Upper Waterhay Fritillary Meadow

Interpretation of the soils, hydrology and plant communities to inform the management needs for the site

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Report to the Floodplain Meadows Partnership

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Executive Summary

Upper Waterhay Meadow is a neutral alluvial floodplain hay meadow that supports a large population of snakeshead fritillary (*Fritillaria meleagris).* The meadow is situated in the floodplain of the Thames overlying a shallow aquifer-fed system on highly organic mid brown loam soils.

Hydrological and vegetation fieldwork: water levels, soil and shallow substrate characterisation, annual vegetation survey and NVC community survey between May 2015 to May 2017, has been brought together with historic data for the site, and interpreted, to develop an understanding of the eco-hydrological functioning of the site on which management decisions may be made.

A previous undated botanical survey (c. 2001) found the majority of the field to be species rich MG4b. Surveys from 2015-2016 suggest that the site presently supports a moderately species rich Burnet floodplain meadow (MG4b): *Alopercurus pratensis - Sanguisorba officinalis* grassland Typical sub-community with abundant *Fritillaria meleagris.* However the grass to herb ratio is high (70:30%), and species diversity decreases towards the north and west part of the site where the community grades into the Tufted hair-grass community (MG9). The vegetation also shows a really good ecotone grading into progressively wetter communities towards the south west corner.

There is a high component of clay in the substrate, and a hard dense layer close to the field surface may impede the easy movement of water. The results from water level monitoring indicate that the site may experience both lower than ideal winter and spring water levels in drier years yet, is also vulnerable to waterlogging from sustained high water levels in a wet year. Whilst the water levels experienced over the last two years do not cause an immediate threat to the community, if these sorts of levels are experienced more regularly, then they could cause a negative change in community to occur. It is therefore recommended that water level monitoring is continued at the site.

The nutrient levels are within the range that should support species rich MG4b or MG4a plant communities; the grassy nature of the sward may therefore simply be a symptom of past fertiliser application and/or the result of a late season hay cut. However, it is more likely that the MG9 community in the north part of the field reflects the clayey shallow substrate type and a tendency for waterlogging. An earlier hay cut is recommended, both to control the grassy element, but also to continue to reduce nutrient levels.

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1. Introduction

This report forms partial fulfilment of the requirements for the Floodplain Meadows Partnership Ambassador Training Course 2015-2017. The meadow was selected for study as the Wildlife Trust, in association with Natural England, wished to refine the understanding of the hydrological functioning of the site, and to assess if the present hydrological regime and management of the meadow is favourable in ensuring the conservation of the Burnet Floodplain Meadow MG4 community.

Upper Waterhay Meadow (2.8ha) is designated as a Site of Special Scientific Interest (SSSI) for its neutral alluvial floodplain grassland that supports a large population of snakeshead fritillary (*Fritillaria meleagris*) which flowers in the spring. The white colour form accounts for about 75% of the population, predominating over the more usual chequered purple form found on neighbouring sites.

The meadow lies on the Thames floodplain to the east of Ashton Keynes (SU068 937) within an extensive area of lakes formed from old gravel workings, and it is itself surrounded on all four sides by lakes, see figure 1.1 below

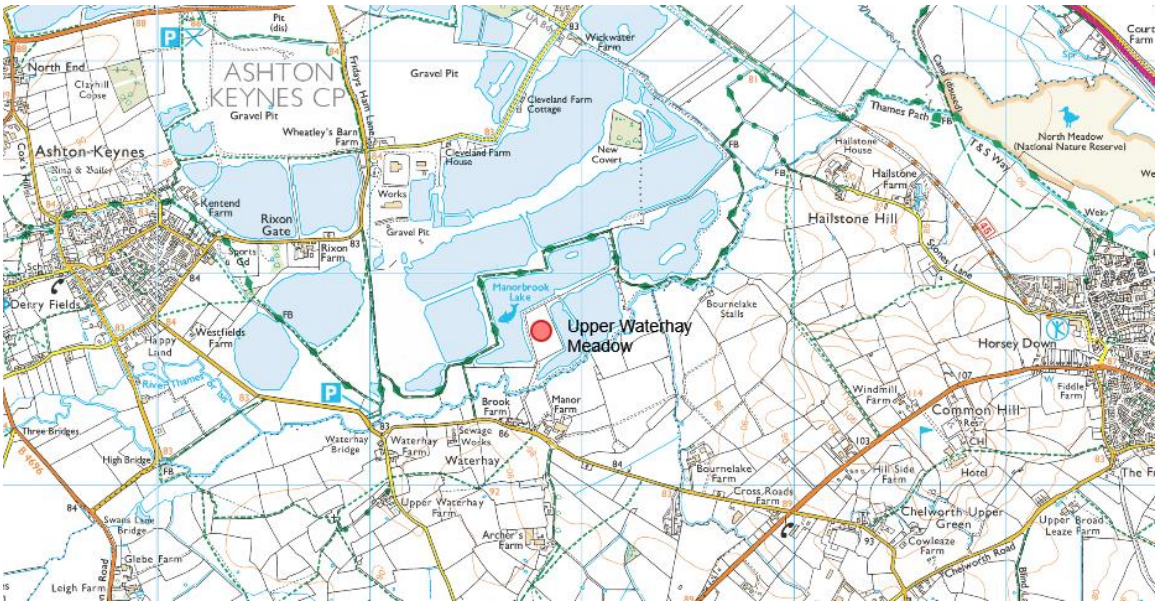

Figure 1.1: Location of Upper Waterhay Meadow (Ordnance Survey Map. ©Crown copyright and database rights 2017. Ordnance Survey 100022021.OS)

The SSSI is owned by the Wiltshire Wildlife Trust (WWT) and traditionally managed by cutting for hay. It is presently managed by a tenant under a Higher Level Stewardship (HLS) Scheme.

A series of field investigations were carried out during May 2015 to May 2017 to gain an understanding of the eco-hydrology of the site:

- Soil water levels – monthly monitoring of dipwells from November 2015 to May 2017.
- Soil and shallow substrate characterisation - to inform the interpretation of the hydrological functioning of the site.
- Annual vegetation survey - undertaken in July 2015 and repeated in June 2016 using permanent quadrats along a fixed transect to assess any change in the extent, location and composition of vegetation.
- NVC community survey – undertaken in June 2016.

Some historical data is also available for the site. An NVC survey was undertaken in 2001 by English Nature, see Annex 4.3 and a Water Level Management Plan was completed for the Environment Agency by Andrews Ward Associates in 2000.

The hydrological and vegetation fieldwork has then been brought together with, where relevant, the historic data, and interpreted to develop an understanding of the eco-hydrological functioning of the site on which management decisions may be made.

2. The site and its hydro-environmental setting

2.1 SSSI and present management

Upper Waterhay Meadow is located to the east of the village of Ashton Keynes (Figure 1.1) and lies in the floodplain of the Thames within an extensive area of lakes formed from old gravel workings; and it is itself surrounded on all four sides by lakes (Figure 1.1 and 2.1).

The wider floodplain area varies in height averaging from 90m to 70m AOD with the land sloping very gently towards the River Thames, although the field itself lies at 81.21 to 81.56 AOD (topographical survey undertaken by Gilman in 1999) and can be perceived as flat, see Figure 2.2.

It is a small 2.8ha snakeshead fritillary meadow owned by the Wiltshire Wildlife Trust. The meadow, surrounded by overgrown hedges and silted up ditches, (Figure 2.1) is managed as a hay meadow with limited aftermath grazing under an Environmental Stewardship Higher Level Scheme by a

tenant. An annual hay cut is taken quite late in the year, generally after the end of July, and the meadow is then occasionally aftermath grazed by 25-30 dairy cattle for a short period.

Figure 2.1: Aerial photograph showing the lakes surrounding the site (APGB Aerial photography © Bluesky International Ltd/Getmapping PLC.).

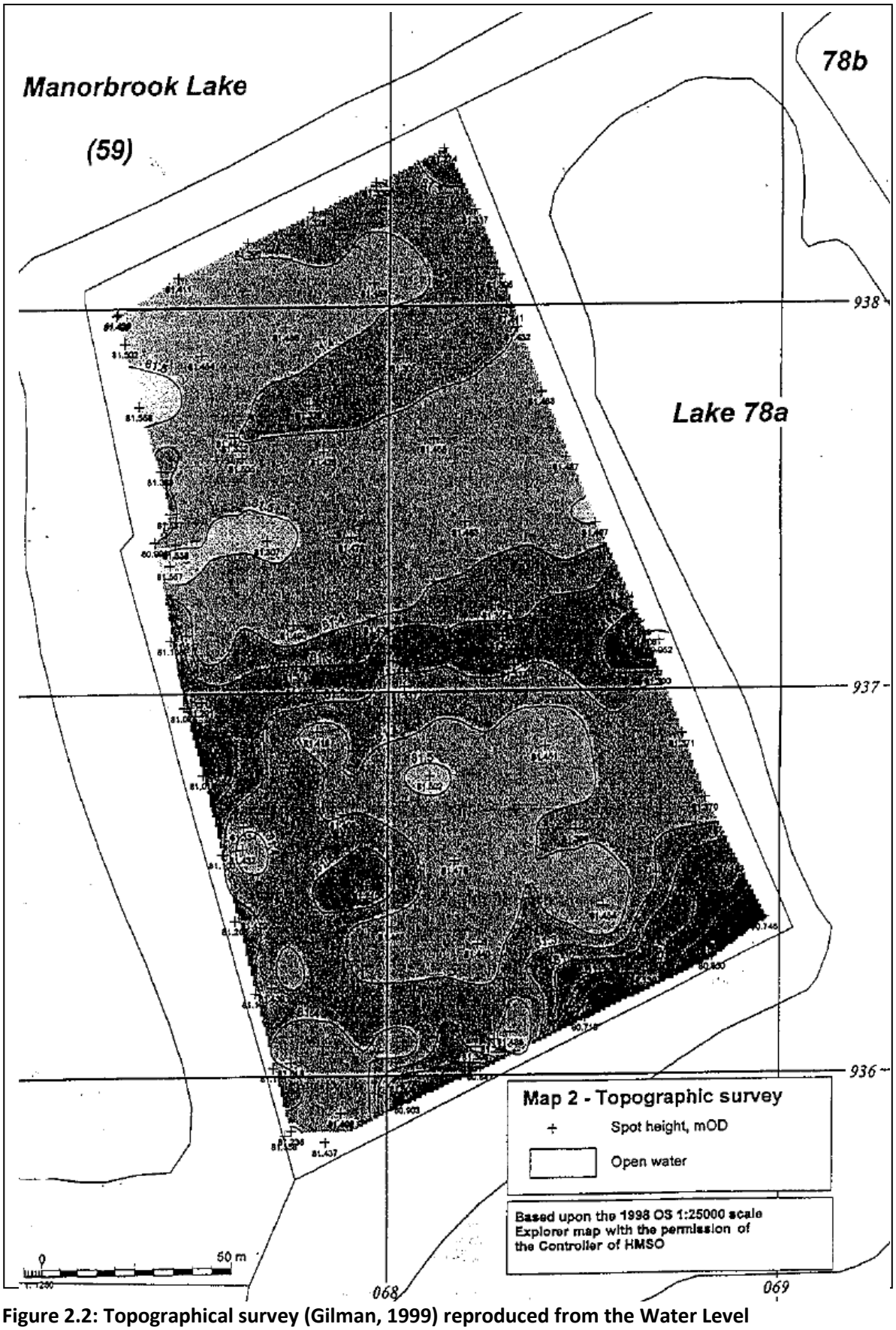

Figure 2.2: Topographical survey (Gilman, 1999) reproduced from the Water Level Management Plan (2000)

2.2 Geology

Geological information has been taken from the BGS's online Geology of Britain Viewer (see bgs.ac.uk) and from the Cotswold Waterpark Trust website 2017.

