



# Hoveton Great Broad Restoration Project Monitoring Plan



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# Hoveton Great Broad Restoration Project Monitoring Plan

Hoveton Great Broad and Hudson's Bay, both part of the larger Bure Broads and Marshes SSSI and are currently in Unfavourable No Change condition, i.e. their condition does not meet the government's Biodiversity 2020 target, and have been so for at least 40 years. They fail to meet Water Framework Directive (WFD) standards, with Overall Ecological Status being Poor. The Hoveton Great Broad Restoration Project aims to achieve clear, macrophyte dominated open water using sediment removal and biomanipulation techniques.

Monitoring of Hoveton Great Broad and Hudson's Bay has been underway for many years as part of the NNR management plan, the Environment Agency (EA) and Broads Authority's monitoring of the Broads. Over the last two years, in preparation for the restoration works, more detailed analysis and monitoring of Hoveton Great Broad and Hudson's Bay has been carried out. As part of the Hoveton Great Broad Restoration Project further monitoring will be carried out before, during and after the sediment removal works, creation of new fen habitat and biomanipulation phases.

## 1. Sediment removal and creation of new fen areas:

### 1.1 Vegetation Monitoring Plan

- I. Monitoring will seek to identify areas where erosion might be occurring, as well as consider and record the density of re-establishing vegetation on the geotextiles and sediment contained behind the geotextiles.
- II. Establishment of vegetation will be monitored twice a year via drone during the growing season until suitable coverage (>80%) of fen vegetation has established.
- III. It is estimated that 50% vegetation cover would be achieved within 5 years of completion of each newly created fen area. Should this level not be achieved, NE will identify the reasons for the failure and would implement additional restoration measures with consultation of the Local Planning Authority.
- IV. Natural England staff will assess whether the established vegetation is developing in to a suitable wetland habitat for the site and carry out management accordingly when it is safe to do so.



## 1.2 Swamp Communities

- I. It is not anticipated that the project works will have a significant impact on the establishment of swamp communities around the margins of Hoveton Great Broad and Hudson's Bay. Therefore swamp communities will be monitored by Natural England under the NNR management plan.

## 1.3 Geotextile and fen habitat areas monitoring, goose grazing.

- I. Temporary low fences are planned to be installed for new fen habitat areas in Hoveton Great Broad as stated in section 12.1.1 of the Environmental Statement - to prevent geese from grazing developing vegetation.
- II. For the first two years following completion, the Geotextile and new fen habitat areas will be monitored monthly by Natural England staff. Thereafter, for the following two years monitoring will take place at 3 monthly intervals.
- III. Natural England monitoring of the Geotextile will include visual inspection for obvious erosion, damage to the Geotextile, consolidation/erosion of backfill areas, vegetation cover and establishment, and evidence of goose grazing. If any damage or erosion is found, the project will inform Netics, take remedial action and consult with the Local Planning Authority accordingly.
- IV. The goose grazing fences are not permanent and will be removed when vegetation cover is sufficient that goose grazing would no longer affect the successful development of new fen vegetation. The threshold for suitable vegetation cover before goose fencing can be removed is 75% cover for three consecutive years.
- V. Percentage cover of vegetation in the summer months will be assessed each year. A second opinion from the Bure Marshes NNR manager will be obtained before the goose fencing will be removed. Natural England will inform the Local Planning Authority when the threshold of vegetation cover has been met and temporary fencing can be removed.
- VI. The need to assess the ability of consolidating mud within the back-filled areas to bear human weight (section 12.2.3 of Environmental Statement) is no longer applicable as the Wroxham Island phase of the project accessible to the general public from Wroxham Broad is no longer going ahead. The geotextiles and new fen habitat areas in Hoveton Great Broad are inaccessible to the public and therefore would not require protective fencing and signage.

