

Thorne, Crowle and Goole Moors SSSI WLMP Summary Report

Summary Report

May 2010

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This summary report describes work commissioned by Tween Bridge Internal Drainage Board (IDB) under Environment Agency letter of 3rd March 2009. Tween Bridge IDB's representative for the contract was Ian Benn. Alex Jones, Kieran Sheehan, Ian Morley and Sam Bishop of JBA Consulting carried out the work.

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Purpose

This summary document has been prepared solely as a draft report for Natural England and the partner IDBs. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

Acknowledgments

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1. Thorne, Goole and Crowle Moors Water Level Management Plan

1.1 Introduction and Background

This report summarises the findings of a programme of investigatory studies, to inform a revision of the current Water Level Management Plan (WLMP) for Thorne, Crowle and Goole Moors Site of Special Scientific Interest (SSSI). Recommendations are made that, if implemented, will increase the site's ability to maintain high stable water levels, which will improve the ecological condition of the site.

Thorne, Crowle and Goole Moors form the largest lowland raised mire in England and were designated as a SSSI in 1986. Thorne Moors have since been internationally recognised, being designated as a Special Protection Area (SPA) and Special Area of Conservation (SAC). A condition assessment carried out by Natural England on 1st September 2008 found the SSSI to be in unfavourable condition, and cited drainage as a particular problem.

