Woodwalton Fen NNR

Management Plan

This plan covers the period:
April 2015 – March 2020

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1.1 Location

		Notes
Location	Woodwalton Fen lies at the extreme eastern edge of the parish of Woodwalton, approximately 2 km south-west of Ramsey Heights, Cambridgeshire.	
County	Cambridgeshire	
District	Huntingdon	
Local Planning Authority	Huntingdonshire District Council	
National Grid Reference	TL 230 845 OS Map Landranger 142-Peterborough	Centre of site

1.2 Land Tenure

	Area (ha)	Notes
Total Area of NNR	208.1	514.2 acres
Freehold		
Leasehold	208.1	99 year Lease dated 30 January 1954: Royal Society of Wildlife Trusts (RSWT), The Kiln, Waterside, Mather Road, Newark, Notts NG24 1WT
Other Agreements		75 year Flood Storage Agreement dated 23 June 1982 (commenced 1977): Middle Level Commissioners (MLC)
Legal rights of access		Annual Lease commencing 2001: Mormon Church (AgReserves) Access from south-west through Manor Farm. Restricted to light vehicle use (checking/feeding cattle, etc) with occasional HGV use (ditch cleaning heavy plant, moving stock)
Other rights, covenants, etc		Construction (historical): • MLC right to divert drains into Great Raveley Drain • Construction of regulating and evacuation sluices • Excavation of meres • Raising of water levels Operation (current): • Use of control sluice to divert flood water onto the fen • Retention of flood water as necessary
Notes		Requirement to appoint Joint Advisory Committee. New Great Fen Joint Technical Advisory Committee formed in 2010 with agreement of all parties. No buildings to be erected without consent. Covenant to maintain bank and fence

1.3 Site Status

Legal designations affecting the site

Designation	Area (ha)	Date	Notes
SAC	208.1	**Designation:** 2002	Woodwalton Fen was included as part of the Fenland proposed **Special Area of Conservation** under the European Habitats Regulations in 2001, along with Wicken Fen and Chippenham Fen NNRs
Ramsar	208.1	**Designation:** 1995	The site was designated for its aquatic fauna and flora and its rare terrestrial plants by the Convention on Wetlands of International Importance (**Ramsar**) in September 1995
NNR	208.1	**Declaration(s):** 1954	The site has been a nature reserve since its donation by Charles Rothschild to the Society for the Promotion of Nature Reserves in 1919.
SSSI	208.1	**Notification (1981 Act):** 1985	
Wider designations:			Part of Great Fen Project area

1.4 Physical Features

The physical aspects of the reserve which form part of the site's importance or which have a bearing on its management

Geology

The reserve lies on an average of 2m depth of freshwater peat. Beneath this is Oxford clay, which in some areas may be covered by boulder clay.

Geomorphology

The reserve lies at the western edge of the fen basin. To the west gentle hills of Oxford clay occur, much of which is covered by boulder clay. No streams of any size flow into the basin. Elevation of the site is about 1 metre below OD. The site now stands more than 1 metre above the surrounding farmland which continues to reduce in height (through oxidisation of the peat) at the rate of about 2cm per annum. There is evidence of a seam of gravel running diagonally across the centre of the site.

Soils

Soils are almost entirely peat, apart from some clay which outcrops at the extreme south-west edge. In the northern part of the site there are two layers of peat divided by a varying depth of 'buttery clay' – a marine silt laid down during a period of inundation by the sea. This buttery clay is absent from the more southern areas. The upper peat layers have been considerably modified by peat cutting. In two areas there are the remains of more acidic peat resulting from the raised bog vegetation which once occurred here. These are cts. 41, 77, 83 and part of 82 at the south end.

Hydrology & Hydrochemistry

Woodwalton Fen is isolated from the rest of the catchment by nature of the clay-cored flood banks constructed in the 1960's and '70's. The only connection to the catchment is via control sluices which exist at all inflows around the site. There are no springs or streams within the site, the only access to water is from the Great Raveley Drain, which is controlled by the Middle Level Commissioners (MLC) and is fed by agricultural run-off and treated sewage effluent.

The site acts as flood storage facility and can store up to 2 million m^3 of water. The frequency and timing of flooding is controlled entirely by the needs of the MLC to balance flows in the main drain. The flooding is operated via sluice-gates in the Great Raveley Drain, opposite dyke 4. Water stored can be evacuated via a sluice at the eastern end of dyke 4, just north of the control sluice. Although there have been few controlled flooding instances in the last few years there have been flood events occurring, particularly at the south end. It is thought that this introduces nutrient-rich silt to the site.

Chemical analysis by the Environment Agency (EA) has shown that during the period from the 1980s to about 2010 there were high levels of phosphate entering the NNR and high nitrate levels still remain. Analysis of water in the 2012-2014 has shown low oxygen levels and high nitrate in some areas.

Climate

As far as temperature is concerned Woodwalton Fen has a continental climate with a mean annual temperature of about 8^{o} C. Average sunshine is typical of much of southern England. Precipitation

is very low as Woodwalton Fen is within the driest area of the country. Average annual precipitation for the period 1963-92 was 545mm (the driest place in Britain – St.Osyth in Essex = 513mm). Records show that during the last management plan period the site experienced both the wettest (2012) and the driest (2011) years since records began in 1934.

1.5 Biological Features

The plants and animals which form part of the reserve's importance and which contribute to national and local biodiversity

The character of Woodwalton Fen is now considerably different from the arable-dominated countryside which surrounds it and almost certainly distinct from the vegetation which occurred before the Whittlesey Mere wetland was drained. Despite the loss of several species due to the effects of drainage and peat digging, the site has retained a large degree of wildlife value characteristic of undrained fenland and is considered to be of Grade 1 national importance in "*A Conservation Review (Ratcliffe 1977)*". Since that time, the NNR has attained international status under the Ramsar convention and is part of the Fenland Special area of Conservation as designated by the European Habitats Regulations. This includes M24 *Molinea/Cirsium dissectum* grassland, M2 *Cladium* mire, great-crested newts

Species totals (where known), BAP species and species of concern or restricted distribution are listed below.

Flora

At least 490 species of plants have been recorded at Woodwalton Fen, although of these, 42 species have only been recorded prior to 1954. Nationally notable species and species of conservation concern include:

Species		***Status***
Latin Name	***English Name***	
Anagallis tenella	Bog pimpernel	
Baldellia ranunculoides		NT
Carex lasiocarpa		VU
Carex x evoluta		VU
Dactylorhiza traunsteineri	Narrow-leaved marsh orchid	*LC but nationally rare*
Eleochaeris acicularis	Needle spike rush	
Epilobium lamyi		
Galeopsis speciosa		VU
Hieracium umbellatum		*Nationally rare (PS)*
Hottonia palustris	Water violet	
Hydrochaeris morsus-ranae		VU
Lathyrus palustris	Marsh pea	NT
Luzula palidula	Fen woodrush	*RDB Red List (CR)*
Myriophylumm verticillatum		VU
Nymphoides peltata	Fringed water lily	
Oenanthe fistulosa		VU
Pedicularis palustris	Marsh lousewort	
*Peucedanum palustre******		VU
Poa palustris		
Potamogeton coloratus	Fen pondweed	
Potamogeton friesii		NT
Potamogeton x fluitans		VU
Potamogeton x salicifolius		Nationally Rare (PS)
Potamogeton x sparganifolius		Nationally Rare (PS)
Potamogeton x zizii		Nationally Rare (PS)

P. trichoides	Hair-like pondweed	
Silene noctiflora		VU
Stellaria palustris		VU
Viola canina	Heath dog violet	*NT*
Viola canina ssp. montana	Heath dog violet	
V.persicifolia	Fen violet	*EN*
Viola tricolour		NT
BAP species:		
Potomageton compressus		
Sium latifolium	Greater water parsnip	EN

Status:

(CR) CRITICALLY ENDANGERED A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
(EN) ENDANGERED A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
(VU) VULNERABLE A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
(NT) NEAR THREATENED A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
(LC) LEAST CONCERN A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Fungi

A total of 482 species had been recorded to the end of 2008 (S.Wells). A visit by the British Mycological Society in the winter of 2013-14 when 197 species were found - including a new British species *Leucoagaricus crystallifer* - has raised the total.

Fauna

Birds - 175 species of birds have been recorded. Important breeding species include Marsh Harrier (which has now become a resident). Bitterns now appear to be resident and may have bred in the reedbed in 2013 and common cranes have been active in and around the reserve since 2008. Cetti's warbler now breeds but turtledoves numbers have declined dramatically with some years producing no birds at all.

BAP species: Bittern, Turtle Dove, Grey Partridge, Skylark, Lesser spotted Woodpecker, Grasshopper Warbler, Willow Tit, Marsh Tit, Spotted Flycatcher, Song Thrush, Linnet, Bullfinch, Cuckoo, Corn Bunting, Yellowhammer, Reed Bunting, Dunnock, Lesser Redpoll

Amphibians & Reptiles– 6 species have been recorded.

BAP species: Great-crested newt, Common Toad, Common lizard and grass snake

Mammals – At least 22 species have been recorded, including otter (BAP) which has been a more frequent visitor since 2008.

BAP species: Pipistrelle, Brown long-eared bat, Brown Hare, Water Vole, Harvest Mouse, Otter.

Invertebrates – A very rich fauna exemplified by record of 150 rare or endangered species in one season (Kirby 2002). Full species lists are kept on file in the SRM's office.

Coleoptera – Over 1000 species recorded. 58 notable aquatic and 172 notable terrestrial species (Invertebrate Sites Register - ISR). The tansy beetle *Chrysolina graminis* was re- discovered in 2014 after an absence of at least 15 and possibly up to 40 years.

Lepidoptera – 957 species of macro and micro moth have been recorded from the NNR to 2011, together with 45 species of butterfly. On the night of 25th July 2008, 271 species were recorded and one mercury vapour trap alone recorded 175 species. Purple emperor *Apatura iris* colonised around 2012.

Nationally rare moth species include:

Archanara algae Rush wainscot
Perizoma saggitata Marsh carpet moth (*RDB)

BAP species:
Chortodes extrema Concolorous
Cosmia diffinis Lesser-spotted Pinion
Hemaris tityus Narrow-bordered Bee-hawk
Idaea dilutaria Silky Wave
Noctua orbona Lunar yellow underwing
Tyta luctuosa The Four-spotted

Odonata – 23 species have been recorded, of which 20 are still regularly seen. The small red-eyed damselfly *Erythromma viridulum* was recorded for the first time during the last management period. No BAP species.

Communities

In addition to species of importance, the following plant communities characterise the majority of the reserve habitats. These are described by their National Vegetation Classification (NVC) headings:

Tall fen, fen meadow, *Molinia* heath/mire, rush pasture, swamp, open water, woodland and willow carr.

Tall fen (NVC S4, 24, 26) occurs in those fields which are mown on a 1-4 year rotation with or without some element of grazing.

Fen meadow (M22, M24) occurs more in the drier south end of the reserve with the exception of cts. 41, 55 and 58 - these areas are of prime botanical importance and it is here that the Red Data Book plants, fen violet and fen woodrush, occur. The M13 community also occurs in some meadows as well as small stands of S1 *Carex elata* mire.

Heath / Molinia mire (M25) is found in more acid areas of the south end.

Rush pasture (MG10) occurs in more eutrophic areas of a few fields across the central and southern parts.

Swamp vegetation (S4) with reed as the main dominant was classified as an 'additional minor habitat' in the revised 1964 Woodwalton Fen Management Plan, but has increased significantly since then, developing around the meres and also along some peat scrapes; the latter linked with

the policy of maintaining higher water levels since 1980. A major reedbed has developed at the north end following scrub clearance in 1983/84 and further major renovation including lowering the ground level in some areas between 1997-2003. This is the main site on the reserve for the Marsh Pea *Lathyrus palustris* and also supports a large population of greater water parsnip.

The reed areas around the meres have been particularly successful in attracting breeding marsh harriers and wintering (possibly breeding) bitterns.

Open water is present over large areas in the winter and spring, while the dyke system, two meres, Alan's windpump reservoir and scattered ponds provide standing water all year round.

Despite the extensive clearance that has taken place, ***willow carr*** is still the most common vegetation-type on the reserve. The presence of Birch *Betula*, Common Oak *Quercus robur,* Hawthorn *Crataegus monogyna* and other shrubby species within the carr enhance its value in the short term by providing variety of cover and feeding situations for invertebrates and for birds, the most notable amongst the latter being nightingale *Luscinia megarhynchos* and long-eared Owl *Asio otus*.

Major scrub clearance between 2002-2004 has reduced the cover of carr and woodland from 125ha to about 100ha – approximately 48% of the NNR area.

Woodland, the final major habitat, comprises mainly Birch and Alder *Alnus glutinosa* but the presence of Oak, and locally Ash *Fraxinus excelsior*, suggest a gradual transition to an oak/ash/alder climax, although higher water levels may slow progress north of the `Z' bank.

Ecotones

Five ecotones and a small relict of acid peat with stands of Bog Myrtle, *Myrica gale,* are valuable transition zones between the major habitats and are a haven for invertebrates in contrast to the intensively managed grassland areas. The ecotones are:

Tall fen/carr, **tall fen/woodland**, **scrub/woodland, grassland/woodland, grassland/scrub.**

References:

A. Bowley (2004) *Woodwalton Fen NNR Management Plan 2004-09 English Nature*
C. M. Cheffings and L. Farrell (Eds) (2005) *Species Status No. 7 The Vascular Plant Red Data List for Great Britain, Joint Nature Conservation Council*
P. Kirby (1987) *The Invertebrate Site Register: Cambridgeshire*
D. Ratcliffe (Ed.) (1977) *A Nature Conservation Review. C.U.P., Cambridge*
S. Wells (2009) *Record of Fungi of Woodwalton Fen update, pers comm.*
P. Stroh (March 2010) *Peter Stroh, pers comm.*

1.6 Cultural Features

Landscape importance, historical and archaeological features of the NNR and its use for purposes other than nature conservation

Joint Character Area:	No. 46 The East Anglian Fens

Landscape Character

The reserve is situated at the extreme western edge of the East Anglian fenland basin. At the south-west corner of the site, the clay is very close to the surface and within a few hundred metres of the western boundary, the land rises up and the peat is absent. At this point the site adjoins JCA no. 88 - Bedfordshire and Cambridgeshire Claylands.

Archaeological and Historical Features

There are few known features, although there is some evidence of a causeway crossing the reserve, which may have been a link between the abbeys of Sawtry and Ramsey. Some items of medieval pottery have been found in ct. 55.

Land-Use History

Prior to 1851, this land was part of the great wetland maintained by the Whittlesey Mere and several other small meres. When Whittlesey Mere was drained in 1851, the surrounding land was gradually drained and converted to arable farmland. Parts of Woodwalton Fen, particularly cts. 44, 54 and the southern fields were farmed during this period, but this had been largely abandoned by 1910 when the site was purchased for nature conservation. Until 1922, it is known that peat was dug from the Fen and transported up Chapel Road to fuel the brick kilns here.

There is long history of management for nature conservation from the early 20th century and this is well recorded. Until the 1940s the site was steadily encroached by scrub and from this the woodland developed which is still present on much of the NNR today. Early clearance was carried out in ct. 39 when the large copper butterfly was introduced, but it was not until the 1950s that major work began. This culminated in about 35 hectares being cleared or coppiced between 2002 and 2005.

Socio-economic Use

Very little use economic use has been made of the reserve since its designation as a nature reserve. The SPNR did cut and sell reed for period and cattle grazing since the late 1960s occasionally produced a small profit. Some reed was again sold in the last management period.

Until 2004, public use was limited by a permit system, a few hundred of which were issued each year. Open access has increased visitor numbers to approximately 6000 (not specifically counted). A ‘no dogs’ policy is operated in order to provide a quieter environment for livestock and sensitive wildlife and also due to the numbers of families and schoolchildren using the site. The NNR has now become very popular with casual visitors, naturalists and photographers and is a central part of the emerging Great Fen landscape scheme.

Education

In the 1980s the site was used extensively by universities for field trips, but since the late 1980s

this interest has dwindled as courses and financial issues changed.
Since about 2005, however, the inclusion of the NNR in the Great Fen Project and close partnership with the Wildlife Trust has meant that increasing numbers of schoolchildren and other groups visit the site. There is increasing interest in the Great Fen area by undergraduate students and other research organisations.
There are now about 60 active volunteers in the Project, many of whom come to work at the Fen and learn new skills.

Research Use

Research is encouraged, both into the scientific principles of conservation management and also the development of machinery and management methods to benefit wildlife. Much of the original management decisions and knowledge of the ecology of the reserve were based on Duncan Poore's PhD work in the 1960s. Since then there have been studies on various topics (see Appendix for list of completed research) including two PhD studies in the last 3 years.

Demonstration

Occasional informal demonstrations have been held on aspects of habitat management work.

1.7 Access Features

Accessibility and visitor appeal, public transport routes, access routes and visitor facilities

Access Classification	Champion	Destination	Other
			✓

Access Plan Category	Open	Managed	Restricted	Excluded
	✓			

Visitor Appeal and Suitability for Access

Woodwalton Fen is situated in a typical Eastern England landscape, resulting from intensive agriculture and as such has high intrinsic appeal as an oasis of natural countryside. This is undoubtedly appreciated by many visitors to the reserve who express their pleasure in just being able to walk within such an area. The fen flowers attract general country lovers as well as botanists, while the butterflies, dragonflies and breeding and wintering birds attract many group and individual visits.

As the site is often quite wet and the substrate easily damaged it is not suitable for large numbers of visitors, horse-riding or more than occasional cycling in dry weather.

Access Provision

General visitors to the NNR have traditionally been confined to those permit-holders with an interest in particular aspect of natural history. About 500 permits were issued annually. Since 2003 there has been an open access policy, but excluding dogs. There are now about 5000-7000 visitors annually.

As the reserve forms the heart of the Great Fen project area together with Holme Fen NNR it is considered reasonable to direct most disabled visitors to Holme Fen (where there is an easy-access trail at Burham's Mere) as facilities would be difficult to install at Woodwalton. There will also be facilities at the Countryside Classroom, run by the Wildlife Trust as part of the Great Fen.

Access by public transport is confined to a limited bus service which stops at the eastern end of Chapel road, about 1 mile from the reserve.

Visitor Facilities

There are three marked trails, three bird-watching hides and an interpretation shelter with leaflet dispenser. The Rothschild Bungalow is used extensively for field courses, visiting groups and individuals.
There is a 'no dogs' policy which increases the suitability of the site for visitors with children and enhances the interests of visitors such as children but also prevents disturbance to wildlife and livestock.