The key geological formation that underlies the area is the Jurassic Oxford clay formation. These impervious clays are overlain by extensive superficial deposits of river terrace sands and gravels up to 6m thick such as the Northmoor sand and gravel member (typically 50% gravel, 45% sand, and 5% fine materials (i.e. silt)) and up to 1.5m deep alluvium (clay, silt sand and gravel) and which were laid down by the River Thames during the ice-ages, see Figure 2.3.

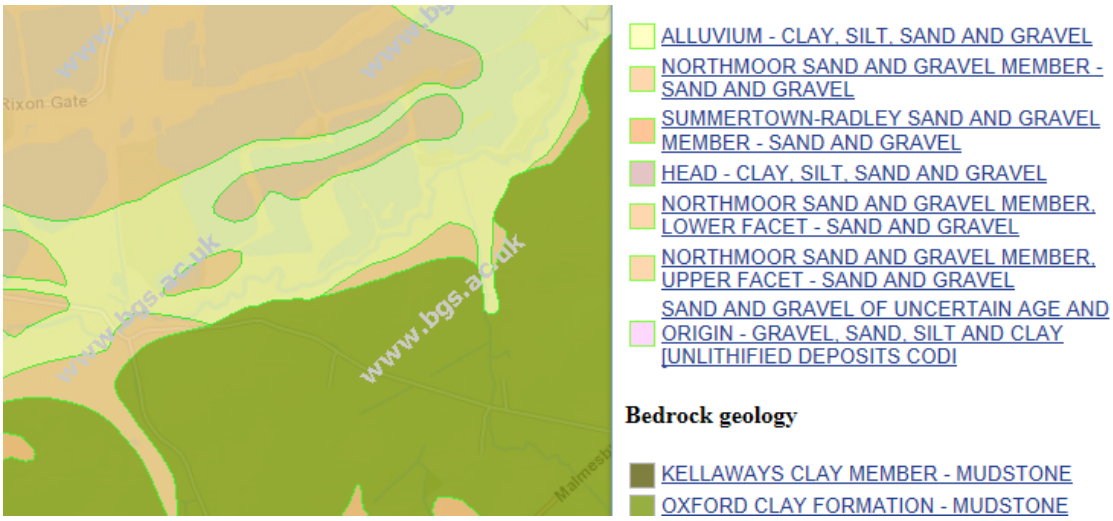

Figure 2.3 Extract from the BGS map (https://www.bgs.ac.uk/) showing the bedrock and overlying drift deposits.

The calcareous nature and the pattern and depth of these drift deposits have had a significant effect on the area through their varying influence on agricultural activity and the potential for mineral extraction and the meadow is now completely surrounded on all sides by lakes restored from old gravel workings (with the majority of the gravel extracted over the last 50 years).

2.3 Hydrology

Groundwater is closely linked to the geology and is present at two different depths which are isolated from each other by the Oxford Clay and other impermeable layers. The deeper water bearing oolitic limestone provides

the water bearing aquifers from which Thames Water abstract, one of those abstractions being located at Ashton Keynes.

It is, however, the 'shallow' groundwater in the sand and gravel drift deposits that lie above the impermeable Oxford Clays that provides the baseflow for the Thames (located 100m to the south) and interact with the lakes and wetlands in the area.

Under natural conditions, and similar to most shallow groundwater bodies, rainfall will provide the greatest influence on groundwater levels. During periods of heavy rainfall, the gravels and sands become saturated relatively quickly which can lead to localised flooding. Conversely, in periods of dry weather, the natural demands of the river often exceed the rate of replenishment causing groundwater levels to also fall quickly.

However, the lakes in the area, for which a constant level is maintained by over-spill pipes, provide a further influence on the hydrology that needs to be taken into consideration.

The meadow is completely surrounded by lakes: Manorbrook Lake lies to the west and north and Lake 78a lies to the south and east, see figures 2.1, 2.4 and Annex 1. It is also the relationship between the water levels in the lakes and the groundwater level in the meadows that is still unknown.

Ditches bordered by overgrown hedgerows also occur along three sides of the meadow, to the south, east and west. These have, however, pretty much silted up and the ditch base is only 0.2 to 0.4m below the level of the field. The ditches to the south and east hold water most winters but the ditch to the west only holds water in a wet year.

The ditches drain to the south east corner of the field and are connected to the River Thames that lies some hundred metres to the south of the meadow although, again, this ditch is also silted up. Historically, a ditch may have also been present along the northern boundary but, if so, this ditch has totally silted up and is now dry all year round.

Figure 2.4: Plan showing the lakes and ditches around the meadow (map derived from Ordnance Survey. © Crown copyright and database rights 2017. Ordnance Survey 100022021.OS)

3 Hydrological Monitoring

3.1 Method

Water level (soil water table elevation) was measured from one dipwell located fairly centrally within the meadow, just to the north of a relic drain that crosses the site.

The dipwell is 0.60m long, 475 mm outside diameter, 425 mm inside diameter PVC tubing encased in a stocking to reduce silt ingress with a cap at the top and tied at the base. The tube has 5 mm wide holes cut at 100mm centres along the length to allow easy water ingress. The dipwell was pushed into, and fits very snugly, into a 500 mm diameter hand-augered hole to a depth of 0.63m where hard (impenetrable) gravel deposits were encountered. The top of the dipwell is 0.08m below the field level and turf was replaced on top of the well. A second dipwell (D2) was

installed towards the end of the monitoring period to a depth of 0.70m (the top 0.09m below the field level).

This arrangement allows easy exchange of water between the dipwell and the surrounding formation, and therefore water levels measured in the dipwell are a good reflection of water levels in the adjacent soil.

The locations of the two dipwells, one installed on the 19 of November 2015, and the second on the 11 November 2016, is shown in Figure 3.1, below, along with the locations of the soil profiles.

Figure 3.1: Aerial photograph showing the location of the dipwells (blue dots) and soil cores (orange and blue dots).

Recordings were taken monthly between November 2015 and May 2017. The coordinates for the dipwells and water level measurement details are given in Annex 2.

A sedimat was placed in a location that reflected the main (MG4b) plant community (between dipwells 3 and 4) over the winter of 2015-16 and again in 2016-17.

It should be noted that 2015 was a dry summer (close to a drought) going into a wet winter with a sustained high water table well into the spring of 2016 followed again a dry summer going into a dry winter.

3.2 Results

One year of data, June 2016 to May 2017 was analysed from dipwell D1 using the Floodplain Meadows Partnership hydrotool (http://www.floodplainmeadows.org.uk/about-meadows/restoration/evidence-base). Assessment of the soil water levels (number of dry weeks to those wet) for this one year would suggest that the site is generally too dry to support the typical MG4 plant community that appears to be present on the majority of the site (and corroborated by the output from the MAVIS tool, see section 5.2). The closest the water table has come to the field surface over this time period is 0.41m in February 2017.

However, it should be noted that this is based on monthly recordings for an isolated single year data set (and a very dry year at that) and a longer data set with respect to water levels is needed to confirm that the hydrology can support the fritillary meadow in the long-term. However, it does highlight that, **in at least some years, the hydrological conditions are less than ideal** to maintain the MG4 Typical community.

Extrapolating the data (and making assumptions based on rainfall (see Annex 3 for rainfall records at Kemsey) for the months where data is missing, then 2 years of data from June 2015 to May 2017 can be analysed using the hydrotool. This results in 39.1 weeks wet and 4.3 dry which then does place the site within the hydrological conditions suitable for supporting the MG4 community.

Due to the importance of the hydrology in maintaining this site it is recommended that water levels are continued to be monitored for at least one further year, and ideally for 3 further years.

An analysis of local bore hole water levels may also be useful in determining how far the water level generally drops in summer although the occurrence of the lakes may make extrapolation of this data difficult for this site. Further investigation of the relationship of the water level in the lakes and that in the site and how much the water level in the lakes effects the ground water level across the site is also needed.

The Environment Agencies Water Level Management Plan[1] (2000) for the site reports that K Gilman undertook a hydrological study in 1999 which showed a more or less constant water table level across the site with differences in wetness being due to ground level. The assessment of data from 7 dipwells located along the southern and western boundaries and monitored for 5 years from 1994 'indicated that the average seasonal range of water should be approximately 0.4m reaching 0.7m in drought years. Gilman considered that there was no evidence for a perched water table independent of the water level in the underlying gravels or for a pronounced gradient of water level across the site. Manorbrook Lake and Lake 78a are both likely to have a significant influence on the water regime within the SSSI and Gilman suggests that flooding from the Thames also is an important feature.'

Comparing the observed data (Nov 2015 to May 2017) with the water level requirements given by Wheeler et al 2004[2] suggests that the water level regime is generally suitable for supporting the MG4 community over the winter months with the water levels lying within or close to the 'ideal' range. The water levels recorded in January and February 2016 are, however, at the very limit of the ideal range, and may suggest that in a wetter year the site may suffer from waterlogging. This is also supported by the mottling found in the soil profile (see Section 4) suggesting that the wet winter with sustained high water table well into the spring is not an isolated event; and the Water Level Management Plan (2000) also reported that the 'water table is seasonally close to the surface with waterlogging and flooding being typical of this site'.

The water levels recorded from January 2017 to April 2017 are at the opposite outer limit of the ideal range – that of the site being too dry - (and

as also indicated by the hydrotool outputs for the whole year). Provided these year to year conditions are not 'the norm' but only occur occasionally in a longer climatic cycle then the hydrological conditions are likely to sustain the MG4 community.

It is recommended that water level monitoring is continued to be undertaken over a period of 3-5 years to confirm this.

Figure 3.2 Photograph of water lying in the south east corner of the site. Whilst surface water lays here in most winter this photograph shows the extent of flooding from Lake 78a in February 2016.

Observations (from monthly visits) of the soil moisture conditions, water levels in ditches and standing water on the site throughout the year suggests, that whilst the site lies within an area classified as functioning floodplain, the whole site rarely floods, and if it does then the duration is very short. A sedimat, placed in a location that reflected the main community (MG4b), was not subject to flooding.

The ditches are predominantly silted up although the ditch along the southern boundary holds standing water most years and the ditches along

the west and east boundaries hold water in wetter years. These all dry up by mid-summer.

A small pond (contains water all year) occurs in the south east corner of the meadow and surface water lies on the adjacent area most winters (reflected in the wetter sedge rich plant community found here). In a wet year this area floods from the adjacent lake, Lake 78, see Figure 3.1 above.

A relic drain across the centre of the field also holds occasional surface water pools most winters. Splashy conditions occur at the north east corner of the site and also close to the northern boundary in most winters and surface water will also lie here in a wet winter.

For most of the site, (and over which the main community lies) the soil is generally dry with some damper areas (where water rises under pressure) in most winters. The even occurrence of the buttercups (*Ranunculus* spp.) and great burnet (*Sanguisorba officinalis*) along with the snakeshead fritillary (*Fritillaria meleagris*) and the generally low occurrence of Meadowsweet (*Filipendula ulmaria*) within the main community across the majority of the site suggests that the main area of the site is not waterlogged for a sustained period.

4 Shallow substrate hand-auger survey

4.1 Method

Soil profiles were taken across the meadow using a 1.2m 50mm diameter auger on the 22 November 2015, 15 April 2016 and the 11 November 2016. Six sample points were chosen to get a reasonable coverage across the field, see Figure 3.1. For each profile, the depth of the darker surface horizon and the depth to sand and/or gravel were measured, and any mottling of grey/brown (which indicates a fluctuating water table) was noted. The results are presented in Annex 4.

The river level was fairly normal, and there had been no significant rainfall or recharge of the groundwater prior to both the November 2015 samples (D1, 3 and 4); and the river level was low, with again no recharge of the groundwater levels prior to the November 2016 sample (D2). Water levels were receding at the time the April 2016 samples were taken (5-6).