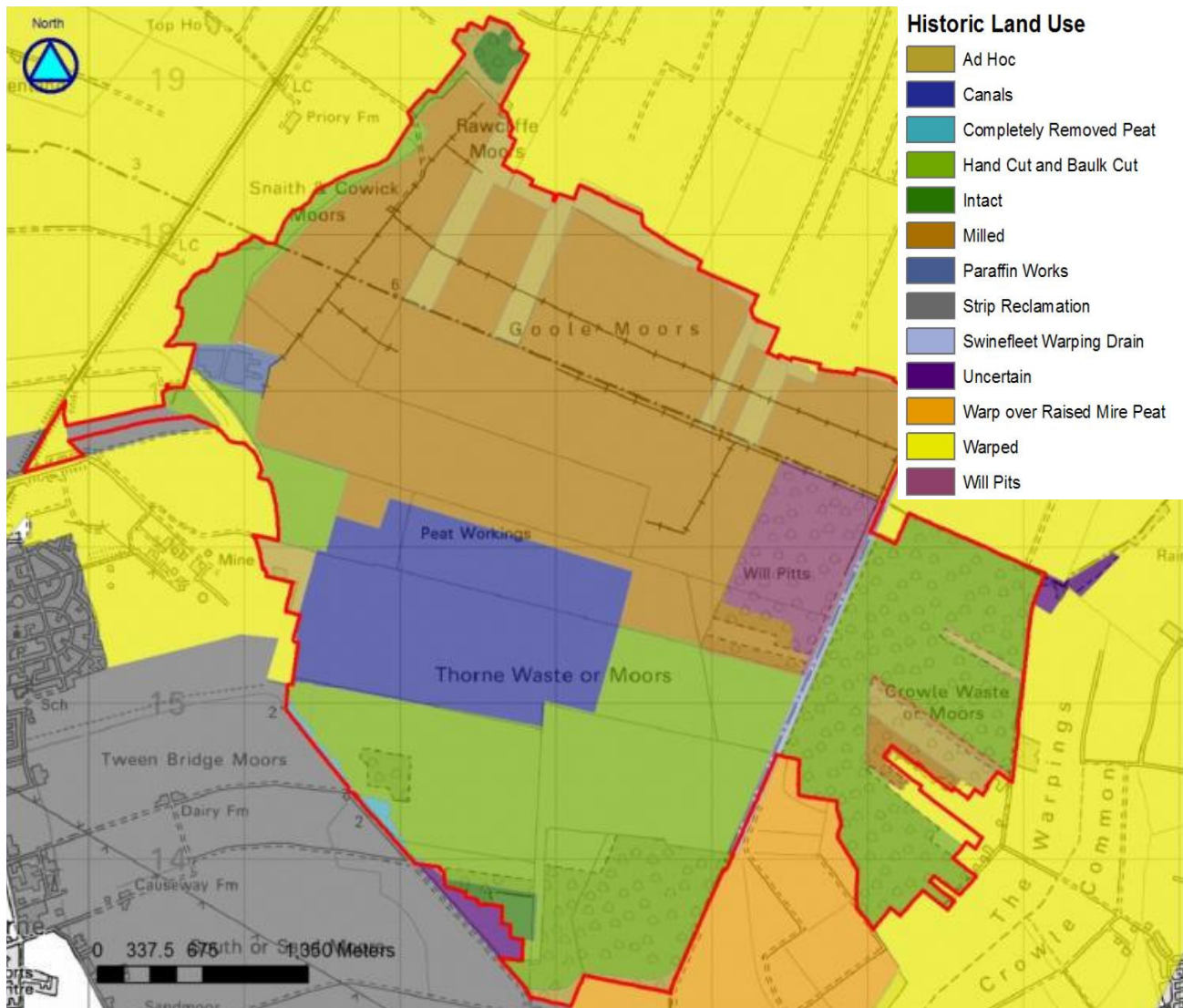
1.1.1 Site History

Thorne and Crowle Moors is a damaged lowland raised bog. Peat began to form on the low permeability 25 Foot Drift Clay Deposits around 3,000 to 4,000 years BP. Waterlogging created anaerobic conditions which slowed down the rate of decomposition of plant material and allowed peat to build up. As the peat accumulated and formed a dome, it became isolated from the surrounding catchment and so the primary source of water for the site became rainfall.

There have been a number of phases of peat cutting works on the site and a number of extraction techniques employed upon it (see Figure 1-1):

- Dutch Hand Graving – i.e. the canals area of Thorne (1890s -1940s);
- English Hand Graving – this produced the ridge and furrow topography seen on much of the south of Thorne Moors and Crowle Moors (19th and early 20th Century);
- Paraffin Works – circa 1880 deep pools to provide dense black peat for fuel were cut at the Paraffin Works;
- Mechanical Block Cutting – this produced a similar topography to the English Hand Graving Method but the cuttings were longer and denser in their cover. This appears to be limited to some areas in the south of Thorne Moors (1970-80s);
- Peat Milling – as seen on Goole Moors and other areas (1980s-90s).

As a result of these phases of extraction and the associated drainage works, the site no longer acts as an intact raised mire system.



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Figure 1-1: Historic Land Uses on and around the Site

1.2 WLMP Investigative Works

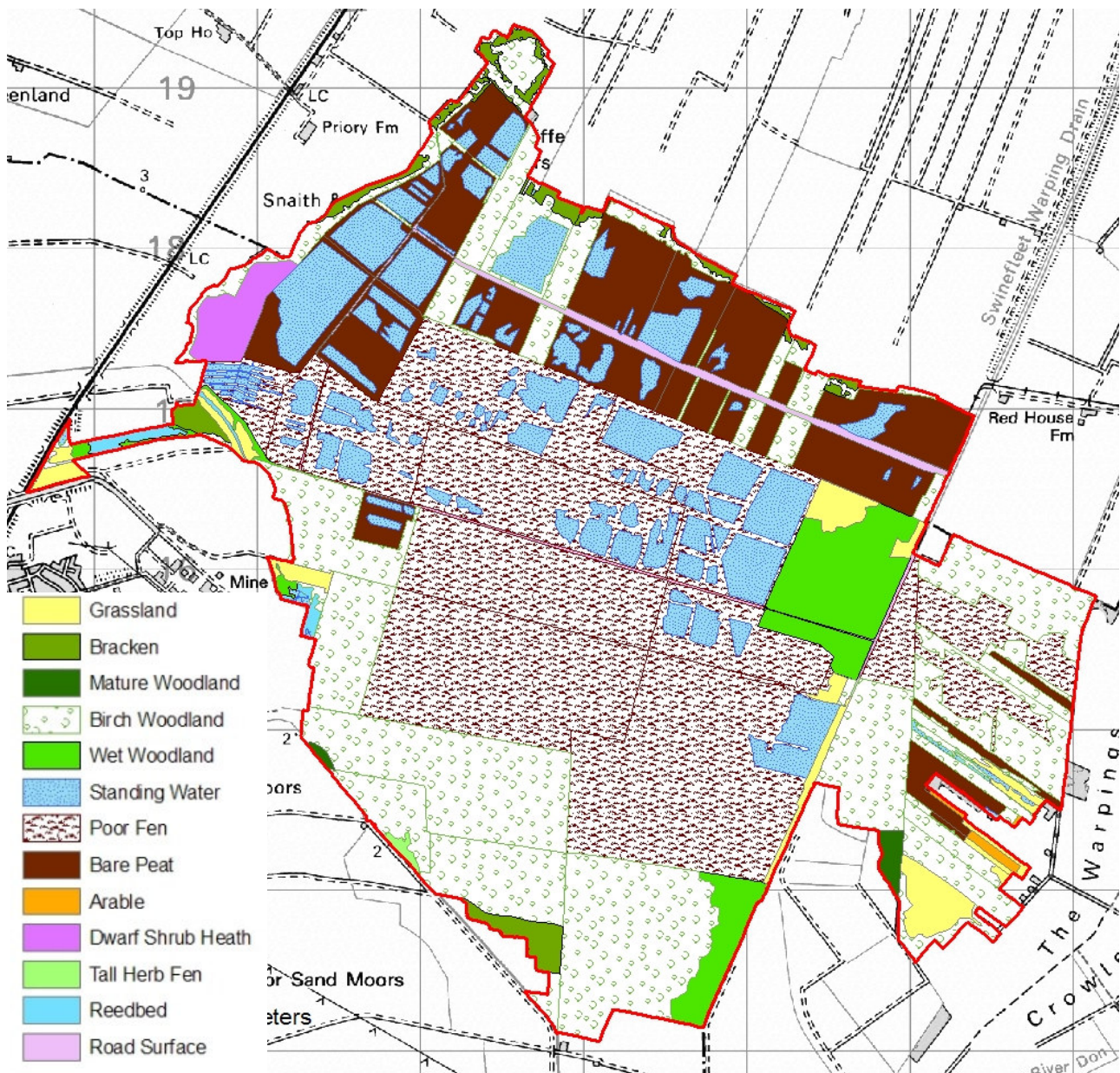
The aim of the investigative works was to research existing information about the site and produce new data which could be used to practically inform the WLMP. The following methodology was used to determine the recommendations proposed;