Facilities in the Bungalow have been improved by the addition of solar-powered lighting which makes it more useable for field courses, meetings etc. as well as general visitors. The building is staffed by voluntary wardens on occasions at weekends in summer. Interpretive displays have been improved over the last 3 years.

1.8 Summary of Site Features

Tables summarising the site's features of importance

Table 1.8.1 Geological and Biological Features

Feature No.	BAP Broad Habitat Type or Geological Site Type	Specific Feature	Explanation of Feature/Ranking	Legal Site Designations						Other Classifications						
				SAC	SPA	Ramsar	Other	SSSI	GCR	European	National BAP	Nationally rare	Nationally	Protected	Character	Other
1	**Fen, marsh and swamp**	S4 *Phragmites australis* swamp S24 *Peucedo-Phragmites australis* fen S25 *Phragmites australis – Eupatorium cannabinum* fen / S28 *Phalaris arundinacea* tall-herb fen	SSSI citation					✓			✓				✓	
2	**Fen, marsh and swamp**	M22 *Juncus subnodulosus-Cirsium palustre* fen meadow	SSSI citation					✓			✓				✓	
3	**Fen, marsh and swamp**	M24 *Molinia caerulea-Cirsium dissectum fen meadow* M25 *Molinea caerulea-Potentilla erecta* mire	SSSI citation	✓				✓			✓				✓	
4	**Fen, marsh and swamp**	S2 *Cladium mariscus* swamp and sedge beds	SSSI citation	✓				✓			✓				✓	

5	**Broad-leaved mixed Woodland / scrub**	W1 *Salix cineria – Galium palustre* W2 *Salix cinerea – Betula pubescens – Phragmites australis* W5 *Alnus glutinosa – Carex paniculata* W6 *Alnus glutinosa – Urtica dioica* woodland	SSSI citation					✓			✓						
6	**Standing open water and canals**	Ditch system and meres	SSSI citation					✓									
7	**Fen, marsh and swamp**	Assemblage of nationally rare and scarce vascular plants Score 300						✓									
8	**Fen, marsh and swamp**	Schedule 8 Vascular plant fen violet (*Viola persicifolia*)						✓			✓						
9	**Standing open water and canals**	Great-crested newt (*Triturus cristatus)*		✓				✓									
10	**Fen, marsh and swamp Standing open water and canals**	Invertebrate assemblages						✓									
11	**Fen, marsh and swamp Standing open water and canals**	Bird assemblages															✓

Table 1.8.2 Landscape Features

Feature No.	Specific Feature	Explanation of Feature/Ranking	Legal Designations				Other Classifications	
			World Heritage Site	National Park	AONB	Heritage Coast	Joint Character Area	Other
12	Fenland	One of few remaining un-drained fens left in Great Britain.					✓	

Table 1.8.3 Archaeological & Historical Features

Feature No.	Specific Feature	Explanation of Feature/Ranking	Legal Designations				Other
			World Heritage Site	Scheduled Monument	Listed Building	Register of Historic Parks/Gardens	Other
	Rothschild's Bungalow						

Table 1.8.4 Socio-economic Use

Feature No.		Very Important	Important	Insignificant
13	**Economic Use**			✓
14	**Community Involvement**		✓	

Table 1.8.5 Education, Research & Demonstration

Feature No.		Very Important	Important	Insignificant
15	**Education**		✓	
16	**Research**	✓		
17	**Demonstration**		✓	

Table 1.8.6 Public Access

Feature No.		Very Important	Important	Insignificant
18	**Public Access**		✓	

Table 1.8.7 Other Estate Assets
Site assets, not listed in preceding summary tables, which the management plan needs to address

Feature No.	Asset Description	Notes
19	Workbase and lean-to implement shed	Built 1998. Internal redecoration year 1-2
20	Rothschild's Bungalow	Built 1911. Ct 42 – Repoint chimney, repair/paint corrugated iron underside to floor. 3-yearly window painting
21	Bird Hides (3)	Built 2003. North reedbed Ct 32, Rothschild's Mere Ct 59, Gordon's Mere Ct 63. 3-yearly wood treatment
22	Cattle sheds	Ct 74
23	Hay barns (2)	Ct 74
24	Interpretative shelter	Main entrance
25	Interpretative boards/signs	Main entrance
26	Windpump	Built 1997. North reedbed Ct 30. Annual greasing, etc
27	Bridges – vehicle (33) and pedestrian (11)	Annual H&S check, repair as necessary
28	Sluices/valves	Annual H&S check, repair as necessary
29	Fences	Check before livestock put in fields.
30	Gates	Check before livestock put in fields

31	Stiles	21 stiles
32	Cattle pens	Ct 74
33	Tracks (access)	Eastern approach, south-western approach (AgReserves). Jointly maintained with MLC

Woodwalton Fen NNR
Management Plan
Part 2 *2015-20*

2.1 Site Analysis

The issues which have positive and negative effects on the management of the site

Site Strengths	Site Weaknesses	External Opportunities	External Challenges
• Well documented historical and cultural associations. • Well documented management and species records. • Strong intrinsic appeal as an oasis of natural countryside. • High diversity of species and habitats. • Internationally important for species and habitats. • Good facilities on site. • Permanent site staff • Good volunteer involvement • Relatively large size (7% of NCR East Anglian fen sites)	• Isolation within an area of intensively drained arable farmland. • Use as flood storage. • Reliant on poor quality water sources (agricultural and urban run-off and treated sewage effluent) to irrigate reserve. • Relatively small size with large number of habitats reliant on intensive management to perpetuate their interest. • Suite of species with very restricted national distribution. Vulnerable to adverse habitat changes/management practices/climate change etc. Limited or no prospect of successful emigration from the NNR • Management activities reliant on weather and staff availability	• Heart of Great Fen project bringing opportunities to link to Holme Fen and create a huge 'buffer' around the NNR • Great opportunities for engaging local communities. • Working with partner agencies, both as Great Fen project partners but also research and business involvement. • Wide opportunity to demonstrate good practice, both in habitat management but also landscape-scale ecosystem services approach. • Involvement of volunteers in habitat management, species recording and education.	• Re-locating flood storage off-site. • Diffuse pollution -continued reliance on high-nutrient water. • Greater public access may compromise some species. • Cost-effective way of controlling invasive species such as soft rush. • Continuation of pump-drained arable farming adjacent to NNR • Restricted access from the south through the Agri-Reserves farm. • Effects of climate change not fully understood but may negatively affect some species.

2.2 Site Management Policy

The broad management policies for the site and the reasons why these options have been chosen

Background

Landscape and Historic Features

Woodwalton Fen is a fragment of once much larger area of fen, bog and meres which was drained in the 19th century. As such it is a precious, albeit much modified, relic of the past as well as one of the most outstanding examples of fens remaining in the Fenland Natural Area.

Documentary evidence of past use is scarce but an early reference to a map of the Fen Levels by Sir Jonas Moore 1666, shows that even at that time the land on which the Fen is situated was privately owned, so it is very probable that the land was used in some way, probably as rough, fen pasture. It is not known if the land was exploited continuously by man from 1666 onwards but the area of the present reserve was still described as fen pasture as late as the 1830s and the Ordnance Survey maps of 1887 indicate that the greater part was covered by rough pasture and scrub.

Stratigraphical studies have shown that acidophilous raised mire vegetation preceded the present fen communities at Woodwalton Fen. Locally, fen flushes with more eutrophic vegetation would have persisted within this system, influenced by calcareous water draining from the Oxford Clay hills to the south and west of the reserve. Traditional fen practices such as mowing for litter, reedcutting, grazing by sheep and cattle and probably localised peat cutting almost certainly preserved an open landscape of fen meadows, marshes, reedbed and waterways.

Sheail and Wells (1976) document a history of drainage, peat digging and some arable cropping between 1870 and 1920. During the second half of the 19th century, intensive drainage made peat cutting possible on a large scale. It is probable that most of the fen surface became a mixture of disturbed bare peat and old cuttings colonised by grasses, sedges and other fen plants, so that ecological diversity probably remained high despite the effects of peat cutting. Towards the end of this phase, beds of Common Reed *Phragmites australis* developed, bushes/scrub were able to grow in localised areas and fen meadows were maintained by grazing and litter cutting. Exposed peat surfaces survived where turf cutting was still practiced and where there were attempts at cultivation. By the mid 1930s diversity was again reduced as bushes and trees had encroached over most of the reserve and many dykes were heavily silted and overgrown.

Reclamation management since the mid 1950s, culminating in the major restoration of 2002-05, has rectified this situation by creating a matrix of habitats representing various seral stages in the colonisation of a fen system. The degree of diversity and wildlife-richness – particularly of oligotrophic bog and specialist fen species – is almost certainly lower now than before drainage, however, due to removal of the acid peat layers and the effects of drainage, although there has been an influx of more common species which may have been absent in pre-drainage times.

There are the remains of an old peat works at the south-eastern corner of the site and possible remnants of a causeway which may be ancient in origin but which has not been investigated by

archaeologists.

It was apparently not until the beginning of the 20th century that the Fen was discovered by botanists and entomologists, but since that time many eminent amateur and professional naturalists have visited the reserve. Along with several student projects there have to date been almost 100 studies undertaken on the flora and fauna of the site, making this one of the most intensively studied of all NNRs (e.g. Sheail and Wells 1976).

Reference:

J. *Sheail and T. Wells (1976*) *The land-use history of the Huntingdonshire fenland, with special reference to Holme Fen and Woodwalton Fen NNRs. CST Report*

Evaluation of site development and management to date

This range of habitats can only be maintained by a combination of optimum water levels and intensive management. There has been much debate as to what are the right water levels within the site and the hydrology is also impacted by the use of the reserve as a flood storage facility for the Middle Level Commissioners.

Habitat diversity has been achieved through a combination of grazing and mowing. Mowing is generally cut and gather, although topping and flailing is effective in some circumstances. More recently, burning standing crop has been used in the reedbed and can be a cost-effective alternative to cutting in some areas. There are advantages and disadvantages of grazing versus mowing. Mowing controls any invasive species such as soft rush, but while raking up the cut material removes a source for recycling of nutrients it also removes litter which is an important habitat for some invertebrates. Grazing creates a more patchy structure, with more heterogeneity particularly for invertebrates, but with the risk of eating flower or seed-heads at crucial times. One example is meadow rue *Thalictrum flavum*.

In order to improve and maintain the wildlife potential of the site – both terrestrial and aquatic – it is now essential to thoroughly revise the Water Level Management Plan during the life of this Management Plan. This should lead to a strategy for improving control of water quantity and quality and re-locating flood storage Until better control of water is achieved it will be necessary to concentrate more effort into grazing, cutting and some weedwiping to ensure that invasive rush and reed do not overcome the more open finer swards for the NNR is important

Tall fen (NVC S4, 24, 26) occurs in those fields which are mown (and the cut vegetation removed) on a 1-4 year rotation with or without some element of grazing. These units are floristically very rich with species like common valerian, purple loosestrife, yellow loosestrife, greater birds-foot trefoil and many sedge species. They are also important for invertebrates such as the marsh carpet moth and provide a good source of nectar and larval foodplants for butterflies.

The rotational cut and gather produces good results and should be continued, although in some years achieving the full programme can be extremely difficult if weather conditions restrict tractor access. This work is highly labour intensive, however, and is heavily reliant on having sufficient available labour.

In some areas a limited amount of light grazing may be used. The maintenance of high winter water levels is essential to maintain this community.

There is an urgent need to assess the effectiveness of this management. Botanical studies suggest that a 2-year rotation may be more effective than longer periods as reed becomes dominant quite quickly but an invertebrate assessment should also be undertaken to assess

this.

Fen Meadow
In cts. 55 and 58, a combination of a more diverse substrate with at least some gravel and grazing results in less competition from reed and a more open sward develops. Ct. 55 has for many years been the main site for the fen violet *Viola persicifolia*, although in the last 5-10 years, the number of flowering plants has been reducing with none found since 2010. Intense research by the Oxfordshire Flora Group (formerly the Rare Plants Group) has suggested that fen plants may be too short-lived to sustain a strong colony for very long, unlike the Eire population in which individual plants are long-lived. Research into the morphology of the species is ongoing through this group.

Grazing, cutting and weed-wiping have all be employed to keep these fields open and reduce the dominance of soft rush. Grazing by 11 Aberdeen/Sussex cattle in 2014 has been particularly effective at producing a varied open sward with bog pimpernel *Anagallis tenella* flowering profusely in ct. 58.

Heath / Molinia mire (M25) communities are generally confined to the relatively drier south end of the reserve on land that was for the most part cultivated in the early years of this century, but which has not been stripped of its acidic peat layer (cts. 78 and 83 and the south end of 82). This is moderately species rich grassland with large stands of bog myrtle *Myrica gale* and other indicators such as heath grass *Danthonia decumbens*. Following scrub clearance in the mid 2000s there was a resurgence of *Calluna* and *Erica* heathers at the southern edge of ct. 83 following scrub removal, although it was disappointing that the plants persisted for only a very short period. Heavy grazing should be avoided.

One further area occurs in ct. 41 in the north of the site and is extremely rich botanically with slender sedge *Carex lasiocarpa* and *Viola canina ssp. montana*. This area will continue to be mown annually with possibly occasional light grazing.

Ct. 77 has for many years been managed by mowing on a 4-year rotation to encourage the establishment and spread of saw sedge *Cladium mariscus* which forms one of the SAC features of the NNR.

Neutral grassland occurs in cts. 81, 82 and the south-eastern corner fields 79, 80 and 84-5. The corner fields are not particularly species-rich apart from ct. 85, where the Deptpford pink *Dianthus armeria* grew when conditions were much drier. Now it supports knapweeds and devil's bit scabious *Succisa pratensis* amongst *Calamgrostis* grassland. There are numerous anthills here which makes mowing management very difficult. The grazing animals are not keen to graze this area and it has been strimmed on several occasions to create a more open sward. In 2014 there appeared to be very little *Succisa* flowering.

The damper cts. 81 and 82 are more species-rich and have supported good colonies of marsh orchids, knapweeds etc. In recent years, however, successive wet years and several instances of drainage water overtopping the southern banks and laying for long periods has encouraged the spread of reed and soft rush. Considerable efforts have been made to combat this by mowing and weedwiping as well as grazing. The success of this has been hampered by wet conditions persisting well into the spring and summer.

Rush pasture (MG10) occurs in more eutrophic areas of a few fields across the central and southern parts.

All rush pasture fields are being affected by the spread of invasive species such as soft rush and reed. It is thought that increased wetness of some summers in the last few years, coupled with occasional flooding with nutrient-rich water and the difficulties of getting stock onto the

land early, is contributing to this and it is essential to maintain the recent level of control of these species.

Swamp vegetation (S4) with reed as the main dominant was classified as an 'additional minor habitat' in the revised 1964 Woodwalton Fen Management Plan, being mainly restricted to dykes in the late stage of the hydrosere prior to the excavation of the two meres, but has increased significantly since then. The reed areas around the meres have been particularly successful in attracting breeding marsh harriers and wintering bitterns, where bands of reed and Lesser Bulrush *Typha angustifolia* have developed in the shallow zones of both meres, with Common Club-rush *Schoenoplectus lacustris* forming small patches in Gordon's Mere. The significant rise in water-table since 1980 has increased the potential for swamp vegetation, particularly along some of the deeper peat scrapes, and it will be favoured by the three year cutting rotations operating in the Tall Fen zones, where many peat scrapes are situated. This can become a problem, however, as reed can quickly dominate other more diverse vegetation.

A major reedbed has developed at the north end following scrub clearance, lowering the ground level in some areas and better water control via a windpump. Some reed has been sold for thatching and was used for re-thatching the Rothschild Bungalow in 2010. Regular management of more than a fraction of the reedbed to prevent it drying out has been impossible and there is an urgent need to experiment with modern larger reed cutting machine such as the soft track harvester. This will also contribute to wider interest in reed production in the Great Fen area. Requirements of species such as marsh harrier, which has nested here for some years, and bittern (booming males heard continuously during 2013) must always take precedence, however. Common cranes made an early attempt to breed here in 2008 and this is probably the most suitable area across the Great Fen at present for this to occur in future. Cranes have had a steady but sporadic presence on the Great Fen ever since (11 were seen flying across the reedbed in 2013)

A minimum of 1.5 ha of reed will continue to be harvested each year, particularly in cts. 33/34. Other areas should be harvested on a longer rotation but not allowed to reach the stage where litter build-up encourages scrub re-growth. Occasional burning of the standing crop may be an effective alternative where resources do not allow cutting.

Occasional light grazing of some areas of the reedbeds could also be beneficial but would need careful control as stock will preferentially graze reed which would kill it off in the long-term.

In general, water levels in the northern reedbed need to be maintained at a higher level. This will encourage reed growth and may be particularly beneficial to potential breeding species such as bittern.

There is a substantial colony of greater water parsnip *Sium latifolium* in the north-east corner by dipwell A2.

Despite extensive scrub clearance, **willow carr** is still a very widespread vegetation-type on the. The presence of Birch *Betula spp.*, Oak *Quercus robur*, Hawthorn *Crataegus monogyna* and other shrubby species within the carr enhance its value in the short term by providing a variety of cover and feeding situations for invertebrates and for birds, the most notable amongst the latter being Nightingale *Luscinia megarhynchos* and Long-eared Owl *Asio otus.*

Recent major scrub clearance has reduced the cover of carr and woodland from 125ha to about 100ha – approximately 48% of the NNR area.

Active coppicing has maintained a good age-structure but has been curtailed in the last 2 years due to deer browsing. Muntjac control has reduced this pressure, although at least one

Chinese water deer also had a liking for coppice shoots.

Management policy is to continue to coppice significant areas each year in order to bring carr into optimum condition and then to coppice every 5-7 years or when considered necessary, depending on growth rates, deer browsing etc.

Over-mature willows are recognised for their importance to a number of invertebrates – e.g. Lunar Hornet Clearwing *Sesia bembeciformis*, wood-boring beetles, dead wood fauna – and some of them should be left to die in situ in all coppice compartments (Kirby 2003).

The effect of browsing by deer, particularly muntjac, should continue to be monitored to provide evidence as to whether or not control methods are reducing the effects of browsing.

Reference:
P. Kirby (2003) *Invertebrate Report*

Fen woodland
Broadleaved semi-natural woodland extends over approximately 30ha and can be divided into Alder and Birch dominated types but the presence of Oak, and locally Ash *Fraxinus excelsior* (about 70 trees), suggest a gradual transition to an oak/ash/alder climax, although higher water levels may slow progress north of the `Z' bank.

The alder woodland was formerly coppiced but is now high forest.
Approximately 6 ha of birch together with a few oak and alder was cleared from the southern end of the site in 2002-04.

