Oxford Flood Alleviation Scheme

MG4 Grassland: Mitigation Strategy

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Author:	Peter Sketch
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Jacobs U.K. Limited

1180 Eskdale Road
Winnersh
Wokingham RG41 5TU

www.jacobs.com

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1. Introduction

1.1 Background

This document is a mitigation strategy for an area of mesotrophic grassland community, classified as MG4 *Alopecurus pratensis-Sanguisorba officinalis* grassland using the National Vegetation Classification (NVC) methodology, which is considered likely to be directly and indirectly impacted by construction works proposed as part of the Oxford Flood Alleviation Scheme (OFAS).

Within the Scheme boundary, the area of MG4 grassland is located at Hinksey Meadow, within Osney Mead (Botley Meadows) Local Wildlife Site (LWS) – see Figure 1.

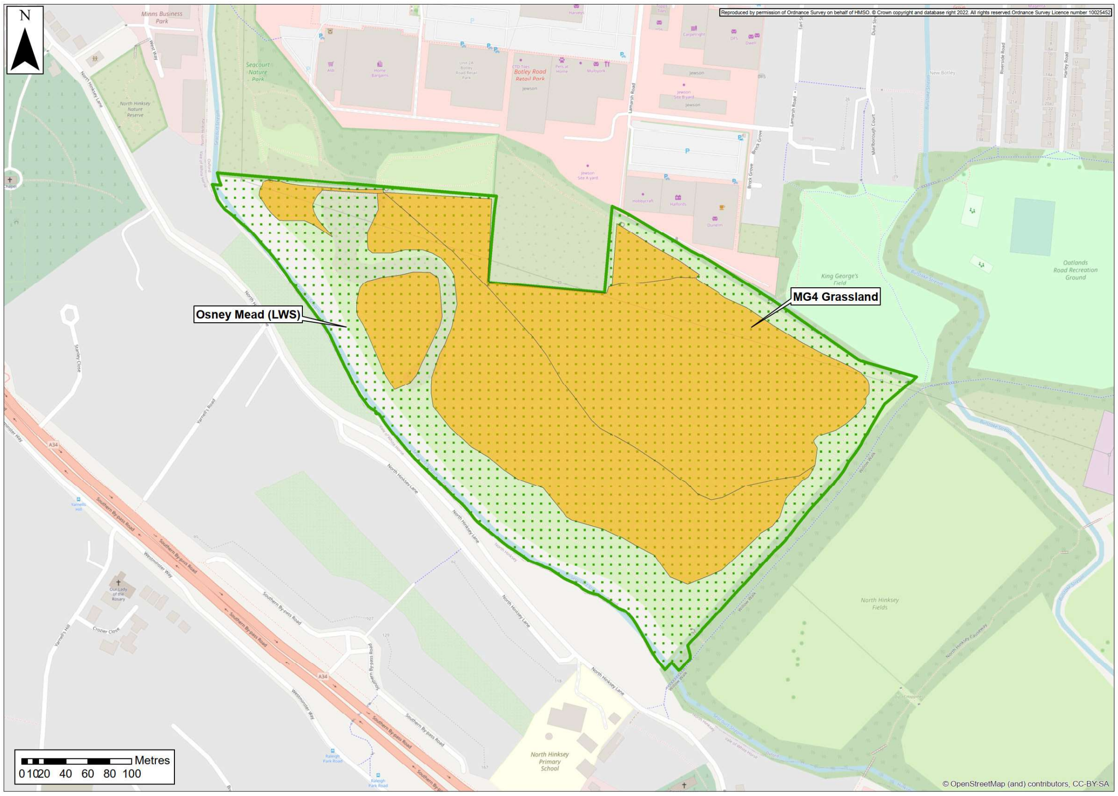
Hinksey Meadow is located between Botley Road and Willow Walk. It has been known to be MG4 grassland for a considerable time; the extent of the MG4 area was confirmed by an NVC survey (King, 2016). In the baseline Phase 1 survey for this area (CH2M, 2015), which used methodology given in the Handbook for Phase 1 Habitat Survey (JNCC, 2010), Hinksey Meadow was classified as semi-improved neutral grassland. Subsequent Phase 1 surveys, using information received from others in addition to survey data, classified it as unimproved neutral grassland, reflecting its known long history as meadow. Follow on surveys in 2020 using a UK Habitat Classification (UKHab) survey methodology, identified the majority of Hinksey Meadow as lowland hay meadow (Jacobs, 2021) and a detailed NVC classification survey with the aim of providing an accurate estimate of the current extent of MG4 (Lambert, S. *et al*., 2020) found much of the central part of Hinksey Meadow supported MG4 grassland.

