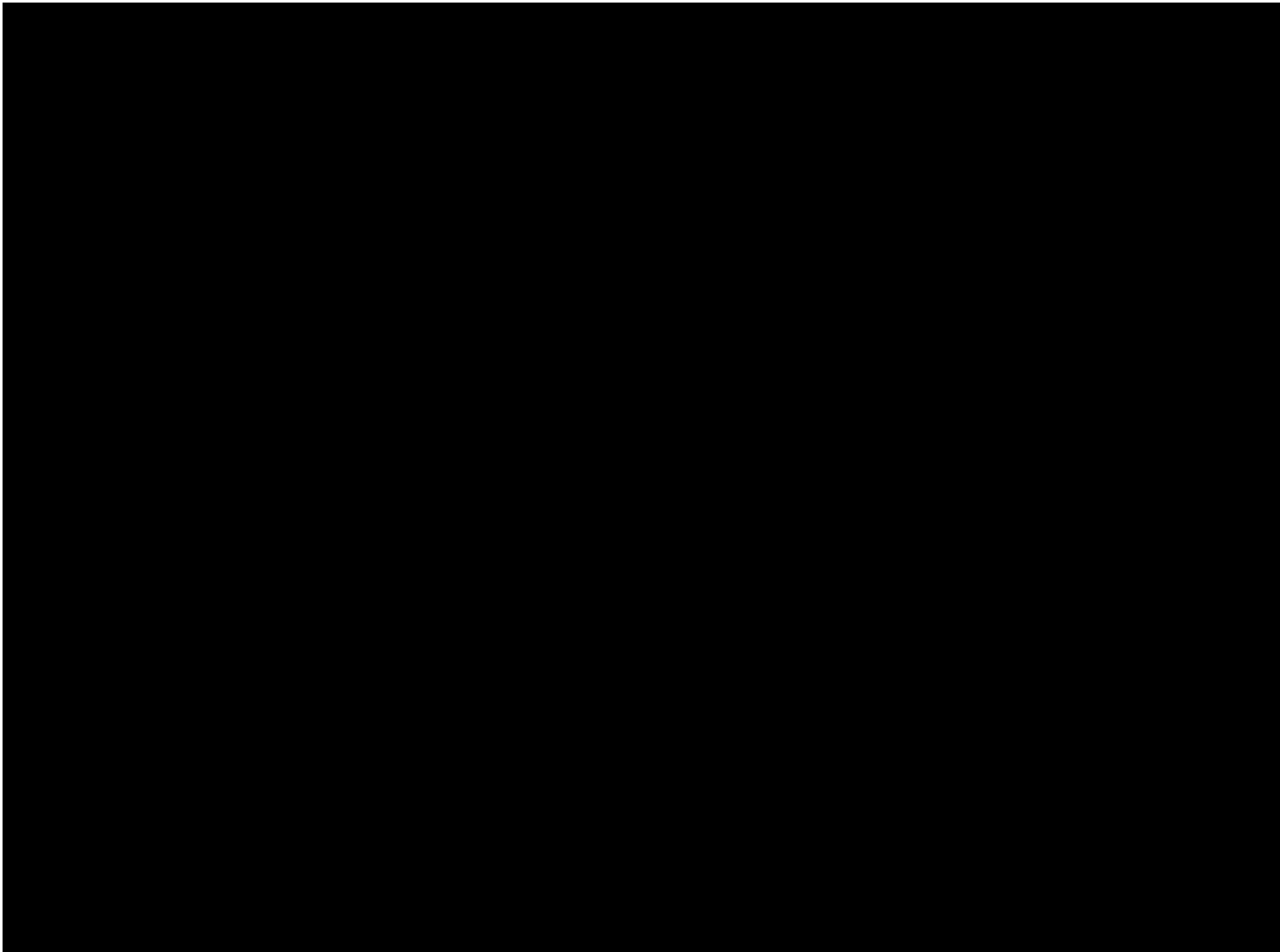
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