Ride maintenance should continue as in the past to maintain access and, where feasible, rides can be cut back at the edges to promote the growth of woodland herbs. Cut material can be heaped at the ride edges to provide additional invertebrate habitat. Trees and shrubbery encroaching onto rides will require periodic cutting back. Deadwood from this source, and that from trees windblown across rides, should be left on site either in stacks or laid at the wood edge. The value of dead wood for the conservation of a substantial percentage of the woodland fauna is well attested and this provision will provide alternative habitat to the standing senescent and dead trees within the woodland.

With the opening up of areas of dense woodland, the possibility now exists to identify candidate 'veteran trees', which can be managed by pollarding or other relevant means over the years to prolong their life.

Regular inspections should be carried out to identify trees overhanging areas which are subject to public access which may present a safety hazard. Any dangerous trees will be pruned or felled as necessary.

Managing the deer population will continue to be necessary in order to maintain a healthy understorey and field layer in the woodland.

Standing Water (Dykes, ponds, meres)
<u>Dykes</u>
The results of botanical and invertebrate surveys in 2002 suggested that there had been a loss of diversity in the dykes. Following this, the dyke slubbing regime dyke cleaning rotations were shortened to between 3-7 years and in a few short stretches even more frequently. Some sections of dyke have also been widened to create more micro-habitat and annual dyke slubbing has been maintained on at last 10% of dykes in any one year.

When it became clear that this process was not achieving any improvement to the ditch flora

an intensive programme of water quality assessment was initiated in 2012 and completed in the autumn of 2014. In some areas, particularly near the Great Raveley Drain, results show that there are high concentrations of nitrates, while high phosphate is more widespread with very low oxygen.

After discussions with experts including the Environment Agency it was agreed to conduct a series of management experiments as well as taking forward the desire to cease using the NNR as flood storage, and improve the quality of water entering the site during summer. Experiments include pumping to create flow, silt pumping and excavating new ditches. Investigations of the oxygen and nitrate in both the internal ditches and Great Raveley, however, have prevented this programme. At first the EA were concerned at introducing low oxygen into the IDB system but then after high nitrate was discovered in the drain itself it was considered imprudent to pump.

A thorough review of the Water Level Management Plan and a Diffuse Water Pollution Plan are now being put in place which it is hoped will enable progress to be made in improving water quality and management. The main emphasis here is to create alternative sites for flood water storage in the Great Fen rather than the NNR.

The dyke edges are an important habitat and many have been brinked at various times during summer to create a diversity of conditions. Tansy beetle *Chrysolina graminis* was re-discovered along dyke 16 during 2014.

Ponds

The ponds at the South End (Moore's ponds) were excavated in the 1960s in order to create areas for research, particularly into colonisation by *Odonata.* Dr Norman Moore has produced several papers detailing this. There is also a population of great-crested newts here which is part of the SAC interest and which was monitored for many years by Dr. A.S. Cooke and more recently by NNR staff and other volunteers.

These experimental Ponds have been recorded for a longer period than almost all aquatic sites in British NNRs and the recording should continue here indefinitely.

Much of the scrub around the ponds is now kept under control, with some ponds having all the scrub removed and others having varying levels of cover – a policy agreed by the Joint Advisory Committee. After an apparent decline in newt numbers noted in 2014 it is now considered that there should be more extensive scrub clearance and at least some clearing out of the vegetation in the water.

Meres

The two meres in the centre of the NNR were created between 1970 and 1982 to win clay for the flood bank. The original mere – Rothschilds - has steep sides and is quite deep. Little vegetation grows in the deep water. Gordon's mere has areas of shallows and is partly divided by a spit, giving a wider range of conditions for aquatic species. Apart from some cutting of reed from the shallows on Gordon's the meres have not received any management since their creation and are unlikely to need any in the foreseeable future.
Alan's windpump reservoir, Randall's mere in the northern reedbed and scattered ponds provide standing water all year round.

References*:*

C. Elton (1966) *The Pattern of Animal Communities. London: Methuen*
P. Kirby (2003) *Invertebrate Report.*
N. Moore (1991) *The development of dragonfly communities and the consequences of territorial behaviour: A 27 year study on small ponds at Woodwalton Fen, Cambridgeshire,*

United Kingdom. Odonatologica 20, 203
N. W. Moore (1991) *The development of dragonfly communities and the consequences of territorial behaviour: A 27-year study on small ponds at Woodwalton Fen, Cambridgeshire, United Kingdom. NERC Centre for Population Biology, Imperial College (The Global Population Dynamics Database Version 2.0. (Available at http://www3.imperial.ac.uk/cpb/databases/gpdd, accessed 2012).*

Ecotones

Tall fen/carr, **tall fen/woodland**, **scrub/woodland, grassland/woodland, grassland/scrub.**

The quality and diversity of the various habitats in the reserve is reflected in the richness of the fauna and flora, but it is often at the junction of habitats that interesting communities develop. Examples are along the ditch edges where reed grows into the water, and along rides where fringing vegetation grades from short grassland into scrub in contrast to the intensively managed grassland areas. Management to retain and enhance these ecotones should be continued wherever possible, after the main habitat work has been achieved.

Deer Management

There has been a population of Chinese water deer (*Hydropotes inermis*) on the site since the 1950s and recently numbers have grown significantly (it is now estimated that there are 200 + deer living within the NNR.) More recently, the population of muntjac (*Muntiacus spp.)* has also grown and it is considered that their browsing is having a moderate effect on regeneration within the woodland.

Research by Dr. A.S. Cook including the widespread use of infra-red cameras, has shown that the cause of the loss much of the woodland understorey and herb layer in the south of the site becopopulation considerably.

Control of muntjac should be maintained over the next management period.

Socio-economic use

There is little scope for this within the present NNR but there are many opportunities in the Great Fen area.

Education, research and demonstration.

The reserve was once used extensively by university field trips but this reduced to almost nothing in the 1990s due to cut-backs and a change in emphasis in courses studied. Two universities, Anglia Ruskin and University of East Anglia still visit on a regular basis. Since the advent of the Great Fen and increased links with the Wildlife Trust at the Countryside Classroom there has been a considerable increase in use by primary school children and also some 'A' level students**.** Lack of facilities such toilets will always limit the amount of educational use of the site, but the partnership with the Great Fen partners will offer many opportunities to use the NNR as an education facility in the future**.**

Research is encouraged, both into the scientific principles of conservation management and also the development of machinery and management methods to benefit wildlife. Most recently a tracked cutting machine, the 'Fen-All Track' machine, has been developed, funded externally

but working primarily on the Fen or Darlows Farm. To date this machine is far from satisfactory and more development is needed to enable cut material to be gathered off the ground.

The creation of a research centre allied to the Great Fen would also be of benefit in this respect

Public Access

Opportunities for public access and involvement exist on various levels:

1. Visitors
2. Volunteer work parties
3. Voluntary Wardens

1. In the summer of 2003, the permit-only system was dropped in favour of an open access policy with the addition of a `no dogs' policy. Welcoming more visitors to the reserve is seen as a positive move to encourage more interest from the general public, rather than just committed naturalists, but the effects of greater access will need to be carefully monitored. The 'no dogs' policy is considered necessary both in the interests of visitors such as children but also to prevent disturbance to wildlife and livestock. This policy has been accepted by the visiting public many of whom are appreciative of being able to visit a site which is 'dog-free'.

Access to the NNR is along a rough track with limited parking so it is not intended to promote any significant increase in visitor numbers.

In anticipation of the higher number of visitors expected and the likelihood that a wider spectrum of interests would be represented, three marked trails were established and all hides were replaced and a new interpretation shelter was installed with leaflet dispenser. Some volunteers have been trained to take guided walks around the Fen as numbers of visits now put too much strain on the SRM's time.

Extra facilities have now been provided for less-able visitors and an electric 4-wheel drive wheelchair is based at the Countryside Classroom to allow better access for disabled. As the Great Fen has developed, it is now intended that few other facilities will be provided at Woodwalton, as disabled facilities are available at Holme Fen and the Countryside Classroom. Facilities in the Bungalow have been further improved, funded partly by the Great Fen Local Group. It is intended to staff the building by voluntary wardens on a regular basis in summer.

There has been considerable increase in the numbers of visitors to the site in the last 5 years.

2. Volunteer work parties have traditionally worked on the site at least three times per annum and this is likely to continue. Since 2009 volunteers work parties have been run every 3 weeks, led by NE or Great Fen staff.

3. There are several voluntary wardens in post at present, some of whom work one or two days per week. There are also many other volunteers registered directly with the Great Fen/Wildlife Trust. As the Great Fen project has expanded a weekend ranger group has been formed and they patrol the NNR.

Public transport serving the area is very limited, but there is a bus stop at the end of Chapel Road, about 1 mile from the NNR. It is not intended to provide additional car parking facilities as the main access to the Great Fen will be at other points where car parking and other infrastructure such as boat facilities are possible. It is not intended to provide additional toilet facilities.

Site Extension / Protection

The main objective of the early Management Plans was "to create and maintain an adequate range of habitat types necessary for the conservation of the characteristic plant and animal associations and rare species of special scientific interest on the fen". The programme of scrub clearance from 1956 to the present day has largely achieved this objective both in mixed fen and reedswamp and in doing so has realised much of the potential value of the reserve. Bush clearance has led to an increase in botanical richness, and general observations backed by monitoring indicate the improvement should continue with appropriate management and as time passes. The reedbed created at the north end of the reserve has attracted rare fen breeding birds.

Management within the NNR, however, cannot address the wider issues of isolation, flood storage and irrigation by nutrient-rich water. These remain intractable problems for the long-term protection of species and habitats, and may become particularly acute if climate change makes some habitats unsuitable within the confines of the reserve. This was one of the main reasons behind the vision of the Great Fen Project.

This project remains the most effective means by which to ensure the long-term future of Woodwalton Fen and create great opportunities for the expansion of species out the NNR and into the surrounding countryside. We will work to consolidate present achievement within the Great Fen such as direct management of Darlows Farm and participation in formulating and assisting with management policy on Middle Farm and land owned by other partners.

There is already evidence of species using both NNR and surrounding ex-arable farmland, such as otter *Lutra lutra,* Chinese water deer and many bird species*,* particularly common crane*.*

Concern has already been expressed at the use of the NNR for flood storage and efforts are quite well advanced to investigate alternative areas for this outside the site. One area which may be of use is the area of farmland to the south and west (AgReserves). There have been discussions with the owners and OHES consultants have conducted a topographical and costing study to look at the practicalities (report expected autumn 2014).

Reference:
Great Fen Partners (2010) *An Indicative Masterplan*

Climate Change

It is difficult to have a full understanding of the extent that climate change will affect Woodwalton Fen .

The NNR lies within the Great Fen area and one of the key reason for starting this project was to solve some of the considerable problems affecting favourable condition on both Holme Fen (site damaged by agricultural drainage) and Woodwalton Fen (site used for floodwater storage). As the project has developed it has embraced many other issues such as climate change adaptation and ecosystem services. So securing future biodiversity on the NNR remains a key factor and the long-term future is inextricably bound up with the development of Great Fen. Re-wetting the Fens offers an important opportunity to halt the loss of carbon from long-term soil stores. Other external factors that will affect Holme Fen are the East Coast railway line and levels of water abstraction.

2.2/10

Using the CP09 Climate change projections using a medium emissions scenario Projections for the East of England in the 2050s are:

- Increased variation within and between years in temperature and rainfall patterns
- Increased frequency of extreme events such as drought and heat waves
- Projections for temperature and precipitation for East of England
- More precipitation will fall in the form of extreme rainfall events
- Increase in winter mean temperature is 2.2ºC (1.1 - 3.4ºC.)
- Increase in summer mean temperature is 2.5ºC (1.2- 4.3ºC).
- Increase in summer mean daily maximum temperature is 3.4ºC; (1.3-6.0ºC)
- Increase in summer mean daily minimum temperature is 2.7ºC (1.2ºC -4.7ºC)
- Change in annual mean precipitation is 0%; (–5- +5%.)
- Change in winter mean precipitation is 14% (3-31%)
- Change in summer mean precipitation is –17% (–40 - 14%.)

Brackets indicate changes which are very likely to be exceeded, and very likely not to be exceeded (10 and 90% probability levels, respectively)

The ambition of the Great Fen project partners is to raise water levels in the area and this may serve to mitigate some of the negative effects of climate change, for example, drought conditions and lower precipitation.

2.3 The Vision

A 50 Year Vision for Woodwalton Fen National Nature Reserve

The mosaic of habitats created by the restoration programme initiated in 2002 will have been maintained. Open fen meadows, ditches and ponds ditches where good quality water supports a wide range of aquatic flora and fauna, reedbed and carr / woodland with a mix of grazed and mown grassland and fen will support a rich and varied flora and fauna, including widespread breeding of the scarce chaser dragonfly and *Potomageton* pondweeds well-represented.

The site will be widely used as a demonstration of management and research projects are contributing to knowledge of management of other fenland sites. The site continues to justify its international status, which now also applies to several areas of the Great Fen.

The spread or possible introduction of species such as fen violet onto the Great Fen will have proved successful and breeding waders such as black-tailed godwit will be well established. Other breeding birds include bittern, marsh harrier, bearded tit as well as growing populations of lesser-spotted woodpecker and willow tit, which were lost in the 1990s/2000s. Common cranes have a thriving population along with little egrets.

Cattle and ponies regularly wander from the NNR to surrounding land, particularly Darlows and Middle Farms and the land newly acquired from the Mormon Church around the southern boundary.

The effects of climate change are difficult to predict but it is likely that more extremes of weather including summer droughts and winter storms will affect some species.

The reserve will be seen by many visitors as the heart of the Great Fen where the ultimate aims of the wider project are seen at their best. Although visitor numbers to the Great Fen will be in excess of 100,000 per annum, the zoned approach to access has been successful in allowing a quiet and ‘wild’ feel to be retained on areas such as Woodwalton Fen.

The water storage facility on the southern farmland has been very successful , not only in

protecting surrounding communities from flooding , but also in enabling water to be cleaned via a reedbed before being allowed to flow into the NNR and Great Fen land, creating a slow flow. As Woodwalton Fen is no longer used as the primary flood water storage facility the decline in nutrient content of the water has allowed a greater diversity of ditch flora and fauna to develop.

2.4 Objectives

What we want to do during the period of the plan to take us towards realising the Vision

2.4.1 Geological and Biological Objectives

Objective 1:

Lowland Fen. Tall Fen Community.
Subject to natural change, to maintain and where possible **enhance condition of the Lowland Fen habitats, vegetation communities and associated fauna**.

NVC communities: S1 *Carex elata* sedge swamp
S4 *Phragmites australis* swamp and reed bed / S24 *Phragmites australis – Peucedanum palustre* tall-herb fen / S25 *Phragmites australis – Eupatorium cannabinum* tall-herb fen
S26d *Phragmites australis/Urtica dioica* fen

Features addressed by this objective

1

Attributes/targets for key features:

Feature 1: Tall Fen community

Target Extent: Minimum 61 ha

Target sward structure: No more than 25% litter, no more than 10% bare ground

Target sward composition: *Phragmites australis, Eupatorium cannabinum, Filipendula ulmaria, Angelica sylvestris, Juncus subnodulosus, Cirsium palustre, Mentha aquatica, Lythrum salicaria, Valeriana officinalis, Iris pseudacorus, Epilobium hirsutum*: at least 5 species constant, one of which must be *Phragmites australis*, combined cover >80%, scrub <10% on open fen

Objective Methods:

SSSI site units: 37,39,45,46,47,48,52,53,60,56
Note: The key to maintaining favourable conditions for all the habitats on the NNR is creating the correct hydrological conditions with water which is of good quality in terms of nutrient status and pH. ***A key factor in achieving the biological objectives which follow is to compile a Water Level Management Plan within the lifetime of this Plan.***

The site contains around 80ha of tall fen. Between 2002 -05 an intensive programme of scrub removal was undertaken to increase the extent of this habitat.

The management of these communities is predominantly via mowing, however some areas are grazed.

The objective of tall fen vegetation will be achieved by the following methods:

> **Cts. 44, 45, 48, 52 and 57 –** each cut one year in three**, ct. 47** which is split into three sections cut on a three year rotation (Now cut in six blocks rather than long strips). Autumn cutting is operated in each unit. It is important to maintain cutting in ct. 57 as NVC work in 1997 suggested that this area is less diverse than others, due possibly to later cutting.

Objective 1:

ct. 37 is cut and gathered in late June/early July of each year to achieve a three year rotation. The practice of cutting in six blocks rather than three long strips will be continued.

ct. 39 is divided into six alternate strips, of which three are cut in the autumn of each year to achieve a biennial rotation. Moving the cutting date forward into late summer may help maintain floristic diversity and reduce competition from reed.

As a variation to the three year rotation, two of the three Tall Fen glades in **ct. 54** have been cut in the autumn of each year, while the uncut glade in any one year has been one of the glades cut in the following two years. The main objective for these glades was to be consistent with the three year rotation, but in addition hoped to achieve conditions for Fen Violet and Fen Woodrush. Experience has, however, shown that cutting these glades in autumn can be difficult, if not impossible, because ground conditions are often too wet. There is also no evidence that this management has benefited the two RDB plants.

Ct. 46 has been cut annually but this was reduced after it appeared that the sward was becoming dominated by a mono-culture of *Juncus sub-nodulosus.*

Two of the cut & gather blocks (cts. 37 and 47) were sub-divided to allow a greater range of ecotones which would be particularly beneficial to invertebrates. The effectiveness of this now needs assessing.

The objectives of tall fen management have generally been achieved by the cut and gather regime but ground wetness remains the main constraint to achieving this consistently. This can be overcome, depending on the degree of wetness, by using pedestrian mowers, belt-rakes or hand-raking and an Argocat, but this is extremely time-consuming and impractical on a large scale. Although recent investment in specialist machinery has made this less time-consuming than in the past it is not always possible to complete all the cut and gather work in wet years in view of workloads elsewhere. It is also not considered necessary to stick rigidly to rotations and a degree of slippage from one year to the next is acceptable but this does lead to a very large amount of biomass to be disposed of and prolonged burning can bring complaints from surrounding communities.

Despite considerable development of novel mowing methods such as the FenAll track vehicle the problem remains of disposing of material given the time and financial constraints. This has been exacerbated by the additional 6ha of potential tall fen requiring managing resulting from completion of the scrub clearance project in the spring of 2004. In the autumn of 2009 very dry weather and the hiring of one extra man for a 4-month period meant that all cut and gather management was completed for the first time in many years. This underlines the reliance not only on good weather but also the benefit of adequate staffing. The present lack of a full staff complement threatens the maintenance of favourable condition.