The MG4 grassland, including its population of snakeshead fritillary *Fritillaria meleagris*, has been repeatedly surveyed over a number of years by Dr Tim King of University of Oxford, on behalf of the landowners, Oxford Preservation Trust (OPT). This mitigation strategy was based on information about the extent of MG4 habitat taken Dr. King's report (2016), but has since been updated and is also taken from Sarah Lambert and The Floodplain Meadows Partnership (2020) NVC survey report, provided to the Environment Agency.

The geographical extents of the MG4 habitat, taken from the NVC survey drawings, and the OFAS works, taken from Scheme drawings, were drawn up by a Jacobs GIS operator and used to calculate the areas affected.

Jacobs has also carried out modelling of surface water flows and groundwater levels under a number of scenarios to determine the effect of constructing the Scheme. The most important scenario for the mitigation strategy is the Q95 flow, which is when water levels in local streams are at levels which they exceed 95% of the time. This represents the water levels in the driest period of a reasonably normal summer, i.e. not drought levels.

Figure 1: Hinksey Meadow towards the northern end of the OFAS



1.2 MG4 Community and Ecology

MG4 is the NVC name for what might be called floodplain meadows in plain English. The botanical name for this community is *Aloecurus pratensis – Sanguisorba officinalis*, after the most typical grass and wildflower species. The key feature of this habitat is its wide variety of grass species and wildflowers, which comes from a long history of largely consistent management. MG4 meadows invariably have relatively low fertility (specifically low levels of phosphate in the soil) and where the soil is saturated or flooded in winter, drying out in spring but retaining enough water that plant growth is not drought-restricted until at least late summer. Management is invariably as meadow; with a hay crop cut in mid-summer. Typically, fields are then grazed by livestock in late summer and autumn, feeding from the re-growth, the livestock being removed in winter and not returning until after the next hay cut. This combination of hay mowing followed by late-summer grazing is the traditional regime at Hinksey Meadow.

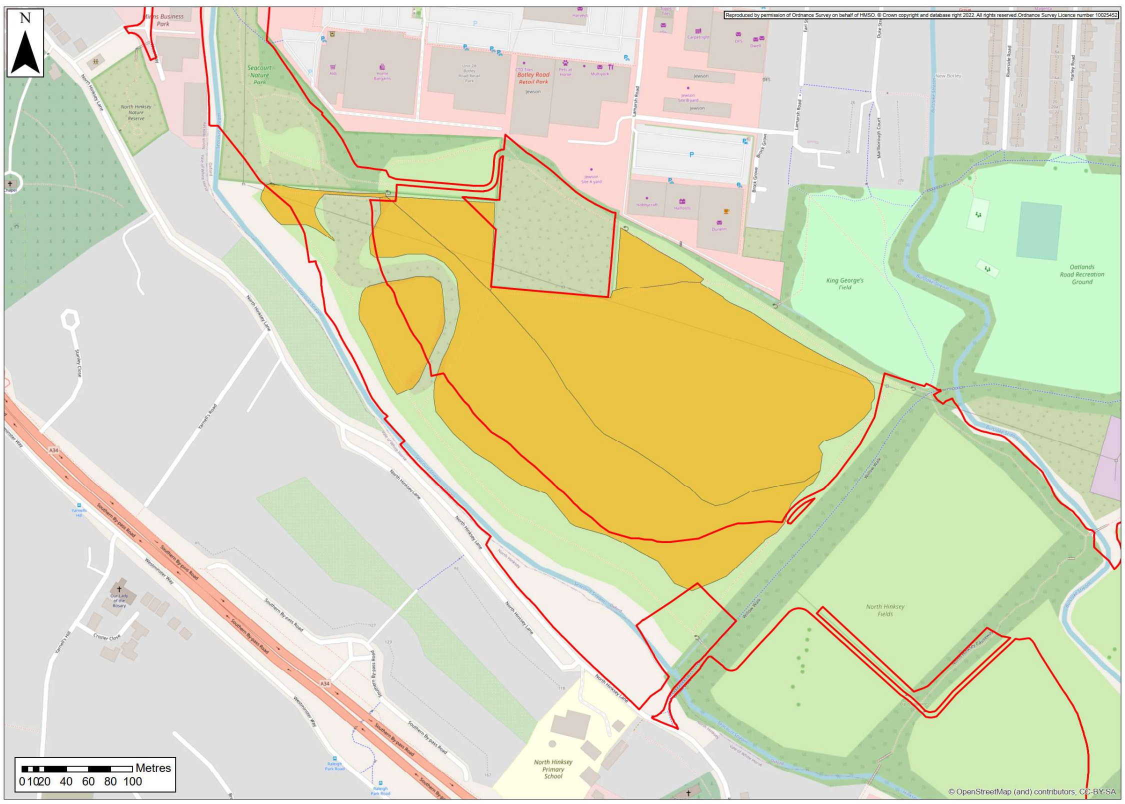
The hay cutting regime is essential for this grassland community, as it both encourages the diversity of wildflowers and removes nutrients from the soil. A significant change in either the water regime, the nutrient levels or the management of the field will lead to a change in plant community over a period of years. Consequently, all sub-communities of MG4 are rare across the UK as traditional hay meadows are being converted to other land uses (e.g., for a range of reasons such as intensification of farming techniques, gravel extraction, development etc.). Jefferson (2007) states there is less than 1500 hectares estimated as remaining in the UK.