## 1.4 Freezing Conditions

- I. Operations will not be carried out during periods of severe weather. In this situation severe weather is when temperatures of zero degrees C, or below, have been recorded locally (Hoveton Gardens weather station as reported on Met Office website) for seven consecutive days but allowing short periods of thaw (temperatures above 0°C) to comply with condition 14 of planning permission of BA/2016/0228/COND .
- II. Work will not recommence on Hoveton Great Broad and Hudson's Bay until the severe weather period has ceased. When counting days of severe weather, short periods of thaw (one or two days) will have no effect on the counting process but periods of thaw of three or more days have the effect of resetting the count of severe weather days back to zero.
- III. A precautionary approach will be taken with regards to freezing conditions and ice



percentage coverage of the broad.

## 1.5 Silt Curtains

- I. As a condition of the sediment removal contract, any work within 50m of the river will be conducted in conjunction with a silt curtain.
- II. The Project Officer will ensure that this condition (condition 10 of the planning permission **BA/2016/0228/COND**) is adhered to.

## 2. Biomanipulation

### 2.1 Fish Barriers

- I. Fish barriers will be installed and biomanipulation will begin in 2020 in consultation with the Local Planning Authority.
- II. After installation Natural England plan to visually inspect fish barriers' structural integrity and check for any obvious subsidence monthly. If any damage or subsidence is found, specialist engineers will be informed and will advise Natural England on how to proceed. Any necessary repairs will be carried out in consultation with the Local Planning Authority.
- III. For the first year following installation the fish barriers will be monitored monthly for evidence subsidence by the Project Officer. Thereafter, monitoring will take place at 3 monthly intervals until fish barriers are removed.
- IV. To inspect the fish barriers' structural integrity below the waterline, a sonar camera will be used every three months. The sonar camera will also be used to check for blow outs underneath fish barriers due to the tidal movement which would compromise the effectiveness of the fish barriers. Again, if any damage is found, specialist engineers will be contacted to advise on the necessary repairs, which will be carried out in consultation with the Local Planning Authority.
- V. Once monitoring indicates that the lake restoration has been successful and the broad has returned to a stable clear-water macrophyte-dominated state, the fish barriers will be removed in accordance to condition 17 of the planning permission BA/2016/0228/COND.

### 2.2 Fish Barrier Removal

- I. The fish barriers shall be removed as soon as is reasonably practicable in accordance with the monitoring plan, as shall be agreed in accordance with condition 7 of the planning permission BA/2016/0228/COND, or after a period of ten years from the date of installation, whichever is the earlier. However, Natural England will seek an extension to condition 18 beyond 10 years if sufficient recovery has not been observed as per protected site favourable condition status.
- II. There are two thresholds which will need to be met before the fish barriers can be removed. These are 1) Water Quality (including zooplankton numbers) and 2) Plant diversity and abundance.
- III. There is a monitoring scheme already underway which will provide a baseline for water quality before lake restoration and will continue throughout the project to provide an overall trend.



- IV. At this stage in the project it is difficult to set the thresholds of these parameters for when to remove the temporary structures. When Natural England are satisfied significant restoration has been achieved it will share the latest data and evidence of water quality and plant diversity and abundance with the Local Planning Authority for review and the fish barriers shall be removed in accordance with condition 18 of planning permission BA/2016/0228/COND when the Local Planning Authority are satisfied this data and evidence indicates it is appropriate to do so.

### 3. Continuous and Ongoing monitoring

Ecological and environmental surveys and monitoring have been initiated in order to design an effective restoration project and to monitor the progress and effectiveness of the project. A summary of the Hoveton Great Broad Restoration Project monitoring and timescales can be seen in table 1 (page 9).

#### 3.1 Baseline Monitoring

Natural England has been carrying out monthly monitoring of Hoveton Great Broad and Hudson's Bay with assistance from ENSIS from University College London since August 2014. Zooplankton and phytoplankton monitoring is especially important to establish the baseline composition and abundance of these communities. Surveying has also studied the natural seasonal variations of these communities throughout the year. Factors being monitored are:

- Photosynthetically Active Radiation (PAR)
- Reduction Oxidation Reaction (Redox – chemical reactions in which atoms have their oxidation state changed)
- Zooplankton
- Phytoplankton
- pH
- temperature
- water clarity (secchi disk measurements)
- Conductivity

Water Quality is sampled at two locations - one in Hoveton Great Broad and one in Hudson's Bay.