4.2 Results:

The soils are mostly highly organic mid brown loams on brown to blue grey clays over chalky sands and gravels

The general profile of the shallow substrate across most of the field (see figure 4.1) is a 0.1 to 0.2m thick layer of calcareous (pH 6.6-7) mid to dark brown highly organic clay loam on a band of clay generally 0.25 to 0.3m thick. The upper 0.1m of this layer is very hard and dense suggesting that

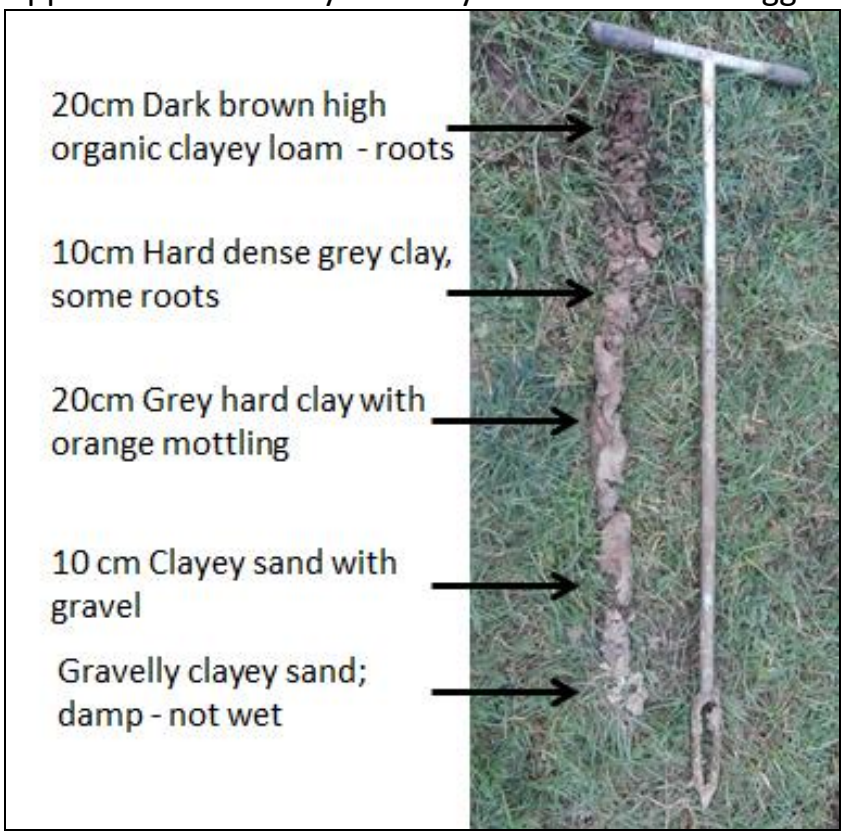

Figure 4.1 Soil profile from core 4 is indicative of the shallow substrate across most of the site

the field may have suffered from some compaction in the past and may impede the easy movement of water. This may be why *Ranunculus repens* (Creeping buttercup) occurs across the site when it appears dry for much of the year and *Sanguisorba officinalis* is abundant. The clays then overlay sands and gravels with a hard impenetrable bedrock deposit of chalky clayey, sandy gravels occurring at 0.6 to 0.7m. The high component of clay in the substrate means that it will be relatively poorly permeable.

The profile varied in the northern part of the field (cores 5 and 6) where the soil layer was 0.05m of loamy clay on 0.2-0.25m clay over a chalky gravel bedrock at only 0.3-0.35m. These cores also corresponded to an area with

poorer species diversity and only the rare occurrence of Fritillary. The very hard mottled clay also suggests that the field is subjected to some long periods of waterlogging or poor drainage.

5 Nutrients

Soil samples were taken from two areas of the meadow, but both within the main community type, one south of the relic drain and one to the north. The Olsen P from the sample to the south of drain was 14mg/kg P, and the sample from the grassland to the north of the drain was higher in Olsen P – 19mg/kg P. This range of plant available phosphorus is well within that that will support a good typical floodplain community and is reflected in the moderately to good species richness of the sward. Research shows that species richness declines above 20mg/kg P (David Gowing 2016[3])

The Ellenberg nutrient level across both areas is 5-5.1 and then in the relic drain and the wetter area they are at 5.7 and 5.9 respectively and higher again in the swamp 6.25.

Although the site has been managed without fertiliser inputs since 1985 when it was notified as a Site of Special Scientific Interest it is thought that it was agriculturally improved using manure applications prior to this date.

We can only assume that fertility has gradually decreased with the management since then, especially as grazing of the site is haphazard but there are no previous soil nutrient records to confirm or disprove this. It is also notoriously difficult to reduce phosphorus levels, as unlike nitrogen it becomes locked onto soil particles. Whilst parts of the sites are therefore close to being too fertile to support a species rich floodplain meadow community nutrients at this site are unlikely to be the main/only reason that would limit species diversity.

6 Vegetation survey

6.1 Rationale and field survey

The description of the vegetation and its eco-hydrological interpretation are based on walkovers, field notes, analysis of five permanent quadrats and the interpretation of additional quadrat data. The choice of location for the

quadrats was based on a visual interpretation of the distribution of the flora across the site.

A transect was established from south to north across the site and five permanent 1m x 1m quadrats were set up along this transect at fairly regular spacing and all located in what visually appeared to be a similar, and the most species-rich, floodplain plant community present.

The plants seen in each permanent quadrat (QT1-QT5) were listed and their percentage cover recorded on 11th July 2015 and again on the 9th June 2016. Plants seen in additional quadrats located across the site (QSE1-QSE2, QD1-QD3, QN1-QN2 and QW1-QW2) were listed and their percentage cover recorded on 9th June 2016. The location of each quadrat, see Figure 6.1a and b, was measured using a mobile application *Topographer*, indicating accuracy of between 0.5-1 metres.

The NVC constancy values were input to MAVIS and the Ellenberg values were also calculated to help inform the analysis. The percentage cover, NVC constancy tables and MAVIS outputs for the quadrats are presented in Annex 5.1

Figure 6.1a: Aerial photograph showing the location of the quadrats sampled across the site. The permanent quadrats, QT1-QT5, (green dots) are located along a south–north transect and are located within the main Fritillary community on the site. Quadrats QN1-QN2 and QW1-QW2 are located in the 'drier' more grass dominated sward in the north and west of the site (yellow and orange dots). QD1-QD3 occur along the relic ditch through the centre of the site. QSE1-QSE4 (blue dots) are located in the sedge dominated community adjacent to the pool in the south east corner of the site and QP1 is located in swamp vegetation. This area is also shown in greater detail below, (APGB Aerial photography © Bluesky International Ltd/Getmapping PLC.).

6.2 Results

Figure 6.2: Aerial photograph annotated to show the different plant communities within the meadow. (APGB Aerial photography © Bluesky International Ltd/Getmapping PLC.).

The meadow is very flat but in terms of the plant community there appears to be a gradient from south to north with the flower species in the sward to the north (beyond Q5) being visually less abundant and with greater grass cover. The snakeshead fritillary (*Fritillaria meleagris*) and great burnet (*Sangiusorba officinalis*) are, however, distributed throughout.

There was an average of 19 species per quadrat in the main community with a good range of grasses and herbs. Whilst it is a very grassy sward (see figure 6.3) with creeping bent (*Agrostis stolonifera*), rough meadow grass (*Poa trivialis*) crested dogs tail (*Cynosurus cristatus*), meadow foxtail

(Alopercurus pratensis), sweet vernal-grass (*Anthoxanthum odoratum*); herbs include common knapweed (*Centaurea nigra*) meadow vetchling (*Lathryus pratensis*), ladies bedstraw (*Galium verum*),ribwort plantain (*Plantago lanceolata*), sorrel (*Rumex acetosa*) and occasional meadow rue (*Thalictrum flavum*). Both great burnet and snakeshead fritillary are frequent throughout the sward.

Figure 6.3 Photograph of the sward taken in late June 2015.

Wetter plant communities occur in the south east corner adjacent to a pool (which contains water all year), along the relic drain in the centre of the field and also in the north east corner of the site which also appears to regularly inundate, see figure 6.2.

Species diversity decreases in the northern part of the site with an average of only 14 species per quadrat. The Ellenberg value for moisture (5.3) indicates that this community is a slightly drier community than that across the main part of the site. This may reflect the fact that this part of the field is drier for longer or the fact that it suffers from longer periods of waterlogging due to the greater clay component in the soils and the shallow profile (0.3-0.35m) to the gravels.

Looking at the output from MAVIS (see Figure 6.4) the fit is strong to a Burnet floodplain meadow (MG4) *Alopercurus pratensis-Sanguisorba officinalis* grassland community (at around 70%) but the actual fit to a sub-community is more ambiguous with the Yorkshire fog (*Holcus lanatus*)-sub-community (MG4c), Typical sub-community (MG4b) and MG4v2 all within 1% of each other.

Plant Community	Main Area	North part of the site	Wetter area	Relic Drain	Swamp
MAVIS NVC best-fit	MG4c 70.31 MG4b 70.19 MG4v2 69.56 MG4a 62.63 MG4d 60.04 MG6d 58.80	MG4c 62.81 MG4v2 60.61 MG9 60.37 MG9b 58.68 MG9a 57.75	MG15a 54.51 MG13v2 50.58 MG10c 48.44 MG4d 46.93 MG16 43.77	MG15a 62.69 MG4d 62.25 MG15 60.18 MG4c 58.79 MG15b 56.19	S5 or S28
Ellenberg Moisture	5.6	5.3	7.2	6.4	9
Ellenberg nutrients	5.1	5	5.9	5.7	6.25
Olsen P	14 19	No data	No data	No data	No data

Figure 6.4: Table showing the NVC communities attributed by MAVIS and the corresponding Ellenberg values for moisture and nutrients.

Based on the diversity and abundance of the species recorded including the snakeshead fritillary, creeping buttercup, sorrel, sweet vernal-grass, common knapweed, ribwort plantain, smooth brome (*Bromus racemosus*) and dandelion (*Taraxacum* spp.), and also considering the soil nutrient levels and the hydrology the community present is most likely the Typical sub-community, MG4b.

This is compared to the community in the northern part of the site which has an NVC best fit to the Yorkshire fog sub-community (MG4c) at 62.81 but also suggests affinity to the Tufted hair-grass (*Deschampsia cespitosa*) community (MG9). MG4c has a high percentage of grasses and is generally associated with a higher water table during the growing season whilst MG9 occurs where soil drainage is slow and may have standing water over the winter. From the monitoring undertaken, and also field observations, it is more likely that the site conditions would more likely support MG9 even though tufted hair-grass is not typical in the sward. This species is, however, possibly suppressed by the cutting regime.

The MG4b community grades into a wetter grassland community: Cuckoo flower grassland (MG15a) *Alopecurus pratensis-Poa trivialis-Cardamine pratensis* grassland (MAVIS best fit: 54.51% with an Ellenberg moisture value of 7.3) in the south east corner and then swamp adjacent to a pool (Ellenberg moisture value of 9). Splashy conditions/areas of surface water lie here every winter. The description for MG15a appears to accurately reflect the community (and conditions) found with sedges: slender tufted sedgepond sedg (*Carex acuta*) and brown sedge (*Carex disticha*) constant and also ragged robin (*Lychnis flos-cuculi*), creeping jenny (*Lysimachia nummularia*) and meadowsweet (*Filipendula ulmaria*) occurring.

The MAVIS output for the vegetation along the relic drain indicated either MG15a at 62.69% or MG4d at 63.45%. This community was more like a species-poor version of the main community so more likely the Burnet Creeping bent sub-community MG4d than MG15a. The Ellenberg value for moisture of 6.4 reflects the damper conditions of this lower lying area.