As was recommended in the last Management Plan stock grazing has been extended using both cattle and ponies but lack of resources to fund additional stock and difficulties of moving the animals around has meant that this has only been a partial expansion. Also, the cattle do not readily eat soft rush and this has become a problem in some areas. Conversely, the Welsh ponies have been very effective. The uneven structure created by light cattle grazing is clearly of benefit in combating dominance of *Phragmites* and creating suitable conditions for invertebrates. Grazing in cts. 37 and 39 would be difficult to achieve, however, and cutting only should be continued here, particularly as these are important refuges for the RDB Marsh Carpet moth (*Perizoma saggittata)* which feeds on meadow rue. Meadow rue is unlikely to flower if it is cut every year or overgrazed. Ct. 53 has been managed by light summer cattle grazing for

Objective 1:

about 5 years and has developed a more varied structure than the other tall fen fields.

Cts 56 and 60 and smaller areas elsewhere within the Tall Fen sub-division are treated as limited intervention areas, receiving no management apart from periodic bush clearance, resulting in a tall fen with scattered small bushes of sallow. An extension of this is a degree of `catastrophe' management involving the use of machinery to clear more mature bushes every 20 years or so such as occurred in cts. 46 and ct. 49 in 1994. The use of heavy machinery creates ideal conditions for early colonisers in the fen succession such as the fen violet. These areas complement the regularly managed sections and provide a relatively stable environment for invertebrates whose requirements are not met by intensive management.

Other communities

Invertebrates

Woodwalton Fen supports an extraordinary diversity of nationally rare species of invertebrate particularly beetles, moths and butterflies. The needs of this assemblage would be expected to be met through the routine management of the habitats in which they occur but it is difficult to accurately assess the invertebrate population without undertaking specialist survey. In response to comments by specialists, the cut and gather regime has been altered in two fields (37 W and 48) in order to provide more interface between cut and uncut vegetation.

We are keen to encourage research into the effects on the invertebrate population of cutting compared to grazing and will encourage co-operation with the survey planned for Chippenham Fen NNR.

Birds

The open fen is not particularly attractive to nesting birds, but in the past snipe were a common feature of some of these fields and still occur in winter.

If breeding is suspected, account of this must be taken in any management operations, including grazing.

Reference:
***T. Pankhurst (1997-98**) NVC Baseline Survey and mapping of mixed fen habitats at Woodwalton Fen NNR*

Likely Significant Effect:
These proposals are necessary for nature conservation management of the site.

Monitoring Methods:

- Monitoring of vegetation communities will be undertaken under the Common Standards Monitoring Programme.
- The effectiveness of cut and gather rotations should be assessed by botanical and invertebrate monitoring. A comparison with Chippenham Fen NNR may be useful as this sort of work has already been done there.
- A detailed NVC survey should be carried out periodically. The last survey was in 1997-2002 and this is a priority for this management period.

Objective 1:

- Monitoring methods for the nationally scarce plants such as fen violet will continue to be refined but species counts remain as the best option.
- The rare invertebrates require specialist survey once in the five years of the plan to test their continued existence and so the specialist can advise on any management changes. These invertebrates have not been monitored adequately in the past.
- Moths have been particularly well monitored over the life of the last plan. Continued surveillance will be continued as opportunities arise.
- Other invertebrates will be monitored as opportunities arise. The butterfly monitoring transects will continue as a contribution to the national recording scheme.
- Water levels in the reedbed and cts. 41 and 55 will continue are to be monitored monthly via dipwells. Results should be collated annually.
- Chemical properties of the dyke water will be sampled on a regular basis as part of the ditch restoration of water quality and also as part of the wider Great Fen surveillance, and the results analysed.
- Bird populations will be monitored by a winter bird transect and continuation of the breeding bird census.

Objective 2:

Lowland fen – Fen Meadow
Subject to natural change, **to maintain and where possible enhance condition of the Purple Moor Grass and Rush Pastures associated vegetation communities and associated fauna.**

NVC communities:
M22 *Juncus subnodulosus – Cirsium palustre* fen meadow
M24 *Molinia caerulea – Cirsium dissectum* fen meadow
M25 *Molinea caerulea-Potentilla erecta* mire
S1 *Carex elata* swamp

Features addressed by this objective:

2,3

Attributes/targets for key features:

Feature 2: Purple Moor Grass and Rush Pastures

NVC classification: M22a *Juncus subnodulosus – Cirsium palustre* fen-meadow, typical sub-community & M22b *Juncus subnodulosus – Cirsium palustre* fen-meadow, S1 *Carex elata* swamp.

Target Extent: Minimum 5 ha

Target sward structure: Sward 2 cm or greater (excluding *Juncus spp*.) but no more than 25% over 40 cm (including *Juncus* species)No more than 25% litter, no more than 10% bare ground

Target sward composition: Record positive indicator species from below to give 2 frequent , 4 occasional or locally abundant. *Berula erecta, Caltha palustris, Cardamine pratensis, Cirsium dissectum, Eupatorium cannabinum, Filipendula ulmaria, Galium palustre/G. uliginosum, Geum rivale, Hydrocotyle vulgaris, Lotus pedunculatus, Lychnis flos-cuculi, Mentha aquatica, Orchidaceae spp., Potentilla palustris, Ranunculus flammula,* small blue-green *Carex spp*. (leaves less than 5mm wide) *(C. flacca, C.nigra, C.panicea), Succisa pratensis, Thalictrum flavum, Valeriana dioica,Viola palustris*.
No more than 10% of the sward large *Carex spp*. e.g. *Carex acutiformis*. or large grasses i.e. *Glyceria maxima, Deschampsia cespitosa Phalaris arundinacea, Phragmites australis*. No more than 80% cover of rush with no more than 50% *Juncus conglomeratus, J. effusus and J. inflexus*

Feature 3: Purple Moor Grass and Rush Pastures

NVC classification: M24b *Molinia caerulea - Cirsium dissectum* fen meadow, typical sub-community & M24a – M13 *Schoenus nigricans* mire

Target Extent: Minimum 5ha

Target sward structure: Sward greater than 5 cm (excluding *Juncus spp.)* but no more than 25% over 60 cm , no more than 25% litter, no more than 10% bare ground

Target sward composition*: Molinia caerulea* at least frequent throughout the sward but no more than 80% cover. *Phragmites australis* no more than 10% cover. Record positive indicator species from the list below to give an overall total of 2 frequent and 3 occasional - *Anagallis tenella, Angelica sylvestris, Carum verticillatum, Cirsium dissectum,Erica tetralix, Eupatorium cannabinum, Filipendula ulmaria, Galium uliginosum/Galium palustre, Lotus pedunculatus, , Orchidaceae spp., Pedicularis sylvatica, Potentilla erecta,* small blue-green *Carex spp*. (leaves less than 5mm wide) *(C. flacca, C.nigra, C.panicea), Sphagnum spp., Succisa pratensis, Valeriana officinalis , Viola palustris.*

Objective 2:

Overall total of at least two species/taxa frequent plus at least three species occasional throughout the sward. No more than 10% of the sward large *Carex spp*. e.g. *Carex acutiformis* or large grasses i.e. *Glyceria maxima, Deschampsia cespitosa Phalaris arundinacea, Phragmites australis*. No more than 80% cover of rush with no more than 50% *Juncus conglomeratus, J. effusus and J. inflexus*

Objective Methods:

Purple moor-grass sward

This community occurs mainly in cts. 41, 76, 82, and 83. Management here is a combination of grazing and mowing, together with maintenance of optimum water levels for the target vegetation-type. Coarse vegetation such as rushes has always been an issue in these areas, and needs constant control if the finer sward is not to be affected. Reed and rushes have spread in the last few years and intensive efforts are necessary to combat this. Weed-wiping followed by cutting and intensive grazing has served to open up the sward considerably. Handcutting of the northern part of ct.76 is usually necessary if the cattle have not grazed this effectively enough and tractor work would damage the ant-hills and *Molinea* tussocks. It is recommended that some of the tussocks here be mown to enable better management of this important floristic area. Maintaining an open sward with optimum water levels is essential in this management period.

Rush pasture

This occurs in cts. 84/85, which have generally been grazed and the aftermath mown and at the eastern edge of the two 'violet' fields 55&58. For two years in 2007/8 84/85 were cut for hay and aftermath grazed, which, in addition, to localised weed-wiping to control *Juncus* has resulted in a good grassland structure. A late cut was made in 2009 after grazing.

In cts. 55/58 more targeted cutting and weedwiping must be implemented to control the rush to reasonable level.

Reference:
T. Pankhurst (1997-98) *NVC Survey*

Likely Significant Effect: These proposals are necessary for nature conservation management of the site.

Monitoring Methods:

- NVC survey Monitoring of vegetation communities will be undertaken under the Common Standards Monitoring Programme.
- A detailed NVC survey as Obj 1.
- Monitoring methods for the nationally scarce plants will continue and participation in the rare plants group research into fen violet continued.
- The rare invertebrates (e.g. marsh carpet moth, tansy beetle) require specialist survey once in the five years of the plan to test their continued existence and so the specialist can advise on any management changes. These invertebrates have not been monitored adequately in the past.
- Moths have been particularly well monitored over the life of the last Plan. Continued surveillance will be continued as opportunities arise.
- Other invertebrates will be monitored as opportunities arise.

Objective 3:

Subject to natural change, **to maintain and where possible enhance condition of the saw sedge community**
NVC Community: S2 *Cladium* Fen

Features addressed by this objective:

4

Attributes/targets for key features:

Feature 4
Target Extent: Minimum 3 ha

Target sward structure: No more than 25% litter, no more than 10% bare ground

Target sward composition: *Cladium mariscus*: constant in dense stands, scrub <10% on open fen

There should be no reduction of the present extent of this community and there are opportunities for the present distribution to expand to colonise areas of woodland which have recently been cleared.

Objective Methods:

Saw Sedge

Ct.77 has for many years been managed by mowing on a 4-year rotation to encourage the establishment and spread of saw sedge *Cladium mariscus* and forms one of the SAC features of the NNR.

This rotational mowing regime should continue, and be extended to include those open areas created by scrub clearance. The western part of ct. 77 has been grazed but care is needed not to eliminate stands of *Cladium* or *Myrica* through overgrazing. This also applies to the heather in ct. 83 which has been stimulated by scrub clearance near the south gate. The bog myrtle stand at the south end of 77 should continue to be gradually cut over to renew its vigour and create varied age-classes.

We will encourage the involvement of commercial contractors if there is any interest in taking the crop for roofing.

Note: For management related to invertebrates and birds see Objective 1

Monitoring Methods:

- NVC survey monitoring of vegetation communities will be undertaken under the Common Standards Monitoring Programme.
- Monitoring methods for the nationally scarce plants will continue
- The rare invertebrates require specialist survey once in the five years of the plan to test their continued existence and so the specialist can advise on any management changes. These invertebrates have not been monitored adequately in the past.
- Moths have been particularly well monitored over the life of the last Plan. Continued surveillance will be continued as opportunities arise.
- Other invertebrates will be monitored as opportunities arise. The butterfly monitoring transects will continue as a contribution to the national recording scheme.
- Chemical properties of the dyke water will be sampled on a regular basis and the results analysed as this may affect the *Cladium* community.
- Bird populations will be monitored by a winter bird transect and continuation of the breeding bird census.

Objective 4:

Ditches and Open Water
Subject to natural change, **to maintain and where possible enhance condition of the ditches and pond vegetation communities and associated fauna.**

NVC community - Fen Pondweed aquatic community (*Potamogeton coloratus*)

Features addressed by this objective:

6

Attributes/targets for key features:

Feature 5
Habitat structure: channel length in early, mid and late successional stages
Target: Mix of early, mid and late succession ditches: 10-25% early, 35-75% mid, 10-25% late

Habitat structure : Composition of bankside vegetation
Target: no more than 10% of the channel length should be heavily shaded.

Habitat structure: Characteristic water levels to be maintained.
Target: In wet ditches summer water depth at least 0.5 m in minor ditches and 1 m in major drains. 90% of channel length should reach this target.

Objective Methods:

Open water habitats- ditches and ponds

The dykes at Woodwalton Fen are species-rich in many places but suffer from nutrient-enrichment resulting from the inflow of agricultural run-off and treated sewage effluent from the Great Raveley Drain. Some dykes have supported populations of pondweeds such as *Potomageton natans* and very occasionally fen pondweed - *Potamogeton coloratus* but these have declined greatly over the last decade or so.

Other interesting species include water violet *Hottonia palustris,* frogbit *Hydrochaeris morsus-ranae* and lesser water parsnip *Berula erecta*.

The aquatic plant communities in turn support a very rich invertebrate community. Beetles and dragonflies are particularly well represented.

The improvement of the ditch water quality is essential if the condition of the ditches is to be improved. Experimental management in the form of silt pumping, creating flow, and new ditch excavation will be trialled during this management period. Rotational clearance of ditches will continue. In response to survey work of both flora and invertebrates we will continue to maintain at least 10% of the ditches slubbed each year and in some cases may re-introduce roding (cutting of vegetation under water).
We will continue to monitor water levels via hydrological monitoring installations every month and rainfall and water levels in dyke 5 daily. Chemical analysis of the water will be needed at intervals to assess the effectiveness of any work to reduce nutrients in the input water as well as ditch work.

The proposed sequence of dyke management is as follows:

Key:

A – slub every other year; B – slub every 3 years; C slub every 5 years; D slub every 5-7 years; E - 7 years +

Objective 4:

(See Map Appendix 1)

Dyke no	***Roding***	***Subbing***	***Brinking***
East – West Dykes (All described from west to east) Area (c) North of dyke 3			
1		E	
2		D(29/31) C (29/32, 30/34) B(30/33,eastof windpump)	
E-W dyke cts. 32/33		D	
3		D (31/35;32/36) C (33/38 east; 34/40 east) A(33/38 west; 34/40 west)	
Area (b) d.3 – d.11			
4	36/42	D (35/41; 36/42) B (37/44 C (39/45	
5		B (41/46); C(42/47) E (44/48) B(45/49 west of r/gauge) C (44/49 east of r/gauge)	
6		E (short section west of bridge) D (48/52) B (49/53)	
7	52/56	D (50/54 C (51/55) B (52/56) A (53/57 west) C (53/57 east)	
8		C (55/58) D (57/60)	
9		D (58/61) C (59/62) D (60/63 east)	
10		B (54/65) C (61/64)	
Area (a)			
11		D (70/79-80)	
12		D (65-66/72; 68/77)	
E-W dyke ct.81		C (81/74) B 75/81	
E-W dyke ct.76 south		B (76/82)	
Heath Dyke		B (77/78 west) C (77/78 east)	
South Heath Dyke		B (78/83 west) C (78/83 east)	

Objective 4:

North-South Dykes				
Area (c)		E		
Ct. 29		W		
Ct.30		E (north of pond) B (south of pond)		
Randall's		B (31/32north) C (31/32 south)		
33/34		B (north of pond) C (south of pond)		
Area (b)				
16 (N)		C (36/37-8 north) B (36/37 south)		
16 (S)		C (42/44)		
17 (N)		C (47/48) D (51/52)		
18		D (37/39 north) C (37/39 south)		
18		A/B (44/45 north) A (44/45 south)		
18	48/49S	B (48/49 north) C (48/49 south)		
18		C (52/53)		
18		A (56/57 north) B (56/57 south)		
18		C (59/60)		
18		B (62/63)		
21 (Stewarts)		B (54/55) A (54/58) C (54/61)		
11		A (67/70 north)		
11		B (67/70 south)		
Cts.74/75		D		
Cts.75/6		C		
Ct.82W		B		
19		D		
20		B (77/79 north) C (77-8/79 south)		
Ct. 83 E		B		
Ct. 75 W		C		
Wheatley's Drain		E		

The two meres in the centre of the reserve were excavated between 1971 and 1982 in order to provide clay to construct the flood bank. The original mere (Rothschilds) has steeply sloping sides and is quite deep. Consequently there is little aquatic vegetation. The second mere – Gordon's – has shallow edges which support communities of reed and clubrush (*Schoenoplectus lacustris*).
Reed edges will be cut periodically around parts of Gordon's mere.
Two other small meres (Randalls and Alan's Windpump reservoir) in the reedbed support little vegetation and need no management in this period.

Objective 4:

The 20 ponds in ct. 74 (Moores ponds) are very steep sided and fed entirely by rainfall. They support the main population of Great-crested newt. The amount of scrub control in these ponds should be increased as it is clear that those ponds with extensive scrub are of little use to great-crested newts.

Likely Significant Effect:

These proposals are necessary for nature conservation management of the site.

Monitoring Methods:

- Monitoring of vegetation communities will be undertaken under the Common Standards Monitoring Programme.
- The rare invertebrates require specialist survey once in the five years of the plan to test their continued existence and so the specialist can advise on any management changes. These invertebrates have not been monitored adequately in the past.
- Monitoring of aquatic flora will be continued annually using the methodology refined by Pankhurst (2002).
- Other invertebrates will be monitored as opportunities arise.
- Chemical properties of the dyke water will be sampled on a regular basis and the results analysed.
- Effects of ditch management will be monitored by re-visiting the survey sections established in 2014.
- Bird populations will continue to be monitored through the winter wildfowl counts.
- Odonata will continue to be monitored in Moores ponds to Dr. Moores methodology.

Objective 5:

Woodlands
Subject to natural change, **to maintain and where possible enhance condition of the Lowland Mixed Deciduous Woodland habitat, vegetation communities and associated fauna.**

NVC communities:
W1 *Salix cinereia – Galium palustre*
W2 *Salix cinerea – Betula pubescens – Phragmites australis*
W5 *Alnus glutinosa – Carex paniculata*
W6 *Alnus glutinosa – Urtica dioica* woodland

Features addressed by this objective:

5

Attributes/targets for key features:

Feature 6
Target structure:

- Understorey (2-5m) present over at least 20% of total stand area.,
- At least three age classes spread across the average life expectancy of the commonest trees.
- Mature/old growth stands or a scatter of large trees allowed to grow to over-maturity/death on site (e.g. a minimum of 10% of the woodland or 5-10 trees per ha).
- A minimum of 3 fallen lying trees >20 cm diameter per ha and 4 trees per ha allowed to die standing.
- At least 95% of cover in any one layer of site-native or acceptable naturalised species.
- Signs of seedlings growing through to saplings to young trees at sufficient density to maintain canopy density over a 10 yr period (or equivalent regrowth from coppice stumps)

Objective Methods:

Wet scrub and woodland was probably developing on open fen when Charles Rothschild purchased the site in 1910. By the time of the 2nd world war in 1939 most of the site was covered in woody growth. Substantial areas have been cleared of woodland and dense scrub since 1954 with about 35ha cleared between 2002-05 to restore fen habitat.

Within the wet woods are woodcock, rare invertebrates, and probably roost sites for bats.

No management is proposed for the woodland blocks, but coppicing will be carried out as set out in the management maps.