2. Scheme impacts

The illustration below (Figure 2) shows the area directly affected by the OFAS works (red line) and the MG4 habitat at Hinksey Meadow (orange area). The nature of the OFAS works varies across the Scheme area, but in Hinksey Meadow almost the entire area within the red line is to be excavated to a depth approximately 500 mm lower than current ground level, to provide a second stage channel for Seacourt Stream. A thin strip approximately 1 m wide around the edge of the red line will not be excavated but will be damaged by erection of fences to prevent construction vehicles from entering the rest of the meadow.

The area directly affected has been calculated as 1.33 ha of MG4 habitat.

Figure 2: Comparison of Scheme area and MG4 habitat



As well as this direct impact, there is a risk of indirect impact to the rest of the meadow. The Scheme will alter the frequency of flooding in various parts of Oxford and will increase or lower groundwater levels in line with changes in the levels of local streams. Without careful design, there would be a potential for the Scheme to cause changes in the ecology of the meadow, either through making the meadow too wet in winter/spring or too dry in summer. Advice from the Floodplain Meadows Partnership, based on groundwater modelling and monitoring by Jacobs, is that Hinksey Meadow is towards the dry end of the ecological tolerance of MG4 grassland and therefore the potential concern would be any changes that left the ground drier during early to mid-summer during the growing season. There is no reason to anticipate that the Scheme would cause changes to the management of the meadow by OPT and their tenant farmer, or that it would lead to increased phosphate levels. Therefore, the issues of concern are confirmed direct loss of MG4 turf and potential indirect loss of a wider area due to groundwater changes.

3. Mitigation strategy approach

We are proposing a four-pronged approach to mitigation:

- Minimising the area of MG4 to be dug up, through designing the second stage channel to be in areas of lower habitat value where possible. This is factored into the area of 1.33 ha to be lost.
- Turves from the MG4 area which needs to be dug up, will either be:
    - translocated to become part of the MG4 meadow which is being created near North and South Hinksey (translocation is subject to agreement from OPT who own the turf);
    - used in the second stage channel at Hinksey meadow; or
    - used by the Hinksey Meadow landowners on another habitat creation scheme.
- Managing water levels in local streams, Seacourt Stream and Bulstake Stream, so as to maintain these levels under both Q95 (low flow) and average year conditions and hence maintaining corresponding groundwater levels at or above existing levels.
- Sowing two new areas of species-rich floodplain meadow (totalling just under 16.5 ha) with a suitable mix of grasses and wildflowers to replicate MG4 grassland and managing these areas as meadow. The seed for this is to be taken from Hinksey Meadow if possible, or from other MG4 grassland otherwise. If the translocation of existing turf does not go ahead, the 1.33 ha identified for this will be added to the area to be sown.