An analysis of any changes in the % cover of plants in the permanent quadrats (QT1-QT5) between 2015 and 2016 was also undertaken, see Annex 5.2, but no significant changes in the cover of individual species was identified either, for the better, or indicating a negative trend. An attempt to compare historic vegetation data for the site with the 2016 survey data has been made and is presented in Annex 5.3. Running the historic data (Constancy tables from an NVC survey thought to have been undertaken in 2001) through MAVIS, again, produces ambiguous results with respect to the sub-community present at that time: MG4b 70.27%, MG4c 69.70% and MG4v2 69.12%. At first glance, it therefore suggests that the NVC community on the site has not really changed between this survey and 2016 (MG4c 70.31%, MG4b 70.19% and MG4v2 69.56%). However, it may be more telling that at the time of the previous survey the whole area visually appeared homogenous (and was sampled as one community stand) and yet in 2016 there appeared to be a definite gradient of increasing abundance of grasses towards the north (and west) and this is corroborated by the quadrat surveys which indicate that a different plant community does now exist in the northern part of the field.

Looking at individual species then the big increases appear to be False oat-grass (*Arrhenatherum elatius*), creeping buttercup (*Ranunculus repens*), meadow vetchling (*Lathyrus pratensis*), tufted vetch *(Vicia cracca*) , and the big decreases: red clover (*Trifolium pratense*), crested dogs-tail (*Cynosorus*

cristata), meadow foxtail (*Alopecurus pratensis*), perennial rye-grass (*Lolium perenne*) and meadow buttercup (*Ranunculus acris*). Whilst the data sets are not directly comparable (refer to Annex 5.3) and any inferences made must be used with caution these findings do suggest that the community has changed, at least over part of the site and warrants further investigation.

The earlier survey described both the wetter area in the south east corner and the vegetation along the relic drain as MG4b degraded. The difference between the earlier survey and 2016 may simply be due to only one quadrat being located in the wetter area in the SE corner. Alternatively it has become wetter. Again, the fact that visually these two communities appeared the same at the time of the earlier survey and in 2016 they appeared distinct may suggest that the community has indeed changed. The slender tufted sedge (*Carex acuta*) and floating sweet-grass (*Glyceria fluitans*) were both absent in the earlier survey which indicates that the area is now wetter.

Reviewing all of the findings together suggest that, provided the hydrological conditions are suitable, then it should be possible to enhance the existing area of MGb and may be possible to restore a greater area to MGb.

In the spring the meadow is a picture, see Figure 6.5, with abundant snakeshead fritillary. Other plant species in flower at this time of year are cuckoo flower, dandelion, meadow foxtail and bulbous buttercup (*Ranunculus bulbosa*). A typical count of the fritillary plants in an area where the fritillary appears abundant (the quartile towards the relic drain and then north of the relic drain to the second relic drain) is 55-65 plants per 1m quadrat. Elsewhere, where the fritillary still occurs, it is less abundant and averages at 30 plants per 1m quadrat.

Figure 6.5: Photograph of the snakeshead fritillary

7 Summary: ecohydrological description

The wet floodplain habitat at this site is supported by a shallow aquifer-fed system. Whilst rainfall will normally have the largest influence on the ground water levels of the site, the meadow is surrounded by lakes which are maintained by over-spill pipes at a set water level. This may well buffer the site from the effects of summer drawdown by the river (Thames) and maintain higher than 'normal' ground water levels in the summer months (and or/over a dry winter). It was not, however, possible to confirm this from the monitoring undertaken.

The site presently supports a moderately species rich Burnet floodplain meadow (MG4b): *Alopercurus pratensis - Sanguisorba officinalis* grassland Typical sub-community with abundant *Fritillaria meleagris.* However the grass to herb ratio is high (at least 70:30%), and species diversity decreases towards the north and west parts of the site where the community grades into the Tufted hair-grass community (MG9). The vegetation shows a really good ecotone towards the south west corner of the field, grading into a wetter community, Cuckoo flower grassland (MG15a) *Alopecurus pratensis-Poa trivialis-Cardamine pratensis* grassland and then swamp adjacent to a pool where splashy conditions occur for most of the year. Vegetation along the lower lying relic drain is the MG4d Creeping bent sub-community.

The nutrient levels, although relatively high (Olsen P is 14 to 19), are within the range that should support species rich MG4b or MG4a communities. The water level monitoring data, however, suggests that the site is subject to less than ideal hydrological conditions, at the very least, occasionally, and possibly more frequently. The soils are mostly highly organic mid brown loams on brown to blue grey clays over chalky sands and gravels and bedrock occurring at 0.6-0.7m over much of the site. The shallow substrate decreases to 0.3-0.35m deep in the north of the site where loamy clays occur. The high component of clay in the substrate means that it will be relatively poorly permeable and the occurrence of a hard and dense layer within the clay suggests that the field may have suffered from some compaction in the past and may impede the easy movement of water over at least some parts of the site.

The results from the water level monitoring suggests that the site can experience both lower than ideal winter and spring water levels in drier years yet, parts of the site will also be vulnerable to waterlogging from sustained high water levels in a wet year.

Further monitoring is needed to confirm that the hydrological regime is sustainable to support the MG4 community at this site in the long-term. The site appears to be vulnerable to both waterlogging from sustained high winter water levels in a wet year and then from lower than ideal winter water and spring levels in dry years. Whilst the water levels experienced over the last two years are unlikely to cause an immediate threat to the community, if these sorts of levels are experienced more regularly, then it could cause a change in community to occur.

As the unquantified threat may be that the site is actually too dry for too long, reinstating the ditches could actually exacerbate this issue. On the other hand, (which would be a greater threat) the site may experience waterlogging in the winter as occurred in 2015/16 on a more regular basis and also evidenced by mottling seen in the soil profile, but again, a longer length of data from water level monitoring is required to confirm or disprove this.

The slightly high nutrient levels and the grassy nature of the sward may simply be a symptom of the past application of fertilisers which is known to have occurred up to 1995 and/or may reflect the fact that the hay cut occurs late in the year. However, it is more likely that the MG9 community

in the north part of the field reflects the clayey shallow substrate type and a tendency for waterlogging. An earlier hay cut is recommended, both to control the grassy element but also to continue to reduce nutrient levels. It is also recommended that water level monitoring is continued at the site.

There is also a need to understand the relationship between water levels in the lake(s) and on the site and this could be done by siting a stilling well or gauging board (or simply GPS?) in Lake 78a and potentially also Manorbrook Lake and another dip well in the ditches or outside the site.

8. Recommendations

1. A Hay cut should be taken earlier in the year (between late June and early July).

2. The area of MG15a habitat should be monitored. The site presently exhibits a really nice ecotone of wetland communities from MG4b to MG15a to swamp and an open pool, but the analysis of historic data and anecdotal evidence suggests that this area has got wetter over time and is also gradually increasing in size to the detriment of the MG4b community. If this is the case, then it may be necessary to consider reinstating the ditches to enable the site to drain more quickly. It should also be noted that the section of ditch between the site and the river is also silted up and this is also not in WWT's ownership. An alternative may be to raise the area between the field and Lake 78a to reduce the impact of the Lake flooding on the site, however, it should be noted that this land is also outside of WWT ownership, figure 3.2.

   Prior to taking this course of action, the impact of desilting the ditches on the whole site must, however, be considered carefully. Based on the, albeit short length of, water level monitoring data suggests that the site may experience drier conditions than ideal.

3. It is therefore recommended that water level monitoring is continued.

4. Repeat monitoring of the two transects established to monitor the fritillaries should be undertaken.

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I would also like to thank Ellie Jones (Wiltshire Wildlife Trust) and Robert Howells, Philippa Mansfield, Lou Webb and Isobel Whitwam (Natural England) for helping me to undertake various elements of the survey.

The field with standing water in relic drain

S Boundary hedge and ditch (Mar 2016)

Southwest corner looking north

Manorbrook Lake

Northwest corner looking east

Northeast corner looking south

Lake 78a

Southeast corner looking west

The Thames

Annex 1: The meadow and its environs

Photos taken Feb 2017

unless stated

Annex 2: Water levels

DETAILS OF DIPWELL INSTALLATIONS				
Name		D1	D2	
Easting		406803	406815	
Northing		193728	193663	
Elevation		86.99	84.71	
Date of Installation		22 Nov	11 Nov	
Depth to base of dipwell		63cm	70cm	
WATER LEVEL RECORDING				
Name		D1	D2	
	Date	Depth to Water Table (cm)		
	22-Nov	Dry		
	18-Dec	Dry		
	05-Jan	Not recorded		
	07-Feb	18.5		
	18-Mar	44		
	15-Apr	38		
	15-May	46		
	09-Jun	Dry		
	09-Jul	Dry		
	09-Aug	Dry		
	09-Sep	Dry		
	09-Oct	Dry		
	22-Nov	Dry	Dry	
	19-Dec	Dry	68	
	13-Jan	61	59	
	03-Feb	41	40.5	
	23 Mar	53	56	
	14 Apr	59	61.5	
	28 Apr	Dry	64	
	31 May	Dry	70	

Annex 3: Rainfall data for Kempsford June 2015 – February 2017

Station name	KEMPSFORD
Station number	250123
External number	---
River	---
Operator	---
NGR	SU148972
Easting	414800
Northing	197200
Parameter-name	RS [Rainfall Storage]
Parameter Type	Precipitation
Time series name	THM/250123/RS/WDay.Total.P
Time series unit	Mm
Time level	Daily
Time series type	Total
Equidistant time series	Yes
Time series value distance	1 day
Time series quality	Production
Time series measuring method	---
Period of record in file: 01/03/2008 09:00:00 to 28/02/2017 09:00:00	
Quality code description	Data Unchecked. T = trace
Time stamp	Value[mm]

June 2015	mm
01/06/2015 09:00	5
02/06/2015 09:00	1.6
03/06/2015 09:00	0.1
12/06/2015 09:00	3.6
13/06/2015 09:00	4
14/06/2015 09:00	T
20/06/2015 09:00	T
21/06/2015 09:00	T
22/06/2015 09:00	T
26/06/2015 09:00	2.1
27/06/2015 09:00	0.1
28/06/2015 09:00	1.5
29/06/2015 09:00	T
30/06/2015 09:00	0.5

July 2015	mm
02/07/2015 09:00	T
03/07/2015 09:00	5.1
04/07/2015 09:00	T
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06/07/2015 09:00	1.5
07/07/2015 09:00	0.7
08/07/2015 09:00	T
11/07/2015 09:00	1.1
12/07/2015 09:00	2.2
13/07/2015 09:00	0.4
14/07/2015 09:00	2.2
16/07/2015 09:00	0.2
17/07/2015 09:00	0.1
18/07/2015 09:00	0.6
20/07/2015 09:00	T
22/07/2015 09:00	T
23/07/2015 09:00	0.9
24/07/2015 09:00	28
25/07/2015 09:00	1.2
26/07/2015 09:00	10.2
27/07/2015 09:00	0.1
29/07/2015 09:00	1.9
30/07/2015 09:00	T

August 2015	mm
02/08/2015 09:00	T
04/08/2015 09:00	T
06/08/2015 09:00	T
09/08/2015 09:00	T
10/08/2015 09:00	2.1
11/08/2015 09:00	T
13/08/2015 09:00	7.1
14/08/2015 09:00	4.8
19/08/2015 09:00	8.1
20/08/2015 09:00	0.1
22/08/2015 09:00	2
23/08/2015 09:00	8.2
24/08/2015 09:00	3.9
25/08/2015 09:00	3.9
26/08/2015 09:00	1.2
27/08/2015 09:00	3.3
28/08/2015 09:00	0.4
29/08/2015 09:00	0.3
30/08/2015 09:00	7.1
31/08/2015 09:00	3.9

