European Site Conservation Objectives: Supplementary advice on conserving and restoring site features

The Broads Special Area of Conservation (SAC)
Site Code: UK0013577

Natural England

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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to The Broads SAC.

This advice should therefore be read together with the SAC Conservation Objectives available here.

Where this site overlaps with other European Sites, you should also refer to the separate European Site Conservation Objectives and Supplementary Advice (where available) provided for those sites.

You should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England when developing, proposing or assessing an activity, plan or project that may affect this site.

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute.

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email

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About this site

European Site information

Name of European Site	The Broads Special Area of Conservation (SAC)
Location	Norfolk and Suffolk
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1 April 2005
Qualifying Features	See section below
Designation Area	5885.347 ha
Designation Changes	N/A
Feature Condition Status	Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	*Alderfen Broad SSSI* *Ant Broads and Marshes SSSI* *Barnby Broad & Marshes SSSI* *Broad Fen, Dilham SSSI* *Bure Broads and Marshes SSSI* *Burgh Common and Muckfleet Marshes SSSI* *Calthorpe Broad SSSI* *Cantley Marshes SSSI* *Crostwick Marsh SSSI* *Damgate Marshes, Acle SSSI* *Decoy Carr, Acle SSSI* *Ducan's Marsh, Claxton SSSI* *Geldeston Meadows SSSI* *Hall Farm Fen, Hemsby SSSI* *Halvergate Marshes SSSI* *Hardley Flood SSSI* *Limpenhoe Meadows SSSI* *Ludham - Potter Heigham Marshes SSSI* *Poplar Farm Meadows, Langley SSSI* *Priory Meadows, Hickling SSSI* *Shallam Dyke Marshes, Thurne SSSI* *Smallburgh Fen SSSI* *Sprat's Water and Marshes, Carlton Colville SSSI* *Stanley and Alder Carrs, Aldeby SSSI* *Trinity Broads SSSI* *Upper Thurne Broads and Marshes SSSI* *Upton Broad & Marshes SSSI* *Yare Broads and Marshes SSSI*
Relationship with other European or International Site designations	The Broadland Ramsar site and Broadland SPA overlies The Broads SAC. Conservation objectives for the Broadland SPA can be found here.

Site background and geography

The Broads in East Anglia, situated in The Broads National Character Area (NCA Profile 80) contain several examples of naturally nutrient-rich lakes. Although artificial, having been created by peat digging in medieval times, these lakes and the ditches in areas of fen and drained marshlands support relict vegetation of the original Fenland flora, and collectively this site contains one of the richest assemblages of rare and local aquatic species in the UK. The stonewort – pondweed – water-milfoil – water-lily (*Characeae – Potamogeton – Myriophyllum – Nuphar*) associations are well-represented, as are club-rush – common reed *Scirpo – Phragmitetum* associations. The dyke (ditch) systems support vegetation characterised by water-soldier *Stratiotes aloides*, whorled water-milfoil *Myriophyllum verticillatum* and broad-leaved pondweed *Potamogeton natans* as well as being a stronghold of little whirlpool ram's-horn snail *Anisus vorticulus* and Desmoulin's whorl snail *Vertigo moulinsiana* in East Anglia. The range of wetlands and associated habitats also provides suitable conditions for otters *Lutra lutra*.

The Broads is the richest area for stoneworts (charophytes) in Britain. The core of this interest is the Thurne Broads and particularly Hickling Broad and Martham Broads, large shallow brackish lakes. Within

the Broads examples of *Chara* vegetation are also found within fen pools (turf ponds) and fen and marsh ditch systems. The Broads supports a number of rare and local charophyte species, including *Chara aspera*, *C. baltica, C. connivens, C. contraria, C. curta, C. intermedia, C. aculeolata, Nitella mucronata, Nitellopsis obtusa, Tolypella glomerata* and *T. intricata*.

The complex of sites contains the largest blocks of alder *Alnus glutinosa* wood in England. Within the complex complete successional sequences occur from open water through reedswamp to alder woodland, which has developed on fen peat. There is a correspondingly wide range of flora, including uncommon species such as marsh fern *Thelypteris palustris*.

This site contains the largest example of calcareous fens in the UK. The great fen-sedge *Cladium mariscus* habitat occurs in a diverse set of conditions that maintain its species-richness, including small sedge mires, and areas where great fen-sedge occurs at the limits of its ecological range. The habitat type forms large-scale mosaics with other fen types, fen-meadows (with purple moor-grass *Molinia caerulea*), open water and woodland, and contains important associated plants such as fen orchid *Liparis loeselii*, marsh helleborine *Epipactis palustris*, lesser tussock-sedge *Carex diandra*, slender sedge *C. lasiocarpa* and fibrous tussock-sedge *C. appropinquata*. There are also areas of short sedge fen (both black bog-rush – blunt-flowered rush *Schoenus nigricans – Juncus subnodulosus* mire and bottle sedge – moss *Carex rostrata – Calliergon cuspidatum/giganteum* mire), which in places form a mosaic with common reed – milk-parsley *Phragmites australis – Peucedanum palustris* fen. The Broads also contain examples of transition mire, that are relatively small, having developed in re-vegetated peat-cuttings as part of the complex habitat mosaic of fen, carr and open water.

Few areas of *Erica tetralix - Sphagnum compactum* wet heath, Molinia meadows and related communities remain where the floodplain is still hydraulically connected to seepage zones on the edge of the ‘upland’, particularly from crag aquifers; wet heath transitions would have been much more frequent around the perimeter of fens prior to installation of catch dykes in these locations.

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying habitats:

The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Alkaline fens. (Calcium-rich spring water-fed fens)
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). (Alder woodland on floodplains)*
- Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*.(Calcium-rich fen dominated by great fen sedge (saw sedge))*
- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. (Calcium-rich nutrient-poor lakes, lochs and pools)
- *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*).(Purple moor-grass meadows)
- Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation. (Naturally nutrient-rich lakes or lochs which are often dominated by pondweed)
- Transition mires and quaking bogs. (Very wet mires often identified by an unstable 'quaking' surface)

Qualifying Species:

The site is designated under article 4(4) of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Desmoulin's whorl-snail *Vertigo moulinsiana*
- Little whirlpool ram's-horn snail *Anisus vorticulus*
- Fen orchid *Liparis loeselii*
- Otter *Lutra lutra*

Table 1: Supplementary Advice for Qualifying Features: H3140. Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.; Calcium-rich nutrient-poor lakes, lochs and pools

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain and where necessary restore the total extent of the feature to 175.51 hectares. .	There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information. The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis. The water bodies in the Broads have been identified as an intermediate type between H3140 and H3150, largely based on the palaeolimnological evidence. As such reference should also be made to table 2 when considering any water body in the Broads. This feature is recorded from: Broad Fen, Dilham SSSI, Bure Broads and Marshes SSSI Ducan's Marsh, Claxton SSSI. Limpenhoe Meadows SSSI, Poplar Farm Meadows, Langley SSSI, Priory Meadows, Hickling SSSI, Sprat's Water and Marshes, Carlton Colville SSSI, Trinity Broads SSSI, Upper Thurne Broads and Marshes SSSI, Upton Broad & Marshes SSSI, Yare Broads and Marshes SSSI	http://eunis.eea.europa.eu/sites/UK0013577 Hall R., 2017, Review of the Broads Total Phosphorus targets – Discussion paper

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Non-native species categorised as 'high-impact' in the UK under the Water Framework Directive should be either rare or absent but if present are causing minimal damage to the feature.	Non-native species constitute a major threat to many open water systems. Impacts may be on the habitat itself (e.g, damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage and the introduction of crayfish plague. The UK Technical Advisory Group of the Water Framework Directive produces a regularly updated classification of aquatic alien species (plants and animals) according to their level of impact. In general high impact species are of greatest concern but low or unknown impact species may be included in the target on a site-specific basis where there is evidence that they are causing a negative impact (for example high cover values or abundances). Those taxa considered likely to colonise lakes, are indicated by an 'L' in the UKTAG guidance. Invasive species found within the Broads SAC area include Himalayan Balsam (*Impatiens glandulifera*), Australian Swamp Stonecrop (*Crassula helmsii*), Floating pennywort (*Hydrocotyle ranunculoides*), Giant hogweed (*Heracleum mantegazzianum*), Japanese knotweed (*Fallopia japonica*), Parrot's feather (*Myriophyllum aquaticum*) Signal Crayfish (*Pacifastacus leniusculus*), zebra/quagga mussel (*Dreissena polymorpha/bungensis*), and Killer shrimp (*Dikerogammarus villosus*)	Norfolk biodiversity Partnership, Non-native Species initiative: http://www.norfolkbiodiversity.org/nonnativespecies / Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Macrophyte community structure**	Restore a characteristic zonation of macrophyte vegetation; *Chara* beds should normally cover a minimum of 50% of the photic zone, although extent will be variable according to site and seasonal changes. Presence of characteristic zones of	This is a strongly characteristic structural aspect of this habitat feature. In many cases *Chara* (stoneworts) will be the dominant feature. The maximum depth at which submerged vegetation is able to grow is a direct indicator of water clarity and also a general indicator of the status of the macrophyte community. A decrease in the maximum depth of macrophyte colonisation along a fixed point transect of greater than 10% indicates a	Natural England (Various) Philips, G *et al* (2015) Broads Authority Annual Macrophyte Surveys This attribute will be periodically monitored as part of Natural

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		vegetation.	site moving out of favourable condition. Consideration should be given to e.g. charophytes (particularly *Chara* species) and *Potamogeton* species. Generally, both emergent and floating/ submerged vegetation should be present in the littoral zone.	England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Macrophyte community structure**	Restore maximum depth of plant colonisation. This is likely to be the maximum depth colonised by *Chara* spp.	This is a strongly characteristic structural aspect of this habitat feature. It will be a response to water transparency, sediment type and disturbance.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Macrophyte community structure**	Restore a characteristic and well defined hydrosere associated with the water body where this is present.	A hydrosere is a naturally-occurring plant succession which occurs in an area of standing fresh water. Over time, an area of open freshwater will naturally dry out, ultimately becoming woodland. During this change, a range of different wetland habitat types such as swamp and marsh, will succeed each other. This structure around the margins of the lake creates a buffer zone that can help protect the lake from a limited amount of sediment and nutrient inputs. It also increases habitat heterogeneity providing additional food sources and refugia.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Physical structure - lake shoreline**	Maintain and where necessary restore the natural shoreline of the lake. Near-natural planform in ≥95% of shoreline length. Near-natural slope profile in ≥95% of the length of the shore zone. The structure and material of the banks should be near-natural with no more than 0-5% affected by hard engineering or 0-10% by soft engineering. No more than 5% of lakeshore	Inclusion of hard engineering solutions to lake management may have detrimental effects on lake ecology, replacing near-natural substrates with man-made materials. Alteration of the shoreline may also result in changes in water movements within the lake, which would have effects on patterns of sediment deposition.	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		should heavily modified.		
Structure and function (including its typical species)	**Physical structure - lake substrate**	Maintain and where necessary restore the natural and characteristic substrate for the lake. The character and extent of types of substrate should be considered.	Marl production is desirable, although this may be low or absent in oligotrophic hard waters. The distribution of sediment particle size and organic content influences the biology of the lake and will affect the suitability of within-lake habitats for invertebrates and macrophytes, and fish spawning grounds. Increases in sediment loading from activities in the catchment area, including those on the lake shore, may result in the smothering of coarse sediments. Increased inputs of leaf litter, as a result of scrub encroachment, may also be cause for concern, as organic-rich sediments may be a poor rooting medium for macrophytes. Increased sediment loads may result in smothering of coarse substrates with fine sediments. Fine sediments will be readily disturbed by movements in the overlying water column or passage of a plant sampling grapnel. Changes in plant community may result from enriched sediments without an accompanying change in water chemistry.	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat; **Key Magnopotamion species**: *Potamogeton alpinus; P. coloratus, P. gramineus, P. lucens, P. perfoliatus, P. praelongus* *P. x angustifolius* (or any other hybrid with one of the above species as a parent). **Key Hydrocharition species:** *Spirodela; Hydrocharis morus – ranae; Riccia fluitans polyrhiza; Stratiotes aloidies; Utricularia*	Some plant or animal species (or related groups of such species) make a particularly important contribution to the necessary structure, function and/or quality of an Annex I habitat feature at a particular site. These species will include; • **Structural** species which form a key part of the Annex I habitat's structure or help to define that habitat on a particular SAC (see also the attribute for 'vegetation community composition'). • **Influential** species which are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of soil/sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat) • **Site-distinctive** species which are considered to be a particularly special and distinguishing component of an Annex	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		australis/ vulgaris agg; *Wolffia arrhiza* **Other characteristic species:** *Callitriche* spp.; *Chara* spp.; *Littorella uniflora*; *Potamogeton crispus*; *Potamogeton filiformis*; *Potamogeton friesii*; *Potamogeton obtusifolius*; *Ranunculus circinatus*	I habitat on a particular SAC. There may be natural fluctuations in the frequency and cover of each of these species. The relative contribution made by them to the overall ecological integrity of a site may vary, and Natural England will provide bespoke advice on this as necessary. The list of species given here for this Annex I habitat feature at this SAC is not necessarily exhaustive. The list may evolve, and species may be added or deleted, as new information about this site becomes available.	
Structure and function (including its typical species)	**Fisheries**	Maintain and where necessary restore a total projected estimate for biomass of total fish production at less than 200kg/ha (this should take into account the growth potential of the resident and stocked fish).	Fish communities may exert a strong influence on overall lake ecology and may cause or exacerbate eutrophication symptoms. Where fisheries are present it should be a balanced mixed fishery. There should be a presumption against stocking non-native species, carp and bream.	
Supporting processes (on which the feature relies)	**Water quality - phosphate**	Maintain and where necessary restore stable nutrient levels appropriate for lake type. The maximum annual mean concentration of TP is 30 µg P l-1	Increased loadings of P to a water body are likely to lead to higher algal biomass in the water column, which in turn can have significant impacts on the standing water ecosystem through, for example, competition with vascular plants for nutrients and light, changes in pH, oxygen depletion and production of toxins. Decreasing dissolved oxygen and increasing ammonia levels are associated with death and decay of algal blooms, as is a release of toxins from toxin-producing species. If palaeolimnological techniques or hindcast modelling have been employed to reconstruct natural background phosphorus concentrations for a particular lake, these can be used to set targets, although it may be necessary to accept a small deviation from these background conditions. Alternatively, historical water chemistry data may exist for individual lakes. Where existing, site-specific water column TP concentrations are consistently lower than the standard appropriate for the habitat type, a lower target should be applied to prevent deterioration from current status.	Natural England (2006) Phillips *et al*., (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Diffuse Water Pollution Plans are being developed for the Bure Broads and Marshes, the Ant, Trinity Broads and Marshes, Upper Thurne and Shallam Dyke Marshes, Waveney and the Yare Broads and Marshes. Sources and apportionment of phosphate, targets and actions to address failure will be available in these documents once published by Natural England and the Environment Agency (due in 2020). A TP target of 30µg P l-1 has been set for this feature within The Broads SAC. Data from Hickling, Horsey and Heigham show macrophyte populations are only supported when the phosphorus concentration is below 35 µg l^{-1}, as when this concentration was exceeded macrophyte populations have been shown to become unstable and at risk. In addition Martham, Upton and Blackfleet have over the past 26 years had phosphorus concentrations less than 35µg l^{-1} associated with important macrophyte populations (Kelly, 2008). In the case of lakes recovering from eutrophication, although there is variation in the data set, once concentrations of TP fall below 30 µg l^{-1} macrophyte cover increases and chlorophyll a decreases. With regard to the more sensitive taxa, such as *Chara* and *Najas marina*, Phillips *et al*., (2015) suggest TP concentrations of less than 50 µg l^{-1}, and perhaps as low as 30µg l^{-1} are required in order for them to establish large stable populations.	
Supporting processes (on which the feature relies)	**Water quality - nitrogen**	Maintain and Restore a stable nitrogen concentration, which will be Total Nitrogen TN <1.5 mg L-1 and no deterioration from baseline.	There is an increasing understanding that some standing waters are sensitive to nitrogen (N) enrichment and eutrophication may be driven by increases in N, but site-specific information is usually required to determine whether N or P is more important. Where P levels are significantly above their target values and there is evidence that the lake is N limited (for example by N levels falling to negligible levels in summer), N targets should be set in addition to P targets. We recommend that such targets should preferably be developed using site-specific information, but should be based around the threshold of 1-2mg/l identified by James et	Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			al. (2005). In this situation N targets should be used in combination with P targets to drive a management strategy for the lake that reduces all nutrient inputs.	
Supporting processes (on which the feature relies)	**Water quality - acidity**	Acidity levels should reflect un-impacted conditions - values of Acid Neutralising Capacity (ANC) should be typically pH 7.5-9.5 for oligo-mesotrophic hard lakes.	Changes in pH can alter the entire freshwater community present within a water body affecting all trophic levels. Potential causes of a shift in pH include air pollution and direct application of lime to the water column as an acidification amelioration strategy (this should not be carried out). Acidity levels should reflect unimpacted conditions - values of Acid Neutralising Capacity (ANC) considered to avoid significant impact on characteristic biota are laid out in the site's FCT (these are the same numerical values as used to protect high ecological status under the WFD in the UK). As a guide, pH 7.5-9.5 for oligo-mesotrophic hard lakes. Although, pH naturally fluctuates throughout the year, e.g, snow melt may lead to pulses of acid water, and increased plant biomass in summer may result in large fluctuations in pH, including daytime increases in pH values. Therefore pH is not used as a monitoring target, however its importance in affecting many in lake processes means that the pH of a water body should not be artificially altered.	Natural England (Various)
Supporting processes (on which the feature relies)	**Water quality - other pollutants**	Maintain and where necessary restore water quality to good chemical status (i.e., compliance with relevant Environmental Quality Standards).	A wide range of pollutants may impact on habitat integrity depending on local circumstance. Good chemical status includes a list of EQSs for individual pollutants that are designed to protect aquatic biota with high levels of precaution. Saline incursion from a range of sources can occur; tidal surges, over deep drainage of surrounding land and sea wall overtopping. Sufficient freshwater flow, particularly calcareous groundwater, through the system should be maintained to flush saline water out as quickly as possible	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the	**Water quality - dissolved oxygen**	Adequate dissolved oxygen levels for health of characteristic fauna. DO>6mg/l throughout the year.	As for species in terrestrial environments, dissolved oxygen (DO) is required for respiration by aquatic organisms. Anthropogenic activities leading to phytoplankton blooms and	Natural England (Various) Natural England (2014) Site