In addition, we propose a monitoring programme to check whether the mitigation measures are effective; if issues emerge we will seek to make changes where possible.

There is consensus among ecologists who have looked at the proposals, that there is a high chance the translocation proposal will not succeed. Therefore, the mitigation plan is based primarily on the other three approaches, which are designed to be adequate mitigation even if none of the translocated turf survives as MG4.

4. Floodplain Meadows Partnership advice

4.1 Overview

This section provides a summary of the advice received from the Floodplain Meadows Partnership in relation to the MG4 grassland at Hinksey Meadow.

Habitat creation and translocation are not a substitute for in situ conservation of this kind of habitat, the latter approach always being preferable where possible.

The Floodplain Meadows Partnership report (FMP, 2017) provides extensive ecological detail about MG4 habitat and how it should be managed. Key recommendations are set out below. It should be noted that there is no example in the published literature of successful translocation of a floodplain meadow, although it should be noted that in most cases the people carrying out the translocation have been unable to replicate appropriate management in the new location, meaning there would be no chance of success. FMP have provided guidance on how to maximise the likelihood of success for the translocation, but they do not suggest confidence that it will be successful.

4.2 Translocation

Guidance and information about translocation has been laid out in the document entitled '*Oxford Flood Alleviation Scheme: assessment of impacts on species-rich floodplain meadow habitat*' by the Floodplain Meadows Partnership (2017).

1) Translocation policy in UK

Though translocation is an option, it is not a good alternative to maintaining habitats in situ, as stated in the current policy for habitat translocation 'A Habitats Translocation Policy for Britain in 2003' (JNCC, 2003). It states that the intrinsic value of the habitat is not retained after a translocation and that it is not a substitute for in situ conservation.

The Floodplain Meadows Partnership continues by identifying the specific reasons, for Hinksey Meadow, that in situ conservation will always be preferable to translocations. These are:

- Ancient habitats are fragile and cannot be re-created in a short timescale;
- Species compositions change as a result of disturbance; therefore the translocation process might change the community structure;
- The history of a specific location cannot be created and therefore may change the distinctive assemblages of species;
- Finding a 'new location' will be difficult in matching the exact same structure and physical conditions of the donor site (geology, soil conditions, hydrology, aspect, topography etc.); and
- The new location doesn't have the same historical, cultural or other human associations with the donor site.

2) Objectives and aspirations

If translocation is the main strategy to preserve the habitat, this target is unlikely to be met, due to the reasons listed above. For this reason, the mitigation strategy focuses on the other three approaches, with translocation treated as an extra.

Aims which could be achievable specific to Hinksey Meadow are:

- Turf survival (at the most basic); and
- Mitigation for loss (by preserving the main features of a community).

The Floodplain Meadows Partnership identifies that turf survival is a sensible objective for Hinksey Meadow if translocation is pursued, with the aim of rescuing turves (which would otherwise be lost) as part of a restoration scheme. There are no examples, in literature, of a successful wet grassland translocation so the aim of mitigation for loss may not be possible. If translocation does not succeed, the results of the evaluation monitoring will be of use in studying the reasons for this and will add to our knowledge of the ecology of this habitat type.

3) Best practice advice

For an increased chance of success, a series of best practices for turf translocation should be followed. These have been created based upon case studies (Bullock, 1998; Box, 2003) and include:

- <u>Similarity between donor and receptor sites</u>

  As mentioned above, to increase success during translocation, the features need to be as similar as possible in both the donor and receptor site. Recommended monitoring at Hinksey Meadow, and potential receptor sites, are:

  a. Soil-water elevation (to assess soil-water regime) using soil (dip) wells;

  b. Soil-moisture release curve (to assess soil porosity);

  c. Nutrient analyses (to assess soil fertility);

  d. Soil profile assessments; and

  e. Topographical information (to assess flood recession routes)

  In some cases, variables can be managed, or engineered, as part of the relocation if exact conditions are not present within the receptor site.