September 2015	mm
01/09/2015 09:00	0.1
03/09/2015 09:00	T
04/09/2015 09:00	
05/09/2015 09:00	T
08/09/2015 09:00	T
11/09/2015 09:00	T
12/09/2015 09:00	0.6
13/09/2015 09:00	T
14/09/2015 09:00	1.4
15/09/2015 09:00	2.8
16/09/2015 09:00	0.8
17/09/2015 09:00	15.3
19/09/2015 09:00	0.1
20/09/2015 09:00	T
21/09/2015 09:00	0.3
22/09/2015 09:00	8.4
23/09/2015 09:00	1.1
24/09/2015 09:00	3.9

October 2015	mm
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06/10/2015 09:00	9.5
07/10/2015 09:00	0.1
08/10/2015 09:00	T
09/10/2015 09:00	T
15/10/2015 09:00	T
16/10/2015 09:00	T
18/10/2015 09:00	0.2
19/10/2015 09:00	T
20/10/2015 09:00	9.3
21/10/2015 09:00	2
22/10/2015 09:00	T
23/10/2015 09:00	0.1
24/10/2015 09:00	3.1
25/10/2015 09:00	0.1
26/10/2015 09:00	T
27/10/2015 09:00	2.2
28/10/2015 09:00	0.4
29/10/2015 09:00	5.9
30/10/2015 09:00	0.4

November 2105	mm
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02/11/2015 09:00	0.1
03/11/2015 09:00	2.1
04/11/2015 09:00	6.6
05/11/2015 09:00	6.3
06/11/2015 09:00	7
07/11/2015 09:00	6.9
08/11/2015 09:00	1.1
09/11/2015 09:00	0.1
10/11/2015 09:00	0.5
11/11/2015 09:00	T
12/11/2015 09:00	1.1
13/11/2015 09:00	4.2
14/11/2015 09:00	5.1
15/11/2015 09:00	1.1
16/11/2015 09:00	7.4
17/11/2015 09:00	1.9
18/11/2015 09:00	0.3
19/11/2015 09:00	4.6
20/11/2015 09:00	1.5
21/11/2015 09:00	0.1
23/11/2015 09:00	6.5
24/11/2015 09:00	0.2
25/11/2015 09:00	2.5
26/11/2015 09:00	0.2
27/11/2015 09:00	2.4
28/11/2015 09:00	8.1
29/11/2015 09:00	3.4
30/11/2015 09:00	0.9

December 2015	mm
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03/12/2015 09:00	5.5
04/12/2015 09:00	0.1
05/12/2015 09:00	0.1
06/12/2015 09:00	1.2
07/12/2015 09:00	1.6
08/12/2015 09:00	0.1
09/12/2015 09:00	T
10/12/2015 09:00	1.1
11/12/2015 09:00	4.3
12/12/2015 09:00	9.7
13/12/2015 09:00	0.5
14/12/2015 09:00	3.5
16/12/2015 09:00	0.2
17/12/2015 09:00	0.9
18/12/2015 09:00	0.8
19/12/2015 09:00	0.2
20/12/2015 09:00	0.3
21/12/2015 09:00	1.5
22/12/2015 09:00	5.8
23/12/2015 09:00	0.5
24/12/2015 09:00	8.5
25/12/2015 09:00	2.9
26/12/2015 09:00	5.7
27/12/2015 09:00	0.6
28/12/2015 09:00	T
29/12/2015 09:00	0.3
30/12/2015 09:00	21.3
31/12/2015 09:00	4.6

January 2016	mm
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02/01/2016 09:00	4.6
03/01/2016 09:00	6.3
04/01/2016 09:00	0.7
05/01/2016 09:00	4.1
06/01/2016 09:00	4
07/01/2016 09:00	0.2
08/01/2016 09:00	5.5
09/01/2016 09:00	5.1
10/01/2016 09:00	11
11/01/2016 09:00	0.2
12/01/2016 09:00	0.5
13/01/2016 09:00	1.9
14/01/2016 09:00	0.1
15/01/2016 09:00	T
16/01/2016 09:00	1.3
17/01/2016 09:00	2.2
18/01/2016 09:00	0.6
20/01/2016 09:00	0.1
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22/01/2016 09:00	3.1
23/01/2016 09:00	1.8
24/01/2016 09:00	0.1
26/01/2016 09:00	8.5
27/01/2016 09:00	1.6
28/01/2016 09:00	0.2
29/01/2016 09:00	8.9
30/01/2016 09:00	0.1
31/01/2016 09:00	T

February 2016	
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03/02/2016 09:00	0.2
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05/02/2016 09:00	10
06/02/2016 09:00	23.8
07/02/2016 09:00	14.3
08/02/2016 09:00	3.7
09/02/2016 09:00	0.4
12/02/2016 09:00	1.3
13/02/2016 09:00	2.8
14/02/2016 09:00	0.1
16/02/2016 09:00	T
17/02/2016 09:00	6.2
18/02/2016 09:00	0.2
19/02/2016 09:00	0.1
20/02/2016 09:00	2.1
21/02/2016 09:00	0.3
29/02/2016 09:00	1.1

March 2016	mm
01/03/2016 09:00	4
02/03/2016 09:00	1.1
03/03/2016 09:00	3.1
04/03/2016 09:00	5.7
05/03/2016 09:00	0.1
07/03/2016 09:00	0.1
08/03/2016 09:00	27.8
09/03/2016 09:00	1.1
10/03/2016 09:00	0.1
15/03/2016 09:00	0.2
24/03/2016 09:00	4.8
25/03/2016 09:00	0.1
26/03/2016 09:00	6.3
27/03/2016 09:00	21.1
28/03/2016 09:00	3.1
29/03/2016 09:00	5.2
30/03/2016 09:00	0.1

April 2016	mm
02/04/2016 09:00	1.3
03/04/2016 09:00	1.3
04/04/2016 09:00	6.5
05/04/2016 09:00	0.1
06/04/2016 09:00	0.8
07/04/2016 09:00	3.7
08/04/2016 09:00	1.1
09/04/2016 09:00	1.6
10/04/2016 09:00	8.4
11/04/2016 09:00	5.2
12/04/2016 09:00	1.3
13/04/2016 09:00	0.2
14/04/2016 09:00	2.5
15/04/2016 09:00	1.3
16/04/2016 09:00	0.9
22/04/2016 09:00	7
23/04/2016 09:00	0.6
24/04/2016 09:00	0
25/04/2016 09:00	0.1
26/04/2016 09:00	0.3
28/04/2016 09:00	2
29/04/2016 09:00	0.5
30/04/2016 09:00	1.2

May 2016	mm
01/05/2016 09:00	0.4
02/05/2016 09:00	3.1
03/05/2016 09:00	0.1
07/05/2016 09:00	0.3
09/05/2016 09:00	6.4
11/05/2016 09:00	4.5
13/05/2016 09:00	0.1
17/05/2016 09:00	4.8
18/05/2016 09:00	8.5
19/05/2016 09:00	0.2
20/05/2016 09:00	2.7
21/05/2016 09:00	4.6
22/05/2016 09:00	1.4
31/05/2016 09:00	5.2

June 2016	mm
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10/06/2016 09:00	32.2
11/06/2016 09:00	3.2
12/06/2016 09:00	7.3
13/06/2016 09:00	3.5
14/06/2016 09:00	0.1
15/06/2016 09:00	12.9
16/06/2016 09:00	4
17/06/2016 09:00	2
18/06/2016 09:00	0.1
19/06/2016 09:00	8.6
20/06/2016 09:00	9.2
21/06/2016 09:00	1.2
22/06/2016 09:00	0.6
24/06/2016 09:00	5.4
25/06/2016 09:00	3.2
26/06/2016 09:00	3
27/06/2016 09:00	0.1
28/06/2016 09:00	3.4
29/06/2016 09:00	2.1
30/06/2016 09:00	0.8

July 2016	mm
09/07/2016 09:00	1.3
10/07/2016 09:00	3
11/07/2016 09:00	0.2
12/07/2016 09:00	3.1
13/07/2016 09:00	0.2
21/07/2016 09:00	1.8
26/07/2016 09:00	1.4
28/07/2016 09:00	0.5

August 2016	mm
01/08/2016 09:00	16.8
02/08/2016 09:00	2.4
03/08/2016 09:00	0.5
18/08/2016 09:00	2.6
19/08/2016 09:00	6.5
20/08/2016 09:00	3.4
21/08/2016 09:00	1.4
24/08/2016 09:00	2.1
25/08/2016 09:00	1.9
26/08/2016 09:00	0.3
27/08/2016 09:00	32.1
28/08/2016 09:00	1.2

September 2016	mm
03/09/2016 09:00	9.2
04/09/2016 09:00	6.8
05/09/2016 09:00	0.2
09/09/2016 09:00	7.5
10/09/2016 09:00	3.8
11/09/2016 09:00	0.1
13/09/2016 09:00	1
14/09/2016 09:00	0.1
15/09/2016 09:00	6.8
16/09/2016 09:00	1.1
19/09/2016 09:00	2.8
20/09/2016 09:00	0.1
24/09/2016 09:00	4
25/09/2016 09:00	0.6
26/09/2016 09:00	1
27/09/2016 09:00	0.1
28/09/2016 09:00	1.2
29/09/2016 09:00	0.3
30/09/2016 09:00	1.9

October 2016	mm
01/10/2016 09:00	6.7
02/10/2016 09:00	0.1
13/10/2016 09:00	0.1
14/10/2016 09:00	0.1
15/10/2016 09:00	4.6
16/10/2016 09:00	1.6
17/10/2016 09:00	1.2
18/10/2016 09:00	0.1
23/10/2016 09:00	0.2
24/10/2016 09:00	4.6
25/10/2016 09:00	0.1
26/10/2016 09:00	0.1
28/10/2016 09:00	0.1
29/10/2016 09:00	0.2

November 2016	mm
03/11/2016 09:00	0.6
04/11/2016 09:00	4.1
06/11/2016 09:00	1.6
08/11/2016 09:00	26
09/11/2016 09:00	1.1
10/11/2016 09:00	0.1
11/11/2016 09:00	11.1
12/11/2016 09:00	1.7
13/11/2016 09:00	0.7
15/11/2016 09:00	0.9
16/11/2016 09:00	0.3
17/11/2016 09:00	5.7
18/11/2016 09:00	0.9
19/11/2016 09:00	15.1
20/11/2016 09:00	9.2
21/11/2016 09:00	14.3
22/11/2016 09:00	9.1
23/11/2016 09:00	0.1
26/11/2016 09:00	0.2

December 2016	mm
02/12/2016 09:00	0.5
05/12/2016 09:00	0.1
06/12/2016 09:00	0.4
08/12/2016 09:00	0.2
09/12/2016 09:00	0.2
10/12/2016 09:00	15.5
11/12/2016 09:00	0.3
12/12/2016 09:00	1.6
13/12/2016 09:00	0.8
14/12/2016 09:00	0.1
15/12/2016 09:00	0.5
16/12/2016 09:00	0.3
18/12/2016 09:00	0.1
19/12/2016 09:00	0.2
20/12/2016 09:00	0.5
21/12/2016 09:00	0.2
23/12/2016 09:00	1.1
24/12/2016 09:00	0.1
25/12/2016 09:00	2.1
28/12/2016 09:00	0.1
29/12/2016 09:00	0.3
30/12/2016 09:00	0.6
31/12/2016 09:00	0.7

January 2017	mm
01/01/2017 09:00	6.2
02/01/2017 09:00	0.2
03/01/2017 09:00	0.1
06/01/2017 09:00	8.4
07/01/2017 09:00	0.4
08/01/2017 09:00	1
09/01/2017 09:00	1.3
10/01/2017 09:00	0.1
12/01/2017 09:00	7.1
13/01/2017 09:00	0.2
14/01/2017 09:00	3.8
15/01/2017 09:00	3
16/01/2017 09:00	4.2
17/01/2017 09:00	0.3
24/01/2017 09:00	0.3
25/01/2017 09:00	0.1
27/01/2017 09:00	4.7
28/01/2017 09:00	0.3
29/01/2017 09:00	9.6
30/01/2017 09:00	2.5
31/01/2017 09:00	14