- A review of the historic development of the site to aid in understanding its current nature;
- A vegetation survey to identify the spatial distribution of habitats, identify key vegetation features, give an indication of the water level height and its fluctuations and inform the levels to which particular areas will achieve the desired vegetation communities;
- Geological, hydrological and hydrogeological conceptualisation was undertaken to understand how water is supplied to and moves through the system, and the controls upon the watertable;
- A semi quantitative assessment of the degree to which water level targets are currently being achieved on site;

- A review of the current Hydrological Protection Zone (HPZ) to assess where water level targets might not be achieved due to drainage around the site's periphery.

1.2.1 Ecology and Vegetation

The main vegetation interest on the site revolves around its restoration into an intact lowland raised mire, with its associated plant communities. At present the vast majority of Thorne, Crowle and Goole Moors do not meet the definition of a raised mire and much of the vegetation can be categorised as poor fen, woodland of various sorts, and open water with some grassland areas around the periphery of the peat mass (Figure 1-2). This does not mean that the existing vegetation cover does not contain any interest, in fact, quite the contrary, the moors are home to a number of rare and unusual plants, including many species of moss.



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Figure 1-2: Broad Habitat Types across the SSSI

At present the majority of the woodland is concentrated south of the Limestone (Fison's) Road, much of it being birch (*Betula spp.*) pioneer woodland that has developed on the areas of bare peat. There are, however, a few exceptions to this, including the wet woodlands at Pony Bridge and Will Pitts as well as the Oak (*Quercus robur*) woodland at Woodpecker Corner.

Poor fen exists over much of the centre of the site and, in some areas, is taking over from the birch woodland as the site becomes wetter. This habitat is characterised by the presence of soft rush (*Juncus effusus*) and cotton-grasses (*Eriophorum spp.*) and thins out northwards where it grades into the peat flats of Goole Moors and its large areas of ephemeral open water.

Crowle Moors is composed of the poor fen, birch scrub woodland and wet woodland habitats, although here their distribution is linear, based on the land holding pattern and subsequent peat-cutting that has occurred in the area.

Neutral grasslands are scattered around the periphery of the site, especially in the Inkle Moor area, with isolated patches elsewhere, such as at Elmhirst. The presence of grassland on the site is indicative of the underlying clay being present at the surface, i.e. areas that have previously been warped, cut for peat or, alternatively, areas that have never formed part of the raised mire.