- <u>Translocation technique</u>

  Within literature, there are two main methods of grassland translocation;

  i. Turf translocation - If deep enough, this method maintains underlying soil profile and minimises damage to individual plants

  ii. Translocate a mixture of soil and vegetation - Though this tends to have a lower success rate than turf translocation and only recommended for the movement of lower quality grasslands

These techniques have critical points to ensure success, along with other considerations, which are listed in full, within the Floodplain Meadows Partnership report (2017)

- Post translocation habitat management

  Receptor site(s) must have an agreement in place, before translocation, to ensure that post translocation management is guaranteed to be similar to the regime currently being undertaken at the donor site (Hinksey Meadow). This must include an annual hay cut, preferably followed by aftermath grazing.

- Evaluation

  Long-term monitoring is essential for keeping a record of the health of the habitat and for determining the success of the translocation. Along with baseline surveys, periodic surveys at no more than 5 year intervals, at both donor and receptor sites, should identify changes in community structure along with contributing towards further knowledge on grassland translocation. The National Vegetation Classification (NVC) is suitable for the assessment of changes in plant communities. If a decline in key plant species is recorded, remedial actions will be developed together with FMP and implemented.

  In addition to fixed point, repeatable botanical quadrats (baseline, then annually for 5 years) there should be invertebrate surveys (baseline, then at 5 and 10 years post translocation).

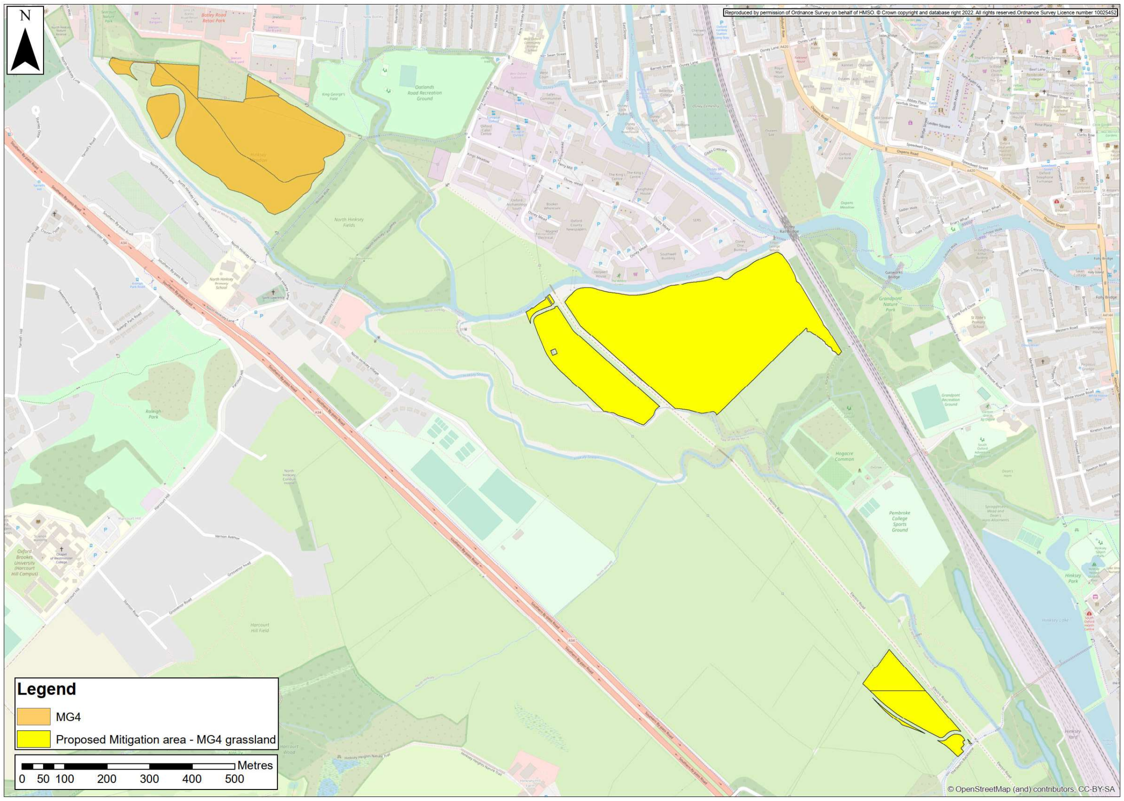
4.3 Creation

The location of the proposed creation of MG4 grassland is just east of the two-stage channel (see Figure 3). Management guidelines and key points for MG4 grassland creation are written with regard to these sites. If the design changes and the location is moved, a revised strategy will be needed – refer back to the Floodplain Meadows Partnership report (2017) for further information.