February 2017	mm
01/02/2017 09:00	3.4
02/02/2017 09:00	1
03/02/2017 09:00	2.5
04/02/2017 09:00	0.4
06/02/2017 09:00	4.7
07/02/2017 09:00	1
08/02/2017 09:00	0.1
11/02/2017 09:00	0.8
12/02/2017 09:00	0.1
15/02/2017 09:00	4.2
16/02/2017 09:00	0.1
20/02/2017 09:00	0.2
22/02/2017 09:00	3.9
25/02/2017 09:00	1.9
26/02/2017 09:00	0.9
27/02/2017 09:00	1.4
28/02/2017 09:00	0.9

Annex 4: Shallow substrate auger survey results

No	Depth (cm)	Description
1D	0-15	Dark brown, high organic clayey loam; – roots
	15-20	Mid brown silty clay – a few roots
	20-40	Mottled clay
	40-45	Sandy clay – wet
	45-50	Clayey sand
	50-60	Sand
	60	Gravelly sandy chalk - wet

Note. Soil core length shorter (60cm) than photograph implies

No	Depth (cm)	Description (– located on ditch line)
2	0-10	Dark brown high organic clayey loam - roots,
	10-20	Hard grey clay mottled with orange – a few roots
	20-60	Soft grey clay. NB water at 60cm
	60-70	Sandy, gravelly clayey chalk

No	Depth (cm)	Description
3	0-20	Dark brown high organic clayey loam - roots,
	20-30	Hard dense grey clay, some roots
	30-60	Grey hard clay with orange mottling
	60-70	Clayey sand with gravel
	70+	Gravelly clayey sand; damp - not wet

No.	Depth (cm)	Description
4	0-5	Loamy clay
	5-15	Hard dense grey clay with orange mottling
	15-25	Clay – mottling – gravel and chalk component at bottom
	25-30	Clay with chalk and gravel
	30-35	Chalky gravel
	35	Chalky gravel bedrock

No	Depth (cm)	Description
5	0-5	Loamy clay
	5-15	Solid grey clay with orange mottling, roots and piece of gravel
	15-20	Gritty (sandy) clay with mottling
	20-30	Chalky gravelly clay (with roots)
	30	Chalky gravel bedrock – wet

No	Depth (cm)	Description
6D	0-12	Mid brown clayey loam – hard and dense – roots
	12-25	Mid brown clay showing orange mottling – a few roots
	25-40	Clay – mottled brown grey with some orange – a few roots
	40-45	Clay – mottled brown grey with some orange and a few bits of chalk and some roots
	45-50	Sandy orange clay with a few bits of chalk
	50-65	As above but greater sand
	65+	Orange gravelly clayey sand with some chalky bits

Annex 5: Vegetation

5.1 NVC description of the survey data

The tables below show the data (percentage cover) surveyed in June 2016.

Permanent (transect) quadrats QT1-QT5 located in the major floodplain meadow plant community on the site

Details of quadrats

Area Name	Transect Quadrats (Main community)		
	Quadrat	Easting	Northing
	QT1	406838	193635
	QT2	406827	193665
	QT3	406827	193702
	QT4	406813	193724
	QT5	406807	193749

Table 1: % cover and NVC constancy table
It should be noted that Fritillaria meleagris was not seen in the surveys but from observation in the spring it can be assumed that this species occurred in all the quadrats.

Survey Date	9 June 2016	% cover					NVC		
Plants		QT1	QT2	QT3	QT4	QT5	Const	Min	Max
Agrostis stolonifera	Creeping bent	40	20	30	5	20	V	5	40
Anthoxanthum odoratum	Sweet vernal-grass	5	5	5	10	5	V	5	10
Festuca rubra	Red fescue	20	35	25	25	20	V	20	35
Holcus lanatus	Yorkshire fog	15	40	10	10	40	V	10	40
Lathyrus pratensis	Meadow vetchling	4	4	5	4	3	V	3	5
Plantago lanceolata	Ribwort plantain	2	10	5	5	15	V	2	15
Fritillaria meleagris	Snakeshead fritillary	5	5	5	5	5	V	5	5
Hordeum secalinum	Meadow barley	5		5	5	10	IV	5	10
Poa trivialis	Rough-stalked meadow-grass	30	10	35		10	IV	10	35
Centaurea nigra	Common knapweed	10		3	5	5	IV	3	10
Ranunculus repens	Creeping buttercup	3	5		3	3	IV	3	5
Rumex acetosa	Common Sorrel	3	3	3	3		IV	3	3
Sanguisorba officinalis	Great Burnet	40	35	15	35		IV	15	40
Vicia cracca	Tufted vetch		2	3	3	3	IV	2	3
Arrhenatherum elatius	False oat-grass		5		10	10	III	5	10
Bromus racemosus	Smooth brome	2	10			5	III	2	10
Cynosurus cristatus	Crested dog's-tail		5		3	10	III	3	10

Taraxacum sect. vulgaria	Dandelion			4	4	5	**III**	**4**	**5**
Alopecurus pratensis	Meadow foxtail	5		5			**II**	**5**	**5**
Cardamine pratensis	Cuckoo flower	1		2			**II**	**1**	**2**
Ranunculus bulbosus	Bulbous buttercup			3		3	**II**	**3**	**3**
Dactylis glomerata	Cock's-foot		3		3		**II**	**3**	**3**
Phleum pratense	Timothy			3		3	**II**	**3**	**3**
Filipendula ulmaria	Meadowsweet			5		15	**II**	**5**	**15**
Primula veris	Cowslip				1		**I**	**1**	**1**
Lolium perenne	Perennial rye-grass				4		**I**	**4**	**4**
Trisetum flavescens	Yellow oat-grass				3		**I**	**3**	**3**
Cerastium fontanum	Common mouse-ear			1			**I**	**1**	**1**
Galium verum	Lady's bedstraw		3				**I**	**3**	**3**
Ranunculus acris	Meadow buttercup	3					**I**	**3**	**3**
Succisa pratensis	Devil's-bit Scabious	3					**I**	**3**	**3**
Crepis	Catsear				4		**I**	**4**	**4**
Juncus inflexis	Hard rush		1				**I**	**1**	**1**

Mavis Modelling Output:
NVC: MG4c 70.31
NVC: MG4b 70.19
NVC: MG4v2 69.56
NVC: MG4a 62.63
NVC: MG4d 60.04
NVC: MG6d 58.80
NVC: MG9 57.94
NVC: MG15b 57.92
NVC: MG15 56.11
NVC: MG8a 55.90

Four non-permanent quadrats, QN1-QN2 and QW1-QW2 were located in the 'drier' northern and western parts of field where there appeared to be less diversity of species with grasses dominating.

Details of quadrats

Northern and western Drier' Area		
Name	Easting	Northing
QN1	406817	193796
QN2	406785	193793
QW1	406779	193728
QW2	406772	193730

Table 2: % cover and indicative NVC constancy table.

Survey Date	09-Jun-16	% cover					NVC		
Plants		**QN1**	**QN2**	**QN1**	**QW1**	**QW2**	**Const**	**Min**	**Max**
Festuca rubra	Red fescue	10	8	10	50	10	**IV**	**8**	**50**
Holcus lanatus	Yorkshire fog	8	15	8	50	10	**IV**	**8**	**50**
Sanguisorba officinalis	Great Burnet	75	40	75	20	55	**IV**	**20**	**75**
Arrhenatherum elatius	False oat-grass	15	10	15	10	7	**IV**	**7**	**15**
Poa trivialis	Rough-stalked meadow-grass	3	8	3	5	10	**IV**	**3**	**10**
Crepis capillaris	Catsear	8	5	8		5	**III**	**5**	**8**
Cynosurus cristatus	Crested dog's-tail	5	8	5		4	**III**	**4**	**8**
Taraxacum sect. vulgaria	Dandelion	3	3	3		5	**III**	**3**	**5**
Ranunculus bulbosus	Bulbous buttercup	5	3	5	3		**III**	**3**	**5**
Lathyrus pratensis	Meadow vetchling		2		3	3	**III**	**2**	**3**
Anthoxanthum odoratum	Sweet vernal-grass	5	5	5			**II**	**5**	**5**
Alopecurus pratensis	Meadow foxtail				5	2	**II**	**2**	**5**
Plantago lanceolata	Ribwort plantain		4			5	**II**	**4**	**5**
Ranunculus acris	Meadow buttercup		3		3		**II**	**3**	**3**
Dactylis glomerata	Cock's-foot				5	3	**II**	**3**	**5**
Trisetum flavescens	Yellow oat-grass	3		3			**I**	**3**	**3**
Trifolium repens	White Clover	5		5			**I**	**5**	**5**
Cardamine pratensis	Cuckoo flower				1		**I**	**1**	**1**
Lolium perenne	Perennial rye-grass					3	**I**	**3**	**3**
Centaurea nigra	Common knapweed		5				**I**	**5**	**5**
Cerastium fontanum	Common mouse-ear					2	**I**	**2**	**2**
Filipendula ulmaria	Meadowsweet					15	**I**	**15**	**15**
Primula veris	Cowslip		2				**I**	**2**	**2**
Ranunculus repens	Creeping buttercup		3				**I**	**3**	**3**
Rumex acetosa	Common Sorrel					2	**I**	**2**	**2**
Trifolium pratense	Red Clover					2	**I**	**2**	**2**
Vicia cracca	Tufted vetch		3				**I**	**3**	**3**

MAVIS modelling Output:
NVC: MG4c 62.81
NVC: MG4v2 60.61
NVC: MG9 60.37

NVC: MG9b 58.68
NVC: MG9a 57.75
NVC: MG4b 56.94
NVC: MG3a 55.15
NVC: MG6a 54.52
NVC: MG3 54.00
NVC: MG1c 53.85

Table 3: % cover and indicative NVC constancy table. Quadrats QSE1 to QSE4 were located in the wetter plant community in the south east corner of the field

A fifth quadrat was located in the area of swamp lying immediately adjacent to the pond (QP1)

Details of quadrats

South East Wet Area (QSE) And Swamp (QP1)		
Name	Easting	Northing
QSE1	406896	193649
QSE2	406882	193626
QSE3	406901	193645
QSE4	406896	193637
QP1	406903	193646

Table 3: % cover and indicative NVC constancy table.
Note QSE1 repeated for the purpose of the NVC interpretation:

Survey Date	**09-Jun-16**	**% cover**					**NVC**		
Plants		SEQ 1	SEQ 2	SEQ 3	SEQ 4	SEQ 1	**Const**	**Min**	**Max**
Poa trivialis	Rough-stalked meadow-grass	10	10	5	25	10	**V**	**5**	**25**
Carex acuta	Slender tufted sedge	30	20	35	35	30	**V**	**20**	**35**
Filipendula ulmaria	Meadowsweet	4	10	5	8	4	**V**	**4**	**10**
Lychnis flos-cuculi	Ragged-Robin	1	10	3	5	1	**V**	**1**	**10**
Alopecurus geniculatus	Marsh foxtail	4	5	10		4	**IV**	**4**	**10**
Glyceria fluitans	Floating sweet-grass	6		30	30	6	**IV**	**6**	**30**
Carex disticha	Brown sedge	10	10		20	10	**IV**	**10**	**20**
Ranunculus repens	Creeping buttercup	2	0	5		2	**IV**	**0**	**5**
Rumex crispus	Curled dock	3	3			3	**III**	**3**	**3**
Cardamine pratensis	Cuckoo flower	2		2		2	**III**	**2**	**2**
Agrostis stolonifera	Creeping bent			5	10		**II**	**5**	**10**
Carex hirta	Hairy sedge	3				3	**II**	**3**	**3**
Lysimachia nummularia	Creeping Jenny			2			**I**	**2**	**2**

Rumex acetosa	Common Sorrel		2				**I**	**2**	**2**
Vicia cracca	Tufted vetch			4			**I**	**4**	**4**
Vicia sativa	Common vetch		2				**I**	**2**	**2**

MAVIS Modelling Output:
NVC: MG15a 54.51
NVC: MG13v2 50.58
NVC: MG10c 48.44
NVC: MG4d 46.93
NVC: MG16 43.77
NVC: MG15 43.11
NVC: MG14a 42.82
NVC: MG10b 41.14
NVC: MG10 40.96
NVC: MG14b 40.60

Swamp

Plants		**% cover**
Phalaris arundinacea	Reed canary-grass	60
Carex acuta	Slender tufted sedge	15
Carex disticha	Brown sedge	10
Vicia sativa	Common sedge	1
Glyceria maxima		40

Most likely NVC:
NVC: S5
NVC: S28a

Quadrats QD1:QD3 located in the relic ditch that crosses the centre of the field

Details of quadrats:

Relic Ditch		
Name	**Easting**	**Northing**
QD1	406840	193713
QD2	406821	193710
QD3	406776	193692

Table 4: % cover and indicative NVC constancy table.
Note the first two quadrats have been repeated for the purpose of the NVC. The NVC should therefore be treated with caution although the vegetation was fairly uniform.