1.2.2 Hydrological Understanding

Overview

The majority of the site is a degraded ombrotrophic (rainfall-fed) raised mire underlain by thick lacustrine clays and silts; this isolates it from the influence of the surrounding agricultural land except in some small areas around the boundary. Due to its size, the ombrotrophic and isolated nature of many of the areas, and the complexity of the site, the conceptualisation (the process through which all that is known about the site is brought together in a working model) divides the site into a number of sub-regions which are shown in Figure 1-3 and discussed in more detail below.

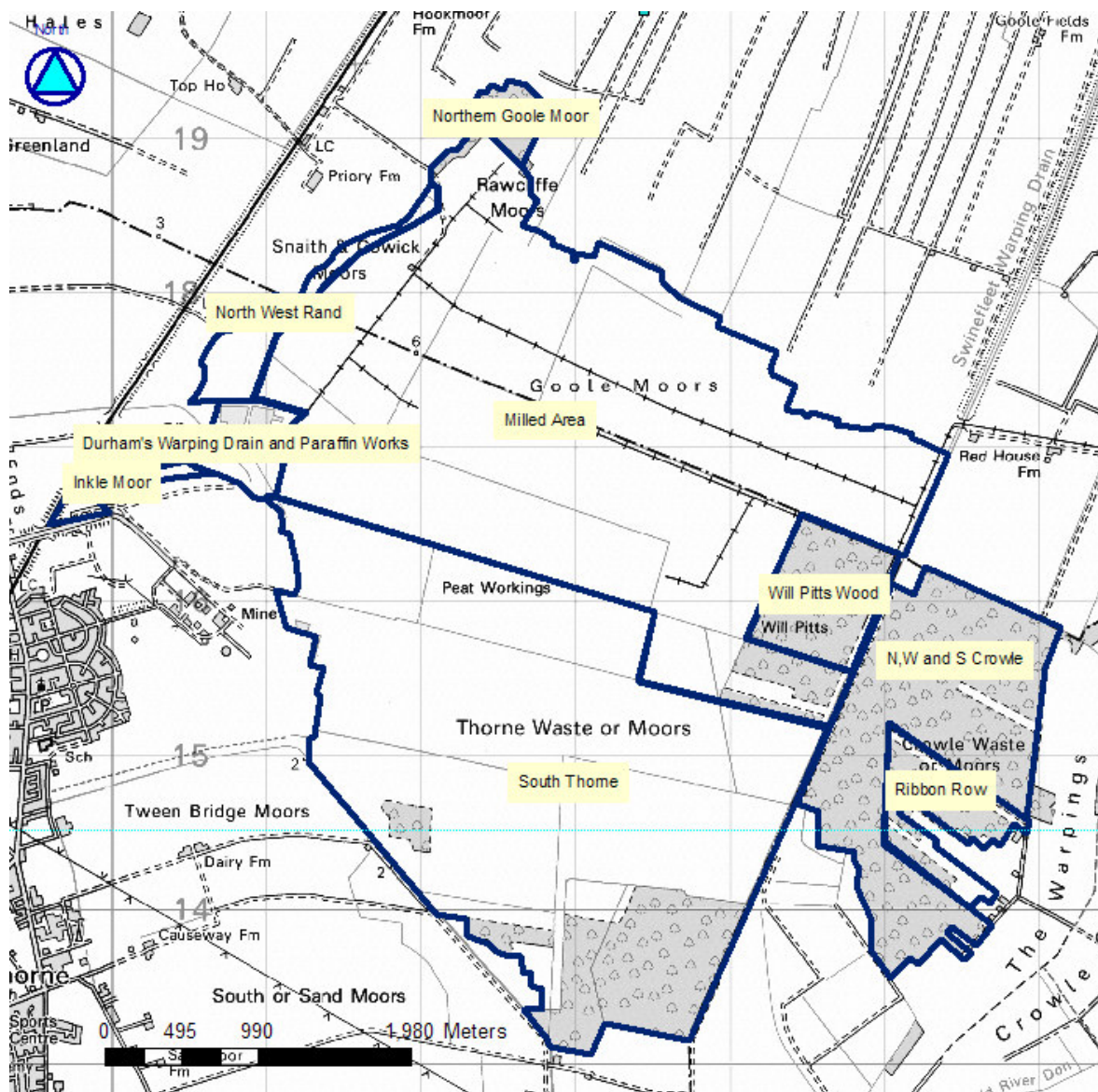


Figure 1-3: Sub-regions of the SSSI

Northern Goole Moors

Northern Goole Moors is an isolated area of intact raised mire. The area is bordered by ditches on all sides which drain the mire, leading to the establishment of bracken and birch woodland around the edges. In the centre, the watertable is near or at the surface during the winter and some *Sphagnum* is present.