These factors will continue to be monitored until September 2016. This will provide the project two full years' baseline surveys before the sediment removal works commences. The baseline data shall be submitted to the Local Planning Authority for their records within six months of commencement of sediment removal.

#### 3.2 Continuing Monitoring

After September 2016 monthly monitoring will be carried out by the Project Officer after a three month training and handover period. Monitoring thereafter will be carried out at five sample points on both Hoveton Great Broad and Hudson's Bay. Factors that will continue to be monitored are:





- Zooplankton
- Phytoplankton (June – September)
- Water Clarity
- pH
- Temperature
- Conductivity

Water Quality will continue to be sampled at two locations – one in Hoveton Great Broad and one in Hudson’s Bay. PAR and redox will not continue to be monitored as they were primarily required to inform the sediment removal plans only. At the end of the project in 2020, monthly monitoring and enumeration will be carried out for at least 12 months to compare against baseline data. Funding is being sought to continue monitoring for the life of the barriers.

### 3.3 Water Quality

- I. Monitoring of water quality is carried out monthly by the Environment Agency, the results of which are used to assess the condition of the broad.
- II. Annual monitoring of aquatic macrophytes is currently undertaken by the Broads Authority at many of the broads and has been ongoing since 1983. This monitoring includes Hoveton Great Broad and therefore this dataset will be one of many factors used to assess the condition of the broad after project completion. If for whatever reason the Broads Authority could not carry out macrophyte monitoring at Hoveton Great Broad any particular year, Natural England would complete the necessary investigations as part of its site condition monitoring programme.
- III. Further Common Standards Monitoring (CSM) has been completed for the Environment Agency for WFD assessment. EA carried out a CSM macrophyte survey in 2009, and Natural England carried an additional CSM survey in 2014. Further CSM will be carried out by NE when yearly macrophyte data indicates significant improvement in site condition.

### 3.4 Sediment sampling

- I. Quarterly sediment sampling has been carried out by the Centre for Ecology and Hydrology (CEH) in 2016 with one outstanding sampling session to be carried out before sediment removal begins in October/November 2016. The sampling system has been designed to provide an objective assessment of the effects of sediment removal and to provide a better understanding of desilting on sediment phosphorus content and release dynamics. The approach follows the “multiple indicator” approach presented by the WFD.
- II. Quarterly sediment sampling includes: sediment cores, phosphorus properties, metal analysis, bottom water samples, dissolved oxygen concentration, conductivity, pH, redox potential, water temperature of bottom waters.
- III. Quarterly sampling will be repeated in 2020 to allow for “before and after” comparisons and a full assessment of the effects of sediment removal.



### 3.5 Fish Surveys

- I. Boat based fish surveys (1-2 weeks in length) were carried out quarterly by The Environment Agency from 2013 - 2015 and 2016/17. The surveys were designed to provide an ecological baseline and inform biomanipulation.
- II. Surveys have been undertaken in Hoveton Great Broad and the surrounding broads to gauge the wider scale fish population and behaviour within The Broads.
- III. Survey methods include overnight surveys of the entrance into Hoveton Great Broad using ARIS cameras in fixed locations, open water surveys using ARIS cameras mounted on vessels (High-Resolution Sonar Assessment (HRSA)) and point-abundant sampling by electric fishing (PASE).
- IV. PASE surveys commenced in October 2013 and continued quarterly until 2015 to provide a pre-biomanipulation baseline. During biomanipulation a report on the pre and post-biomanipulation fish community will be produced and submitted to the Broads Authority. Following biomanipulation surveys will be conducted every 3 years during further fish removals, or after any flood events which over top the fish barriers. ARIS and HRSA has proved hard to analyse. If an effective method for analysing the base data is developed then another year of quarterly HRSA surveys will be carried out 3 years after biomanipulation to provide a comprehensive picture of the fish community to compare against baseline surveys.
- V. A pike spawning survey was carried out in March/April 2014 and a cyprinid (fresh water fish) spawning survey was carried out in spring 2015 to add to baseline data and evaluate the effects of the project on the wider Bure fishery.
- VI. Acoustic fish tracking of bream and pike within the Ant, Bure, and Thurne is being monitored as part of a PhD (2016-2019) to monitor the importance of Hoveton Great Broad and Hudson's Bay within the wider system.