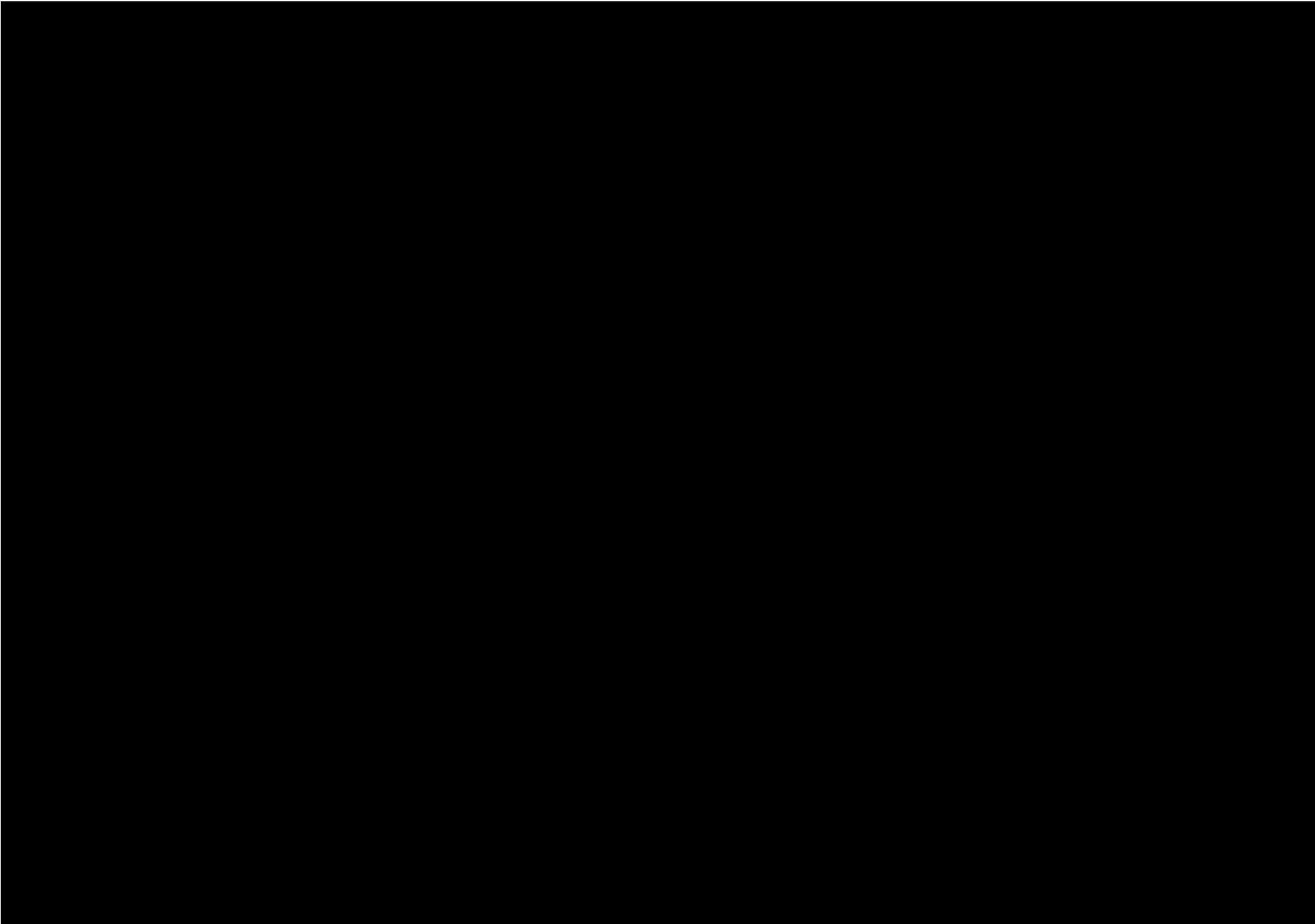
## **Appendix C – Site maps**

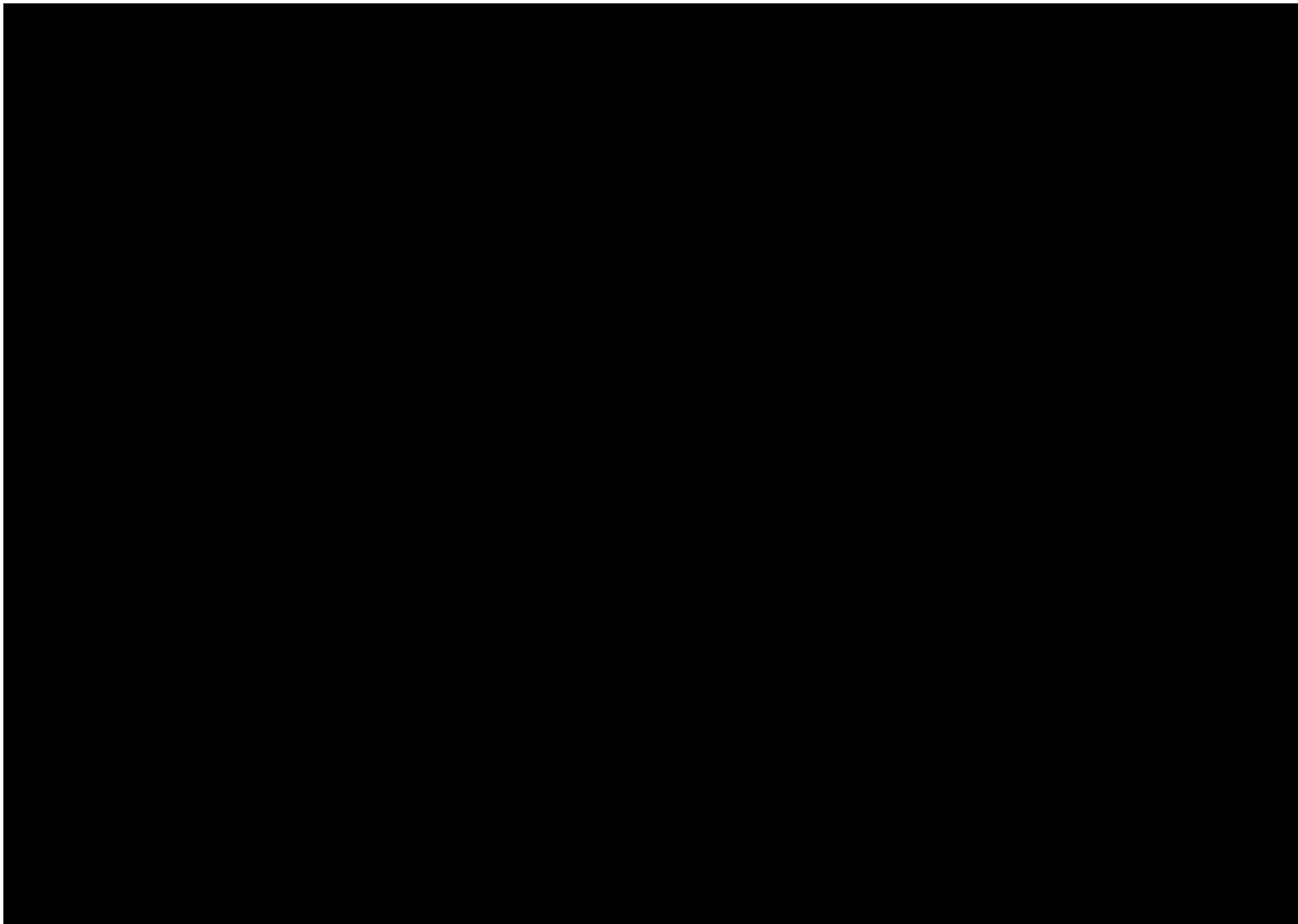