The milled area

This area covers much of Goole Moors, Snaith and Cowick Moors and the northern half of Thorne Moors. It has been subject to mechanical milling peat extraction which has produced large, flat, bare fields of peat surrounded by deep drains. This whole area forms a depression in the centre of the mire. Therefore, to ensure that this area does not become what would in effect be a lake, the standing water is pumped out by Natural England into the Swinefleet Warping Drain and discharged into the Ouse. This area has been subject to a restoration programme by Natural England, who have installed an extensive series of bunds over much of the area to aid rewetting, stabilise groundwater fluctuations and thereby produce conditions that allow the appropriate bog vegetation to colonise.

The North West Rand

This area lies on the western boundary of the milled areas and stands proud of both the milled area and the agricultural land to the west. In the past it has been subject to peat extraction using English hand graving, producing the current ridge-furrow topography. On the edge of the site, a lagg alder thicket exists, which is subject to regular inundation.

The Paraffin Works

In this area peat was historically extracted to produce paraffin. The area is covered by small regularly spaced pools.

Inkle Moor

Inkle Moor has never been part of the ombrotrophic peat mass, though its western end would have formed part of the lagg around the raised mire, and has been subject to several phases of agricultural reclamation. This unit of the SSSI has been designated for its neutral grassland, interest rather than lowland raised bog.

Will Pitts Wood

This is an area of wet woodland which was subject to extraction before it was unsuccessfully warped. This led to the abandonment of this area for agricultural production and the subsequent establishment of wet woodland.

South Thorne

This area has a complicated history and includes areas subject to Dutch hand graving (the canals), English hand graving and mechanical bulk extraction, Rhododendron cultivation and agricultural improvement. This has created a complex topography and microtopography which has changed how water moves through the system. The area is made more complex by the floated roads which divide and isolate areas by acting as low permeability bunds. This has led to a very heterogeneous landscape, with areas of suitable high stable watertables lying very close to drier areas colonised by thick birch scrub.

North, West and South Crowle

This area is bounded to the west by the Swinefleet Warping Drain which isolates Crowle Moors from Thorne Moors. The area has been subject to English hand graving, which has increased the drainage of the surface of the bog. Like the South Thorne area, this area is quite heterogeneous. On its southern boundary an area of woodland, has colonised due to the efficient drainage of the agricultural land that borders the site.

Ribbon Row

This is an area in the centre-east of Crowle Moors. Here the land was historically owned in long narrow strips. These strips have been subject to different degrees of peat extraction, which has left some narrow extant strips, bordered by areas where the majority of the peat has been extracted, separated by tall peat cliffs. This has left the high areas drained and colonised by birch scrub and the low areas subject to rapidly fluctuating watertables and colonisation by *Juncus spp.*

1.3 Restoration Aims

In the areas designated under the SSSI citation for their lowland bog interest, target water levels for the site have been defined as follows (JBA Consulting, 2008):

- **The watertable is to be maintained close to the ground surface (ideally c.0.10mbgl (metres below ground level)) and should not fall to more than 0.25mbgl in more than one year in five.**
- **Water levels in the ditches should not fall more than 0.50mbgl in more than one year in five.**

These targets are based on the conditions required to create an ombrotrophic lowland raised mire in favourable condition. Due to the history of peat extraction on-site, the degree to which it has been drained, the topography and the change in the physical properties of the peat, in many areas of the site strict adherence to the water level targets will not be achievable in the short term. Figure 1-4 classifies the site with respect to the water level management targets, showing that though a large proportion of the site is sufficiently wet, over much of the site the watertable either fluctuates too much or is too low.