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
feature relies)			increased loadings of organic matter to lakes can cause decreases in the concentration of dissolved oxygen available to support the species present. Mean dissolved oxygen refers to DO being measured at 0.5m intervals throughout the entire water column where the water column is not stratified and measurements taken at 0.5 m intervals below the thermocline only where stratification occurs. Deep or sheltered lakes exhibit seasonal stratification of temperature and oxygen levels. In eutrophic lakes in which thermal stratification occurs, summer oxygen levels in the hypolimnion may be very low, encouraging phosphorus release from the sediments and impacts upon the biota.	Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature relies)	**Water transparency**	Maintain and restore the clarity of water at or to at least a depth of 3.5 metres. For shallow lakes, where depth is less than 3.5m, macrophyte cover should be present through the submerged habitat	Water transparency is the major determinant of the depth of colonisation by macrophytes, therefore, it should not be reduced. This should allow plant colonisation to at least 3.5m, but if maximum depth of colonisation has previously been recorded at greater water depths this should be maintained. Increased nutrient loads leading to increased algal growth will reduce water transparency, disturbance of the sediment by water sports and bottom feeding fish such as carp and bream also increase turbidity and reduce water transparency. Increased sediment loads to a lake would also have this effect. In Broadland, particularly the Thurne catchment, suspended ochre is a significant contributor to poor water transparency. Ochre is produced by disturbed and dried fen peat particularly under brackish conditions, and is washed into ditches and other watercourses. Significant and longstanding plumes of ochre rich water can be observed entering some waterbodies (e.g. Horsey mere). Good land management avoiding soil cultivation, avoiding excessive drainage and sensitive watercourse management in vulnerable catchments can help limit the release of ochre.	
Supporting processes (on which the feature relies)	**Water quality - algae**	Chlorophyll a concentration should comply with WFD high ecological status and not have a negative impact on the ecosystem. Blooms	Chlorophyll is the pigment used for photosynthesis by plants, and the concentration of chlorophyll in the water column during the growing season therefore provides a good measure of the abundance of phytoplankton. Phytoplankton is	Natural England (2014) Site Improvement Plan – Broadland

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		of blue-green or green algae should not occur in low nutrient waters.	an important driver of structure and function in lakes and high phytoplankton levels (algal blooms) are usually associated with nutrient enrichment. Characteristic and representative non-charophyte algal cover may be significant, but excessive growths of uncharacteristic, filamentous algae on lake substrate or macrophytes are indicative of nutrient enrichment. UKTAG Lake Assessment Methods: Phytoplankton. Chlorophyll a and Percentage Nuisance Cyanobacteria. Available online at: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/lake%20phytoplankton.pdf Where possible, chlorophyll *a* data should be interpreted in combination with macrophyte depth distribution, nutrient concentrations, palaeolimnology and Secchi depth to give a powerful impression of the extent of nutrient impacts on the lake.	(SIP Profile 030)
Supporting processes (on which the feature relies)	**Hydrology**	At a site, unit and/or catchment level, maintain natural hydrological processes to provide the conditions necessary to sustain the feature within the site.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Hydrology influences lake ecosystem functioning in two ways: determining residence time (flushing) and water level fluctuations. Flushing of lakes is important for dilution and removal of nutrients and phytoplankton, and for reduction in sedimentation. The timing of different flushing rates within the year influences the biology of the lake. For example, reduced flushing in summer would encourage bloom conditions. Modifications of inflows and outlets or changes in hydrology, e.g, from flood control regimes, abstraction and gravel removal can lead to unnatural	Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030) OHES, 2014, *An Investigation into the Management of Catch Dykes in The Broads*, Natural England report.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			changes in lake levels. Abstraction for public water supply, agricultural and industrial use can limit the groundwater contribution to this habitat. Where this is shown to be having an effect on habitat features measures should be taken to maintain adequate groundwater supply. Detrimental saline intrusion via a range of mechanisms can occur; tidal surges and over drainage of surrounding land. Sufficient freshwater flow, particularly calcareous groundwater, through the system is needed to flush saline water out as quickly as possible as is addressing anthropogenic saline intrusion. Hydrology can also be affected by within site or catchment management, such as catch dykes. Where sites are impacted by such structures the restoration of natural hydrology gradients to the upland should be considered.	
Supporting processes (on which the feature relies)	**Sediment load**	Maintain and where necessary restore the natural sediment load	Increases in the sediment load also increases nutrient loads to a site. Increases in non-calcium carbonate siltation could result from increased lake productivity, changes in catchment land-use and drainage, lake level fluctuations, climatic fluctuations or changes in sewage treatment. Some peat slumping is acceptable, provided this is not induced due to land drainage. Increases in siltation could result from increased lake productivity, changes in catchment land-use (particularly over-grazing), lake level fluctuations, climatic fluctuations, or changes in sewage treatment. A range of lakes throughout the Broads have been mud pumped within the last 30 years, often followed by further biomanipulation. The recent ADAS study (2013) suggests that grassland is the main source of sediment to rivers in the Bure and Ant catchments. Findings are likely to reflect its proximity to watercourses and may suggest compaction and localised damage. Catchment Sensitive Farming measures to identify	Broadland Catchment Partnership (2012) **Sediment fingerprinting report for the Bure, Ant and Muckfleet** *Catchment management implications in relation to other evidence.* Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			and mitigate sediment input in these catchments could focus on grassland with the 'Horsford', Scarrow, and Buxton Beck priority sub-catchments. The finding that arable is a low source of sediment and organic particles is likely to reflect soil management efforts of farmers and their advisers, and the success of environmental stewardship schemes encouraging floodplain pasture and grass margins to buffer watercourses. Other evidence reveals (i) water soluble pesticides and nitrate are entering rivers via surface water run-off, leaching and/or field drains from arable land (ii) run-off is known to originate from arable land during extreme rainfall events that appear to be increasing in frequency and magnitude.	
Supporting processes (on which the feature relies)	**Supporting off-site habitat**	Maintain where necessary restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature.	Include only where applicable. The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to prevent/reduce/absorb damaging impacts from adjacent land uses e.g, pesticide drift, and nutrient enrichment.	Broads Climate Partnership 2016 Norfolk Wildlife Trust (2009) OHES, 2014, An Investigation into the Management of Catch Dykes in The Broads, Natural England report. Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH3), oxides of nitrogen (NOx) and sulphur dioxide (SO2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales.	
Supporting processes (on which the feature relies)	**Functional connectivity /isolation**	Maintain the natural connectivity of the water body to other water bodies.	The natural isolation of some standing water bodies can provide some protection from threats such as pollution and invasive species. Hydrological isolation can also lead to unique or diverse species assemblages this may be due to genetic isolation or the absence of predators. These water bodies should have their isolated state maintained. In contrast other standing water bodies naturally rely on hydrological connectivity to other freshwater systems for water supply, and can support migratory species. Hydrological connectivity may also be important for geneflow, and habitat and species resilience. These water bodies should have their hydrological connectivity maintained. Many of the oligo-mesotrophic hard waters will be aquifer-fed. Connectivity between lakes and surrounding wetlands are important for resource protection and ecosystem functioning and are particularly at risk from drainage, water level stabilisation and shoreline modifications. Isolation from an adjacent polluted water body may prevent nutrient enrichment, but can restrict the natural, appropriate hydrological regime of the habitat and so is not a permanent	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			solution. Improvement of water quality in the adjacent water body should be addressed followed by removing artificial isolation and restoring natural function and connectivity	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a complex of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 2: Supplementary Advice for Qualifying Features: H3150. Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation; Naturally nutrient-rich lakes or lochs which are often dominated by pondweed