Control of muntjac deer will be carried by the local deer control group.

Other communities

Invertebrates

Woodwalton Fen supports an extraordinary diversity of nationally rare species of invertebrate particularly beetles, moths and butterflies. The needs of this assemblage would be expected to be met through the routine management of the habitats in which they occur but it is difficult to accurately assess the invertebrate population without undertaking specialist survey.

Objective 5:

Birds

The sallow coppice is of particular importance to nesting birds such as grasshopper warbler nightingale and other warblers, and regular cutting is essential to maintain a dense undergrowth. Due partly to loss of habitat (primarily by muntjac browsing) nightingale numbers have fallen markedly over the last few years. Hopefully deer control will encourage an increase in suitable habitat and numbers will increase, although national declines in the breeding population may mitigate against this.

For many years the population of breeding birds in the southern woodland was monitored using Common Bird Census (CBC) techniques. As this proved too time-consuming and only covered part of the site, a point-count system was used in the mid 1990s after which it was replaced by an adapted version of the BTO Breeding Bird Census which has been used ever since. This will be continued and the results analysed regularly.

A spring dusk bird survey has been undertaken for several years and also as part of the national woodcock survey, and grasshopper warblers and nightingale have also been recorded separately in the last few years. These surveys will continue and other 'ad hoc' surveys conducted as and when necessary.

Long-eared owls have been monitored annually for many years by volunteers. We will continue with these surveys as appropriate and respond to national initiatives for other species. One example of this would be the lesser spotted woodpecker which has declined nationally and on the reserve. This was the subject of an RSPB survey recently which included the NNR.

Likely Significant Effect:

These proposals are necessary for nature conservation management of the site.

Monitoring Methods:

- Monitoring of vegetation communities will be undertaken under the Common Standards Monitoring Programme.
- A detailed NVC survey will be carried out once every five years (last survey was in 2001)
- Monitoring methods for the nationally scarce plants will be designed during the life of the plan.
- The rare invertebrates require specialist survey once in the five years of the plan to test their continued existence and so the specialist can advise on any management changes. These invertebrates have not been monitored adequately in the past.
- Other invertebrates will be monitored as opportunities arise.
- Deer monitoring will be undertaken through exclosures and monitoring of browsing.
- Bird populations will be monitored by a winter bird transect and wildfowl counts, continuation of the breeding bird census and species counts where applicable.

Objective 6:

All habitats – Rare plant assemblage
Subject to natural change, **to maintain and where possible enhance condition of the Rare plant assemblage**

Features addressed by this objective:

7,8

Attributes/targets:

Feature 9
Feature: Presence of rare plants
Attribute: Extent
Target: Sub-populations present in several locations

Feature: Presence of rare plants
Attribute: Presence /absence
Target: To maintain or ideally increase the populations of target species.

Objective Methods:

The following rare plants found on the site are considered to be particularly threatened in the Red Data Book:

Species Name (Latin)	***Species Name(English)***	***Status***
Carex lasiocarpa		VU
Carex x evoluta		VU
Galeopsis speciosa		VU
Hydrochaeris morsus-ranae		VU
Luzula palidula	Fen woodrush	CR
Myriophylumm verticillatum		VU
Oenanthe fistulosa		VU
*Peucedanum palustre****		VU
Potamogeton friesii		NT
Potamogeton x fluitans		VU
Silene noctiflora		VU
Stellaria palustris		VU
Viola canina	Heath dog violet	NT
Viola canina ssp. montana	Heath dog violet	
V.persicifolia	Fen violet	NE
BAP species:		
Sium latifolium	Greater water parsnip	NE

The majority of their habitat needs are believed to be met via general management of the NNR in terms of water levels and vegetation control. However the population of plants such as fen violet, some orchids and pondweeds are declining. The reasons for the declines are unclear and will certainly vary depending on the species, but water quality and availability and competition from other species may be involved. In addition, the isolation of the site may be contributing to loss of genetic vigour in some species and lack of emigration or immigration may also be important. More detailed research is needed to find the answers.

Objective 6:

One particularly important consideration is the nationally significant population of fen violet *Viola persicifolia.* The reserve is one of only 3 remaining national populations, so it is important to retain and increase the size and viability of the Woodwalton population. The plants flower from May-June so regular mowing or heavy grazing before then may be detrimental to the long-term survival of the population. Early spring grazing is not likely to affect it but other earlier-flowering species might be affected and particularly ground nesting birds. The population is monitored by recording the number of plants annually.

It is clear that competition from species such as soft rush may be a limiting factor and that ground disturbance can lead to spectacular increase in numbers of the local population for a limited period. Water levels in spring are also critical; the plants will not germinate in standing water but need sufficient moisture to prevent drying out.

A working group has been set up to co-ordinate the surveillance of this species on Woodwalton, Wicken Fen and Otmoor. We would like to encourage further detailed research based on the recommendations of the group. We may require additional resources to deliver the recommendations of the working group.

Likely Significant Effect:

These proposals are necessary for nature conservation management of the site.

Monitoring Methods:

- Monitoring of the nationally scarce plants will be carried out simultaneously with the NVC survey.
- Key species will be counted annually.

Objective 7:
Ditches and Open Water Subject to natural change, **to maintain and where possible enhance populations of Great-crested newt (*Triturus cristatus*)** (European Habitats Directive Schedule 2 Protected species)
Features addressed by this objective:
9
Attributes/targets:
Feature: Great-crested newt **Attribute:** Extent **Target:** Population present in Moores Ponds and at least two locations outside. **Attribute:** Population size **Target:** Present in sample breeding ponds at least once every 4 years. (i.e. acceptable for eggs to be absent from individual ponds 3 years out of 4; fail if any breeding pond lacks eggs for 4 years)
Likely Significant Effect: **These proposals are necessary for nature conservation management of the site.**
Monitoring Methods:
• Record presence by one day or night visit mid-March to mid-May. Survey for 4 consecutive years within this management period.

2.4.2 Landscape and Cultural Objectives

Objective 8:

Socio-economic use
To maintain the current level of socio-economic use of the site.

Features addressed by this objective:

All

Attributes/targets:

Feature 10: economic use

Target contribution of a farm enterprise :
Maintain the use of an external reed cutter where appropriate.
Maintain the use of external graziers' cattle or ponies to supplement summer grazing.

Feature 11: community involvement

Target community events :
To permit community events such as guided walks or talk where there is no conflict with nature conservation and within the access strategy.

Target volunteers :
To have several volunteers to carry out essential wildlife monitoring and assist with reserve management work. Contribute to the Great Fen 3-weekly programme of volunteer tasks.

Objective Methods:

There has been some cutting of part of the reedbed by a commercial reed cutter but as yet no commercial crop has been produced. Some reed was used for re-thatching the Bungalow and over the next few years it is hoped that some commercial crop can be produced, both of reed but also potentially the areas of sedge in ct. 77. Occasionally we may need to restrict access due to wildlife needs e.g. Marsh harrier nesting in the reedbed. We will maintain the use of external cattle graziers to supplement the grazing in the summer when we have too much forage for the NE-owned herd. We will assist with the management of stock and undertake stock checking of the cattle on a daily basis but overall management responsibility remains with grazier. We will ensure the site infrastructure is maintained.

We will expand our programme of guided walks, assisted by Great Fen staff. These walks will be advertised on the Natural England website, in the local press and with posters on the reserve and at other local sites.

We plan to maintain and ideally expand the current number of volunteers on the NNR. Our current volunteers deliver a lot of quality information to our understanding of the site. We would benefit from an increase in recording effort on the NNR and are keen to increase the range of volunteering opportunities. We will work with the Great Fen partners to merge all volunteers into the 'Great Fen'.

Likely Significant Effect:

These proposals are not necessary for nature conservation management but will have no likely significant effect on the internationally important nature conservation features of the site.

Objective 8:
Monitoring Methods:
• Volunteers are recorded on a register of volunteers and their time input is recorded at the end of every financial year. • The number of events facilitated by Natural England is recorded each year.

Objective 9

Education, Research and Demonstration
To maintain a reasonable level of education, research and demonstration

Features addressed by this objective:

All

Attributes/targets:

Feature 12: educational use
Target number of educational visits : No target

Feature 13: research
Target number of research projects carried out : No target

Feature 14: demonstrations
Target number of demonstrations : No target

Objective Methods:

We will encourage research on the site. We will work with volunteers and academic bodies to encourage research.

We would like to encourage the following ;

- The effects of grazing against mowing on the invertebrate community of the fen.
- Study of rare plants and in particular the fen violet population
- Study into the morphology of *Juncus effusus* and develop methods of control
- Develop more knowledge of the effects of nutrient-rich water inputs to the site from the Great Raveley Drain.

We would welcome any suggestions for further research on the NNR.

We will remain available to schools, colleges and universities for educational visits, should they request it and maintain close links with the staff at the 'Countryside Classroom'.

We are keen to demonstrate the practical management techniques we employ on the NNR would be willing to deliver demonstration events to this end.

Likely Significant Effect:

These proposals are not necessary for nature conservation management but will have no significant effect on the internationally important nature conservation features of the site.

Monitoring Methods:

- The number of educational visits and demonstrations is reported annually.

2.4.3 Estate Asset Objectives

Objective 10

Legal and other obligations

To fulfil all legal and other obligations arising from legislation, leases and legal consents etc.

Features addressed by this objective:

All

Attributes/targets:

Feature 15: health and safety

Target compliance with legal obligations towards staff and visitors :100% compliance; no incidents

Feature 16: livestock regulations

Target compliance with legal obligations including welfare, movements, biosecurity, identification, where not the responsibility of grazier:

100% compliance

Feature 17: waste disposal

Target compliance with legal obligations:

Ensure all waste is disposed of within current regulations

Feature 18: felling licence

Target compliance with legal obligations :100% compliance

Feature 19: protected wildlife

Target compliance with legal obligations :100% compliance

Feature 19: cross-compliance

Target compliance with obligations :

100% compliance with statutory obligations for 'cross-compliance'.

Objective Methods:

We will operate all health and safety procedures positively. We will undertake risk assessments and implement their recommendations. We will maintain a lone working buddy system. We will attempt to have all reserve staff trained in First Aid.
We will appropriately train our staff and volunteers who use machinery.
We will check trees for safety in a zoned manner according to risk.

There are many obligations relating to livestock, including those concerned with welfare, movements, and animal identification. These are the responsibility of the livestock keeper, whether that be an external grazier or NE staff. We will undertake our responsibilities fully. Bio-security may become a legal obligation if foot-and-mouth, blue-tongue, bird flu, TB or other notifiable disease becomes present in the surrounding area. All legal precautions, plus extras if necessary, will be taken to prevent the spread of disease onto / off Woodwalton Fen. As legal restrictions may change rapidly during an outbreak, staff will vigilantly assess the situation.

All normal commercial and domestic waste, including metal, plastics and paper for recycling will be disposed of through the District Council collection service. Materials for recycling will be collected separately and taken to the nearest recycling facility. Quantities of waste too large for

Objective 10

this, such as old fencing material or fly-tipped waste on our land will be removed in skips hired for the purpose. 'Special' waste such as oil wastes or car batteries, pesticides or florescent bulbs will be taken to local authority collection points for recycling. Unwanted vehicle tyres will be taken to authorised tyre dealers for disposal or recycling. For other special wastes, e.g. fly-tipped asbestos or dumped cars we will contact the local authority for advice. We will comply with the legal obligation to keep records of waste transfer to authorised disposal sites or to licensed collectors. We will make sure our contractors (e.g. fencing contractors who generate old fencing material waste) supply us with copies of waste transfer notes to ensure that they also comply with legislation. Where we dispose of waste on-site, e.g. burning up to 10 tonnes of felled trees, we will apply for a waste disposal exemption, or licence for greater quantities. We will ensure our contractors do the same where relevant.

A felling licence is required for the felling of more than a small defined volume of wood. If necessary Natural England will apply for a felling licence for any of our work.

This management plan meets our obligations for SSSI / SAC / SPA management, but any changes will need further assents. Several protected species occur on Woodwalton Fen (see section 1) and we will comply with legal requirements regarding protection of these species.

We will comply with all Defra rules for keeping the land in 'Good Agricultural and Environmental Condition' as required by cross-compliance. This will enable the land to be eligible for the Single Farm Payment. We will oblige our grazier to do the same. In particular we will annually write a Soil Management Plan as required.

Likely Significant Effect:
These proposals are not necessary for nature conservation management but will have no significant effect on the internationally important nature conservation features of the site.

Monitoring Methods:

- Health and safety – by Natural England's East of England Health and Safety Committee
- Livestock regulations – informal monitoring by Reserve Manager
- Waste disposal – collection of waste transfer notes
- Protected species – informal monitoring by all staff (protected species), formal checks by Team Leader for SSSI / SAC / SPA assents.

Objective 11:

Internal/External Scheme obligations
To fulfil obligations arising from voluntary external and internal schemes.

Features addressed by this objective:

All

Attributes/targets for key features:

Feature 20: interpretation plan

Target usage :
Possess and operate an interpretation plan as required internally

Feature 21: green travel plan

Target usage :
Possess and disseminate a green travel plan as required internally.

Feature 22: standards for visitor facilities

Target implementation :
To meet internal standards for visitor facilities.

Feature 23: safety checks

Target for safety of access structures and trees:
Maintain in safe condition.

Objective Methods:

We will write and operate an interpretation plan for visitors. This will set out what we will interpret, and how. This is in the appendices.

Our green travel plan informs visitors how they may visit the NNR using public transport or their fuel-efficient cars.

Natural England has standards for visitor facilities for its nature reserves, which fall into various categories depending on suitability for access. Woodwalton Fen currently falls into the old English Nature 'silver' category. These standards are under review.

We will check all access structures, such as gates and stiles and steps once every three months, and take corrective action where necessary to maintain structures in a safe condition. We will check tree safety, with our own staff (non arboriculturalists) at least once a year in high risk areas where people are most likely to be found. These 'Zone 1' areas are shown on a map in the maps section. Safety checks will not be carried out in areas closed to the public, where no visitors are expected, if there is the possibility of illegally disturbing rare birds. The access structure and tree safety check sheets are in the appendices.

Likely Significant Effect:

The proposals are not necessary for nature conservation management of the European

Objective 11:
site but will have no significant effect on the internationally important nature conservation features of the site.
Monitoring Methods:
• The access furniture and safety fencing are monitored and reported formally every three months. • Tree safety checks in Zone 1 (high risk) areas are carried out at least annually.

Objective 12:

Estate Assets
To maintain the estate assets in good condition.

Features addressed by this objective:

All

Attributes/targets:

Cattle Herd

Livestock fencing, gates and stiles
Target condition: Stock fencing and access furniture will remain in serviceable condition.

Cattle handling facility and crush: maintain in good condition.

Visitor infrastructure : Maintain droves and hides and Rothschild Bungalow in safe and attractive condition.

Workshop and office facility & machinery: Maintain in good condition and a safe clean working environment.

Rainfall and water level monitoring devices: We will maintain the monitoring structures on the NNR.

Fuel and waste storage: Legal compliance.

Objective Methods:

We currently have a herd of up to 40 cattle. We will adapt numbers according to the need to maintain the sward structure in optimum condition. In the winter there can be insufficient forage to carry the stock and we keep the herd in winter quarters at the south end of the reserve where they are fed.
The livestock require resources in terms of daily checking, veterinary medicines and routine checkups. We intend to continue owning the stock but will supplement this with use of grazier if deemed necessary. (In 2009 we had a herd of 5 ponies for a few weeks to graze ct. 35).

The livestock fencing will be replaced as necessary, with the amount of replacement fencing varying on a year to year basis depending on the condition of the fencing. Fence repairs will be made where necessary so that the fence remains serviceable for as long as possible before replacement. Electric fencing will continue to be used.

There are a number of gates which will be repaired or replaced as necessary to maintain them in a safe and serviceable condition.

The cattle handling facility will be maintained / enhanced to ensure we have the capacity to manage the stock effectively.

The hide structures will be checked on a regular basis to ensure that safe access is maintained. The boardwalks will be checked annually and repaired as necessary. The 'Bungalow' is a key feature of the site. It is intended to re-thatch the building in 2010 or 2011. Additionally, works to the pillars and chimney are required.

Objective 12:

The reserve base will be maintained to ensure it remains as a clean, safe and welcoming working environment. The building condition is managed by a national team and we will work with them to ensure issues are identified and resolved as soon as possible.

Likely Significant Effect:
The fence repair / replacement proposals are necessary for nature conservation management of the European site.

The other proposals are not necessary for nature conservation management of the European site but will have no significant effect on the internationally important nature conservation features of the site.

Monitoring Methods:

- The access furniture and safety fencing are monitored and reported formally every three months.
- Fence condition is formally recorded every five years but checked frequently on an informal basis.