Survey Date	**09-Jun-16**	**% cover**					**NVC**		
Plants		QD1	QD2	QD3	QD1	QD2	**Const**	**Min**	**Max**
Alopecurus pratensis	Meadow foxtail	10	5	15	10	5	**V**	**5**	**15**

Festuca rubra	Red fescue	20	10	5	20	10	**V**	**5**	**20**
Poa trivialis	Rough-stalked meadow-grass	25	20	15	25	20	**V**	**15**	**25**
Filipendula ulmaria	Meadowsweet	4	20	40	4	20	**V**	**4**	**40**
Rumex acetosa	Common Sorrel	3	3	3	3	3	**V**	**3**	**3**
Rumex crispus	Curled dock	5	5	4	5	5	**V**	**4**	**5**
Bromus commutatus	Meadow brome	5	10		5	10	**IV**	**5**	**10**
Hordeum secalinum	Meadow barley		20	25		20	**III**	**20**	**25**
Lolium perenne	Perennial rye-grass		20	30		20	**III**	**20**	**30**
Alopecurus geniculatus	Marsh foxtail	5			5		**II**	**5**	**5**
Carex disticha	Brown sedge		10			10	**II**	**10**	**10**
Juncus effuses	Soft rush	3			3		**II**	**3**	**3**
Lathyrus pratensis	Meadow vetchling		1			1	**II**	**1**	**1**
Lychnis flos-cuculi	Ragged-Robin	1			1		**II**	**1**	**1**
Lysimachia nummularia	Creeping Jenny	3			3		**II**	**3**	**3**
Plantago lanceolata	Ribwort plantain		3			3	**II**	**3**	**3**
Cardamine pratensis	Cuckoo flower		2			2	**II**	**2**	**2**
Polygonum amphibium	Amphibious bistort	3			3		**II**	**3**	**3**
Ranunculus repens	Creeping buttercup		2			2	**II**	**2**	**2**
Taraxacum sect. vulgaria	Dandelion	1			1		**II**	**1**	**1**
Agrostis stolonifera	Creeping bent			10			**I**	**10**	**10**
Carex hirta	Hairy sedge			2			**I**	**2**	**2**
Vicia cracca	Tufted vetch			3			**I**	**3**	**3**

Mavis Modelling Outputs

NVC: MG15a 62.69
NVC: MG4d 62.25
NVC: MG15 60.18
NVC: MG4c 58.79
NVC: MG15b 56.19
NVC: MG6d 51.31
NVC: MG4v2 49.05
NVC: MG4b 48.99
NVC: MG8b 45.53
NVC: MG8v2 44.88

5. 2. Permanent quadrat analysis & interpretation

Changes in each of the five permanent quadrats between 2015 and 2016 are shown in the table below with the species listed in rows and the recording years represented by the columns. This data should be treated with caution as it is very difficult to interpret any changes between two years, however there is no indication that the plant community had changed between the two years, and even the changes in cover of the plants highlighted as ones to watch could be due to general seasonal changes rather than anything more significant.

Table 5 shows the results for the surveys for 2015 and 2016

Colour-coding has been used to show the following types of change:

- **Light blue - indifferent, of no consequence;**
- **Light green - a change for the better;**
- **Light orange – needs watching, could become a negative feature;**
- **Light red - a negative trend;**
- **Darker red - a trend for immediate consideration**

Plants		% Cover									
		2015					2016				
		Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
Agrostis stolonifera	Creeping bent	40	5	10	10	5	40	20	30	5	20
Alopecurus pratensis	Meadow foxtail		5			8	5		5		5
Anthoxanthum odoratum	Sweet vernal-grass	5	8	5	4	5	5	5	5	10	5
Arrhenatherum elatius	False oat-grass		30			5		5		10	10
Bromus racemosus	Smooth brome						2	10			5
Cynosurus cristatus	Crested dog's-tail				5			5		3	10
Dactylis glomerata	Cock's-foot							3		3	
Festuca rubra	Red fescue	5	5	25		20	20	35	25	25	20
Holcus lanatus	Yorkshire fog	5	20	15	20	35	15	40	10	10	40
Hordeum secalinum	Meadow barley		5	10	10	3	5		5	5	10
Lolium perenne	Perennial rye-grass				5					4	
Phleum pratense	Timothy								3		3
Poa trivialis	Rough-stalked meadow-grass	20	5	10			30	10	35		10
Trisetum flavescens	Yellow oat-grass	5	4							3	
Cardamine pratensis	Cuckoo flower	2		2			1		2		
Centaurea nigra	Common knapweed	3			3		10		3	5	5

Cerastium fontanum	Common mouse-ear								1		
Cirsium arvense	Creeping thistle	1									
Filipendula ulmaria	Meadowsweet		2		5				5		15
Fritillaria meleagris	Fritillary	Not surveyed					Count undertaken				
Galium verum	Lady's bedstraw		5					3			
Lathyrus pratensis	Meadow vetchling	5	5	3	3	2	4	4	5	4	3
Leontodon hispidus	Rough hawkbit		5		4						
Lotus uliginosus	Greater bird's-foot trefoil	1	5								
Luzula campestris	Field wood-rush	1									
Plantago lanceolata	Ribwort plantain	3	15	15	10	10	2	10	5	5	15
Primula veris	Cowslip									1	1
Ranunculus acris	Meadow buttercup	2	3		3		3				
Ranunculus bulbosus	Bulbous buttercup					3			3		3
Ranunculus repens	Creeping buttercup	Likely survey error					3	5		3	3
Rumex acetosa	Common Sorrel		3	2	3	3	3	3	3	3	
Sanguisorba officinalis	Great Burnet	20	10	20	10	15	40	35	15	35	
Succisa pratensis	Devil's-bit Scabious						3				
Taraxacum sect. vulgaria	Dandelion			3	5				4	4	5
Vicia cracca	Tufted vetch		5					2	3	3	3
Sanguisorba minor	Salad burnet	2	5								
Crepis	Catsear									4	
Juncus inflexis	Hard rush							1			
Notes		Plus Devil's bit scabious, Cuckoo flower, Meadow Rue, Goats' beard									

5.3 Long-term trends

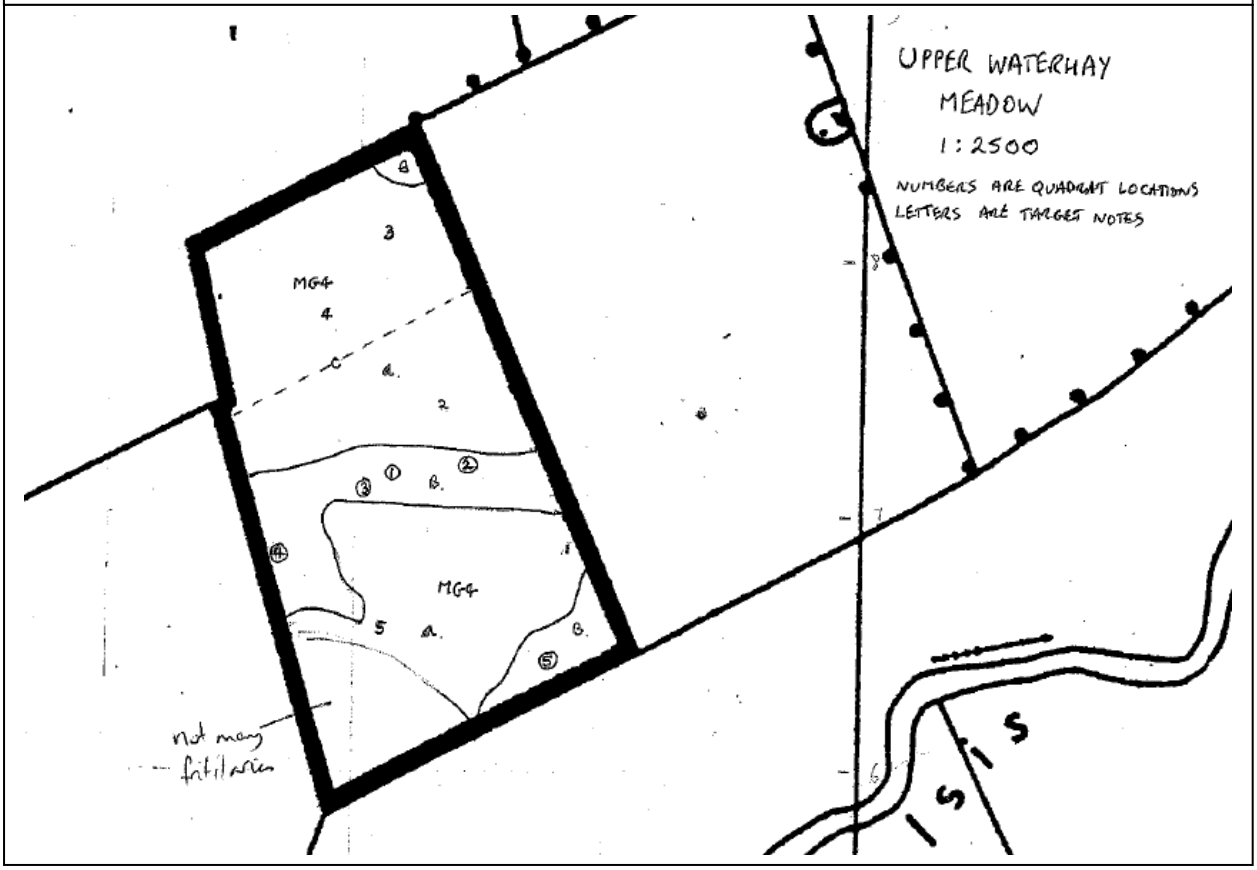
Historic NVC data is available for the site from Natural England. This is undated but thought to have been undertake in 2001. The data is reproduced here and consists of: an NVC description, map, NVC constancy tables derived from the quadrat data, and a description of the Condition Assessment for the SSSI against the MG4 community.

NVC Description

Only two vegetation communities are present. The major one is MG4, with smaller areas of degraded MG4 subject to periodic inundation in slightly lower lying parts of the field.