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to baseline-value of 292.12 hectares.	See general explanatory notes for this attribute in Table 1.	http://eunis.eea.europa.eu/sites/UK0013577
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure non-native species categorised as 'high-impact' in the UK under the Water Framework Directive are either rare or absent but if present are causing minimal damage to the feature	Non-native species constitute a major threat to many open water systems. Impacts may be on the habitat itself (e.g, damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. For example, species such as signal crayfish have been responsible for much of the decline of native crayfish through competition, habitat damage and the introduction of crayfish plague. The UK Technical Advisory Group of the Water Framework Directive produces a regularly updated classification of aquatic alien species (plants and animals) according to their level of impact. In general high impact species are of greatest concern but low or unknown impact species may be included in the target on a site-specific basis where there is evidence that they are causing a negative impact (for example high cover values or abundances). Those taxa considered likely to colonise lakes, are indicated by an 'L' in the UKTAG guidance. Invasive species found within the Broads SAC area include Himalayan Balsam (*Impatiens glandulifera*), Australian Swamp Stonecrop (*Crassula helmsii*), Floating pennywort (*Hydrocotyle ranunculoides*), Giant hogweed (*Heracleum mantegazzianum*) Japanese knotweed (*Fallopia japonica*), Parrot's feather (*Myriophyllum aquaticum*) Signal Crayfish (*Pacifastacus leniusculus*) and Killer shrimp (*Dikerogammarus villosus*)	Norfolk biodiversity Partnership, Non-native Species initiative: http://www.norfolkbiodiversity.org/nonnativespecies/ Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain and where necessary restore a characteristic zonation of vegetation. Extensive beds of submerged macrophytes should be present,	This is a strongly characteristic structural aspect of this habitat feature. It will be a response to water transparency, sediment type and disturbance.	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		with emergent vegetation which may include beds of common reed *Phragmites austra*lis, bulrushes *Schoenoplectus lacustris* and *S. tabernaemontani* or reedmace *Typha latifolia* and *T. angustifolia*,		annual macrophyte surveys
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain and where necessary restore maximum depth of plant colonisation. This will often be the maximum depth colonised by *Potamogeton* spp.	This is a strongly characteristic structural aspect of this habitat feature. It will be a response to water transparency, sediment type and disturbance. The maximum depth at which submerged vegetation is able to grow is a direct indicator of water clarity and also a general indicator of the status of the macrophyte community. A decrease in the maximum depth of macrophyte colonisation along a fixed point transect of greater than 10% indicates a site moving out of favourable condition. Consideration should be given to e.g. charophytes (particularly Chara species) and Potamogeton species. Generally, both emergent and floating/ submerged vegetation should be present in the littoral zone.	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Macrophyte community structure**	Maintain and where necessary restore a characteristic and well defined hydrosere associated with the water body where this is present.	A hydrosere is a naturally-occurring plant succession which occurs in an area of standing fresh water. Over time, an area of open freshwater will naturally dry out, ultimately becoming woodland. During this change, a range of different wetland habitat types such as swamp and marsh, will succeed each other. This structure around the margins of the lake creates a buffer zone that can help protect the lake from a limited amount of sediment and nutrient inputs. It also increases habitat heterogeneity providing additional food sources and refugia. Where present, well defined hydroseres (including the transition to terrestrial vegetation) should be maintained. Marginal *Scirpo-Phragmitetum* species associated with this lake type include the following: *Phragmites australis, Schoenoplectus lacustris, Sparganium erectum*, *Typha* spp., *Alisma plantago aquatica.* Extensive beds of submerged macrophytes should be present.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Changes to zonation often indicate negative impacts on the lake. Loss of shallow water species may indicate alteration of the shoreline, or changes in hydrology, extent or substrate. Grazing, shading and wave action all have the potential to reduce the emergent vegetation present.	
Structure and function (including its typical species)	**Physical structure - lake shoreline**	Maintain the natural shoreline of the lake. Near-natural planform in ≥95% of shoreline length. Near-natural slope profile in ≥95% of the length of the shore zone. The structure and material of the banks should be near-natural with no more than 0-5% affected by hard engineering or 0-10% by soft engineering. No more than 5% of lakeshore should heavily modified.	Inclusion of hard engineering solutions to lake management may have detrimental effects on lake ecology, replacing near-natural substrates with man-made materials. Alteration of the shoreline may also result in changes in water movements within the lake, which would have effects on patterns of sediment deposition.	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical species)	**Physical structure - lake substrate**	Maintain and where necessary restore the natural and characteristic substrate for the lake. The character and extent of types of substrate should be considered.	The distribution of sediment particle size and organic content influences the biology of the lake and will affect the suitability of within-lake habitats for invertebrates and macrophytes, and fish spawning grounds. Increases in sediment loading from activities in the catchment area, including those on the lake shore, may result in the smothering of coarse sediments. Increased inputs of leaf litter, as a result of scrub encroachment, may also be cause for concern, as organic-rich sediments may be a poor rooting medium for macrophytes. Increased sediment loads may result in smothering of coarse substrates with fine sediments. Fine sediments will be readily disturbed by movements in the overlying water column or	Bennion, H. *et al* (2003) Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			passage of a plant sampling grapnel. Changes in plant community may result from enriched sediments without an accompanying change in water chemistry.	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat: **Key Magnopotamion species:** *Potamogeton alpinus*; *P. coloratus*; *P. gramineus*; *P. lucens*l *P. perfoliatus*; *P. praelongus*; *P. x angustifolius* (or any other hybrid with one of the above species as a parent). **Key Hydrocharition species:** *Spirodela; Hydrocharis morus – ranae; Riccia fluitans polyrhiza; Stratiotes aloidies; Utricularia australis/ vulgaris* agg; *Wolffia arrhiza* **Other characteristic species:** *Callitriche* spp.; *Chara* spp. (each species contributes to the total; *Littorella uniflora*; *Potamogeton crispus*; *Potamogeton filiformis*; *Potamogeton friesii*; *Potamogeton obtusifolius*; *Ranunculus circinatus*	See general explanatory notes for this attribute in Table 1	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments and through the annual macrophyte surveys
Structure and function (including its typical	**Fisheries**	Maintain a total projected estimate for biomass of total fish production at less than 200kg/ha (this should take into account the	Fish communities may exert a strong influence on overall lake ecology and may cause or exacerbate eutrophication symptoms. Where fisheries are present it should be a balanced mixed fishery. There should be a presumption against stocking	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
species)		growth potential of the resident and stocked fish).	non-native species, carp and bream.	
Supporting processes (on which the feature relies)	**Water quality - phosphate**	Restore stable nutrient levels appropriate for lake type. The maximum annual mean concentration of TP is 30 µg P l-1	Increased loadings of P to a water body are likely to lead to higher algal biomass in the water column, which in turn can have significant impacts on the standing water ecosystem through, for example, competition with vascular plants for nutrients and light, changes in pH, oxygen depletion and production of toxins. Decreasing dissolved oxygen and increasing ammonia levels are associated with death and decay of algal blooms, as is a release of toxins from toxin-producing species. If palaeolimnological techniques or hindcast modelling have been employed to reconstruct natural background phosphorus concentrations for a particular lake, these can be used to set targets, although it may be necessary to accept a small deviation from these background conditions. Alternatively, historical water chemistry data may exist for individual lakes. Where existing, site-specific water column TP concentrations are consistently lower than the standard appropriate for the habitat type, a lower target should be applied to prevent deterioration from current status. A TP target of 30µg P l-1 has been set for this feature within The Broads SAC. Data from Hickling, Horsey and Heigham show macrophyte populations are only supported when the phosphorus concentration is below 35 µg l^{-1}, as when this concentration was exceeded macrophyte populations have been shown to become unstable and at risk. In addition Martham, Upton and Blackfleet have over the past 26 years had phosphorus concentrations less than 35µg l^{-1} associated with important macrophyte populations (Kelly, 2008). In the case of lakes recovering from eutrophication, although there is variation in the data set, once concentrations of TP fall below 30 µg l^{-1} macrophyte cover increases and chlorophyll a decreases. With regard to the more sensitive taxa, such as *Chara* and *Najas marina*, Phillips *et al*., (2015) suggest TP concentrations of less than 50 µg l^{-1}, and perhaps as low as	Hall, R. (2017) Review of the Broads Total Phosphorus targets. Unpublished discussion paper for Natural England Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			30µg l^{-1} are required in order for them to establish large stable populations.	
Supporting processes (on which the feature relies)	**Water quality - nitrogen**	Maintain a stable nitrogen concentration at between 1-2mg/l. Total Nitrogen TN <1.5 mg L-1 and no deterioration from baseline	There is an increasing understanding that some standing waters are sensitive to nitrogen (N) enrichment and eutrophication may be driven by increases in N, but site-specific information is usually required to determine whether N or P is more important. Where P levels are significantly above their target values and there is evidence that the lake is N limited (for example by N levels falling to negligible levels in summer), N targets should be set in addition to P targets. We recommend that such targets should preferably be developed using site-specific information, but should be based around the threshold of 1-2mg/l identified by James *et al*. (2005). In this situation N targets should be used in combination with P targets to drive a management strategy for the lake that reduces all nutrient inputs.	Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature relies)	**Water quality - acidity**	Maintain and Restore acidity levels to those reflecting unimpacted conditions; values of Acid Neutralising Capacity (ANC) are typically pH 7.0-9.0 for eutrophic lakes.	Changes in pH can alter the entire freshwater community present within a water body affecting all trophic levels. Potential causes of a shift in pH include air pollution and direct application of lime to the water column as an acidification amelioration strategy (this should not be carried out). Acidity levels should reflect unimpacted conditions - values of Acid Neutralising Capacity (ANC) considered to avoid significant impact on characteristic biota are laid out in the site's FCT (these are the same numerical values as used to protect high ecological status under the WFD in the UK). As a guide, pH 7.0-9.0 for eutrophic lakes. Acid neutralising capacity (ANC) >40µeq L-1 (annual mean). Although, pH naturally fluctuates throughout the year, e.g, snow melt may lead to pulses of acid water, and increased plant biomass in summer may result in large fluctuations in pH, including daytime increases in pH values. Therefore pH is not used as a monitoring target, however its importance in affecting many in lake processes means that the pH of a water body should not be artificially altered.	Natural England (Various)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature relies)	**Water quality - other pollutants**	Maintain and where necessary restore water quality to a good chemical status (i.e., compliance with relevant Environmental Quality Standards).	A wide range of pollutants may impact on habitat integrity depending on local circumstance. Good chemical status includes a list of EQSs for individual pollutants that are designed to protect aquatic biota with high levels of precaution. Several sites have recorded diffuse pollution events over time which has effected the condition of this feature. These include: Bure Broads and Marshes SSSI, Shallam Dyke Marshes, Thurne SSSI and Upper Thurne Broads and Marshes SSSI. Saline incursion from a range of sources can occur; tidal surges, over deep drainage of surrounding land and sea wall overtopping. Sufficient freshwater flow, particularly calcareous groundwater, through the system should be maintained to flush saline water out as quickly as possible.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature relies)	**Water quality - dissolved oxygen**	Maintain dissolved oxygen levels to >6mg/l for cyprinid waters throughout the year.	As for species in terrestrial environments, dissolved oxygen (DO) is required for respiration by aquatic organisms. Anthropogenic activities leading to phytoplankton blooms and increased loadings of organic matter to lakes can cause decreases in the concentration of dissolved oxygen available to support the species present. Mean dissolved oxygen refers to DO being measured at 0.5m intervals throughout the entire water column where the water column is not stratified and measurements taken at 0.5 m intervals below the thermocline only where stratification occurs.	Natural England (Various)
Supporting processes (on which the feature relies)	**Water transparency**	Maintain and where necessary restore the clarity of water at or to at least a depth of 2.5 metres.	Water transparency is the major determinant of the depth of colonisation by macrophytes, therefore, it should not be reduced. This should allow plant colonisation to at least 2.5m, but if maximum depth of colonisation has previously been recorded at greater water depths this should be maintained. Increased nutrient loads leading to increased algal growth will reduce water transparency, disturbance of the sediment by water sports and bottom feeding fish such as carp and bream also increase turbidity and reduce water transparency. Increased sediment loads to a lake would also have this effect. In Broadland, particularly the Thurne catchment, suspended	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			ochre is a significant contributor to poor water transparency. Ochre is produced by disturbed and dried fen peat particularly under brackish conditions, and is washed into ditches and other watercourses. Significant and longstanding plumes of ochre rich water can be observed entering some waterbodies (e.g. Horsey mere). Good land management avoiding soil cultivation, avoiding excessive drainage and sensitive watercourse management in vulnerable catchments can help limit the release of ochre.	
Supporting processes (on which the feature relies)	**Water quality - algae**	Maintain and where necessary restore chlorophyll concentrations to levels which comply with 'high' ecological status.	Chlorophyll is the pigment used for photosynthesis by plants, and the concentration of chlorophyll in the water column during the growing season therefore provides a good measure of the abundance of phytoplankton. Phytoplankton is an important driver of structure and function in lakes and high phytoplankton levels (algal blooms) are usually associated with nutrient enrichment. Characteristic and representative algal cover may be significant, but excessive growths of uncharacteristic, filamentous algae on lake substrate or macrophytes are indicative of nutrient enrichment. Presence of extensive cover of, e.g, *Cladophora glomerata*, is indicative of a site in unfavourable condition. Assessment Methods: Phytoplankton. Chlorophyll a and Percentage Nuisance Cyanobacteria. Available online at: http://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Biological%20Method%20Statements/lake%20phytoplankton.pdf Where possible, chlorophyll *a* data should be interpreted in combination with macrophyte depth distribution, nutrient concentrations, palaeolimnology and Secchi depth to give a powerful impression of the extent of nutrient impacts on the lake.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the	**Hydrology**	At a site, unit and/or catchment level (as necessary, maintain and where necessary restore natural	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in	Natural England (Various) Natural England (2014) Site

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
feature relies)		hydrological processes to provide the conditions necessary to sustain the feature within the site.	source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Hydrology influences lake ecosystem functioning in two ways: determining residence time (flushing) and water level fluctuations. Flushing of lakes is important for dilution and removal of nutrients and phytoplankton, and for reduction in sedimentation. The timing of different flushing rates within the year influences the biology of the lake. For example, reduced flushing in summer would encourage bloom conditions. Modifications of inflows and outlets or changes in hydrology, e.g, from flood control regimes, abstraction and gravel removal can lead to unnatural changes in lake levels. Abstraction for public water supply, agricultural and industrial use can limit the groundwater contribution to this habitat. Where this is shown to be having an effect on habitat features measures should be taken to maintain adequate groundwater supply. Detrimental saline intrusion via a range of mechanisms can occur; tidal surges and over drainage of surrounding land. Sufficient freshwater flow, particularly calcareous groundwater, through the system is needed to flush saline water out as quickly as possible as is addressing anthropogenic saline intrusion	Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature relies)	**Sediment load**	Maintain and where necessary restore the natural sediment load.	Increased sediment loadings may result in clogging of the lake bed, increased siltation in the basin and deoxygenation of sediments. Blockage of coarser substrates with finer sediment restricts water flow-through, whilst increases in organic matter increase biochemical oxygen demand. Increases in the sediment load also increases nutrient loads to a site. Examples of causes of increases in siltation include: increased lake productivity, changes in catchment land-use, such as housing developments, intensification of agriculture, lake level fluctuations, climatic fluctuations and associated changes in drainage patterns.	Natural England (Various) Bennion, H. (2003) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Increases in siltation could result from increased lake productivity, changes in catchment land-use (particularly over-grazing), lake level fluctuations, climatic fluctuations, or changes in sewage treatment. A range of lakes throughout the Broad have been mud pumped within the last 30 years, often followed by further biomanipulation.	
Supporting processes (on which the feature relies)	**Supporting off-site habitat**	Maintain and where necessary restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature.	Include only where applicable. The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to prevent/reduce/absorb damaging impacts from adjacent land uses e.g, pesticide drift, and nutrient enrichment.	Broads Climate Partnership (2016) Norfolk Wildlife Trust (2009)
Supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Functional connectivity /isolation**	Maintain the natural connectivity or lack of connectivity of the water body to other water bodies as appropriate. .	The natural isolation of some standing water bodies can provide some protection from threats such as pollution and invasive species. Hydrological isolation can also lead to unique or diverse species assemblages this may be due to genetic isolation or the absence of predators. These water bodies should have their isolated state maintained. In contrast other standing water bodies naturally rely on hydrological connectivity to other freshwater systems for water supply, and can support migratory species.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Hydrological connectivity may also be important for geneflow, and habitat and species resilience. These water bodies should have their hydrological connectivity maintained. Connectivity between lakes and surrounding wetlands are important for resource protection and ecosystem functioning and are particularly at risk from drainage, water level stabilisation and shoreline modifications. Isolation from an adjacent polluted water body may prevent nutrient enrichment, but can restrict the natural, appropriate hydrological regime of the habitat and so is not a permanent solution. Improvement of water quality in the adjacent water body should be addressed followed by removing artificial isolation and restoring natural function and connectivity. Some lakes within the Broads are connected and some are not connected, hence both conditions are relevant for this site.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a complex of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 3: Supplementary Advice for Qualifying Features: H6410. Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae); Purple moor-grass meadows