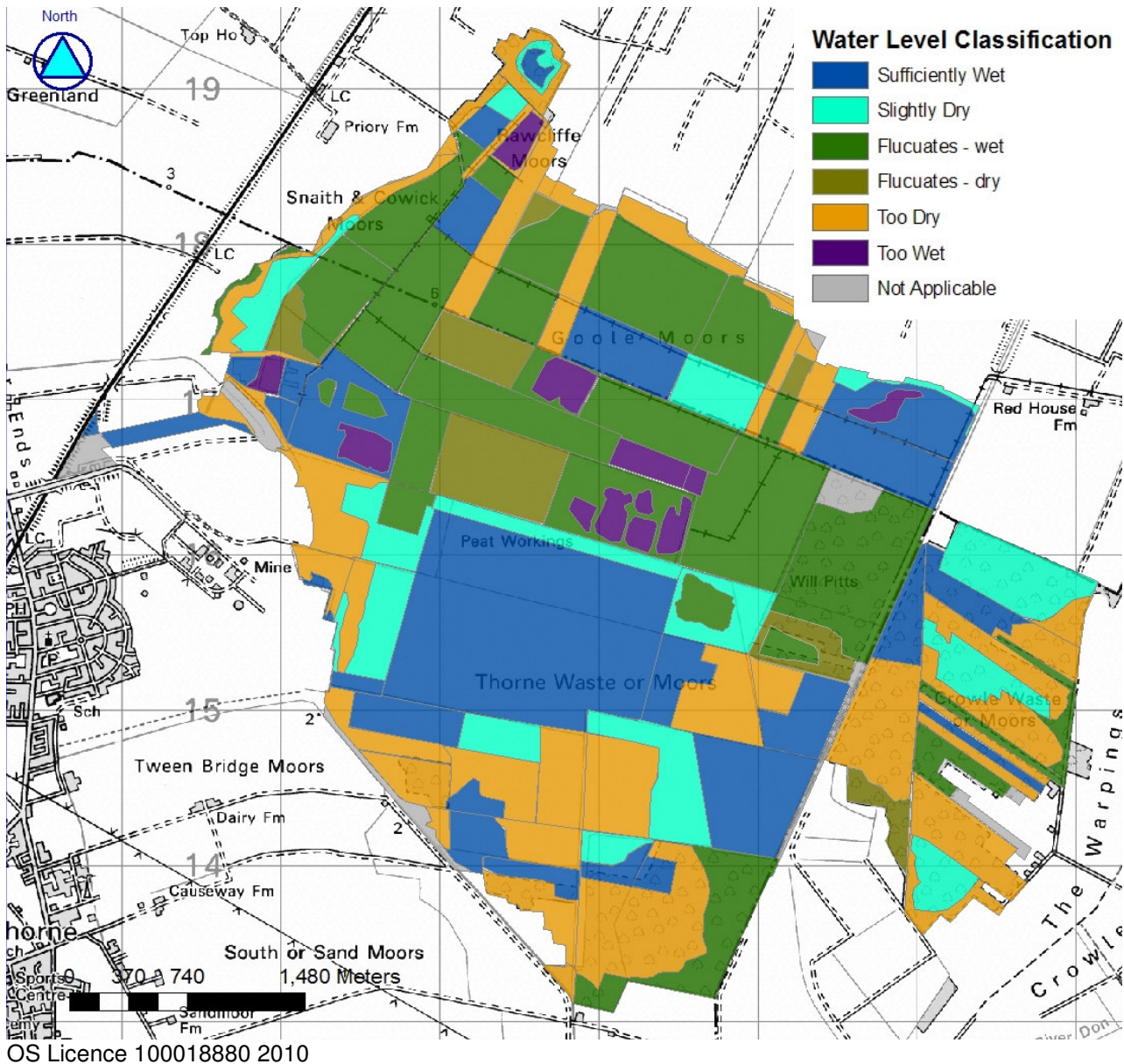


Figure 1-4: Water Level Classification across the SSSI

The full report lays out practical, interim restoration aims which will lead to a self-sustaining system which, given time, will achieve the water level targets and be a significant step towards producing a healthy ombrotrophic raised mire system. The practical interim restoration principles consist of;

- Stopping further degradation of the peat mass by raising the watertable to near or at the ground surface throughout the year;
- Removal of scrub in areas where it is inappropriate and ensuring it does not re-establish through raising the watertable;
- The establishment of peat forming vegetation;
- Given the timescales involved in the creation of raised mire peat, restoration measures should have a long life span or lead to the creation of a self-sustaining system;
- The interim restoration aims decided upon should be stepping stones towards the creation of a self-sustaining lowland raised mire system.