Management guidelines for the fields where MG4 grassland is created must ensure these sites have an annual hay cut. Ideally, an aftermath grazing regime would follow but could be replaced by a second hay cut if aftermath re-growth warrants it.

Where the objective is to create a species rich-plant community, but not specifically one classified as MG4 (i.e. in areas which are part of the overall Scheme but not part of this mitigation strategy), then management through grazing only is an option for other neutral grassland classifications such as MG5 *Cynosurus cristatus-Centaurea nigra* grassland, MG8 *Cynosurus cristatus*-Caltha palustris grassland or MG13 *Agrostis stolonifera-Alopecurus geniculatus* grassland, depending upon hydrology. This does not apply to the areas where we are aiming to create specifically MG4 grassland, for which an annual hay cut is essential, but may apply to other fields in the Scheme area.

Figure 3: Proposed MG4 creation sites



As mentioned in section 4.2, the conditions at the site, in this case for creation/restoration, are essential for success. After identifying potential sites using computer models, direct monitoring of the 'most suitable' sites should be conducted, with the appropriate analysis performed. This should include, but not be restricted to, the monitoring of water regime, soil phosphorus and information on soil porosity. Below are specific guidelines to these conditions which will determine which location is most likely to succeed in the creation of a species-rich floodplain meadow.

1) Hydrology

Three hydrological guidelines have been identified as required for the creation of species rich floodplain meadows. These are:

- Groundwater depth is generally between 0.5 – 1.0 m;
- Depth to top of gravel is between 0.2 - 1.2 m; and
- Soil is well structured and free-draining

2) Soil fertility

The typical phosphorus levels required for this type of habitat creation should be within 5 – 20 mg/l (Olsen's extraction), with the correlating phosphate indices 0 and 1. Values above this figure will result in a species richness decline which might be suitable for restoration but not as a potential translocation site.

The Floodplain Meadows Partnership calculated soil phosphorus from three samples from Hinksey Meadow provided a range of 6 - 12.4 mg/l. Therefore, fields with phosphorus availability within the same range have been sought for creation.

3) Evaluation

As mentioned above, long-term monitoring is essential for the identification and recording of habitat changes and measuring success, if it is at a creation/restoration or translocation site. Monitoring for the creation/restoration sites should include, but not be restricted to:

- Monthly groundwater levels - are they as predicted and if it is still sufficient for the anticipated plant community. Where water levels fall from optimal levels, opportunities to manage water levels should be implemented (see Section 5.3);
- Annual fixed quadrats of plant community – to monitor the development of the plant community. If a decline in key plant species is recorded, remedial actions will be developed with advice from FMP;
- Soil fertility every 3 years – is it still within range of target species, which may inform management;
- Invertebrate surveys at baseline, 5 and 10 years – to monitor any changes during development or operation;
- Soil profile during baseline – to determine exact depths of gravels and other horizons (only required if not already been recorded);
- Soil porosity during baseline – at sites identified for restoration to identify soil characteristics and interpret the groundwater regime; and
- New area, as a whole (both creation and translocation areas) – as success is not guaranteed, lessons learnt during either creation/restoration or translocation can be used as a working example for similar projects in the future.

5. Proposed mitigation

5.1 Minimising area directly affected

We have used the surface water model and the plan of the known extent of the MG4 to minimise the land take. The contractor has agreed that the haul road in this part of the Scheme area will be within the footprint of the excavation, to avoid losing additional land. The limit of the land which the contractor is allowed access to must be clearly set out in the contract documents and enforced with fencing. No vehicle access will be allowed to the fenced-off area. OPT's tenant will be able to make the normal hay cut in the summer each year during construction.