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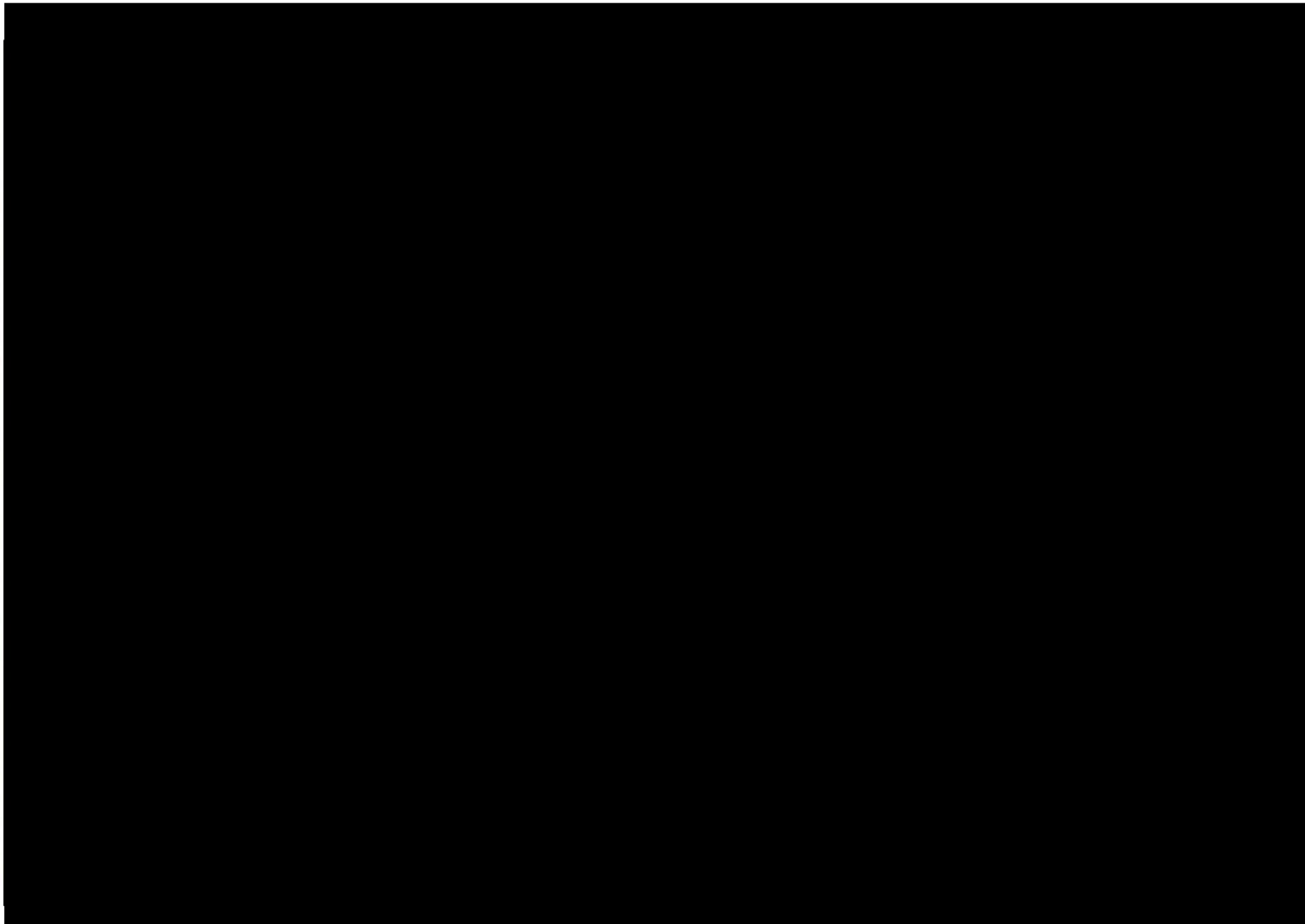