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to 58.31 hectares.	See general explanatory notes for this attribute in Table 1. This feature is recorded on the following sites within the SAC: Ant Broads and Marshes SSSI, Burgh Common and Muckfleet Marshes SSSI, Cantley Marshes SSSI, Decoy Carr, Acle SSSI, Ludham - Potter Heigham Marshes SSSI, Poplar Farm Meadows, Langley SSSI, Priory Meadows, Hickling SSSI, Sprat's Water and Marshes, Carlton Colville SSSI, Trinity Broads SSSI, Upper Thurne Broads and Marshes SSSI, Upton Broad & Marshes SSSI, Yare Broads and Marshes SSSI.	https://eunis.eea.europa.eu/sites/UK0013577 This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain and where necessary restore the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat. Smaller fragments of habitat can typically support smaller and more isolated populations which are more vulnerable to extinction. These fragments also have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature.	
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification type:	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC).	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		• M24 *Molinia caerulea - Cirisum dissectum* fen meadow type.	Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e., the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations).	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat: • Constant and preferential plant species of *Molinia caerula-Cirisum dissectum* fen meadow type present in a feature at this SAC	See general explanatory notes for this attribute in Table 1	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation: undesirable species**	Maintain and where necessary restore the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread.	Undesirable non-woody and woody vascular plants species may require active management to avert an unwanted succession to a different and less desirable state. Often they may be indicative of a negative trend relating to another aspect of a site's structure and function. These species will vary depending on the nature of the particular feature, and in some cases these species may be natural/acceptable components or even dominants. Invasive species found within the Broads SAC area include Himalayan Balsam (*Impatiens glandulifera*), Australian Swamp Stonecrop (Crassula helmsii), , Giant hogweed (*Heracleum mantegazzianum*), Japanese knotweed (*Fallopia japonica*),	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation community transitions**	Maintain and where necessary restore the pattern of natural vegetation zonations/ transitions.	Transitions/zonations between adjacent but different vegetation communities are usually related to naturally-occurring changes in soil, aspect or slope. Such 'ecotones' retain characteristics of each bordering community and can add value in often containing species not found in the adjacent communities.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Retaining such transitions can provide further diversity to the habitat feature, and support additional flora and fauna. Transitions may be between other fen communities, open water and scrub / woodland	
Structure and function (including its typical species)	**Soils, substrate and nutrient cycling**	Maintain and where necessary restore the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat. For this feature, soil P index should typically be index 0 (< 9 mg l -1)	Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature.	
Structure and function (including its typical species)	**Water quality**	Where the feature is dependent on surface water and/or groundwater, maintain and where necessary restore water quality and quantity to a standard which provides the necessary conditions to support the feature [adviser to provide site-specific standards where available].	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Hydrology: Water table**	Maintain and where necessary restore a hydrological regime that provides a sub-surface water table during the summer (range -2 to -48 cm below ground level) and a winter water table ± at the surface. Inundation should be absent or only occasional to a minor degree in winter.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. Site specific targets may be developed as part of Natural England and Environment Agency on going work on	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			sustainable abstraction. The full range of water levels is not relevant to all locations where this feature occurs.	
Structure and function (including its typical species)	**Supporting off-site habitat**	Maintain where necessary restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature.	The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to prevent/reduce/absorb damaging impacts from adjacent land uses e.g, pesticide drift, and nutrient enrichment.	Broads Climate Partnership (2016)
Structure and function (including its typical species)	**Maintaining integrity of hydrological catchment**	Maintain the full range of hydrological/hydrogeological aspects of a site's catchment that contribute to its functioning and the maintenance of the feature.	The movement, quality and distribution of water within a site's wider catchment and outside of the site's boundary will affect its ability to support this wetland habitat feature. Catchment size will vary. A site's water table and other hydrological aspects may be affected by changes in the use of the land surface, water abstraction, flood alleviation, development and mineral extraction in the wider catchment.	
Structure and function (including its typical species)	**Functional connectivity with wider landscape**	Maintain and where necessary restore the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site.	This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site. These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			advise as to whether these are applicable on a case by case basis. Isolation from an adjacent polluted water body may prevent nutrient enrichment, but can restrict the natural, appropriate hydrological regime of the habitat and so is not a permanent solution. Improvement of water quality in the adjacent water body should be addressed followed by removing artificial isolation and restoring natural function and connectivity	
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	This recognises the increasing likelihood of natural habitat features to absorb or adapt to wider environmental changes. Resilience may be described as the ability of an ecological system to cope with, and adapt to environmental stress and change whilst retaining the same basic structure and ways of functioning. Such environmental changes may include changes in sea levels, precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of a feature within a site. The vulnerability and response of features to such changes will vary. Using best available information, any necessary or likely adaptation or adjustment by the feature and its management in response to actual or expected climatic change should be allowed for, as far as practicable, in order to ensure the feature's long-term viability. The overall vulnerability of this SAC to climate change has been assessed by Natural England (2015) as being high taking into account the sensitivity, fragmentation, topography and management of its habitats. This means that this site is considered to be the most vulnerable sites overall and are likely to require the most adaptation action, most urgently. A site based assessment should be carried out as a priority. This means that action to address specific issues is likely, such as reducing habitat fragmentation, creating more habitat to buffer the site or expand the habitat into more varied	Broads Climate Partnership (2016) Natural England, 2015. Climate Change Theme Plan and supporting NBCCV Assessments for SACs and SPAs Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			landscapes and addressing particular management and condition issues. Individual species may be more or less vulnerable than their habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable.	
Supporting processes (on which the feature relies)	**Air quality**	Maintain and where necessary restore, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Conservation measures**	Maintain and where necessary restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain or restore the structure, functions and supporting processes associated with the feature.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. Conservation measures for this feature typically include grazing, cutting, scrub management, weed control, recreation/visitor management. Also covered is maintenance of surface drainage features such as drains, grips, gutters and foot drains. Retention of suitable land use infrastructure/ patterns to enable site management e.g, pastoral livestock farming	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a series of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 4: Supplementary Advice for Qualifying Features: H7140. Transition mires and quaking bogs; Very wet mires often identified by an unstable `quaking` surface

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to 5.89 hectares.	See general explanatory notes for this attribute in Table 1. This feature is recorded from the following sites: Alderfen Broad SSSI; Ant Broads and Marshes SSSI; Sprat's Water and Marshes, Carlton Colville SSSI; Upper Thurne Broads and Marshes SSSI; Upton Broad & Marshes SSSI; Yare Broads and Marshes SSSI	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments European Environment Agency (2019) https://eunis.eea.europa.eu/sites/UK0013577
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain and where necessary restore the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	Distribution includes the spatial pattern or arrangement of this habitat feature, and its component vegetation types, across the site. Changes in distribution may affect the nature and range of the vegetation communities present, the operation of the physical, chemical, and biological processes in the system and the resiliency of the site and its features to changes or impacts. The mechanisms underlying any change in the extent of this feature should be taken into account. This may be indicative of changing hydrological conditions, particularly in water chemistry that may be being exacerbated by non-natural influences.	
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types. • M5 *Carex rostrata-Sphagnum squarrosum* • M9 *Carex rostrata-Calliergon cuspidatum/giganteum*	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. *BS5 *Dryopteris cristata/ Sphagnum* transition mire was a vegetation community that was described during the Broads Fen Survey 2007-10 (OHES, 2010). It doesn't fit with	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		• S27 *Carex rostrata-Potentilla palustris* fen • BS5* *Dryopteris cristata/ Sphagnum* transition mire	communities previously described by Rodwell in the original work on NVC, but fits within the SAC transition mire communities.	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat; • Constant and preferential plant species of the M5, M9, S27 NVC vegetation types at this SAC	See general explanatory notes for this attribute in Table 1	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure invasive and introduced non-native species are either rare or absent, but if present are causing minimal damage to the feature. No more than one species <5% cover.	Invasive or introduced non-native species can be a serious potential threat to the structure and function of these habitats, because they are able to exclude, damage or suppress the growth of their associated typical species, reduce structural diversity of the habitat and prevent the natural regeneration of characteristic site-native species. Once established, the measures to control such species may also impact negatively on the features of interest (e.g use of broad spectrum pesticides). Undesirable species include: *Brachythecium rutabulum; Phragmites australis; Phalaris arundinacea; Glyceria maxima; Typha latifolia; Epilobium hirsutum; Urtica dioica; Juncus spp. Eurhynchium praelongum; Pteridium aquilinum; Rubus fruticosus; Molinia caerulea*	Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Presence/ cover of woody species**	Maintain and Restore a low cover (<10% of the area) of scrub or trees within stands of H7140.	Native trees and shrubs occur naturally on bog and fen surfaces but an abundance of scrub and trees on bogs and fens is sometimes regarded as detrimental because they are indicators and perpetrators of drying out and may cause damage to vegetation structure through shading effects.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Birch, pine, willow and rhododendron (an invasive non-native species) are the main species of concern. The seeds of most invasive woody species are wind dispersed, so trees are able to establish on raised bog and fen surfaces.	
Structure and function (including its typical species)	**Exposed substrate**	Maintain a low cover of exposed substrate of between 5% & 10% across feature.	For this wetland habitat type, maintaining some continuous extent of exposed, open ground surface is required to support the establishment and supply of those component species which often rely on wet and sparsely-vegetated conditions.	
Structure and function (including its typical species)	**Hydrology**	At a site, unit and/or catchment level as necessary, Maintain natural hydrological processes to provide the conditions necessary to sustain the feature within the site. Relatively high water levels at or near the surface throughout the year, with surface wetness present in summer.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Wheeler et al. (2009) provide range and mean for summer & winter water levels for those wetland NVC types constituting Annex 1 habitats. This provides a rough guide to appropriate levels, but it is critical that individual sites and their needs are considered as there is considerable variation within the NVC communities listed and recorded water levels. Site specific targets may be developed as part of Natural England and Environment Agency on going work on sustainable abstraction.	Natural England (Various) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Water chemistry**	Maintain and where necessary restore the surface water and groundwater supporting the hydrology of the bog at a low nutrient status.	UKTAG (2012) provides threshold values for nitrate concentration in groundwaters for different wetland types. The threshold values will mainly be used in the characterisation of GWDTE status for the WFD, primarily as a risk screening tool, to assess if sites are 'at risk' or 'not at risk' from groundwater mediated nutrient pressure. Due to the complex cycling of nutrients within many GWDTE, these threshold values are less well suited for application within sites but rather just to groundwater that is directly feeding the site.	Hoare, D (2006) Nutrient budgets for isolated SSSI Broads. Unpublished report for Broads Authority. Document may be available on request from Natural England. Natural England (2014) Site Improvement Plan – Broadland

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
				(SIP Profile 030)
Structure and function (including its typical species)	**Hydrology**	Maintain a high piezometric head and permanently high water table (allowing for natural seasonal fluctuations) on groundwater dependent sites.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Some examples of H7140 may be wholly or partly groundwater dependent. Others have a greater dependence on surface water or rain water inputs. It is critically important to understand the eco-hydrological context of all sites. Site specific targets may be developed as part of Natural England and Environment Agency on going work on sustainable abstraction.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	See general explanatory notes for this attribute in Table 3	Broads Climate Partnership (2016) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Supporting off-site habitat**	Maintain the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature.	Include only where applicable. The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to prevent/reduce/absorb damaging impacts from adjacent land uses e.g, pesticide drift, and nutrient enrichment.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature relies)	**Air quality**	Maintain or restore as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1. .	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Conservation measures**	Maintain and where necessary restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the feature.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. This habitat in most cases requires ongoing cutting or grazing maintain its open character.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a complex of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 5: Supplementary Advice for Qualifying Features: H7210. Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*; Calcium-rich fen dominated by great fen sedge (saw sedge) *

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to 209.07 hectares.	See general explanatory notes for this attribute in Table 1.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments Parmenter, J., 1995, OHES, 2010,
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	Distribution includes the spatial pattern or arrangement of this habitat feature, and its component vegetation types, across the site. Changes in distribution may affect the nature and range of the vegetation communities present, the operation of the physical, chemical, and biological processes in the system and the resiliency of the site and its features to changes or impacts.	
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types: • S2 *Cladium mariscus* • S24 *Phragmites australis - Peucedanum palustre* tall herb fen • S25 *Phragmites australis – Eupatorium cannabinum* fen Stands where *Cladium mariscus* is present with >10 per cent cover.	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical	**Invasive, non-native and/or introduced species**	Ensure invasive and introduced non-native species are either rare or absent, but if present are causing minimal damage to the	Invasive or introduced non-native species can be a serious potential threat to the structure and function of these habitats, because they are able to exclude, damage or suppress the growth of their associated typical species, reduce structural	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
species)		feature.	diversity of the habitat and prevent the natural regeneration of characteristic site-native species. Once established, the measures to control such species may also impact negatively on the features of interest (e.g use of broad spectrum pesticides).	
Structure and function (including its typical species)	**Presence cover of woody species**	Maintain where necessary restore a low cover of not more than 10% of scrub or trees within stands of H7210.	Native trees and shrubs occur naturally on bog and fen surfaces but an abundance of scrub and trees on bogs and fens is sometimes regarded as detrimental because they are indicators and perpetrators of drying out and may cause damage to vegetation structure through shading effects. Birch, pine, willow and rhododendron (an invasive non-native species) are the main species of concern. The seeds of most invasive woody species are wind dispersed, so trees are able to establish on raised bog and fen surfaces.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Exposed substrate**	Maintain and where necessary restore a low cover of exposed substrate of between 5% & 25% across feature.	For this wetland habitat type, maintaining some continuous extent of exposed, open ground surface is required to support the establishment and supply of those component species which often rely on wet and sparsely-vegetated conditions. This will vary depending on nature of vegetation community. For some strongly spring-fed sites, a higher value may be appropriate.	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat; • Constant and preferential plant species of the S2; S24 and S25 NVC vegetation types at this SAC • Stands where *Cladium mariscus* is present with >10	See general explanatory notes for this attribute in Table 1	Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		per cent cover.		
Structure and function (including its typical species)	**Hydrology**	At a site, unit and/or catchment level maintain natural hydrological processes to provide the conditions necessary to sustain the feature within the site.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Wheeler *et al*. (2009) provide range and mean for summer & winter water levels for those wetland NVC types constituting Annex 1 habitats. This provides a rough guide to appropriate levels, but it is critical that individual sites and their needs are considered as there is considerable variation within the NVC communities listed and recorded water levels. Site specific targets may be developed as part of Natural England and Environment Agency on going work on sustainable abstraction.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Water chemistry**	Maintain and where necessary restore the low nutrient status of irrigating water, ensuring it is rich in base ions, particularly calcium.	UKTAG (2012) provides threshold values for nitrate concentration in groundwaters for different wetland types. The threshold values will mainly be used in the characterisation of GWDTE status for the WFD, primarily as a risk screening tool, to assess if sites are 'at risk' or 'not at risk' from groundwater mediated nutrient pressure. Due to the complex cycling of nutrients within many GWDTE, these threshold values are less well suited for application within sites but rather just to groundwater that is directly feeding the site.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Hydrology**	Maintain and where necessary restore a high piezometric head and permanently high water table (allowing for natural seasonal fluctuations) on groundwater dependent sites.	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Critically important to understand eco-hydrological context of all sites. Site specific targets may be developed as part of Natural England and Environment Agency on going work on sustainable abstraction.	
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain and where necessary restore the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	See general explanatory notes for this attribute in Table 3	Broads Climate Partnership (2016) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Supporting off-site habitat**	Maintain and where necessary restore the extent, quality and spatial configuration of land or habitat surrounding or adjacent to the site which is known to support the feature	Include only where applicable. The structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary. Changes in surrounding land-use may adversely (directly/indirectly) affect the functioning of the feature and its component species. This supporting habitat may be critical to the typical species of the feature to support their feeding, breeding, roosting, population dynamics ('metapopulations'), pollination or to prevent/reduce/absorb damaging impacts from adjacent land uses e.g, pesticide drift, and nutrient enrichment.	
Supporting processes (on which the feature relies)	**Air quality**	Restore as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Conservation measures**	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		feature.	Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. This habitat in most cases requires ongoing cutting to maintain its open character.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a series of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 6: Supplementary Advice for Qualifying Features: H7230. Alkaline fens; Calcium-rich springwater-fed fens