5.2 Translocation

To have any chance of success, translocation must follow the guidelines provided by the Floodplain Meadows Partnership (FMP 2017). Timing, methodology and proper preparation of the receptor area are all critical, as is immediate establishment of the correct management regime at the receptor site. Translocation is best carried out outside the active growing season; a further constraint in this location is that, due to the high likelihood that soils will be waterlogged in March, only the autumn period is available. The target timing for translocation is September, most likely September of the year prior to the start of earth works due to other programme constraints. Translocation later in the autumn may also be possible, if the ground remains dry enough, but the overall Scheme programme will benefit from doing the translocation at the first opportunity.

The receptor sites must be prepared in advance, so that turf can be translocated directly. Since the receptor sites are mapped as UKHab habitats *Lolium-Cynosurus* neutral grassland, other neutral grassland and modified grassland, and too high in phosphate nutrients, topsoil should be removed from the 1.33 ha area, to the same depth as the thickness of the turf to be moved.

The turf to be translocated will be significantly deeper than standard turf, as the seedbank and mycorrhizal system are important. This will require specialist equipment. A depth of 300 mm may be sufficient; ideally between 300 mm and 500 mm would allow some of the subsoil to be moved at the same time. Turf needs to be placed on to well-structured soil in a way that avoids compaction of the soil. Where trafficking on the exposed subsoil is unavoidable, some mechanical disturbance (e.g. harrowing) and subsequent weathering is needed to loosen the soil such that hydraulic continuity can be established with the turf.

The translocated turf may need watering early on, if the weather is dry. Once established it should be able to survive using natural water levels. Management as hay meadow should start immediately in the first summer, with the same timing of hay cut as is used at Hinksey Meadow.

The second stage channel, from which the turves are to be removed, will be reinstated by planting with MG4 seed mix, as is proposed for the new meadow area.

Translocation is subject to landowner agreement, which has not yet been obtained. If OPT decline to agree to the translocation, and assuming Compulsory Purchase has not been used on this land, the turves removed will belong to OPT and it will not be open to the Environment Agency to insist on them being translocated. In this situation there would be two options:

(1) translocate the turves to another site, identified by OPT, or to a temporary location controlled by OPT;

(2) store the turves off-site, watering as necessary to keep them healthy over perhaps two years, then use them to reinstate the new second-stage channel once it has been dug to the correct depth. As the new location would be approximately 500 mm lower than existing ground level, it would be significantly wetter than the existing ground and it is likely that the reinstated turf would gradually change to a different species mix to suit the new wetter conditions.

5.3 Managing water levels

The original proposal included very few fixed-crest weirs. The groundwater model found that lower water levels, particularly in Bulstake Stream, led to lower groundwater levels at Hinksey Meadow during Q95 (dry summer) flow conditions. Although groundwater would reduce by only approximately 250 mm, this could be enough to cause long-term ecological change across the whole meadow, not just the directly-affected area. Further groundwater model runs were undertaken to investigate the potential mitigation that could be built into the Scheme through management of bed levels in the water courses.

Localised bed-raising (via riffles or other means) within Bulstake Stream is predicted to lead to an increase of the low flow (Q95) water level by 300-400 mm. The groundwater model suggests that this would result in groundwater across Hinksey Meadow being returned to current levels or slightly higher. Since the MG4 grassland is believed to be at the drier end of its range of ecological tolerance, a slight increase in groundwater levels during low flow periods would not be a concern, while any significant decrease could cause issues.

The riffles used to raise levels during low flows will be lower than the normal level of the stream, so under normal and flood conditions they would be completely submerged, avoiding any effect on fish migration or any increase in groundwater flooding. The raising would be designed as riffles, looking like natural stones when exposed during low flows rather than concrete structures. The measures would need to be in place before Bulstake Stream is connected to the new channel, but would not need any settling-in period and could be installed immediately before the connection is established, or alternatively they could be installed during the previous summer. They will need to be installed outside of fish spawning & migration season.

5.4 New meadow

Two areas in North Hinksey and South Hinksey, totalling approximately 17.8 ha, have been identified for the creation of species-rich floodplain meadow (see Figure 3), with the long-term aim of creating MG4. This includes the 1.33 ha for the translocation experiment. We have tested existing phosphate levels in the larger, more northerly area, where levels are in line with requirements, particularly towards the western part of the proposed meadow, while phosphate levels towards the eastern end are higher. In the smaller, more southerly field, nutrient levels aren't yet known; we will need to check if the soil here is too rich; if so, we will need to seek advice as to whether additional measures are needed, in addition to the subsequent management techniques.