The MG4 is of variable quality, but overall it is moderately species-rich. Grasses predominate, the most abundant species being *Agrostis stologifera, Cynosurus cristatus, Festuca rubra, Holcus lanatus, Anthoxanthum odoratum, Hordeum secalimnum, Lolium perenne, Alopecurus pratensis* and *Poa trivialis*. The most frequent dicotyledonous species are *Trifolium pratense, Ranunculus acris, Rumex acetosa, Plantago lanceolata* and *Sanguisorba officinalis. Fritillaria meleagris* was recorded in all quadrats, but cover was underestimated as the plants die back rapidly after flowering in April and May. Other frequent species include *Filipendula ulmaria, Lathyrus pratensis and Centaurea nigra.*

A much less species-rich community is present in parts of the field. It resembles MG4, but lacks several species, and may owe its composition to seasonal inundation. *Agrostis stolonifera* is dominant with species indicative of wetter conditions including abundant *Filipendula ulmaria* and *Ranunculus repens*. *Carex hirta, Lychnis flos-cuculi, Lysimachia nummularia, Caltha palustris* and *Carex disticha* also suggest inundation. The abundance of *Rumex crispus* may indicate disturbance by stock when wet.



Constancy Tables. Constancy is the proportion of the total number of quadrats in which the species was recorded. Five quadrats were recorded in each stand type.

MG4	Constancy	Maximum Domin Score
Agrostis stolonifera	5	6
Cynosurus cristatus	5	6
Festuca rubra	5	6
Holcus lanatus	5	6
Trifolium pratense	5	6
Anthoxanthum odoratum	5	5
Hordeum secalinum	5	4
Ranunculus acris	5	4
Lolium perenne	5	3
Rumex acetosa	5	3
Fritillaria meleagris	5	1
Alopecurus pratensis	4	5
Plantago lanceolata	4	4
Sanguisorba officinalis	4	4
Poa trivialis	4	3
Cerastium fontanum	4	2
Hypochoeris radicata	4	1
Filipendula ulmaria	3	3
Lathyrus pratensis	3	3
Centaurea nigra	3	2
Taraxacum sp	3	2
Deschampsia cespitosa	2	4
Phleum pratense	2	3
Ranunculus bulbosus	2	2
Cirsium arvense	2	1
Bromus commutatus	1	3
Ranunculus repens	1	3
Cardamine pratensis	1	2
Festuca arundinacea	1	2
Festuca pratensis	1	2
Geranium dissectum	1	2
Lotus corniculatus	1	2
Crepis capillaris	1	1
Dactylis glomerata	1	1
Vicia cracca	1	1

Degraded MG4	Constancy	Maximum Domin Score
Agrostis stolonifera	5	9
Filipendula ulmaria	5	7
Ranunculus repens	5	7
Poa trivialis	5	5
Alopecurus pratensis	5	4
Rumex crispus	4	4
Phleum pratense	3	4
Anthoxanthum odoratum	3	3
Hordeum secalinum	3	3
Carex hirta	2	4
Plantago lanceolata	2	3
Lathyrus pratensis	2	2
Lolium perenne	2	2
Trifolium pratense	2	2
Leontodon autumnalis	1	3
Trifolium repens	1	3
Vicia cracca	1	3
Deschampsia cespitosa	1	2
Lysimachia nummularium	1	2
Centaurea nigra	1	1
Cerastium fontanum	1	1
Festuca arundinacea	1	1
Lychnis flos-cuculi	1	1
Rumex acetosa	1	1
Taraxacum sp	1	1

SSSI Site condition
The site failed on species composition. Only three species from the list of positive indicators were recorded as frequent or occasional: *Filipendula ulmaria, Sanguisorba officinalis* and *Lathyrus pratensis.* It was not possible to assess the numbers of *Frililaria meleagris* as it was too late in the summer, but remains were scattered throughout the MG4. The ratio of herbs to grasses was less than 35%. Of the negative indicator species *Rumex crispus* was frequent only in the seasonally inundated and poached areas outside the MG4, *Cirsium arvense* was considerably less than 10% cover. Sward height was between 40cm and 45cm throughout, an acceptable height for a hay meadow immediately before cutting. Current management would seem suitable, and the current unfavourable state of the sward composition is likely to be the result of manure application in the past, possible before SSSI scheduling in 1985.

Comparison of the data sets is difficult and this analysis must be treated with caution for the following reasons:

- at least one, if not two quadrats were located within an area that in 2016 appeared visually distinct from the main area of MG4 (ie. it was less species diverse and had greater abundance of grasses). In this earlier survey these two quadrats, with three others, formed the basis for the NVC description whereas in 2016 the areas were sampled separately: QT1-5 and then QN1-

2 and QW1-2 respectively. The fact that at the time of the previous surveys these areas visually appeared homogenous and yet in 2016 they appeared different is perhaps telling in itself. Having said this, cover of Fritillary occurred across the two areas and appeared most abundant north of the relic drain although declining in abundance further north and to the west.

- The community described as 'MG4 degraded' due to inundation in the earlier survey was also clearly distinct in 2016 as a separate community. However in the earlier survey two areas were identified as forming part of this habitat – and 4 quadrats were sampled from the relic ditch and 1 quadrat from the wetter low lying area to the south east. In 2016 these areas were sampled separately: QD1-QD3 and QSE1-QSE4. Without the raw quadrat data comparing this data is again difficult.

An attempt to compare the NVC constancy table outputs for the two data sets is made in the table 6 below and the MAVIS outputs for the earlier survey is given in table 7.

Table 6: Attempts to compare the two NVC descriptions for the main MG4 community on the site

Plants		NVC Const		Increase or Decrease?	Comments
		?	2016		
Agrostis stolonifera	Creeping bent	V	**V**	+	
Anthoxanthum odoratum	Sweet vernal-grass	V	**V**	+	
Festuca rubra	Red fescue	V	**V**	+	
Holcus lanatus	Yorkshire fog	V	**V**	+	
Lathyrus pratensis	Meadow vetchling	III	**V**	↑	
Plantago lanceolata	Ribwort plantain	IV	**V**	↑	**Drier?**
Fritillaria meleagris	Snakeshead fritillary	Not known	**Not known**		
Trifolium pratense	Red clover	V		↓	**Short lived?**
Hordeum secalinum	Meadow barley	V	**IV**	↓	
Poa trivialis	Rough-stalked meadow-grass	IV	**IV**	+	
Centaurea nigra	Common knapweed	III	**IV**	↑	**Drier?/reducing fertility?**
Ranunculus repens	Creeping buttercup	I	**IV**	↑	**Waterlogging?**
Rumex acetosa	Common Sorrel	V	**IV**	↓	
Sanguisorba officinalis	Great Burnet	IV	**IV**	+	
Vicia cracca	Tufted vetch	I	**IV**	↑	**Drier?**
Hypocharis radicata		IV		↓	
Arrhenatherum elatius	False oat-grass		**III**	↑	**Late haycut**
Bromus racemosus	Smooth brome		**III**	↑	**Could be id?**

Bromus commutatus		I		↓	
Cynosurus cristatus	Crested dog's-tail	V	**III**	↓	**May have been missed**
Taraxacum sect. vulgaria	Dandelion	III	**III**	+	
Alopecurus pratensis	Meadow foxtail	IV	**II**	↓	
Cardamine pratensis	Cuckoo flower		**II**	↑	**May have been missed**
Ranunculus bulbosus	Bulbous buttercup	I	**II**	↑	**May be drier?**
Dactylis glomerata	Cock's-foot	I	**II**	↑	**Late haycut**
Phleum pratense	Timothy	II	**II**	+	
Filipendula ulmaria	Meadowsweet	III	**II**	↓	**Drier?**
Primula veris	Cowslip		**II**	↑	**Drier?**
Deschampsia caespitosa	Wavy hair-grass	II		↓	**Is rare (plus north of site)**
Cirsium arvense	Creeping thistle	II		↓	**Better management?**
Alopecurus geniculatus	Marsh foxtail		**I**	↑	
Lolium perenne	Perennial rye-grass	V	**I**	↓	
Trisetum flavescens	Yellow oat-grass		**I**	↑	
Cerastium fontanum	Common mouse-ear	IV	**I**	↓	**Less poaching?**
Galium verum	Lady's bedstraw		**I**	↑	**Drier?**
Ranunculus acris	Meadow buttercup	V	**I**	↓	
Succisa pratensis	Devil's-bit Scabious		**I**	↑	
Crepis capillaris	Catsear	I	**I**	+	
Juncus inflexis	Hard rush		**I**	↑	
Festuca arundinacea	Giant fescue	I		↓	**Present in Northern part of site**
Festuca pratense	Meadow fescue	I		↓	
Geranium dissectum	Common geranium	I		↓	
Lotus corniculatus	Greater birds' foot trefoil	I		↓	

Running the historic data (Constancy tables from an NVC survey thought to have been undertaken in 2001) through MAVIS produces ambiguous results with respect to the sub-community present at that time: MG4b 70.27%, MG4c 69.70% and MG4v2 69.12%. At first glance, it could be interpreted that the NVC community on the site has not really changed between this survey and 2016 (MG4c 70.31%, MG4b 70.19% and MG4v2 69.56%). However, it may be more telling that at the time of the previous survey the whole area visually appeared homogenous (and was sampled as one community stand) and yet in 2016 there appeared to be a definite gradient of increasing abundance of grasses towards the north (and west) and this is corroborated by the quadrat surveys which indicate that a different plant community does now exist in the northern part of the field.

Table 7: MAVIS output for the two surveys

Earlier survey	2016 main	2016 north
NVC: MG4b 70.27	NVC: MG4c 70.31	NVC: MG4c 62.81
NVC: MG4c 69.70	NVC: MG4b 70.19	NVC: MG4v2 60.61
NVC: MG4v2 69.12	NVC: MG4v2 69.56	NVC: MG9 60.37
NVC: MG4a 63.47	NVC: MG4a 62.63	NVC: MG9b 58.68
NVC: MG15b 62.37	NVC: MG4d 60.04	NVC: MG9a 57.75
NVC: MG6d 62.30	NVC: MG6d 58.80	NVC: MG4b 56.94
NVC: MG4 58.78	NVC: MG9 57.94	NVC: MG3a 55.15
NVC: MG15 57.78	NVC: MG15b 57.92	NVC: MG6a 54.52
NVC: MG8d 56.27	NVC: MG15 56.11	NVC: MG3 54.00
NVC: MG8a 56.18	NVC: MG8a 55.90	NVC: MG1c 53.85

Looking at individual species (Table 6) then the big increases appear to be False oat-grass (*Arrhenatherum elatius*), creeping buttercup (*Ranunculus repens*), meadow vetchling (*Lathyrus pratensis*), tufted vetch *(Vicia cracca*) , and the big decreases: red clover (*Trifolium pratense*), crested dogs-tail (*Cynosorus cristata*), meadow foxtail (*Alopecurus pratensis*), perennial rye-grass (*Lolium perenne*) and meadow buttercup (*Ranunculus acris*). This would suggest that the community has changed, at least over part of the site, and warrants further investigation.

It may be that the northern part of the field is subject to greater inundation and waterlogging than the rest of the field (except the south east corner where surface water lies most winters and is the first area that floods from the adjacent lake) due to the shallow clay soil profiles found here. Or it may also be the effect of management with the hay cuts occurring quite late, often after the end of July, and the grass/herb ratio of the sward across the whole site high.

The MAVIS output for the low lying area to the south east in 2016 suggests MG15a. The earlier survey described both the wetter area in the south east corner and the vegetation along the relic drain as MG4b degraded. The difference between the earlier survey and 2016 may simply be due to only one quadrat being located in the wetter area in the SE corner. Alternatively it has become wetter. Again, the fact that visually these two communities appeared the same at the time of the earlier survey and in 2016 they appeared distinct may suggest that the community has indeed changed. The slender tufted sedge (*Carex acuta*) and floating sweet-grass (*Glyceria fluitans*) were both absent in the earlier survey which indicates that the area is now wetter.

In 2016 the MAVIS output suggests that the community along the relic drain is NVC: MG15a or MG4d (62.69% and 62.25% respectively) although the description is more likely MG4d and this would fit the 'degraded MG4' description attributed by the prior survey.