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to 5.89 hectares.	See general explanatory notes for this attribute in Table 1. This feature is recorded on the following sites: Ant Broads & Marshes, Broad Fen, Dilham, Ducan's Marsh, Claxton SSSI; Smallburgh Fen SSSI; Sprat's Water and Marshes, Carlton Colville SSSI; Upton Broad & Marshes SSSI,	https://eunis.eea.europa.eu/sites/UK0013577 This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain the distribution and configuration of the feature, including where applicable its component vegetation types, across the site.	Distribution includes the spatial pattern or arrangement of this habitat feature, and its component vegetation types, across the site. Changes in distribution may affect the nature and range of the vegetation communities present, the operation of the physical, chemical, and biological processes in the system and the resiliency of the site and its features to changes or impacts.	
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types: • M9 *Carex rostrata – Calliergon cuspidatum/giganteum* mire • M10 *Carex dioica – Pinguicula vulgaris* mire • M13 *Schoenus nigricans – Juncus subnodulosus* mire.	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature.	Shaw, S.C & Tratt R (2015) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure invasive and introduced non-native species are either rare or absent, but if present are causing minimal damage to the feature.	Invasive or introduced non-native species can be a serious potential threat to the structure and function of these habitats, because they are able to exclude, damage or suppress the growth of their associated typical species, reduce structural diversity of the habitat and prevent the natural regeneration of characteristic site-native species. Once established, the measures to control such species may also impact negatively on the features of interest (e.g use of broad spectrum pesticides).	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Presence/ cover of woody species**	Maintain a low cover of woody species of not more than 10% scrub/tree cover. No woody species in flushes or springs; low *Salix* sp acceptable more than 5m from edge of spring/flush feature.	Native trees and shrubs occur naturally on bog and fen surfaces but an abundance of scrub and trees on bogs and fens is sometimes regarded as detrimental because they are indicators and perpetrators of drying out and may cause damage to vegetation structure through shading effects. Birch, pine, willow and rhododendron (an invasive non-native species) are the main species of concern. The seeds of most invasive woody species are wind dispersed, so trees are able to establish on raised bog and fen surfaces.	Shaw, S.C. & Tratt. R (2015) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Browsing and grazing by herbivores**	Maintain appropriate levels of grazing.	These habitat features are often preferentially grazed and may be vulnerable to significant overgrazing pressure associated with the management of the wider local landscape.	Shaw, S.C. & Tratt. R (2015) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Exposed substrate**	Maintain and where necessary restore the exposure of the subtstrate to appropriate levels, which will typically be between 5% & 25% across feature.	For this wetland habitat type, maintaining some continuous extent of exposed, open ground surface is required to support the establishment and supply of those component species which often rely on wet and sparsely-vegetated conditions. The open nature and sometimes skeletal nature of the substrate supporting these features requires a higher upper threshold than for some other wetlands.	
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain and where necessary restore the abundance of the typical species listed below to enable each of them to be a viable component of the Annex 1 habitat; • Constant and preferential plant species of the M9 and M13 NVC vegetation types at this SAC • Liverworts: *Aneura pinguis, Pellia endiviifolia*	See general explanatory notes for this attribute in Table 1	Natural England (Various)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Hydrology**	At a site, unit and/or catchment level as necessary, maintain or restore as appropriate natural hydrological processes to provide the conditions necessary to sustain the feature within the site, including a high piezometric head and permanently high water table (allowing for natural seasonal fluctuations).	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Wheeler *et al.* (2009) provide range and mean for summer & winter water levels for those wetland NVC types constituting Annex 1 habitats. This provides a rough guide to appropriate levels, but it is critical that individual sites and their needs are considered as there is considerable variation within the NVC communities listed and recorded water levels. Site specific targets may be developed as part of Natural England and Environment Agency on going work on sustainable abstraction.	Shaw, S.C. & Tratt. R (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Water chemistry**	Maintain and where necessary restore the low nutrient status of irrigating water, ensuring it is rich in base ions, particularly calcium.	UKTAG (2012) provides threshold values for nitrate concentration in groundwaters for different wetland types. The threshold values will mainly be used in the characterisation of GWDTE status for the WFD, primarily as a risk screening tool, to assess if sites are 'at risk' or 'not at risk' from groundwater mediated nutrient pressure. Due to the complex cycling of nutrients within many GWDTE, these threshold values are less well suited for application within sites but rather just to groundwater that is directly feeding the site.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain and where necessary restore the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site.	See general explanatory notes for this attribute in Table 3	Broads Climate Partnership (2016) Shaw, S.C. & Tratt. R (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Functional connectivity with wider landscape**	Maintain and where necessary restore the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site.	This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site. These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis.	
supporting processes (on which the feature relies)	**Air quality**	Maintain as necessary, the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature relies)	**Conservation measures**	Maintain and restore where necessary restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain and restore the structure, functions and supporting processes associated with the feature.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.	Shaw, S.C. & Tratt. R (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a series of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be				

Attributes	Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request			

Table 7: Supplementary Advice for Qualifying Features: H91E0. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae); Alder woodland on floodplains *

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to 763.27 hectares.	See general explanatory notes for this attribute in Table 1. For this feature tree roots (particularly of veteran trees) can extend a considerable distance beyond the boundary of the site - they can be impacted by soil compaction (such as caused by vehicles or construction works); agricultural operations or other soil disturbance (like trenches); and agro chemicals or other chemicals which get into the soil. Any loss of woodland area - whether at the edge or in the middle of a site will reduce the core woodland area where woodland conditions are found - these support significant assemblages of species dependent on woodland conditions (e.g lichens and bryophytes - being one example). Loss of any woodland area which fragments a site into different parts will clearly disturb the movement of species between the remaining parts of the woodland. Targets for extent may be modified where a target has been set to increase the extent of other habitat features on the site at the expense of woodland. Across the SAC there is a need to balance the requirements of woodland and fen habitats. The approach been for the retention of SAC woodland whilst non-SAC woodland has been prioritised for restoration to fen habitat.	https://eunis.eea.europa.eu/sites/UK0013577 Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain the distribution and configuration of the feature, including where applicable its component vegetation types, across the site	A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat. Smaller fragments of habitat can typically support smaller and	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			more isolated populations which are more vulnerable to extinction. These fragments also have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature.	
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the following National Vegetation Classification types: • W2a *Alnus glutinosa – Filipendula ulmaria* • W5 *Alnus glutinosa – Carex paniculata* woodland • W6 *Alnus glutinosa – Urtica dioica* woodland • W7 *Alnus glutinosa – Fraxinus excelsior – Lysimachia nemorum* .	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e., the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations).	https://eunis.eea.europa.eu/habitats/10198 Natural England (Various) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation structure - canopy cover**	Maintain an appropriate tree canopy cover across the feature, which will typically be between 40-90% of the site.	Canopy cover is the overall proportion of vegetative cover consisting of any woody layer ranging from established regeneration to mature and veteran stages. Woodland canopy density and structure is important because it affects ecosystem function and in particular microclimate, litterfall, soil moisture, nutrient turnover and shading; this in turn influences the composition of plants and animals in lower vegetation layers and soil. Open canopies with just scattered trees will have less of a woodland character and reduced diversity of woodland-dependent species (although they may be still be important as a form of woodland-pasture). Completely closed canopies across	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			the whole woodland are not ideal either however, as they cast heavier shade and support fewer species associated with edges, glades and open grown trees, and have little space where tree regeneration could occur. In general, the woodland canopy of this feature should provide a core of woodland interior conditions with some open and edge habitat as well.	
Structure and function (including its typical species)	**Vegetation structure - open space**	Maintain areas of permanent/ temporary open space within the woodland feature, typically to cover approximately 10% of area.	Woodland structure includes variations in age, tree form, layering, the distribution and abundance of open space and dead wood. It plays a critical role in woodland ecosystem functioning. The targets set within this attribute should reflect the most appropriate structure for the woodland feature on a particular site, taking account of its known interest, history, past management and the landscape context. Having some open, sunlit and largely tree-less areas as part of the woodland community is often important to facilitate natural tree and shrub regeneration and also to provide supporting habitat for specialist woodland invertebrates, birds, vascular and lower plants. Such open space can be permanent or temporary and may consist of managed grazed areas, linear rides and glades, or naturally-produced gaps caused by disturbance events such as windthrow/fire/tree falling over/snow damage.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation structure - old growth**	Maintain the extent and continuity of undisturbed, mature/old growth stands (typically comprising at least 20% of the feature at any one time) and the assemblages of veteran and ancient trees (typically >10 trees per hectare).	Good woodland structure includes variations in age, tree form, layering, the distribution and abundance of open space and dead wood. It plays a critical role in woodland ecosystem functioning. The targets set within this attribute should reflect the most appropriate structure for the woodland feature on a particular site, taking account of its known interest, history, past management and the landscape context. For this habitat type, old or over-mature elements of the woodland are particularly characteristic and important features, and their continuity should be a priority.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation structure - dead wood**	Maintain the continuity and abundance of standing or fallen dead and decaying wood, typically between 30 - 50 m3 per hectare of standing or fallen timber or 3-5 fallen trees >30cm	Woodland structure includes variations in age, tree form, layering, the distribution and abundance of open space and dead wood. It plays a critical role in woodland ecosystem functioning. The targets set within this attribute should reflect the most appropriate structure for the woodland feature on a particular site, taking account of its known interest, history, past	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		per hectare, and >10 standing dead trees per hectare.	management and the landscape context. Dead and actively decaying wood, either as part of a standing tree or as a fallen tree on the woodland floor, is an important component of woodland ecosystems, and supports a range of specialist invertebrates, fungi, lichens and bryophytes, and associated hole-nesting birds and roosting bats, all of which may be very typical of the feature.	
Structure and function (including its typical species)	**Vegetation structure - age class distribution**	Maintain where necessary restore at least 3 age classes (pole stage/ medium/ mature) spread across the average life expectancy of the commonest trees.	A distribution of size and age classes of the major site-native tree and shrub species that indicate the woodland will continue in perpetuity, and will provide a variety of the woodland habitats and niches expected for this type of woodland at the site in question.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation structure - shrub layer**	Maintain an understorey of shrubs covering 10 - 60% of the stand area (this will vary with light levels and site objectives).	Woodland structure includes variations in age, tree form, layering, the distribution and abundance of open space and dead wood. It plays a critical role in woodland ecosystem functioning. The targets set within this attribute should reflect the most appropriate structure for the woodland feature on a particular site, taking account of its known interest, history, past management and the landscape context.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Vegetation structure - woodland edge**	Maintain a graduated woodland edge into adjacent semi-natural open habitats, other woodland/ wood-pasture types or scrub.	Woodland edge is defined as being the transitional zone between the forest feature and adjacent but different habitat types - the best woodland edges will have a varied structure in terms of height and cover. Many typical forest species make regular use of the edge habitats for feeding due to higher herb layer productivity and larger invertebrate populations. Grasslands / arable fields managed with high doses of agro-chemicals could potentially not allow this gradation of woodland edge and could have other impacts on the integrity of the site (pollution/ nutrient enrichment etc.).	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Adaptation and resilience**	Maintain and where necessary restore the resilience of the feature by ensuring a diversity (at least 3 species) of site-native trees (e.g alder, willow - Salix spp, ash, elm - Ulmus spp, black poplar) across the site.	See general explanatory notes for this attribute in Table 3 Tree pests and diseases are a threat to maintaining appropriate species diversity. This is likely to be exacerbated by climate change. Appropriate biosecurity and control measures should be applied within the habitat and on adjacent and connected land.	Broads Climate Partnership (2016) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Structure and function (including its typical species)	**Browsing and grazing by herbivores**	Maintain browsing at a (low) level that allows well developed understorey with no obvious browse line, & lush ground vegetation with some grazing sensitive species evident (bramble, ivy etc.), and tree seedlings and sapling common in gaps.	Herbivores, especially deer, are an integral part of woodland ecosystems. They are important in influencing woodland regeneration, composition and structure and therefore in shaping woodland wildlife communities. In general, both light grazing and browsing is desirable to promote both a diverse woodland structure and continuous seedling establishment. Short periods with no grazing at all can allow fresh natural regeneration of trees, but a long-term absence of herbivores can result in excessively dense thickets of young trees which shade out ground flora and lower plant species. However, heavy grazing by deer or sheep prevents woodland regeneration, and can cause excessive trampling and/or poaching damage, canopy fragmentation, heavy browsing, barkstripping and a heavily grazed sward.	
Structure and function (including its typical species)	**Regeneration potential**	Maintain the potential for sufficient natural regeneration of desirable trees and shrubs; typically tree seedlings of desirable species (measured by seedlings and <1.3m saplings - above grazing and browsing height) should be visible in sufficient numbers in gaps, at the wood edge and/or as regrowth as appropriate ;	The regeneration potential of the woodland feature must be maintained if the wood is to be sustained and survive, both in terms of quantity of regeneration and in terms of appropriate species. This will Include regeneration of the trees and shrubs from saplings or suckers, regrowth from coppice stools or pollards, and where appropriate planting. Browsing and grazing levels must permit regeneration at least in intervals of 5 years every 20. The density of regeneration considered sufficient is less in parkland sites than in high forest. Regeneration from pollarding of veteran trees should be included where this is happening.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Tree and shrub species composition**	Maintain a canopy and under-storey of which 95% is composed of site native trees and shrubs.	Native trees and shrubs in general support a greater diversity of associated species than non-native species, especially amongst groups of invertebrates which depend directly on trees for food and shelter. There are many plants and animals which use or co-exist with non-native trees, but many rare and threatened woodland species are specialists adapted to one or a few native trees or shrub species (birches, willows and oaks, are examples of trees that host many specialist insect species).	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its	**Key structural, influential**	Maintain and where necessary restore the abundance of the typical species listed below to	See general explanatory notes for this attribute in Table 1	Roger Meade Associates (2013)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
typical species)	**and/or distinctive species**	enable each of them to be a viable component of the Annex 1 habitat; • Constant and preferential plant species of W2a, W5, W6 and W7 NVC vegetation types at this SAC • 80% of ground flora cover referable to W2a, W5, W6 and W7 NVC communities.		This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Invasive, non-native and/or introduced species**	Ensure invasive and introduced non-native species are either rare or absent, but if present are causing minimal damage to the feature.	Invasive or introduced non-native species are a serious potential threat to the biodiversity of native and ancient woods, because they are able to exclude, damage or suppress the growth of native tree, shrub and ground species (and their associated typical species), reduce structural diversity and prevent the natural regeneration of characteristic site-native species. Once established, the measures to control such species may also impact negatively on the features of interest (e.g use of broad spectrum pesticides). Such species can include Rhododendrons, snowberry, Japanese knotweed, giant hogweed and Himalayan balsam, for example. Similarly, this would include pheasants, rabbits and non-native invertebrate 'pest' species.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Structure and function (including its typical species)	**Soils, substrate and nutrient cycling**	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat.	Soil is the foundation of basic ecosystem function and a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature.	
Supporting processes (on which the	**Water quality/ quantity**	Where the feature is dependent on surface water and/or groundwater, maintain and where	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
feature relies)		necessary restore water quality and quantity to a standard which provides the necessary conditions to support the feature.	at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.	
Supporting processes (on which the feature relies)	**Functional connectivity with wider landscape**	Maintain and where necessary restore the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site	This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site. These features may also be important to the operation of the supporting ecological processes on which the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis.	Norfolk Wildlife Trust (2009)
Supporting processes (on which the feature relies)	**Hydrology**	At a site, unit and/or catchment level (as necessary, maintain or as necessary restore natural hydrological processes to provide the conditions necessary to sustain the feature within the site	Defining and maintaining the appropriate hydrological regime is a key step in moving towards achieving the conservation objectives for this site and sustaining this feature. Changes in source, depth, duration, frequency, magnitude and timing of water supply can have significant implications for the assemblage of characteristic plants and animals present. This target is generic and further site-specific investigations may be required to fully inform conservation measures and/or the likelihood of impacts. Alluvial forests can be dynamic in nature,	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			being part of successional habitats and transitions to drier woodlands. Hydrological processes (including periodic inundation) are critical to how they function and must not be negatively impacted.	
Supporting processes (on which the feature relies)	**Illumination**	Ensure artificial light is maintained to a level which is unlikely to affect natural phenological cycles and processes to the detriment of the feature and its typical species at this site.	Woodland biodiversity has naturally evolved with natural patterns of light and darkness, so disturbance or modification of those patterns can influence numerous aspects of plant and animal behaviour. For example, light pollution (from direct glare, chronically increased illumination and/or temporary, unexpected fluctuations in lighting) can affect animal navigation, competitive interactions, predator-prey relations, and animal physiology. Flowering and development of trees and plants can also be modified by un-natural illumination which can disrupt natural seasonal responses.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a series of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 8: Supplementary Advice for Qualifying Features: S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Connectivity with other populations**	Maintain the abundance and supporting habitat of Desmoulins whorl snail upstream of the SAC and the connectivity between populations.	This recognises population vulnerability of the top-most population to localised extinction; it remains likely that colonies are moved in flood events to downstream sites, so loss of headstream populations weakens the opportunities to overcome localised extinction events further downstream. **The River Wensum** is a major tributary of the River Yare and a designated SAC which also has *Vertigo moulinsiana* as a qualifying feature. Maintaining the population for this site may be crucial in supporting downstream populations within The Broads SAC.	European Site Conservation Objectives for River Wensum SAC (UK0012647)
Population (of the feature)	**Abundance**	Maintain a healthy adult: juvenile structure and population density (typically>250 individuals per m^2 in late summer), whilst avoiding deterioration from current levels as indicated by the latest peak count or equivalent.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/ restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving	Natural England (Various) http://publications.naturalengland.org.uk/file/5305910488465408