WOODWALTON FEN

5- YEAR WORK PLAN 2015-20

Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
1. Lowland Fen – Tall Fen Community Subject to natural change, to maintain and where possible **enhance condition of the Lowland Fen habitats, vegetation communities and associated fauna**. **Lowland fen – Fen Meadow** Subject to natural change, **to maintain and where possible enhance condition of the Purple Moor Grass and Rush Pastures associated vegetation communities and associated fauna**	RP00	Collect data, climatological, general	✓	✓	✓	✓	✓	Rainfall. L-T Monitoring network Climate station at Monks Wood
	RP10	Collect data, hydrological, general	✓	✓	✓	✓	✓	Dipwells and gaugeboards
	RP40	Collect data, pedological, general		✓				Carry out peat depth and ph survey across site.
	RB00	Collect data, biological, general	✓	✓	✓	✓	✓	
	RF00	Collect data, vegetation, general	✓	✓	✓	✓	✓	
	RF20	Collect data, other vascular plants, general	✓	✓	✓	✓	✓	
	RA10	Collect data, birds, general	✓	✓	✓	✓	✓	
	RA40	Collect data, Lepidoptera, general	✓	✓	✓	✓	✓	National census counts.
	RA80	Collect data, other/general invertebrates, general	✓	✓	✓	✓	✓	
	RA90	Collect data, fauna, general	✓	✓	✓	✓	✓	
	RH90	Collect data, other activities, by others	✓	✓	✓	✓	✓	
	MH0+	Manage habitat,	✓	✓	✓	✓	✓	Scrub clearance and maintain

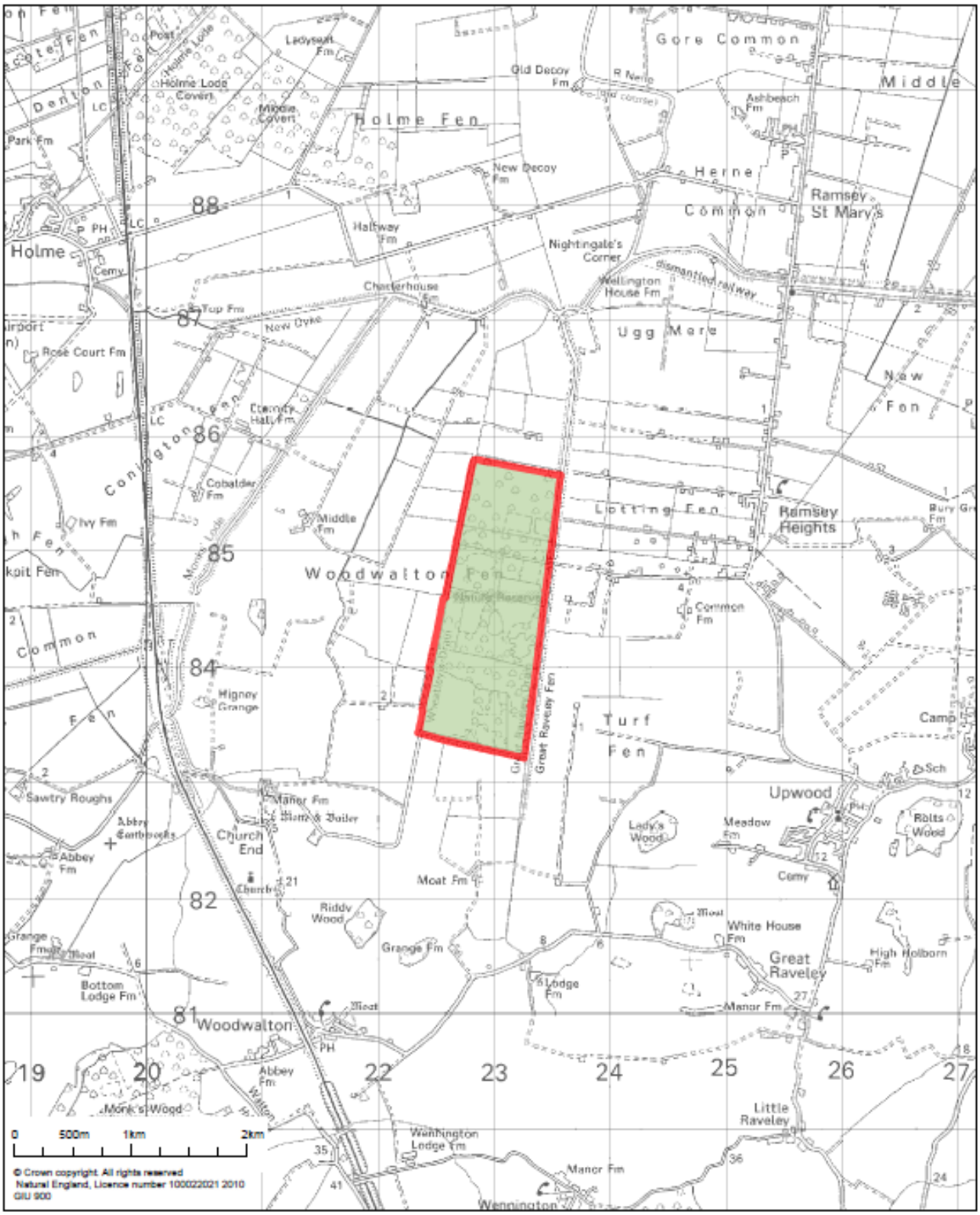
Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
Saw sedge swamp Subject to natural change, **to maintain and where possible enhance condition of the saw sedge community** **NVC Community:** S2 *Cladium* Fen		forest/woodland/scrub, general						coppice cycle.
	MH5+	Manage habitat, swamp/fen/inundation, general	✓	✓	✓	✓	✓	
	MS10	Manage species, other vascular plant	✓	✓	✓	✓	✓	
	ME20	Comply with legal obligations	✓	✓	✓	✓	✓	
	MG++	Husband grazing animals, general	✓	✓	✓	✓	✓	Livestock health. TB checks.
	MS10	Manage species, other vascular plant	✓	✓	✓	✓	✓	
	ME20	Comply with legal obligations	✓	✓	✓	✓	✓	
	MS00	Manage species, tree/shrub	✓	✓	✓	✓	✓	
Ditches and Open Water Subject to natural change, to maintain and where possible enhance condition ditches and pond vegetation communities and associated fauna.	RP00	Collect data, climatological, general	✓	✓	✓	✓	✓	
	RP10	Collect data, hydrological, general	✓	✓	✓	✓	✓	Water quality
	RP40	Collect data, pedological, general		✓				Carry out ditch substrate survey across site.
	RB00	Collect data, biological, general	✓	✓	✓	✓	✓	
	RF00	Collect data, vegetation, general	✓	✓	✓	✓	✓	Continue to monitor ditch lengths for silt pump assesment
	RF20	Collect data, other	✓	✓	✓	✓	✓	Sium, R. lingua, Chara,

Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
		vascular plants, general						Myriophyllum etc.
	RA90	Collect data, fauna, general	✓	✓	✓	✓	✓	Monitor water voles
	RA80	Collect data, other/general invertebrates, general	✓	✓	✓	✓	✓	
	RH90	Collect data, other activities, by others	✓	✓	✓	✓	✓	
	MH6+	Manage habitat, open water, general	✓	✓	✓	✓	✓	Experimental ditch management work eg silt pumping, Regular dyke slubbing
	MS10	Manage species, other vascular plant	✓	✓	✓	✓	✓	
	ME20	Comply with legal obligations	✓	✓	✓	✓	✓	
5. Lowland deciduous woodland Subject to natural change, **to maintain and where possible enhance condition of the Lowland Mixed Deciduous Woodland habitat, vegetation communities and**	RP00	Collect data, climatological, general	✓	✓	✓	✓	✓	
	RP10	Collect data, hydrological, general	✓	✓	✓	✓	✓	
	RB00	Collect data, biological, general	✓	✓	✓	✓	✓	
	RF00	Collect data, vegetation, general	✓	✓	✓	✓	✓	
	RA10	Collect data, birds, general	✓	✓	✓	✓	✓	
	RA40	Collect data, Lepidoptera, general	✓	✓	✓	✓	✓	
	RA80	Collect data, other/general	✓	✓	✓	✓	✓	

Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
associated fauna.		invertebrates, general						
	RA90	Collect data, fauna, general	✓	✓	✓	✓	✓	Continue monitoring programme for effect of deer browsing
	RH90	Collect data, other activities, by others	✓	✓	✓	✓	✓	Deer stalking records
	MH0+	Manage habitat, forest/woodland/scrub, general	✓	✓	✓	✓	✓	Control muntjac numbers to prevent removal of herb layer and tree regeneration
	MS00	Manage species, tree/shrub	✓	✓	✓	✓	✓	
	MS10	Manage species, other vascular plant	✓	✓	✓	✓	✓	
	ME20	Comply with legal obligations	✓	✓	✓	✓	✓	
All habitats – Rare plant assemblage Subject to natural change, to maintain and where possible enhance condition of the Rare plant assemblage	RV0+	Collate documents, and datasets, general	✓	✓	✓	✓	✓	
	RP00	Collect data, climatological, general	✓	✓	✓	✓	✓	
	RP10	Collect data, hydrological, general	✓	✓	✓	✓	✓	Dipwells
	RP40	Collect data, pedological, general	✓	✓	✓	✓	✓	Soil properties may affect fen violet
	RB00	Collect data, biological, general	✓	✓	✓	✓	✓	
	RF00	Collect data, vegetation, general	✓	✓	✓	✓	✓	
	RF10	Collect data, trees/shrubs, general	✓	✓	✓	✓	✓	
	RF20	Collect data, other	✓	✓	✓	✓	✓	Continue with research

Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
		vascular plants, general						programme on Viola persicifolia
	MH5+	Manage habitat, swamp/fen/inundation, general	✓	✓	✓	✓	✓	
To maintain the current level of socio-economic use of the site.	RH90	Collect data, other activities, by owners / tenants/public bodies/neighbours	✓	✓	✓	✓	✓	
	ML0*	Liaise owners/neighbours/others	✓	✓	✓	✓	✓	
To maintain a reasonable level of education,research and demonstration	RH3*	Collect data, public use	✓	✓	✓	✓	✓	
To fulfil all legal and other obligations arising from legislation, leases and legal consents etc	ME20	Comply with legal obligations	✓	✓	✓	✓	✓	
	AL0*	Legal/land agency matters	✓	✓	✓	✓	✓	
To fulfil obligations arising from voluntary external and internal schemes.	AI0*	Inspections and audits	✓	✓	✓	✓	✓	
	AA0*	Site acquisition/declaration	✓	✓	✓	✓	✓	
	AI0*	Inspections and audits	✓	✓	✓	✓	✓	
	AR0*	Reports & correspondence, general	✓	✓	✓	✓	✓	
	AP**	Planning, plan preparation and revision, general	✓	✓	✓	✓	✓	
To maintain the estate assets in good condition.	ML0*	Liaise owners/neighbours/others	✓	✓	✓	✓	✓	

Objective	Project Code	Project Title	Year					Notes
			1	2	3	4	5	
	ME00	Manage estate fabric, general	✓	✓	✓	✓	✓	Regular safety checks on all structures.
	ME10	Manage buildings, general	✓	✓	✓	✓	✓	Rothschild Bungalow and workshop/office. Regular maintenance. Redecorate workshop in year 1
	ME40	Provide/maintain paths/rides/roads	✓	✓	✓	✓	✓	
	MM0*	Manage estate, machinery	✓	✓	✓	✓	✓	

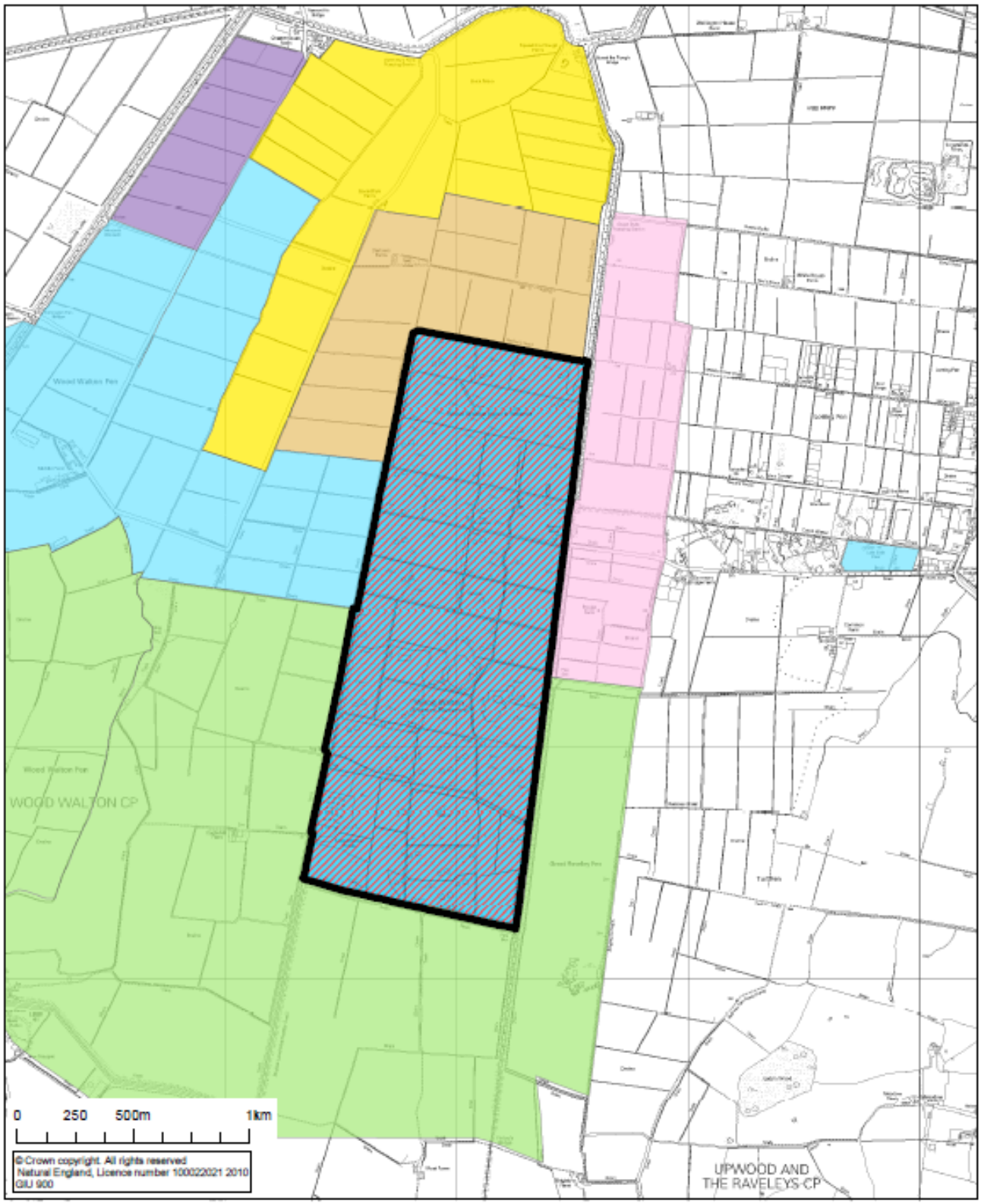


Woodwalton Fen NNR

Location Plan
OS Explorer 142 - Peterborough

NATURAL ENGLAND

Map 1



Woodwalton Fen NNR
Land Tenure

- E.P. Brand Farms
- Papworth Trust
- The Mormon Church
- The Royal Society of Wildlife Trusts
- The Royal Society of Wildlife Trusts (Leased to NE)
- Various
- Natural England
- Woodwalton Fen NNR

NATURAL ENGLAND

Map 2

Woodwalton Fen NNR
Site Designations

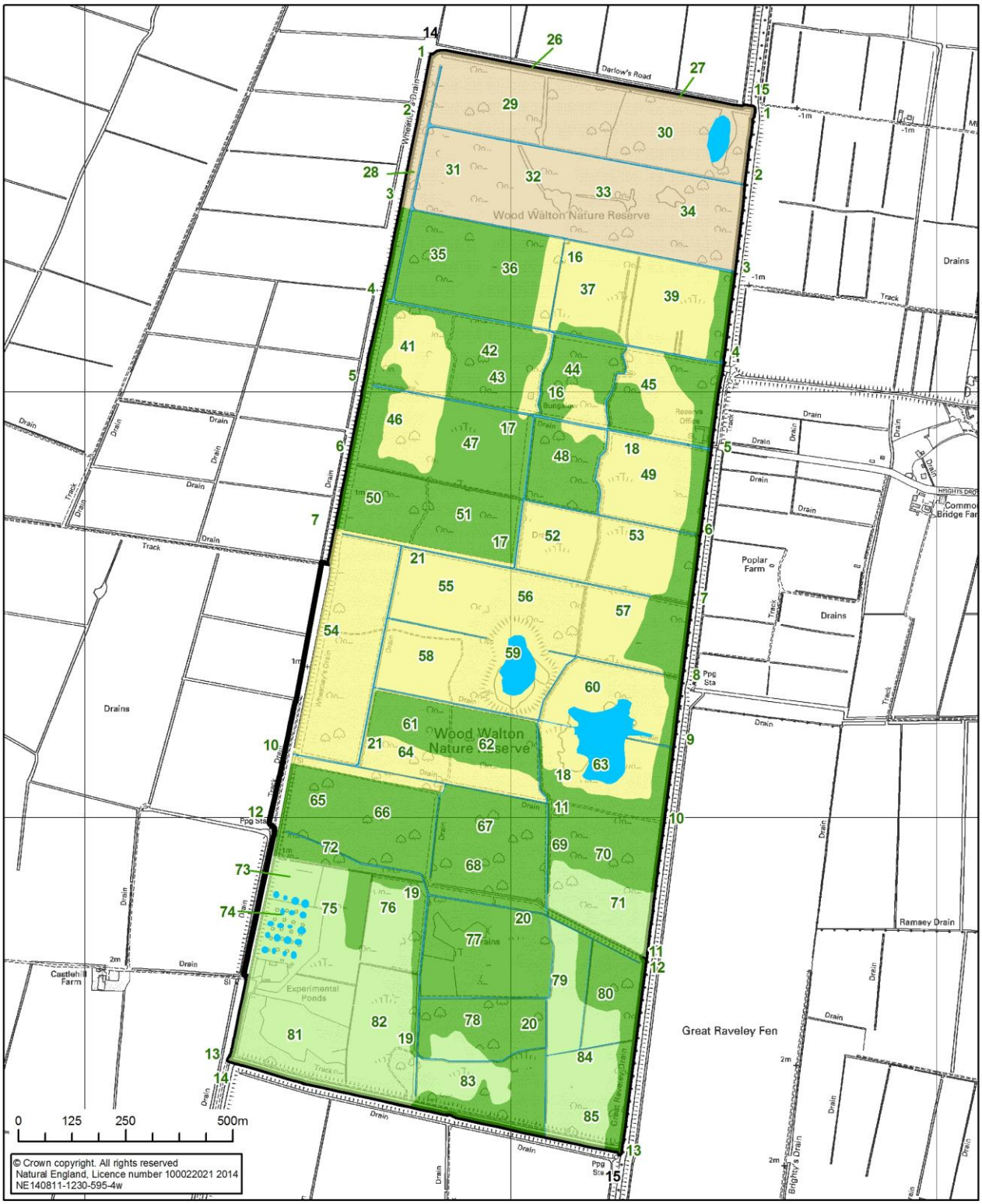
SAC - Special Area of Conservation, Ramsar &
SSSI - Site of Special Scientific Interest

NNR - National Nature Reserve

Woodwalton Fen NNR Boundary

NATURAL ENGLAND

Map 3



Woodwalton Fen NNR
Management Compartments & Units

NATURAL ENGLAND

- Fen Marsh & Swamp - Lowland
- Fen Marsh & Swamp - Lowland
- Broadleaved, Mixed & Yew Woodland - Lowland
- Neutral Grassland - Lowland
- Standing Open Water & Canals