Due to the variation in the state of the site, the particular nature of the practical interim restoration aims varies across the site. For example, the aim for Northern Goole Moors, which is the most intact part of the site, is to create a sustainable isolated lowland raised mire within decades. Whereas, on the milled area, which has been subject to extensive recent mechanical peat extraction, the first interim aim is less ambitious; requiring the initial creation of a poor fen habitat colonised by cotton-grass and *Sphagnum* with a high, stable watertable in which peat accumulation can occur.

1.4 Proposed Plans

An options appraisal informed by the practical interim restoration aims was then conducted to assess alternative approaches to the actions required. Over the whole site similar techniques are recommended to aid restoration, these include;

- Scrub clearance;
- Bund systems, including contour bunding of hand cut areas;
- Ditch blocking;
- Piling and re-profiling;
- Lagg creation;
- New ditches outside of the mire;
- Levees;
- Pumping and modification of the drainage regime.

The preferred option best fulfils the practical restoration aims and will aid in leading to the creation of a self-sustaining ombrotrophic raised mire habitat in favourable condition. The location of the structures in the preferred option are shown in Figure A 1 and Figure A 2.

The overall cost of the preferred option has been estimated to be £3.7 million. The table below breaks this cost down into the sub-regions where they will be incurred and the type of works that are required.

Table 1-1: Costings break-down by area

Costing Area	Northern Goole Moor	milled area	South Thorne	Crowle	North West Rand	Inkle, Durham's and Paraffin
Works	Costs (£)	Costs (£)	Costs (£)	Costs (£)	Costs (£)	Costs (£)
Clearance of woodland and scrub	31,000	112,500	491,000	310,000	38,200	31,000
Reprofiling	N/A	11,800	47,800	113,800	N/A	N/A
Creating and infilling drains and levee creation	10,800	N/A	19,200	10,400	9,200	100
Drain Blocking	1,500	N/A	N/A	2,400	200	1,000
Bunding	N/A	382,000	18,500	47,900	N/A	N/A
Handling Peat and Clay	N/A	12,700	63,500	151,000	N/A	N/A
Piling	N/A	29,600	14,400	N/A	N/A	N/A
Adjustable Weirs	N/A	19,100	38,600	16,600	N/A	N/A
EIA(Environmental Impact Assessment)	20,000	N/A	N/A	N/A	N/A	N/A
Pumping Station	N/A	815,000	N/A	N/A	N/A	N/A
Preliminaries (site set up, planning etc.)	8,700	276,600	144,200	130,500	9,500	6,400
Engineer's Fees	3,500	111,200	86,800	52,400	3,800	2,600
Total	75,500	1,770,500	924,000	835,000	60,900	41,100

1.5 Impacts of Thorne, Goole and Crowle Moors on the surrounding land

1.5.1 Current Impacts on the Surrounding Land

Due to the site's current drainage, topography and the underlying clay, water levels on site and in the surrounding area tend to have little influence on each other. The site, though it does not currently meet the water level targets, is in general, significantly wetter than the surrounding agricultural land. This, however, does not mean the wet nature of the site puts additional strain on the surrounding agricultural system; rather the reverse. The site is fed solely by rainfall, and so it is wetter because it is able to hold onto its water and store it on-site for a greater period than the well drained agricultural land. This means that more water is lost to evapotranspiration and peak flows off the site are attenuated. There are however certain areas where water from the site does enter the surrounding agricultural drainage network.

Surface water

There are a number of current surface water discharge points off-site, which are also shown on Figure 1-5;

- Angle Drain (below Will Pitts Scrape) (NGR 474405, 414697) (Point 1);
- Angle Drain (to Thorne Waste Drain) (NGR 472861, 413113) (Point 2);
- Pumped from Blackwater Dike (NGR 475226, 416618) (Point 3);
- Drain on the northern edge of the paraffin works (NGR 470527, 417271) (Point 4);
- Discharges through the North Rand (NGR 474850, 417150; 474350, 417250 and 473081, 418215) (Points 5, 6 and 8);

- Though the Southern Boundary Drain is blocked by an earth bund (NGR 471282, 415150), this regularly overtops (Point 7);
- Other minor discharge points (e.g. Point 0).