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, Plastic tray sampling, or white sheet beating surfaces are typically used as sample points in wetlands for assessments of this species. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection. Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site.	A contraction in the range, or geographic spread, of the feature (and its component vegetation) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. Contraction may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Such fragmentation may have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for this feature and this may affect its viability. This feature has been recorded from the following sites: Alderfen Broad SSSI; Ant Broads and Marshes SSSI; Barnby Broad & Marshes SSSI; Broad Fen, Dilham SSSI; Bure Broads and Marshes SSSI; Burgh Common and Muckfleet Marshes SSSI; Cantley Marshes SSSI; Crostwick Marsh SSSI; Geldeston Meadows SSSI; Hardley Flood SSSI; Sprat's Water and Marshes, Carlton Colville SSSI; Stanley and Alder Carrs, Aldeby SSSI; Trinity Broads SSSI; Upper Thurne Broads and	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Marshes SSSI; Upton Broad & Marshes SSSI and Yare Broads and Marshes SSSI	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain the total extent of the habitat(s) which support the feature at 1042.43 hectares	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data.	Killeen, I.J (2003) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Supporting habitat: structure/ function	**Ground moisture**	Maintain appropriate soil/ground moisture conditions so that water levels are continuously at or just above the ground surface throughout the year.	High groundwater levels throughout the year are considered to be one of the most important factors influencing the distribution of Desmoulin's whorl snail. For this feature the water level must remain close to the surface so that the ground remains at least moist for most of the summer, although some seasonal drying appears to be acceptable. Relatively high groundwater also contributes to maintaining a high humidity in the vegetation. The optimal degree of ground moisture for this feature is usually measured as 2 or 3 using a version of the '5 Point Wetness scale' (Killeen & Moorkens 2003).	Killeen, I.J (2003)
Supporting habitat: structure /function	**Soils, substrate and nutrient cycling**	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, within typical values for the supporting habitat.	Soil supports basic ecosystem function and is a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with the supporting habitat of this Annex II feature. *Vertigo moulinsiana* is susceptible to nutrient enrichment from artificial and natural fertilisers and requires low nutrient habitat.	Abrehart Ecology (2015)
Supporting habitat: structure/ function	**Vegetation composition - invasive non-native plants**	Ensure invasive non-native plants are either rare or absent within the site.	Desmoulin's whorl snails are potentially or actually at risk from non-native invasive plants. Such plants are considered a major threat to habitat due to their rapid growth and dominance over native species and the difficulty of controlling them.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Species of concern include Japanese knotweed (*Polygonum* [*Fallopia*] *japonica*), Himalayan [Indian] balsam (*Impatiens glandulifera*) and giant hogweed (*Heracleum mantegazzianum*).These riparian plants may directly alter the composition of Desmoulin's whorl snail habitat by replacing preferred species and increasing shading.	This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Supporting habitat: structure/ function	**Vegetation structure**	Maintain dense stands of tall vegetation, which is typically >70cms tall by August, with an abundance of tussocks and decaying leaf litter.	Humidity is important to all whorl snails (*Vertigo* spp.) and the different species achieve their requirements by occupying different levels (i.e., vertical movement) within their microhabitats. Desmoulin's whorl snail is a climbing species on emergent vegetation, living over a large vertical range at different times of year. The snail may over-winter in the lower levels of vegetation, within tussocks or in amongst decaying layer of leaf litter and vegetation. Associated supporting vegetation is usually tall, bulky marginal plants such as *Glyceria, Carex, Cladium, Sparganium* & *Iris*. Supporting habitat is typically tall herb swamp and fen communities such as NVC types S7, S5, S2, S3 & S6 NVC communities, but also in stands with *Phragmites*. Drift into communities such as S26, especially with strong *Urtica* populations, which can signal undesirable ground drying.	Killeen, I.J (2003) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030) This attribute will be periodically monitored as part of Natural England's SSSI Condition Assessments
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site.	See general explanatory notes for this attribute in Table 3 The sites with Vertigo moulinsiana in Norfolk had a strong association with the National Vegetation Communities of S7 *Carex acutiformis* swamp, S6 *Carex riparia* swamp, S28 Phalaris arundinacea tall-herb fen and the S3 *Carex paniculata* swamp. Vertigo moulinsiana is a species that is becoming dependent upon conservation of its habitat and is especially vulnerable to a lowering of the water table.	Broads Climate Partnership (2016) Killeen, I.J (2003) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting	**Air quality**	Maintain or, where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
habitat relies)		this feature of the site on the Air Pollution Information System (www.apis.ac.uk).		(www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. The basic requirements for Desmoulin's snail is swampy, usually unshaded ground with tall waterside plants. Water levels must remain close to the surface so that ground remains at least moist for most of the summer. The snail will disappear from areas where conditions become dry enough for plants such as nettle *Urtica dioica* and great willowherb *Epilobium hirsutum* to become frequent; conversely conditions must not become so wet that aquatic plants such as watercress *Rorippa nasturtium-aqualatis* and fools watercress *Apium nodiflorum* take over. Ideally no grazing by domestic stock should take place in areas that support the snail, although it does live where grazing intensity is low and patchy. Cutting and mowing will remove tall vegetation that the snail requires. The management requirements for Desmoulin's snail may conflict the management required to support a number of the other SAC habitats; the needs of both features will need to be balanced on the parts of the SAC that it is recorded from.	Baker, R. & Howlett, D. (2009) Desmoulin's Whorl Snail: Survey of Heigham Sound 2009. Roy Baker and Derek Howlett, Wheatfen Partnership. The Broads Authority Killeen, I.J (2003) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Mosaic of biotopes on floodplains**	Maintain and where necessary restore the extent and patterning of In-channel and riparian biotopes which are characteristic of natural fluvial processes. There should be no physical	Watercourses with a high degree of naturalness are governed by dynamic processes which result in a mosaic of characteristic physical features and habitats (or 'biotopes'), including a range that are important to Desmoulin's Whorl Snail. A range of physical habitat modifications to rivers (such as channel straightening, widening and deepening, bankside and bed	Killeen, I.J (2003)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		modification of existing conditions which would reduce the connectivity between river and floodplain.	protection, close floodbanks and impoundments) can disconnect them from their floodplain, resulting is disjointed distributions of suitable habitat for Desmoulin's Whorl Snail. Rivers that have sections that are already significantly physically modified should be subject to a process for planning and implementing physical restoration measures. This should be based on restoring natural geomorphological processes (including where possible restoration of continuity between river and floodplain) as far as possible to allow restoration of characteristic and sustainable biotope mosaics, working within the practical constraints of essential flood protection for people and the built environment. In certain instances, sections of river channel may lie outside the boundary of the site, but may still be integral to how the site functions	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water flow (rivers)**	Maintain the natural flow regime of the river, with daily flows as close to what would be expected in the absence of abstractions and discharges (the 'naturalised' flow).	The natural flow regime both shapes and sustains characteristic biotope mosaics on the river and its floodplain. All parts of the natural flow regime are important, including flushing flows, seasonal baseflows and natural low flows. Any significant impacts on the natural flow regime should be rectified sustainably by reducing flow modifications. Peak flows are of particular importance in aiding the spread of individuals for colonization of suitable habitats downstream. Canalisation of rivers, deepening of drainage channels, and creation of vertical profiles to riverbanks, eliminating wetland marsh habitat could adversely affect Desmoulin's whorl snail populations.	Killeen, I.J (2003)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quality/ quantity**	Maintain water quality and quantity to a standard which provides the necessary conditions to support the feature	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year during key stages of their life cycle. Poor water quality and inadequate quantities of water can adversely affect the availability and suitability of breeding, rearing and feeding habitats. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the SAC Conservation Objectives but in	Killeen, I.J (2003)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			some cases more stringent standards may be needed to support the SAC feature. Further site-specific investigations may be required to establish appropriate standards for the SAC. Desmoulin's whorl snail populations are potentially or actually at risk from water quality issues, particularly elevated phosphate and nitrate levels, and organic pollution. The snails may be directly vulnerable to organic pollution, particularly during periods of high flows when they can be immersed or transported. They are also vulnerable to poor water quality if it affects their habitat. The habitat on which Desmoulin's whorl snail depends can be impacted by pollution if it results in changes to the plant community. Elevated levels of nutrients, particularly phosphates and nitrates, are likely to be detrimental if changes result in the vegetation community. This is particularly relevant to snail habitat in river margins and drains, if the vegetation is likely to become rank." In the Norfolk Broads, Desmoulin's whorl snail lives on the margins of large rivers known as ronds, where there is often a broad zone of *Phragmites* protecting a mixed sedge/*Glyceria* habitat adjacent to higher man-made banks or bunds. Many of these rivers are slightly brackish or have tidal back-up. In the upper section of the River Deben estuary in Suffolk, a population occurs in transitional marsh lying between saltmarsh and woodland	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	Where the feature or its supporting habitat is dependent on surface water and/or groundwater, maintain water quality and quantity to a standard which provides the necessary conditions to support the feature.	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed to reflect the	Mason, G.H., Shaw, S.C. and Kirby, P. (2013) Killeen, I.J (2003) Abrehart Ecology (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC. Maximum snail densities, at locations where the hydrological conditions were considered to be at, or close to, the snail's optimum, were recorded where water levels were continuously above the ground surface throughout the year, and where mean annual water levels were more than 0.25 m above the surface. Annual fluctuation at these locations were between about 0 m and 0.6 m above ground level. Medium-density snail populations were associated with conditions where water levels fluctuated within 0.2 m of the surface, both above and below ground level. The critical minimum summer water level threshold, where the snail occurs but only at very low abundance, was estimated to be 0.5 m below surface ground level. However, it is unlikely that populations would be sustained under such conditions." Flooding, from hydrogeological changes resulting in higher than acceptable water levels will heavily reduce the snail's habitat in the short term. Lower water levels will create a drying sedge habitat which will heavily reduce the snail habitat in the long term.	
Version Control: Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The targets for some attributes listed above include both 'maintain' and 'restore' objectives. This is because The Broads SAC is a series of geographically-separate component sites which are currently in different states of condition. Overall, both objectives will be applicable to the SAC but these will differ between each component site depending on its particular circumstances. Natural England will able to provide further specific advice on request				

Table 9: Supplementary Advice for Qualifying Features: S1355. *Lutra lutra*; Otter

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Anthropogenic mortality**	Reduce levels of mortality as a result of anthropogenic (man-made) factors so that they are not adversely affecting the overall abundance and viability of the population.	High numbers of otter casualties within or adjacent to SAC catchments will adversely affect the condition and viability of the population and mitigation measures should be initiated as quickly as possible. Causes of mortality may include roads, accidents with fishing equipment (nets, lobster creels), poisoning, pollutants, hunting and acidification/contamination of water courses (which reduces fish populations). It should be noted that otters are also a European protected species, and that it is an offence to deliberately disturb, capture, injure or kill an otter. There continues to be a high level of anthropogenic mortality, particularly on the region's roads. This certainly underestimates the level of anthropogenic mortality as some dead otters will inevitably not be found or reported. Despite these losses the increase in range by otters within the region has been considerable.	Environment Agency (2010)
Population (of the feature)	**Population abundance**	Maintain the continued presence of an actively-breeding otter population within the SAC, whilst avoiding deterioration from current levels as indicated by the latest mean peak count, estimate or equivalent.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords	Environment Agency (2010)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. For otters, it is difficult to estimate population size. It could be assumed that where there is a high frequency of positive signs in an area, such as a large number of spraints (of several ages), that otters are likely to be occupying the site. Breeding will be indicated by the presence of natal dens, cub sightings and intensive otter activity (e.g, feeding, sprainting, pathways through vegetation). DNA analysis of spraints is now being used as a technique for identifying otters.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site.	A contraction in the range, or geographic spread, of the feature (and its component vegetation) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. Contraction may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Such fragmentation may have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for this feature and this may affect its viability. The Fifth otter survey of England 2009 – 2010 reports there has been a significant increase in otter range in this area since the last survey (2000-2002). The main survey results and the alternate squares spot-checks show that otters are now using most of the watercourses in Broadland.	Environment Agency (2010)
Supporting habitat: extent and	**Extent of supporting habitat**	Maintain the total extent of the habitat which support the feature at 5885.347 hectares.	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the	This attribute will be periodically monitored as part of Natural England's SSSI Condition