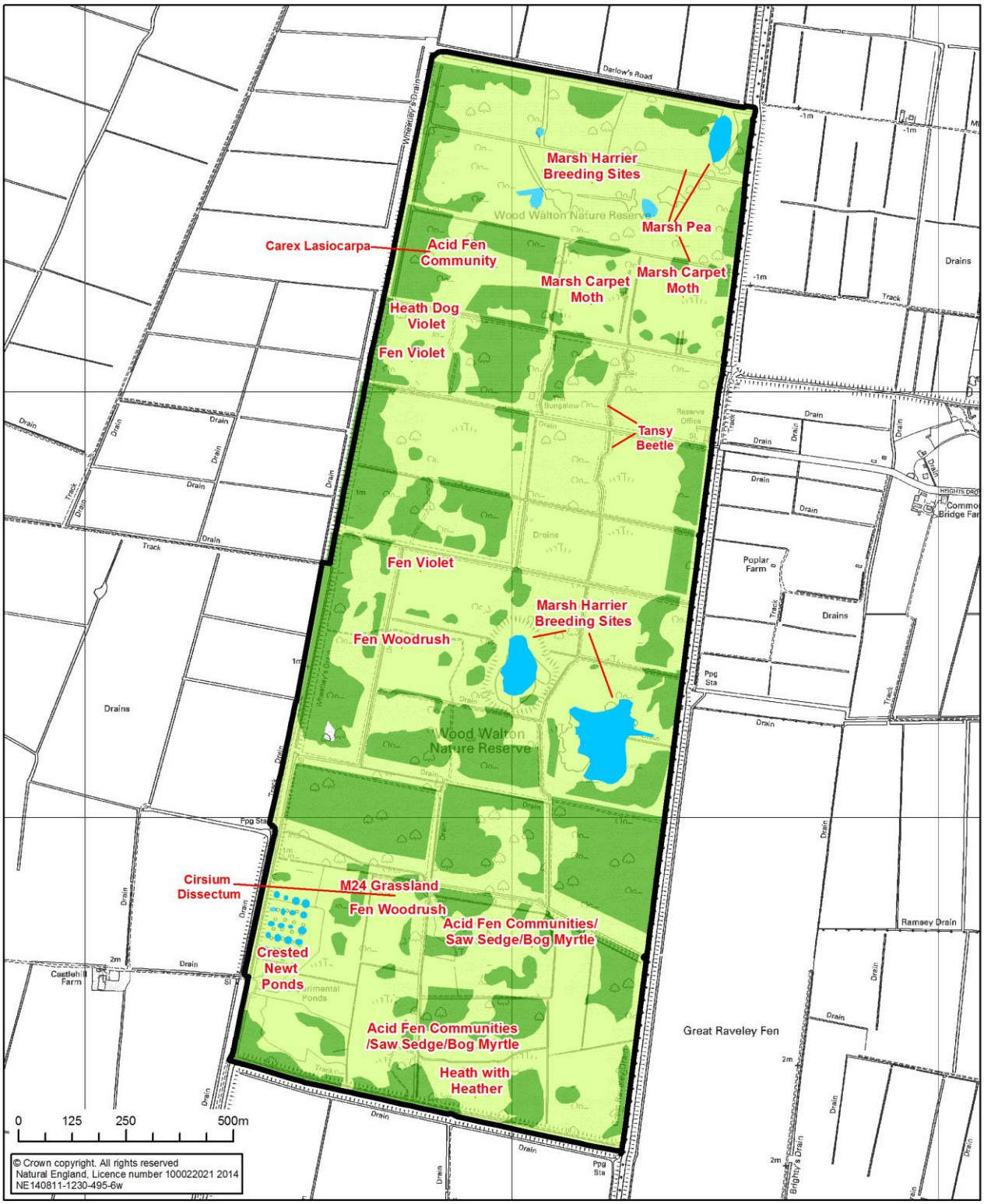
Map 4

Woodwalton Fen NNR
Vegetation Communities

NATURAL ENGLAND

Map 5

- Open water
- Scrub & woodland
- Ditches (throughout site)
- Mixed Fen
- Reedbed
- Grassland/Heathland

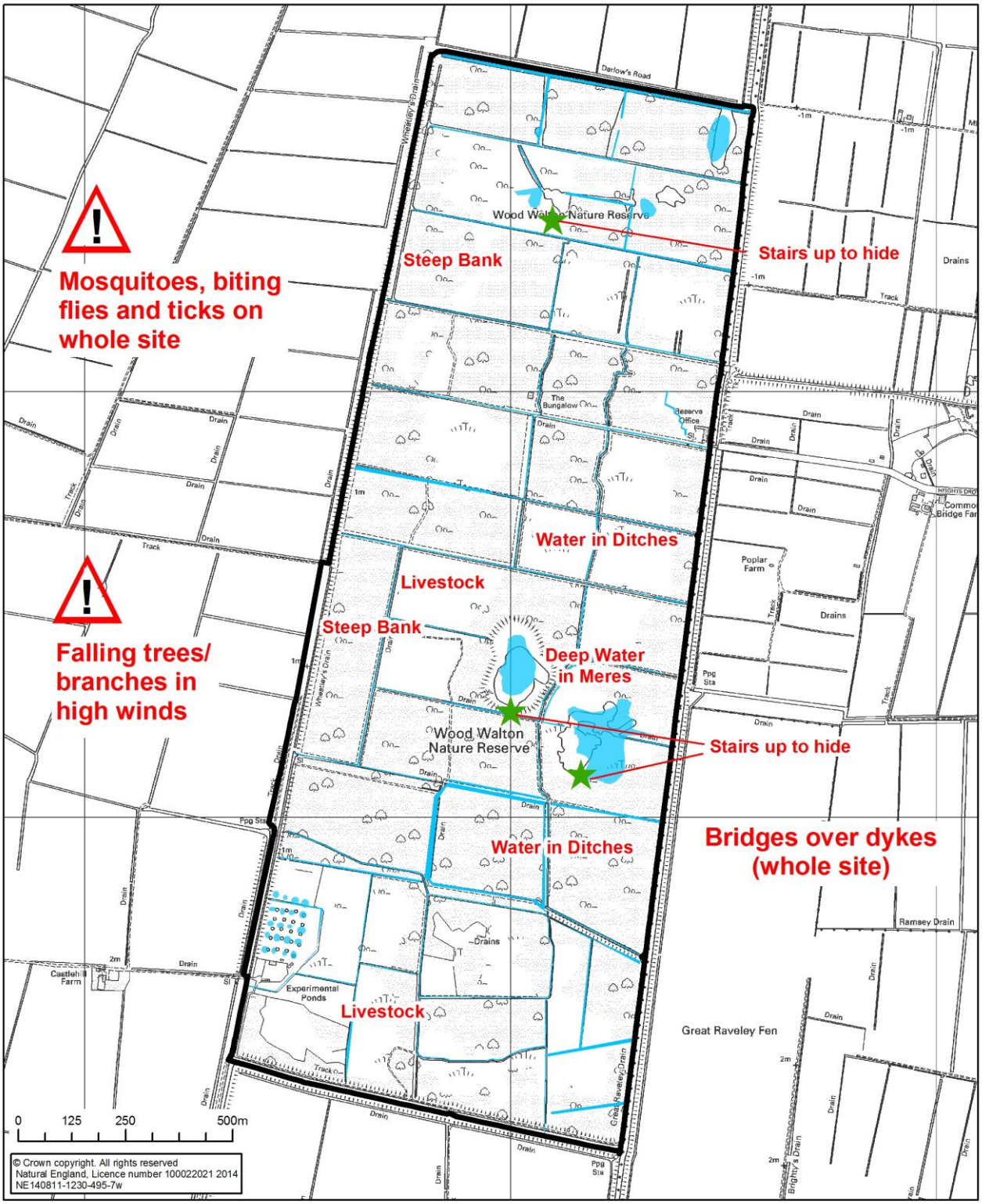


Woodwalton Fen NNR
Other Biological Features

Open Fen/Grassland
Open Water
Scrub & Woodland

NATURAL ENGLAND

Map 6

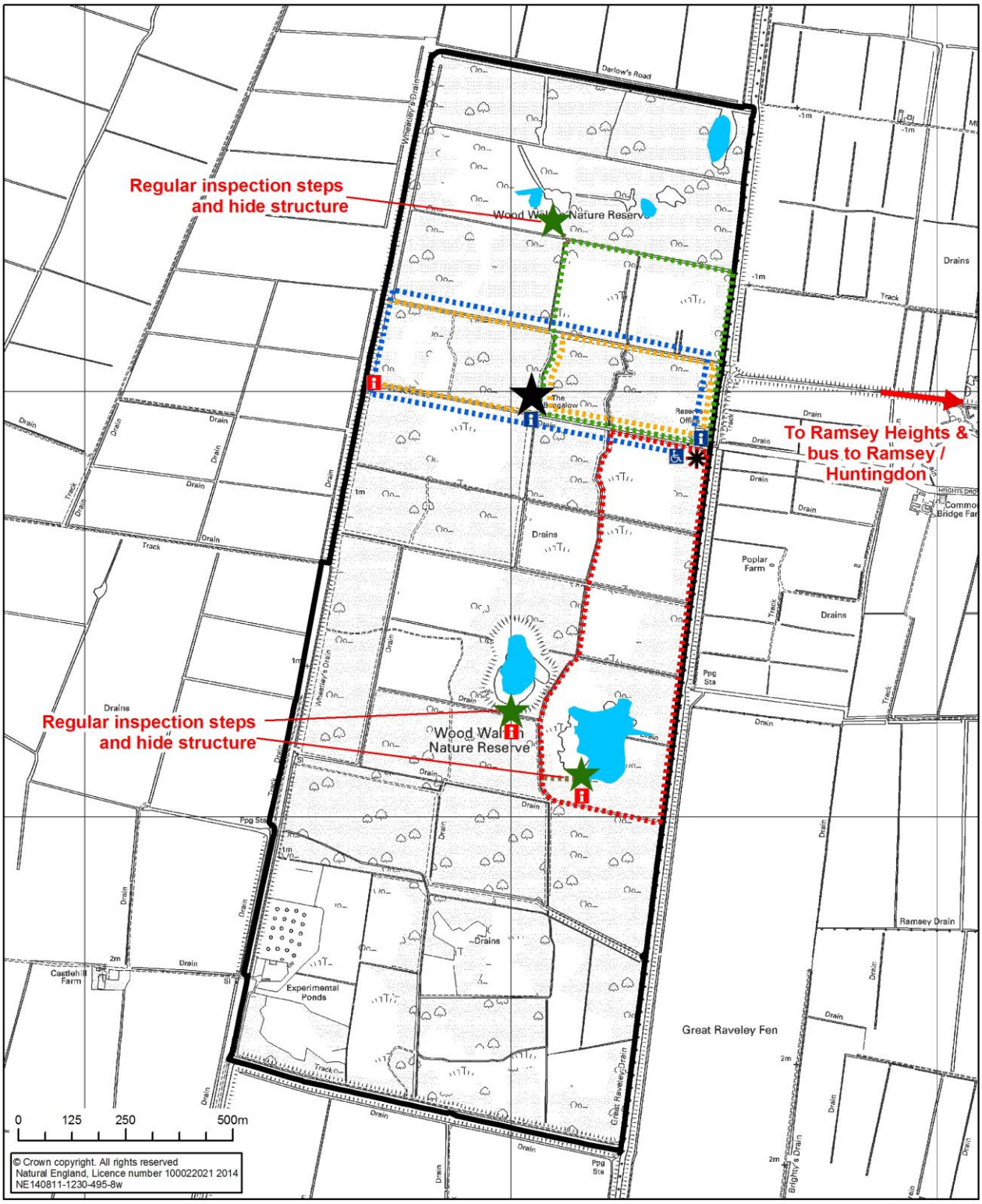


Woodwalton Fen NNR
Site Hazards

Water

NATURAL ENGLAND

Map 7

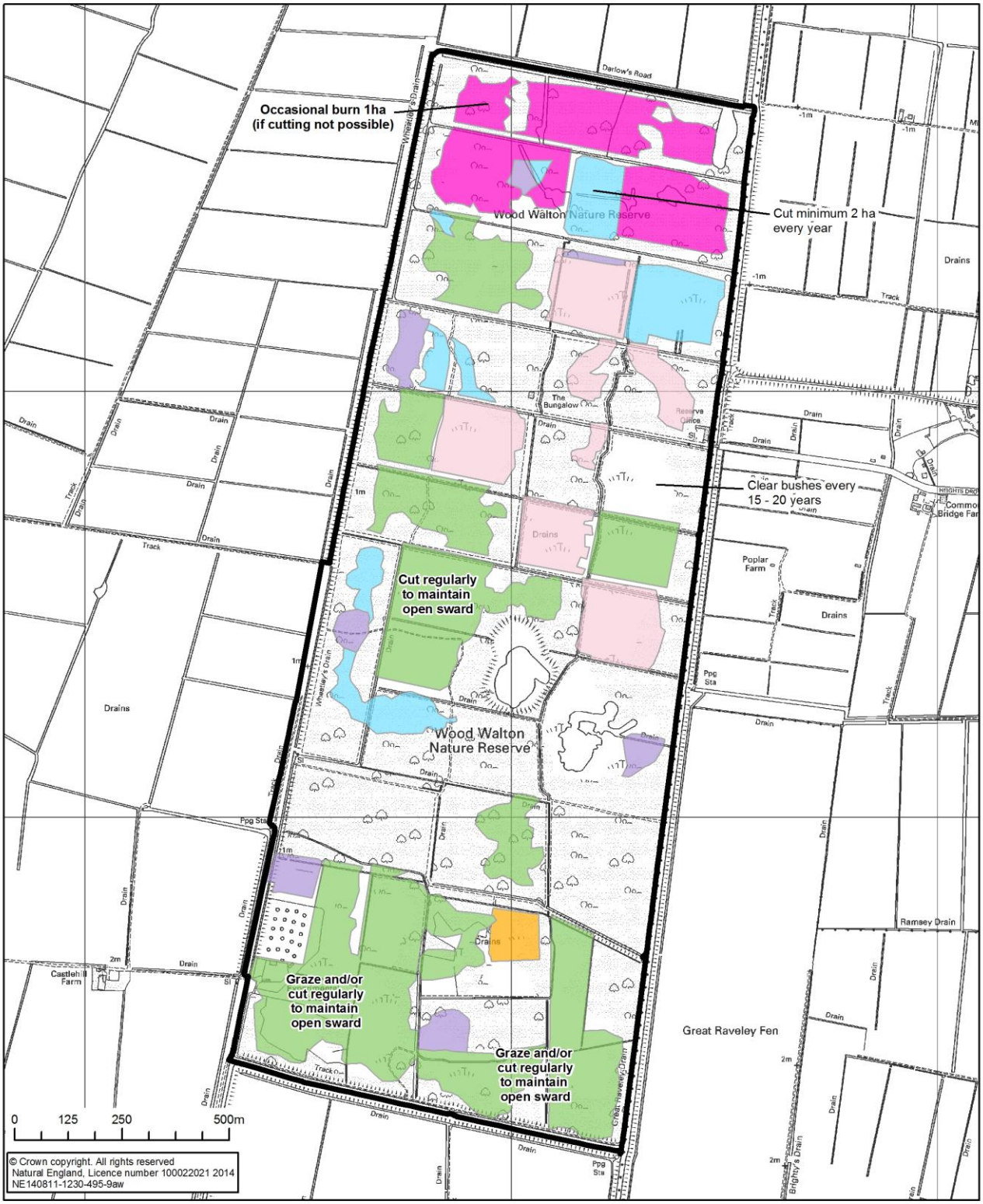


Woodwalton Fen NNR
Planned Management, Access & Visitor Facilities

- Boardwalk
- Bungalow Trail
- Great Fen Trail
- Marsh Harrier Trail
- Water Birds Trail
- 1 Disabled Parking Space
- All terrain electric wheelchair
- Interpretative Board
- New Interpretative Board Year 1
- Hides
- Rothchilds Bungalow
- Ponds & Meres

NATURAL ENGLAND

Map 8



Woodwalton Fen NNR
Planned Management - Geological & Biological Objectives
Cutting & Grazing

NATURAL ENGLAND

- Annual cut
- Cut every 2 years
- Cut every 3 years
- Cut every 4 years (Cladium)
- Cut every 5 years
- Graze

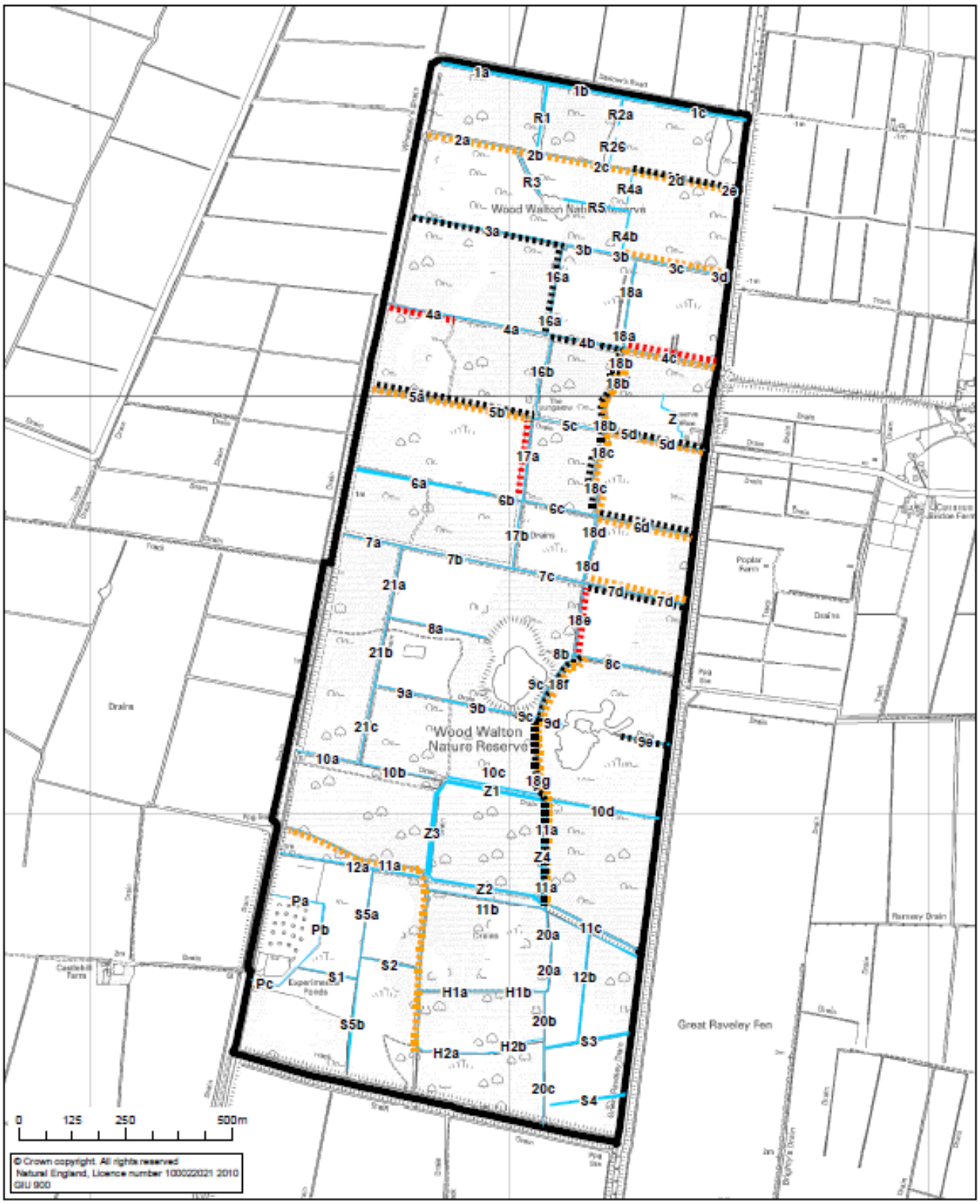
Map 9a

Woodwalton Fen NNR
Planned Management - Geological & Biological Objectives
Coppicing