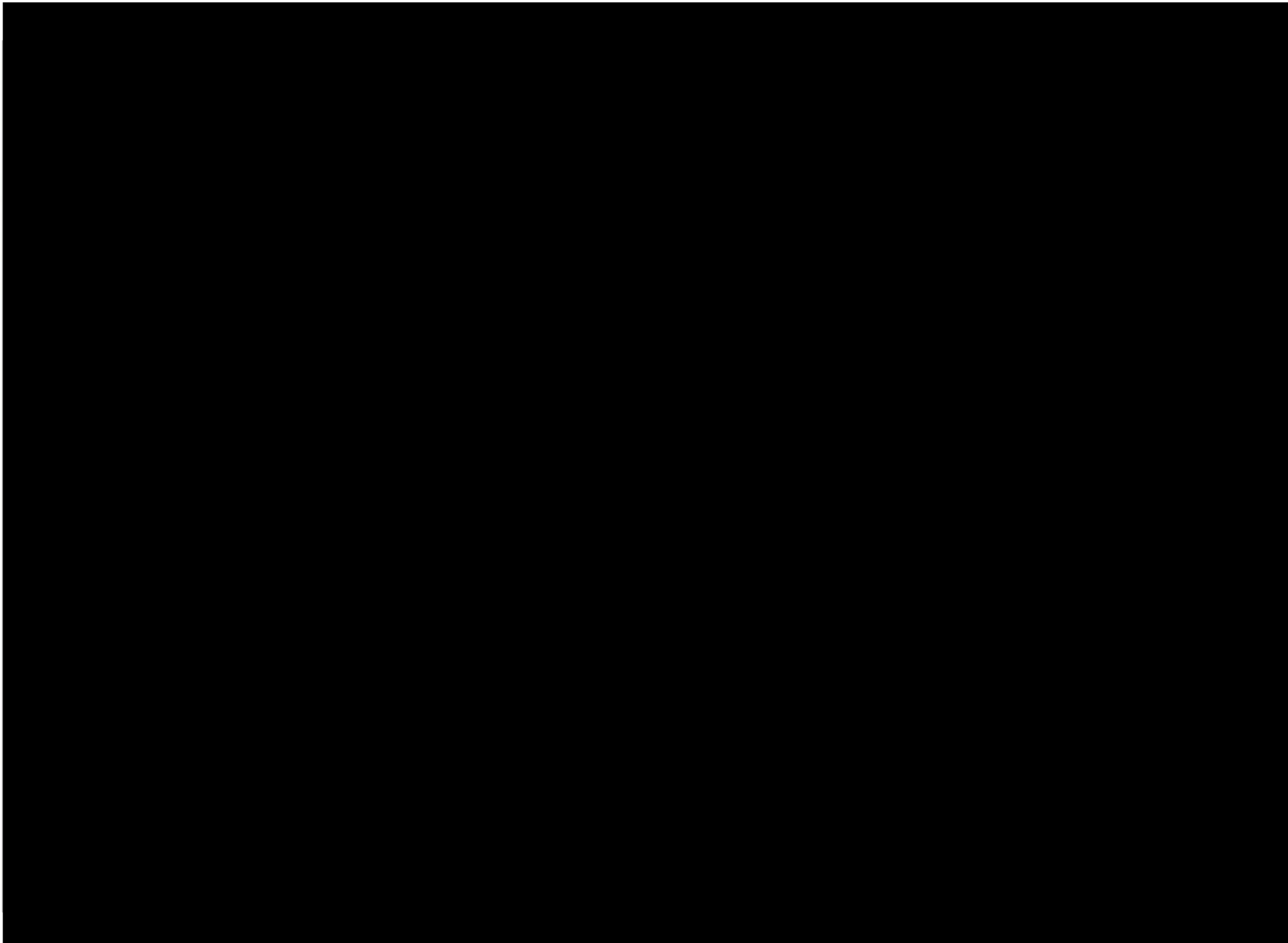












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## **Appendix D – Site photos**

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