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
distribution			extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data. This feature is recorded as present on all the SSSIs that make up the SAC. It may be presumed that maintaining and/or restoring the habitat features to Favourable Condition will also maintain that of this feature.	Assessments
Supporting habitat: structure/ function	**Abundance of breeding and resting places**	Maintain an abundance of natural breeding and resting sites within the site.	It should be noted that otters are highly mobile and are likely to spend their time within wider territories, where designated sites only form a proportion of their range and make a contribution to their wider requirements. Otters are a European protected species, and it is an offence to disturb their resting places. Otters will often use many holts at any one time. They may give birth in one, but raise their young in another. Important features of a successful breeding site are the availability of food, limited disturbance and safety from the risk of flooding. It is important to consider the whole site and not just the known holts as appropriate management will influence all of these factors. Some natal den structures have a limited lifespan (e.g, hollow tree trunks, piles of timber etc.) and if alternative opportunities for natal dens are limited, suitable replacements can be created or constructed. Maintaining dense bank vegetation, areas of reed etc. will ensure that there are suitable areas for resting couches.	
Supporting habitat: structure/ function	**Availability of refugia**	Maintain an abundance of dense bankside vegetation to limit significant disturbance to animals.	For rivers, most of the floodplain is outside the boundary of the site, yet the integrity of the interest feature will often be dependent upon the quality of the adjacent habitat out with the boundary of the site. This is likely to be the case where bankside vegetation may be an important barrier to disturbing activity but may lie adjacent to and outside the boundary. Nevertheless it will be important to maintain, or in some cases, to restore dense bankside cover.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting habitat: structure/ function	**Food availability**	Maintain fish biomass within expected natural levels for the supporting habitat (subject to natural fluctuations).	In freshwater, key fish prey sources for otters include eels, salmonids, roach and sticklebacks. Frogs can also form an important part of the diet, depending on the habitat and time of year. Crayfish and water beetles may also form part of the diet, as well as an occasional water bird (young coots, moorhens, ducks) or mammal (rabbits, water voles - although this is uncommon). The diet of coastal otters may include eelpout, rockling, butterfish, lumpsuckers and an occasional crab. The diet of otters varies depending on the availability of prey, which in turn varies with the time of year. There should be a diverse range of food sources available throughout the year, within the normal expectations of each particular water course. It should be noted however, that otters may take prey from adjacent fisheries which are stocked to an artificially high level, especially where there are numerous stocked gravel pits on a floodplain. This can lead to artificially high prey densities adjacent to European sites, which might be expected to, in turn, result in artificially high densities of otter on the designated sites. This highlights the importance of biosecurity around stocked fisheries, and if implemented at all artificial still water fisheries on a floodplain might result in a legitimate reduction in otter density.	Environment Agency (2010)
Supporting habitat: structure/ function	**Habitat quality - coastal habitat**	Maintain the quality of supporting coastal habitat features, which at this site comprise; Horsey Mere & Hickling Broad.	Otters inhabiting coastal areas will spend around three-quarters of their time on land, so terrestrial features are important. Having access to areas for resting, breeding and feeding away from the coast are also important, so habitats surrounding these coastal areas should be maintained (e.g, waterways and reedbed areas in Norfolk).	
Supporting habitat: structure/ function	**Habitat quality - river habitat**	Maintain the quality of supporting river habitat features, based on the advice for H3260 habitat, based on natural river function, which provides a characteristic biotope mosaic that caters for otters.	Dense bank vegetation, marshes and reedbeds are important for otters, but they will use a long stretch of river and this won't necessarily fall within a protected site. Dense bank vegetation and reedbeds are favoured as resting areas, but otters will often travel some distance to a preferred 'couch' and this will not necessarily be along the edge of the river. The structure and quality of bankside vegetation, reedbeds and other nearby habitats should be maintained, particularly where there is evidence of use by otters. However, it is thought that the most significant determinant of otter usage of a habitat is the	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			abundance of prey (Kruuk *et al,* 1998)	
Supporting habitat: structure/ function	**Habitat quality - waterway habitat**	Maintain the quality of supporting waterways habitat features.	Smaller tributaries of larger river systems (streams, becks etc.) are extremely important for otters and have been shown to have been used more frequently by otters than larger rivers (Kruuk *et al*, 1993). This is thought to be in part due to differences in fish density and preference for hunting in shallow water with areas of riffles and boulders.	
Supporting habitat: structure/ function	**Water flow - rivers**	Maintain the natural flow regime of the river to that close to what would be expected in the absence of abstractions and discharges (the 'naturalised' flow).	Permanent or long-lasting reductions in flow may affect the availability and diversity of prey. This could lead to otters moving into new areas, increasing the likelihood of conflict with other otters. This may also alter they prey targeted by otters as they may hunt for low-preference food such as birds, rabbits, fish carrion or for frogs, depending on the time of year.	
Supporting habitat: structure/ function	**Water quality/ quantity**	Maintain water quality and quantity to a standard which provides the necessary conditions to support the feature.	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year during key stages of their life cycle. Poor water quality and inadequate quantities of water can adversely affect the availability and suitability of breeding, rearing and feeding habitats. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the SAC Conservation Objectives but in some cases more stringent standards may be needed to support the SAC feature. Further site-specific investigations may be required to establish appropriate standards for the SAC. The main impact of water chemistry on this feature is its effect on the food supply. For example, moderate levels of levels of eutrophication may increase certain fish populations, but excessive eutrophication can be detrimental. Excessive acidity in watercourses may also affect fish populations. Impacts from toxic pollutants can be devastating and were the major cause of otter population declines in the 50s, 60s and 70s.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the	**Adaptation and resilience**	Maintain the feature's ability, and that of its supporting habitat, to adapt or evolve to wider	See general explanatory notes for this attribute in Table 3 Recovery has been in response to three main factors, the ban	Environment Agency (2010) Natural England (2014) Site

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
feature and/or its supporting habitat relies)		environmental change, either within or external to the site.	on pesticides that caused extinction of otters from many parts of England in the 1960s and early 1970s, legal protection for the otter since 1978, and the significant improvement in water quality in previously fishless rivers since the 1970s. Re-introduction programmes of captive bred and re-habilitated otters in certain parts of the country are likely to have speeded up the recovery locally in East Anglia, Yorkshire and the upper Thames. However the majority of the recovery has been the result of natural expansion from the remnant populations. The prospects are for full recovery across England probably within the next two decades or so.	Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Connectivity within and to the site**	Ensure there are no significant artificial barriers to the safe passage and movement of otters into, within and away from the site.	Barriers such as roads, weirs etc. can generally increase the risk of harm to animals as they traverse or avoid them. If these barriers are considered a problem then mitigating measures could be taken. Otter populations within the SAC are dependent on the integrity of sections of river channel, riparian areas, freshwater still-waters, floodplains and transitional and marine waters that lie outside of the site boundary. Headwater areas and tributaries may not fall within the site boundary, yet otters may use these areas for feeding and these will be critical for sustaining populations within the site. Boundaries to river SACs often follow the first break of slope on the bank, with the result that much of the riparian habitat will lie outside the SAC, particularly if the river channel is operating under natural processes and moves laterally over time within the floodplain. It is possible that holts of otters that form part of the population for a SAC may lie on the adjacent floodplain out with the boundary of the SAC.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quality : Toxic chemicals**	Avoid the presence of pollutants affecting the site, which are potentially toxic to otters.	The major cause of the decline in otter populations in the 60s and 70s was toxic chemicals such as dieldrin and related pesticides. Contaminants that might have an effect on otters may have an indirect effect (e.g, on food supply - organic pollution, eutrophication, acidification from mine waste and acid rain), a mainly direct effect (e.g, oil spillage, radioactivity) or effects of bioaccumulation (e.g, metals, especially mercury, cadmium and lead; pesticides and PCBs). PCBs, organochlorine pesticides and heavy metals all being seen as detrimental to otters, although the use of many of these is now banned.	
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The attribute Soils, Substrates and Nutrient cycling has been removed as it is not considered important for this feature.				

Table 10: Supplementary Advice for Qualifying Features: S1903. *Liparis loeselii*; Fen orchid

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Flowering/ fruiting performance**	Ensure at least some plants should be flowering/fruiting each year. At each site the minimum requirement should be >20 flowering stems present at least once in each 5-year period	Even just one flowering/fruiting plant will often be found to have 10-15 flowering stems producing potentially prodigious quantities of seed (5,000-20,000 seeds on a large multi-stemmed plant). Weather conditions (winter storms, cold spring and summer drought) can limit seed production in any one year, but poor fruiting in two or three in every five is unlikely to be a problem.	RSPB and NWT data Illyes, Z. *et al.* (2005)
Population (of the feature)	**Metapopulation size and structure**	Maintain both the geographical extent/limits of each metapopulation and the number of colonies/sites contained within it.	Each colony in relation to its nearest neighbours and other colonies will form groups or clusters which function as a larger metapopulation. Some (usually outlying and very small) populations may 'come and go'. Natural losses are acceptable, but the aim should be to ensure that, over the medium to long term, local losses are more or less offset by re/colonisation at other sites. Plants from a strong Broadland population have been used to reintroduce the species elsewhere.	Natural England (Various) RSPB and NWT data
Population (of the feature)	**Population abundance**	Restore the abundance of the population to a level which is above the baseline population-size known or estimated at or soon after the time of SAC designation. Or an alternative baseline-population previously approved by Natural England Chief Scientist, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any	Shaw, S.C. & Tratt, R. (2015) RSPB and NWT data

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection. Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available. Over 100 *Liparis* plants were counted in 2009 but the count dropped to less than a dozen in 2011 (K. Hart, NWT, pers. comm.). About 30 *Liparis* plants were seen in 2012 and 2013, and 2014 was better (M. Amis, NWT, pers. comm.).	
Population (of the feature)	**Population structure**	Restore a 'healthy' structure to the population which should comprise plants of different ages, with flowering/fruiting plants, vegetative plants, 'youngsters'	Separate counts should be kept of flowering/fruiting and vegetative mature plants and seedlings/youngsters. Mature plants do not flower/fruit every year, and elderly plants may cease flowering several years before finally succumbing. Plants are said to live for ten or more years, although most are	Natural England (Various) Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998)

<table>
<tr><th colspan="2">Attributes</th><th>Targets</th><th>Supporting and Explanatory Notes</th><th>Sources of site-based evidence (where available)</th></tr>
<tr><td></td><td></td><td>and seedlings all present.</td><td>lost some years before they reach old age.

2014 Populations
<table><tr><th>Site</th><th>Number of spikes</th></tr><tr><td>Sutton</td><td>1538 (partial count)</td></tr><tr><td>Sutton Hand Marsh</td><td>30</td></tr><tr><td>Catfield Great Fen</td><td>187</td></tr><tr><td>Catfield Mill Marsh West</td><td>1843 (partial count)</td></tr><tr><td>Catfield Mill Marsh East</td><td>183</td></tr><tr><td>Catfield Mill Dyke East</td><td>1</td></tr></table>
Demographic studies on tagged plants in ten permanent plots in one population (Sutton Fen) between 1983 and 1990 showed that individuals were mostly short-lived but developed quickly. Small (young) individuals had particularly high mortalities and the majority died without flowering; individuals frequently, but not invariably, increased their leaf dimensions in successive years; flowering was almost entirely restricted to 2-leaved plants, especially robust individuals, and most flowering individuals re-appeared in the next growing season. The main period of emergence was between mid-June and mid-July, though some individuals that emerged in mid-June disappeared by mid-July (apparently due to mollusc grazing).

The number of plants in the population showed considerable flux (though not all plots showed the same trends). A peak of numbers in some plots in 1986 and 1987(due to both high rates of recruitment and low mortality) was followed by a crash in 1988 and 1990. This affected the entire population (1990 numbers were about one third of those in 1983) but was particularly evident in plots which had shown an earlier strong increase in numbers. The population peak occurred after a winter burn and may have occurred in response to this. The cause of the subsequent decline is not known with certainty but it was associated with lack of vegetation management, low fen water levels (lack of surface inundation) at the time of emergence of Liparis plants and mollusc grazing damage. The</td><td></td></tr>
</table>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			effects of these events are difficult to disentangle, but grazing damage, perhaps facilitated by lack of shallow flooding at the time of shoot emergence, may be the proximate cause of loss. The short-lived character of many *Liparis* individuals and the quite rapid population turnover suggests that effective conservation management must provide conditions suitable for recruitment of new individuals as well as the maintenance of established plants, but the character of suitable regeneration niches is not well understood. It is possible that perpetuation of *Liparis* populations may require some disturbance (perhaps winter burning or light trampling) as well as mowing. Rejuvenation of the hydrosere, by further peat removal, may be another long-term requirement.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain and where necessary restore the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site.	A contraction in the range, or geographic spread, of the feature (and its component vegetation) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. Contraction may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Such fragmentation may have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for this feature and this may affect its viability.	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain the total extent of the habitats which support the feature at: 169.58 hectares	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data.	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Fen orchid flowers throughout the months of June and July, and the fen variety is believed to prefer areas where peat cutting is taking place. The orchid colonises the bare fen surface as an 'early successional' species, taking advantage of a new habitat	
Supporting habitat: structure/ function	**Hydrological regime**	Maintain presence and supply of freshwater as surface or subsurface seepages, streams.	A year-round supply of freshwater may be crucial, so anything that limits or removes that supply could be detrimental (e.g, lowering of water table, re-direction of surface watercourses or flow rate reduction). The influence of groundwater and resulting water chemistry plays a critical role in supporting fen orchid.	
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	Maintain and where necessary restore the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, within typical values for the supporting habitat.	Soil supports basic ecosystem function and is a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with the supporting habitat of this Annex II feature. Rejuvenation of the hydrosere, by further peat removal, may be another long-term requirement.	Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998)
Supporting habitat: structure/ function	**Vegetation community composition**	Maintain and where necessary restore the characteristic vegetation communities which support the features freshwater communities.	Vegetation composition of supporting habitat can be variable but the frequent presence of the following species tend to be positive indicators of suitable habitat in its usual freshwater sites: *Phragmites australis–Peucedanum palustre* fen, *Schoenus nigricans* sub-community (S24f) (*Peucedano-Phragmitetum schoenetosum*) or sometimes the *Myrica gale* sub-community (S24g) (*Peucedano-Phragmitetum myricetosum*) sedge beds. Also recorded at Upton Broad & Marshes SSSI is M9 *Carex rostrata – Calliergon cuspidatum/giganteum* mire and M13 *Schoenus nigricans – Juncus subnodulosus* mire. At least some of: *Campylium protensum*, *Calliergon giganteum*,	Shaw, S.C. & Tratt, R. (2015) Natural England (Various)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Scorpidium scorpioides, *Cinclidium stygium*, *Carex appropinquata*, *C. lasiocarpa*, *Schoenus nigricans* to be present.	
Supporting habitat: structure/ function	**Vegetation succession and maintenance of early-succession communities**	Maintain and where necessary restore supporting habitat in an open, sparsely vegetated early-successional condition.	A range of 'natural' and 'anthropogenic' factors may help in maintaining habitat patches at an early-successional stage. Many factors that may be advantageous 'in moderation' could be detrimental in larger doses, but determining 'safe' and 'unsafe' levels may be difficult and are probably site-specific (dependent on topography, exposure, substrate, etc.). Aim should be to maintain open vegetation, so any shift towards more closed/tall/rank communities should be avoided as far as possible. **Rejuvenation** of the hydrosere, by further peat removal, may be another long-term requirement. Fen orchid occurs in early successional stages of fen development and hence it is important to maintain an appropriate distribution of optimum habitat patches to support colonisation.	Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	Maintain and where necessary restore the feature's ability, and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site.	See general explanatory notes for this attribute in Table 3	Broads Climate Partnership (2016) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	Maintain or, where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Conservation measures**	Maintain and where necessary restore the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain and restore the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. The fenland form of *Liparis loeselii* is currently known from only three sites in eastern England, having been lost from about 30 former localities since the start of the nineteenth century. The reason for its loss is sometimes uncertain, but in only a small number of instances can it be attributed confidently to drainage. The habitat of the current *Liparis* populations, all in the Norfolk Broadland, can be summarized as 'base-rich, wet, low-fertility, herbaceous fen'. Vegetation management, usually summer mowing, helps maintain the relatively low-growing, herbaceous vegetation that the orchid requires. In addition, all localities are in reflooded turbaries, the plant growing on a relatively buoyant mat of vegetation.	Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Grazing pressure**	Where vegetation is not kept open by other means, maintain a grazing regime which is extensive in nature with cattle the dominant grazing animal or where grazing is not practical maintain an appropriate cutting regime.	Low levels of grazing likely to be acceptable, but this should not be viewed as a primary way of keeping habitat patches open - in any case, grazing not an option on many. Intensive grazing likely to be damaging.	Shaw, S.C. & Tratt, R. (2015) Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting	**Water quantity /quality**	Where the feature or its supporting habitat is dependent on surface water and/or groundwater, maintain and where necessary restore water quality and quantity to a standard which	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type.	Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998) Natural England (2014) Site