NATURAL ENGLAND

- Coppiced 2002 - 2004
- Year 1 - 2010 - 2011
- Year 2 - 2011 - 2012
- Year 3 - 2012 - 2013
- Year 4 - 2013 - 2014
- Year 5 - 2014 - 2015

Map 9b



Woodwalton Fen NNR
Planned Management - Geological & Biological Objectives
Dyke Brinking

NATURAL ENGLAND

Brinking carried out during Autumn

Brinking carried out in August

Brinking carried out during Summer

Ditches

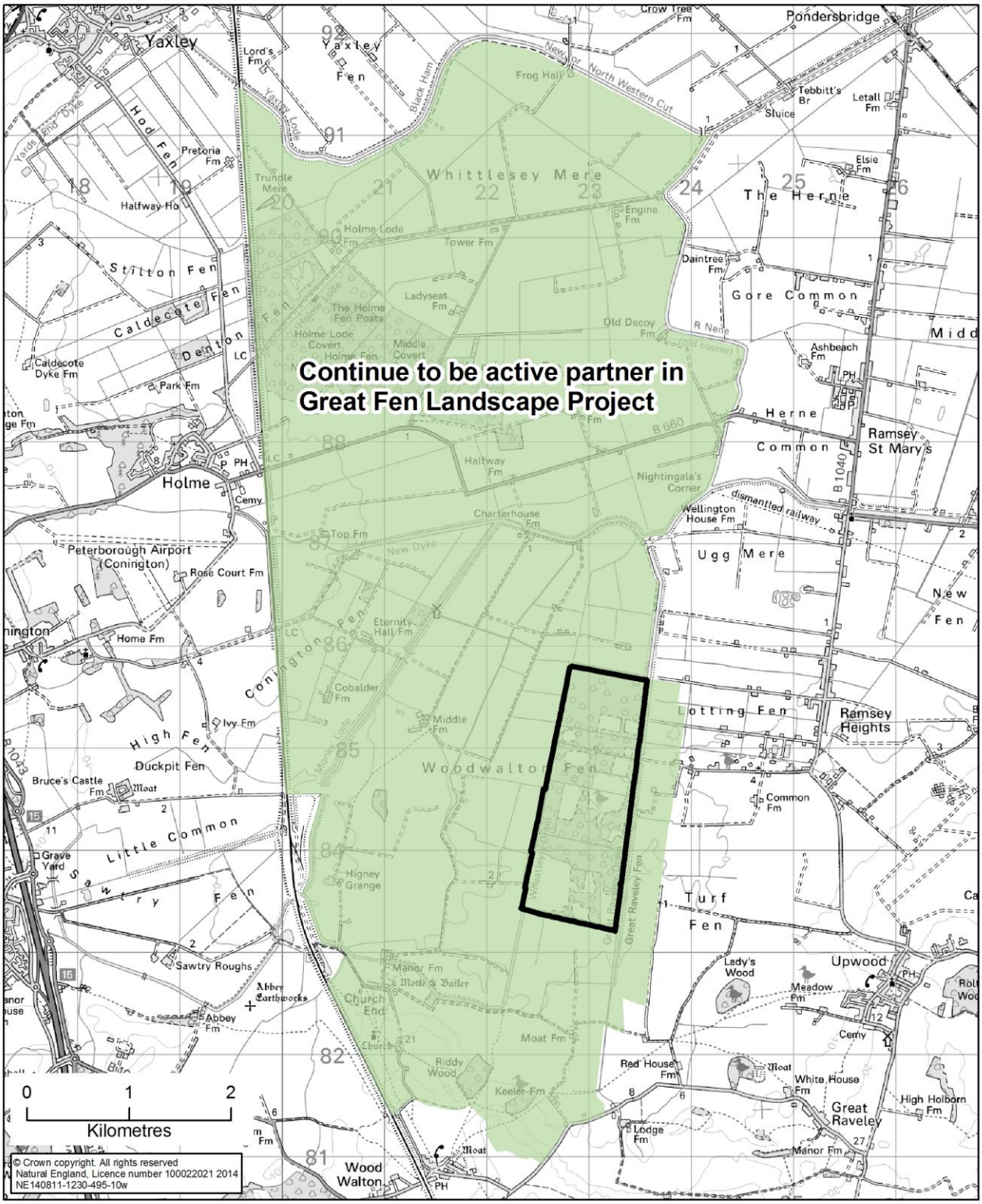
Map 9c

Woodwalton Fen NNR
Planned Management - Geological & Biological Objectives
Dyke Slubbing

A	Slub every other year	D	Slub every 5-7 years
B	Slub every 3 years	E	Slub every 7 years +
C	Slub every 5 years	F	Non-intervention

NATURAL ENGLAND

Map 9d



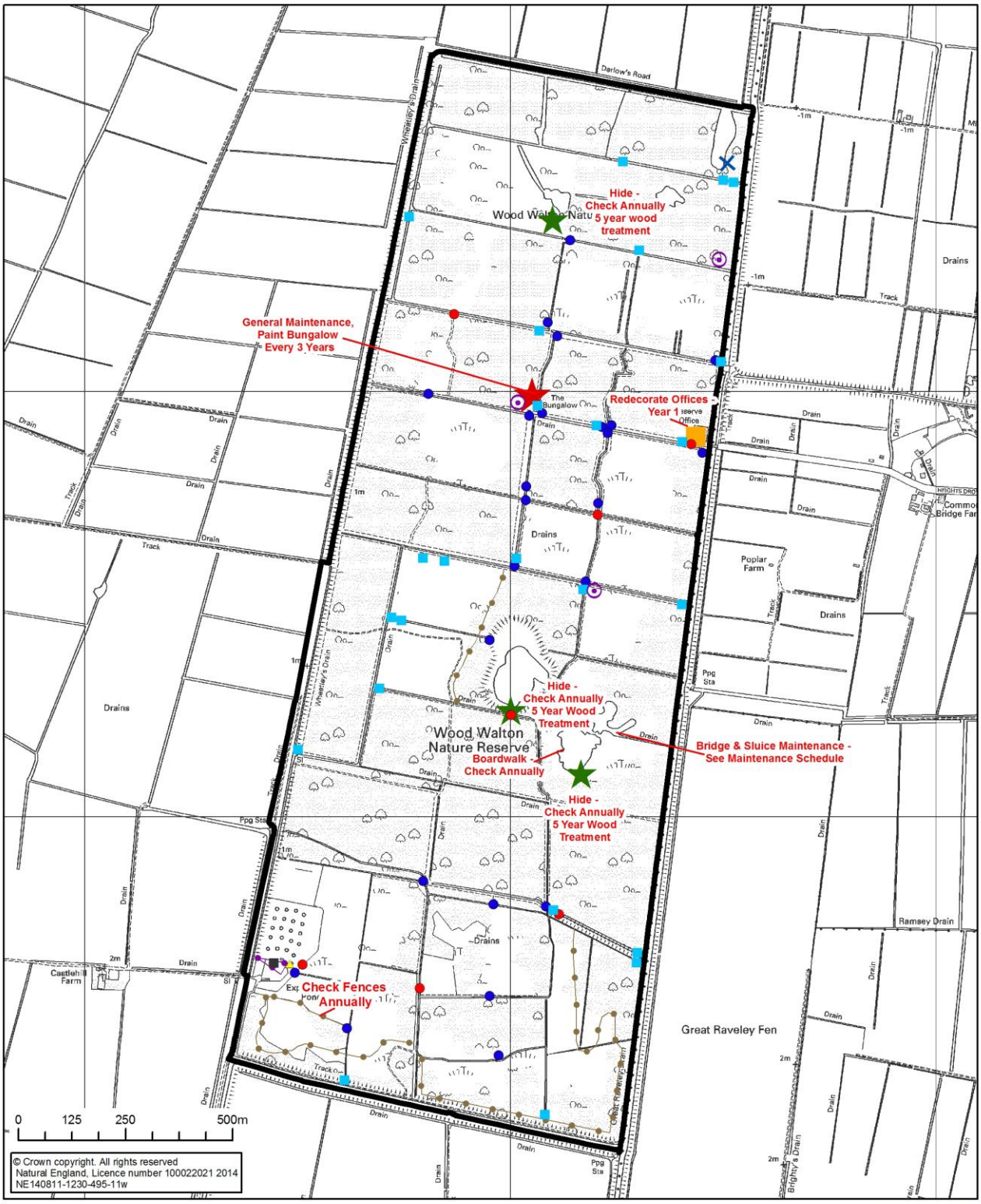
Woodwalton Fen NNR
Planned Management, Cultural & Landscape Objectives
Great Fen Area

NATURAL ENGLAND

Woodwalton Fen NNR

Great Fen

Map 10



Woodwalton Fen NNR
Estate Assets

NATURAL ENGLAND

- Office / Workshop
- Rothchilds Bungalow
- Hides
- Wind Pump
- Foot Bridge
- Vehicle Bridge
- Cattle Shed
- Hay Barn
- Cattle Pens
- Fence
- Water Control
- Seat - regular wood treatment

Map 11

Appendix 1. Climate Change Vulnerability Assessment for Woodwalton Fen

Feature no.	Feature name	Rainfall	Temperature	Exteme Events	In Combination	Reasoning	Confidenc	Responses
1	Invertebrate Assemblage	M	M	M	M	Each species will react differently to changing conditions, and insufficient is known about the invertebrate community to answer this with any confidence. Aquatic invertebrates may be particularly vulnerable to higher water temperatures.	L	More monitoring is extremely important to assess rare invertebrates and the management or conditions that affect them. Until more is known it is extremely difficult to speculate about mitigation measures. All other responses listed below may be beneficial to limiting the effect of climate change on invertebrates.
2	Lowland ditch systems	L	M	M	M	Increased temperatures and longer growing seasons may intensify symptoms of eutrophication and may act as a forward switch to a turbid algal dominated state. There may be a loss of submerged macrophyte species with possible replacement by evergreen and/or floating macrophyte species. Increased flood events may lead to increased nutrient influx and increased sedimentation. Species reliant on cold and/or oxygenated water may have their habitat reduced by increased temperatures and reduced oxygen concentrations. Ditches are under threat from a wide range of non-native species, some of which may be better adapted and spread more quickly in a changing climate.	M	Reducing non-climatic sources of harm, e.g. reducing nutrient sediment loads and management presures, can help to increase resilience. The current trial of extracting nutrient-rich sludge from some of the drains is a good example of this and should be extended if successful, and finding an alternative storage for flood water is vital for keeping nutrient levels low. Problematic non-native species are not know at the site but all involved in management works should watch out for their presence and appropriate action taken where necesssary. Within the wider Great Fen area, soil organic matter should be restored and soil compaction avoided, creation of semi-natural vegetation should be considered for its effect of slowing surface water run-off, and the use of fertiliser should be avoided.
3	M22 - *Juncus subnodulosus* - *Cirsium palustre* fen meadow M24 - *Molinia caerulea* - *Cirsium dissectum* Fen Meadow M25 - *Molinia caerulea* - *Potentilla erecta* mire	H	M	H	H	Drier summers could clead to the loss of wetland species as conditions dry out. Drier conditions in late spring could reduce the suitability of the habitat for breeding waders, while the early onset of the growing season could reduce the suitability of the meadows for ground nesting birds that require a short sward. Flood events could lead to increased run-off and nutrient enrichment and could disrupt livestock grazing. Summer waterlogging could lead to increased areas of bare ground, favouring ruderal species.	M	The intension is that alternative flood storage land will be found within the Great Fen project through the scoping process for the new Water Level Management Plan, thus highly reducing the probability that Woodwalton Fen will be flooded. If flooding remains a possibility, alternative grazing land should be available for any livestock grazing the site. There is scope for managing the ground water levels on the reserve through the ditch network.
6	Population of RDB plant - *Luzula pallidula* , Fen Wood-rush	H	M	M	H	Lower summer rainfall, especially in combination with higher summer temperatures causing more evapotranspiration, may lead to the habitat becoming unsuitable for this species. Drought events may cause plant stress or mortality.	M	There is scope for managing the groundwater levels on the reserve through the ditch network.
7	Population of Schedule 8 plant - *Viola persicifolia* , Fen Violet	L	M	M	L	Insufficient is known about the conditions that this plant needs for each of its lifestages, and this makes it very difficult to predict how it might be affected by climate change. It requires a seasonally high water level (damp in spring but not inundated), but fluctuation appears beneficial. It is a poor competitor, and early onset of the growing season due to higher spring temperatures could increase competition. Any increase in nutrients due to flood events would certainly have a negative impact.	L	Continued monitoring of the plant will be important, and translocation to other areas of the reserve should be considered if there is a sustained decline in population levels. Finding alternative flood storage and thereby preventing influx of nutrient rich water is important for this species. Managing ground water levels through the ditch network may also be important.

8	S2 - Cladium mariscus swamp and sedge-beds	M	M	M	M	Small changes in climate will have a greater effect on species, such as *Cladium mariscus*, that live within a narrow range of conditions. Increased water temperature may change pH to more acidic conditions that do not suit the calciphile *Cladium mariscus*. *Cladium mariscus* also appears to be sensitive to water level, and summer drought may be a threat. Increased nutrient levels, due to flooding events or drying out and oxidation of the peat, may threaten this habitat.	L	There should be some scope for maintaining current groundwater levels through increased control of the ditch network. Finding an alternative storage for flood water, as proposed, will be beneficial.
9	S24 - *Phragmites australis* - Peucedanum palustris tall-herb fen S25 - *Phragmites australis* - *Eupatorium cannabinum* tall-herb fen S28 - *Phalaris arundinacea* tall-herb fen	H	M	M	H	Warmer temperatures may cause a longer growing season will increase plant growth and may influence competition. Flood events could lead to increased run-off and nutrient enrichment, potentially leading to changes in community composition that disadvantage fenland specialist species. Flooding events could also disrupt management, making it harder to complete cutting regimes. Drier summers combined with greater evapotranspiration may lead to a loss of some fenland specialist species and changes in community composition. This is of particular concern here since there are so many species of conservation concern. Drying and oxidation of the peat may cause further damage to the degraded peat and release nutrients which will favour competitive, generalist species and disadvantage the fenland specialist species.	M	Cutting regimes and stocking densities may have to be altered to adapt to increased plant growth. Cutting regimes may have to be more flexible, but with current workforce and equipment this would be difficult. It is more likely, however, that the cutting regime becomes easier, since the late summer/early autumn conditions are likely to be drier. There are already nutrient-stripping mechanisms for the main drains leading to the site. There is some scope for managing the groundwater levels on the reserve through the ditch network.
12	S4 - *Phragmites australis* swamp and reed-beds	L	M	M	L	Drier summers will mean that the reed beds are more susceptible to invasion by species that require a lower water table such as willow, and aquatic species may be lost. Bird species that require very wet reed beds, such as bitterns, may find the habitat unsuitable, and the same will probably apply to some invertebrate species. Higher water temperature could lead to changes in the community composition, particularly affecting invertebrates. Flood events could lead to increased run-off and nutrient enrichment, potentially affecting all aspects of the community and reducing species richness.	M	It is expected that some level of control of water level management through the ditch system will help to retain groundwater levels in dry summers, but it is possible that more scrub management will be necessary. Finding an alternative flood storage solution, as proposed, will help to limit the effects of flood events.

13	Vascular Plant Assemblage	M	M	M	M	Each species will react differently to changing conditions. Changes in conditions that are likely to affect important plant species are: A potentially longer growing season caused by increased temperatures that may influence competition. Potential nutrient enrichment caused by drying out and oxidation of peat, or increased flood events leading to an influx of nutrient-rich water. Drier summers in combination with warmer summer temperatures may mean that conditions become too dry for some species	L	Alternative flood storage solutions could limit the nutrient enrichment, and increased control of groundwater through the ditch network should help to reduce land drying in summer. Cutting and/or grazing regimes may have to be adapted to counteract increased growth/competition.
14	Woodland: W1 - *Salix cinerea - Galium palustre* woodland W2 - *Salix cinerla - Betula pubescens - Phragmites australls* woodland W5 - *Alnus glutinosa - Carex paniculata* woodland W6 - *Alnus glutinosa - Urtica dioica* woodland	L	M	M	L	Warmer winters are likely to benefit deer (and squirrels, but tree communities at this site are not particularly vulnerable to squirrel damage), potentially causing reduced ground flora cover or reduced natural regeneration. Increased risk of wind throw and of stress/mortality due to drought or flooding events. Higher winter water table may cause water logging of the soil and lead to increased dominance of alder or willow and changes in the ground flora. Stressed trees are more susceptible to pests and diseases, and warmer winters may benefit pests and diseases (e.g. *Phytophthora*, which may infect *Alnus glutinosa)*	M	The deer management effort may have to be increased. Currently there is a programme of willow control. Tree deaths due to stress of increased ground or flood water or wind throw may be beneficial to the work programme since less tree management may be needed. It is expected that some level of control of water level management through the ditch system will allow tree cover to be maintained in as much of the site as deemed appropriate.
82	Community Involvement	L	L	L	L	There are volunteer work parties that are not likely to be much disrupted by occasional flooding events or restricted access in winter.	H	
83	Education	L	L	L	L	There are school and university visits that are not likely to be much disrupted by occasional flooding events or restricted access in winter.	H	
84	Research	L	L	L	L	There are ongoing research projects that are not likely to be much disrupted by occasional flooding events or restricted access in winter.	H	There may be opportunities to study the effects of climate change on plant and animal communities
85	Demonstration	L	L	L	L		H	
86	Public Access	M	L	M	L	Some parts of the reserve that are currently used by the public may be flooded more often in the winter or during extreme flood events.	H	If this happens regularly a high water visitor route may be necessary. There is likely to be the need to provide more duckboards etc.on walkways
87	Estate Assets	L	L	L	L	Wetter conditions may cause increased tree fall and waterlogging of paths.	H	Structures such hides may need additional maintenance and more emphasis placed of protected visitors from falling trees.

Appendix 2. List of research projects carried out at Woodwalton Fen NNR

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