### 3.6 Invertebrates

- I. Standardised aquatic invertebrate surveys were carried out on three dates in 2014 to provide baseline information on the invertebrate community.
- II. The surveys will be carried out again on the same three dates in 2021 following restoration work.
- III. The project are seeking funding to carry out a further invertebrate survey once a diverse and stable macrophyte community has been established in Hoveton Great Broad and Hudson's Bay

## 4. Conclusion

Natural England has carried out ecological and environmental baseline monitoring since 2014 in order to provide comprehensive information on communities, species abundance and behaviours and quantitative data to inform the restoration plans. This will provide comparative data on which the Hoveton Great Broad Restoration team can measure the successful restoration of the Broad. Monitoring will continue on a monthly basis throughout the project to monitor the progress and effectiveness of the project. Post project sampling and monitoring will





ensure that the environmental benefits of restoration are long term.

Monitoring of the geotextile and new fen habitat areas will be thorough and carried out on a monthly basis by the Project Officer for the first two years after completion of the sediment removal works. Thereafter, for the following two years monitoring will be carried out three monthly. Where works or repairs are required they will be done so in accordance with advice from engineering experts and with consultation from the Local Planning Authority. Temporary structures such as goose grazing fences and fish barriers will be removed as soon as the appropriate environmental thresholds have been met.



**Table 1. Hoveton Great Broad Restoration Project Monitoring timetable**

<b>Ecological monitoring timetable</b>	<b>Prior to project start</b>	<b>Year 1 2015-2016</b>	<b>Year 2 2016/17</b>	<b>Year 3 2017/18</b>	<b>Year 4 2018/19</b>	<b>Year 5 2019/20</b>	<b>Year 6 2020/21</b>	<b>Post project</b>
<b>Project timetable:</b>	Project start					Project end	Project end	Afterlife
Mudpumping								
Isolation								
Biomanipulation								
<b>Macrophytes:</b>								
BA point surveys	Annual since 1983	Summer survey	Summer survey	Summer survey	Summer survey	Summer survey	Summer survey	
Condition Assessment surveys	2014 ~every 3 years		Summer survey					Summer survey date tbc
<b>Invertebrates</b>	3x in 2014						3x in 2021	
<b>Zooplankton</b>	Monthly started in May 2014	Monthly	Collected June - Sept	Collected June - Sept	Collected June - Sept	Monthly	Monthly	
<b>Phytoplankton</b>	Monthly started in May 2014	Monthly	Collected June - Sept	Collected June - Sept	Collected June - Sept	Collected June - Sept	Collected June - Sept	
<b>Fish</b>								
ARIS	Quarterly started Feb 2014	Quarterly						



PASE	Quarterly started Oct 2013	Quarterly	Quarterly			During biomanip ulation		Every 3 years during further fish removals
<b>Water quality</b>	Monthly enhanced started in May 2014	Monthly enhanced	Monthly enhanced	Monthly enhanced	Monthly enhanced	Monthly enhanced	Monthly enhanced	Monthly
<b>Sediment sampling</b>		Quarterly				Quarterly		
<b>WeBS</b>	Monthly Oct- March	Monthly Oct- March	Monthly Oct- March	Monthly Oct- March	Monthly Oct- March	Monthly Oct- March	Monthly Oct- March	
<b>Dyke surveys</b>		Annual summer				Annual summer		