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
habitat relies)		provides the necessary conditions to support the feature.	Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed to reflect the ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC. The habitat of the current *Liparis* populations, all in the Norfolk Broadland, can be summarised as 'base-rich, wet, low-fertility, herbaceous fen'. Vegetation management, usually summer mowing, helps maintain the relatively low-growing, herbaceous vegetation that the orchid requires. In addition, all localities are in reflooded turbaries, the plant growing on a relatively buoyant mat of vegetation.	Improvement Plan – Broadland (SIP Profile 030)
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: The attributes for **Habitat structure: regeneration/colonisation niches** and **Habitat dynamics: coastal erosion and accretion** have been removed as they refer to coastal sites; Fen Orchid is included within the SAC as an example of the species in fenland habitat.				

Table 11: Supplementary Advice for Qualifying Features: S4056. *Anisus vorticulus*; Little whorlpool ram's-horn snail

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population (of the feature)	**Population abundance**	Maintain the abundance of the population at a level which is above the baseline population-size known or estimated at or soon after the time of SAC designation, whilst avoiding deterioration from its current level as indicated by the latest mean peak count or equivalent.	This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve. This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature. Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment. Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection.	Gloeer, P & Groh, K (2007) Abrehart Ecology, 2012, *Article 17 assessment of* Anisus vorticulus *in Norfolk*

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available.	
Supporting habitat: extent and distribution	**Distribution of supporting habitat**	Maintain and restore as necessary the distribution and continuity of the feature and its supporting habitat, including where applicable its component vegetation types and associated transitional vegetation types, across the site	A contraction in the range, or geographic spread, of the feature (and its component vegetation) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to future environmental changes. Contraction may also reduce and break up the continuity of a habitat within a site and how well the species feature is able to occupy and use habitat within the site. Such fragmentation may have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for this feature and this may affect its viability.	
Supporting habitat: extent and distribution	**Extent of supporting habitat**	Maintain and where necessary restore the total extent of the habitats which support the feature.	In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data. Any management of any dyke where the little whirlpool rams-horn snail *Anisus vorticulus* occurs will have to be carried out under licencing from DEFRA, this will be required for any routine ditch management. To maintain suitable habitat for the snail, ditch management is required to prevent the ditches becoming completely vegetated and drying up. Under such management, disturbance and potential destruction of individuals is likely.	Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			The ditches where *Anisus vorticulus* were found included some of the more botanically species rich ditches encountered or those with abundant floating and/or submerged vegetation and low abundance of algae. These ditches were targeted for this opportunistic survey as being most likely to support the rare mollusc, or at least a good range of species	
Supporting habitat: structure/ function	**Ditch management**	Maintain and where necessary restore a physical structure dominated by unshaded, gently-shelving ditch margins with low levels of accumulated in-channel silt.	Ditch management impacts: >80% of all the surveyed ditches should have a berm/margin (with gentle gradient) on one side or both. The same section of drainage ditch or water-body should not be completely cleared (i.e., clearing both sides of the channel, removing both weed and the sediments) at intervals less of than 7 years. Ideally, silt removal should be much less frequent (i.e., no less than every 10 years). Any management of any dyke where the little whirlpool rams-horn snail *Anisus vorticulus* occurs will have to be carried out under licencing from DEFRA, this will be required for any routine ditch management. To maintain suitable habitat for the snail, ditch management is required to prevent the ditches becoming completely vegetated and drying up. Under such management, disturbance and potential destruction of individuals is likely.	Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.
Supporting habitat: structure/ function	**Ditch margin structure**	Maintain and where necessary restore open, lightly grazed ditch channel margins.	Shallow marginal areas warm quickly and are beneficial to many aquatic invertebrates. If banks are too steep, grazing animals are prevented from reaching the ditch margins to graze and drink and do not keep the margins open.	Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.
Supporting habitat: structure/ function	**Ditch vegetation structure**	Maintain and where necessary restore a well-vegetated channel, with native vegetation in at least 10% of ditches with a ratio of 50:50 emergent to floating/ submerged.	The ditches where *Anisus vorticulus* were found included some of the more botanically species rich ditches encountered or those with abundant floating and/or submerged vegetation and low abundance of algae. These ditches were targeted for this opportunistic survey as being most likely to support the rare mollusc, or at least a good range of species. *A. vorticulus* prefers clean, quiet water, well vegetated with aquatic plants but little emergent vegetation, usually near the surface with floating plants such as *Lemna trisulca* (Kerney,	Cousins, M (2017) See also: Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			1999). The snail has declined in its strongholds as a result of pollution, habitat destruction and possibly also modern drainage ditch maintenance methods which need to account for its preference for middle stages of succession.	
Supporting habitat: structure/ function	**Soils, substrate and nutrient cycling**	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, within typical values for the supporting habitat	Soil supports basic ecosystem function and is a vital part of the natural environment. Its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with the supporting habitat of this Annex II feature.	
Supporting habitat: structure/ function	**Vegetation composition: invasive non-native species**	Ensure invasive non-native species which pose a threat to the feature are either absent or being contained at a level which does not significantly affect the feature	The presence of the more aggressive species such as *Crassula* or *Hydrocotyle ranunculoides* is a particular concern.	
Supporting processes (on which the feature and/or its supporting habitat relies)	**Adaptation and resilience**	Maintain and where necessary restore the feature's ability, and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site	See general explanatory notes for this attribute in Table 3	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Air quality**	Maintain or, where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	See general explanatory notes for this attribute in Table 1.	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk).
Supporting processes (on which the feature and/or its supporting	**Conservation measures**	Maintain and restore where necessary the management measures within and outside the site boundary which are necessary to maintain and	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further details about the necessary conservation measures for this site can be provided by contacting Natural England.	Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
habitat relies)		restore the structure, functions and supporting processes associated with the feature and/or its supporting habitats.	This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, site management strategies or plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. The little whirlpool rams-horn snail *Anisus vorticulus* is a small aquatic snail with a flattened spire that is rarely more than 5mm across. It occurs in unpolluted, calcareous waters in dykes within grazing marshes with a diverse aquatic macrophyte flora with little emergent vegetation. It is associated with *Lemna triscula*. The main threats to the species are inappropriate management, land drainage, siltation and under-grazing of the dyke margins.	Cousins, M. (2017) Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water nutrient status**	Maintain and restore where necessary a total phosphorus level <0.1 mg L-1.	The ranges are derived from Pevensey which probably has the biggest population of *Anisus* although their locally derived targets for the other component sites should be checked against this and the lowest impact levels adopted for assessments. The mollusc species assemblage can be described as indicating a good level of naturalness and is a significant contribution to the species richness and biodiversity of these ditches. This is based on the good range of native species including indicator species; the absence of recently introduced species; the lack of species tolerant of high nutrient status and periodic drying; and with the presence of the rare *Anisus vorticulus.*	Cousins, M. (2017)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water quantity/ quality**	Where the feature or its supporting habitat is dependent on surface water and/or groundwater, maintain and where necessary restore water quality and quantity to a standard which provides the necessary conditions to support the feature	For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can adversely affect the structure and function of this habitat type. Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework	Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology. Natural England (2014) Site Improvement Plan – Broadland

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but in some cases more stringent standards may be needed to reflect the ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC. Water quality that is suitable for *Anisus vorticulus* is water without turbidity; with a pH from 7 to 7, 5; with calcium from 40 to 400 mg/l and with electrical conductivity from 200 to 1100 mS/m.	(SIP Profile 030)
Supporting processes (on which the feature and/or its supporting habitat relies)	**Water salinity**	Restore salinity at a level which would not significantly affect *Anisus* populations	Raised salinity levels may occur at a result of changes in sea level and/or frequency of tidal or brackish inundations.	Article 17 assessment of *Anisus vorticulus,* An ecological survey including floral and fauna observations undertaken for Natural England by Abrehart Ecology.
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: N/A				

References

Abrehart Ecology (2015) SAC status reporting on Vertigo moulinsiana in Norfolk & Suffolk 2014. Report to Natural England. (Available from http://publications.naturalengland.org.uk/file/5305910488465408)

Abrehart Ecology (2012) Article 17 assessment of Anisus vorticulus, An ecological survey including flora and fauna observations undertaken for Natural England by Abrehart Ecology.

Baker, R. & Howlett, D. (2009) Desmoulin's Whorl Snail: Survey of Heigham Sound. Report by Wheatfen Partnership for The Broads Authority

Broadland Catchment Partnership (2012) Sediment fingerprinting report for the Bure, Ant and Muckfleet. Catchment management implications in relation to other evidence.

Broads Climate Partnership (2016) The Changing Broads. A Summary of the Broads Climate Adaption Plan Available from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/519214/climate-adrep-broads-summary.pdf

Cousins, M (2017) Bure Broads and Marshes SSSI, Norfolk. Mollusc records during ditch and invertebrate proxy condition assessment 11-13th Sept 2017, Mags Cousins (Ecologist, Field Unit, Natural England). Unpublished Survey. (Available on request from Natural England)

Environment Agency (2010) 5th Otter Survey of England 2009 - 2010 - Technical Report.

Gloeer, P & Groh, K (2007) A contribution to the biology and ecology of the threatened species *Anisus vorticulus* (Troschel, 1834). Mollusca 25 (1) 2007. (Available from https://www.researchgate.net/publication/237803532_A_contribution_to_the_biology_and_ecology_of_the_threatened_species_Anisus_vorticulus_Troschel_1834_Gastropoda_Pulmonata_Planorbidae)

H. Bennion, A. Burgess, J. Boyle, P.G. Appleby, N. Rose, C. Sayer and S. Theophile (2003) Sediment survey of the Suffolk Broads. Unpublished report to English Nature. (Available on request from Natural England)

Illyes, Z. Rudnóy, S. & Bratek, Z. (2005) Aspects of in situ, in vitro germination and mycorrhizal partners of *Liparis loeselii.* Acta Biologica Szegediensis*.* **49**: 137-139.

Killeen, I.J (2003) Ecology of Desmoulin's Whorl Snail Vertigo moulinsiana. Conserving Natura 2000 Rivers, Ecology Series No. 6. (Available from http://publications.naturalengland.org.uk/file/117011)

Mason, G.H., Shaw, S.C. and Kirby, P. (2013) An Investigation of Water Levels and Fen Vegetation Hydrological Requirements at Burgh Common (with additional comments on the water management at Muckfleet Marshes). Report for Broads Authority, Norwich.

Natural England (2006) Nutrient budgets for 3 isolated SSSI lakes (Alder Fen). Unpublished report. (Available on request from Natural England)

Natural England (2014) Site Improvement Plan – Broadland (SIP Profile 030) (Available from http://publications.naturalengland.org.uk/file/6218680128241664)

Natural England (Various) Definitions for Favourable Condition for SSSIs underpinning The Broads SAC (Available on request from Natural England)

Norfolk Wildlife Trust (2009) Assessment of threats to County Wildlife Sites. (Available from https://www.norfolkwildlifetrust.org.uk/documents/cws/assessment_of_threats_to_cws_in_norfolk)

OHES, (2010), *Fen plant communities of Broadland: Results of a Comprehensive Survey 2005-2009*, Report for Broads Authority and Natural England, Norwich.

OHES Environmental (2014) An Investigation into the Management of Catch Dykes In The Broads

OHES Environmental (2017) Report into vulnerability of soils to produce ochre. Unpublished report for Internal Drainage Board.

Parmenter, J., 1995, *Broadland Fen Resource Survey*, English Nature and Broads Authority, Norwich

Phillips, G, Bennion, H., Perrow, M.R., Sayer, C.D., Spears, B.M., Willby, N (2015) A review of lake restoration practices and their performance in the Broads National Park, 1980-2013. Report for Broads Authority, Norwich and Natural England. (Available from: http://www.broads-authority.gov.uk/__data/assets/pdf_file/0006/549114/Broads-Lake-Review.pdf)

Roger Meade Associates (2013) Stanley & Alder Carrs Norfolk National Vegetation Classification and plant species survey August 2013. Unpublished report to Natural England (Available on request from Natural England)
Shaw, S.C. & Tratt, R. (2015) Observations on Schoenus nigricans–Juncus subnodulosus mire (M13) sites in selected East Anglian Fens, 2014. S.C. Shaw & R. Tratt Sheffield. March 2015. Report to: Environment Agency, Kingfisher House, Peterborough. (Available on request from Natural England)

Wheeler, B. D. Wheeler, Lambley, P. W. and Geeson, J (1998) Liparis loeselii (L.) Rich. In eastern England: constraints on distribution and population development. In Botanical Journal of the Linnaean Society, Volume 126, Issue 1-2, 1 January 1998, Pages 141–158, (Available from https://doi.org/10.1111/j.1095-8339.1998.tb02522.x)