Spreading of green hay (hay cut including the seed heads of the grasses and wildflowers) is the preferred method to sow the meadow. The sites will need to be prepared in advance, either through scarification of the existing sward to create approximately 50% bare soil or through clearance and cultivation. Green hay can be placed on the scarified/bare soil, or a seed mixture can be used if green hay is not available. Both receptor sites are outside the contractor's working area, so the sowing can be carried out in any year, preferably in late summer.

After sowing the new meadow must be switched to mowing instead of grazing immediately. It is essential that the cut hay is removed from the site, to help lower nutrient levels in the soil and improve the chance of long-term success. If soil nutrient levels are higher than ideal levels, there may need to be a second cut, with arisings removed from the site, rather than grazing in the first few years.

As adjacent fields are likely to return to grazing after the Scheme is complete, the meadows will need to be fenced to keep out livestock during early summer and to allow late-summer grazing of the meadows. Long-term management agreements for the meadows are being set up with the relevant landowners.

6. Proposed monitoring

There is a five-year programme of monitoring and management of planting for the Scheme. In the meadow areas this will be extended to 20 years, due to the risk of long-term changes which may happen too slowly to be picked up immediately. We will carry out fixed point repeatable botanical quadrats, which together with an overall visual assessment can be used to inform NVC surveys of the flora in the translocated area, the newly-planted meadow and the remaining Hinksey Meadow, plus periodic surveys of groundwater levels, soil fertility, pollinator and invertebrate communities as explained above (section 4.3, paragraph (3)).

We have not yet identified who will carry out the monitoring; we have access to a number of botanical surveyors who can undertake the task, but we also intend to discuss with Oxford University whether they would be interested, as they have staff with extensive experience of monitoring the existing Hinksey Meadow.

The success or failure of the translocation should be documented, to provide information to anyone proposing a similar attempt in future. If the translocation does not succeed, botanists may be able to learn valuable ecological information if there is an appropriate level of monitoring and assessment.

In the case of the remaining Hinksey Meadow, if evidence emerges that the meadow is suffering from low groundwater during the summer, further raising of low-flow water levels in Bulstake Stream may be needed. This could be done by adding an additional riffle, at relatively low cost. The monitoring strategy developed will need to ensure that it identifies thresholds and trigger points for pre-determined groundwater levels that when exceeded, will prompt action.

7. References

Box, J. 2003. Critical factors and Evaluation Criteria for Habitat Translocation. Journal of Environmental Planning and Management, 46, 839-856.

Bullock, J.M. 1998. Community translocation in Britain: setting objectives and measuring consequences. Biological Conservation, 854: 199-214.

CH2M 2015. Oxford Flood Alleviation Scheme: Ecological Appraisal IMSE500177-HGL-00-ZZ-RE-C- 000029, Environment Agency

CH2M 2017. Oxford Flood Alleviation Scheme: Extended Phase 1 Habitat Survey Autumn 2017 IMSE500177-CH2-XX-00-TN-EN-0705, Environment Agency

Floodplain Meadows Partnership 2017. Oxford Flood Alleviation Scheme: assessment of impacts on species-rich floodplain meadow habitat

Gowing, D.J.G. 2004. Lowland Wet Grassland Community Guidelines. In Brooks, A.W. ed., 2004. Ecohydrological Guidelines for Lowland Wetland Plant Communities. Environmental Agency.

Jacobs 2021. Oxford Flood Alleviation Scheme: Habitat and botanical survey report IMSE500177-CH2-XX-00-SU-EN-0734, Environment Agency

Jefferson, R.G. and Pinches, C.E. 2007. The conservation of floodplain meadows in Great Britain: an overview

Joint Nature Conservation Committee 2003. A Habitats Translocation Policy for Britain. Joint Nature Conservation Committee in conjunction with the Countryside Council for Wales, English Nature and Scottish Natural Heritage. JNCC, Peterborough

King, T.J. 2016. Hinksey Meadow/Osney Mead, North Hinksey, Oxford. Botanical Survey 2016

Lambert, S. and Floodplain Meadows Partnership 2020. Hinksey Meadow National Vegetation NVC Survey