The majority of these points tend to have relatively small discharge rates. The discharge points from Goole Moors northwards have only been observed to flow in the winter when water levels on Goole Moors rise enough above the surface to allow water to flow off-site. The majority of the other major discharge points either have control structures on them, or earth bunds, or in the case of point 3 is the pumping station.

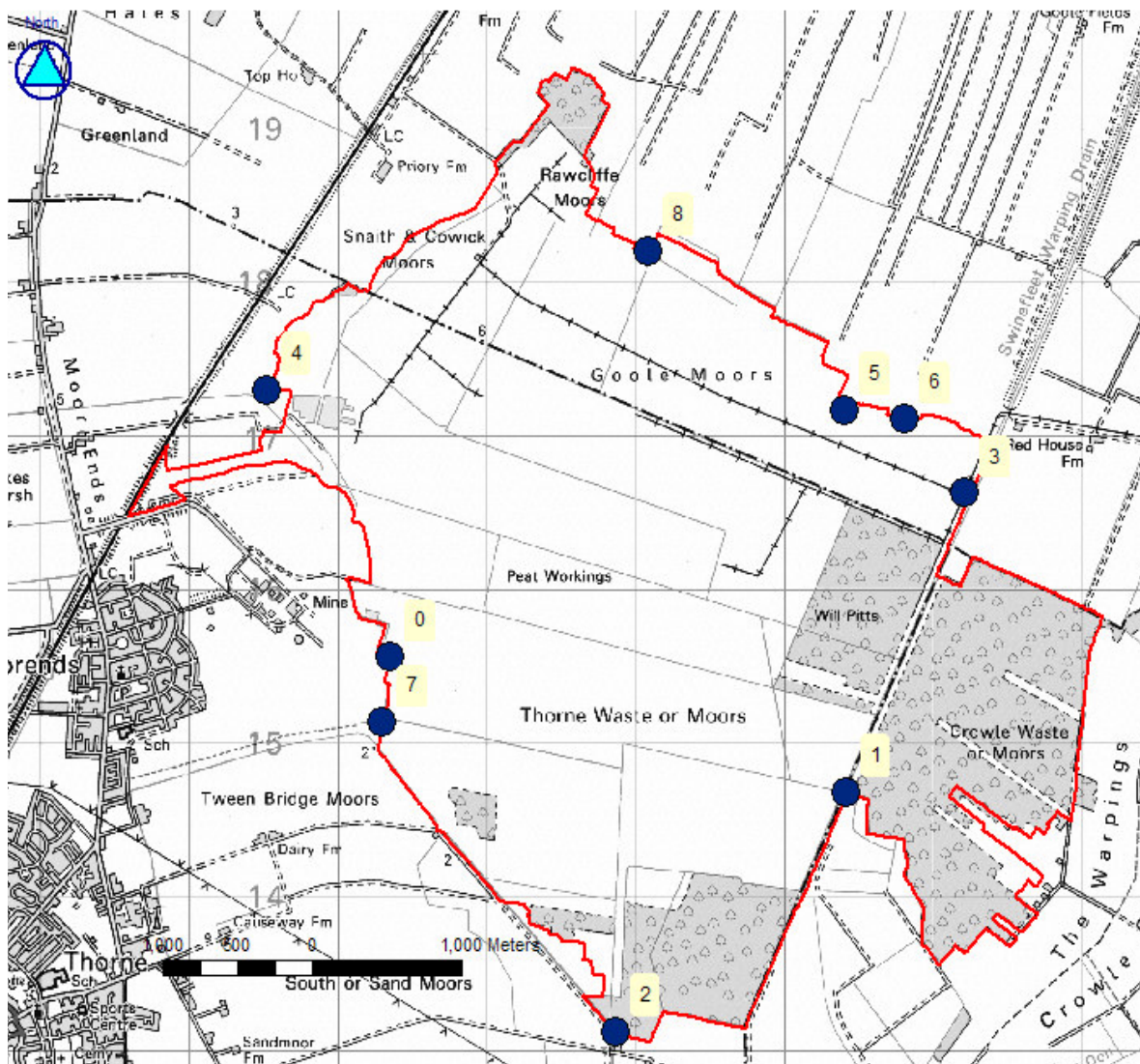
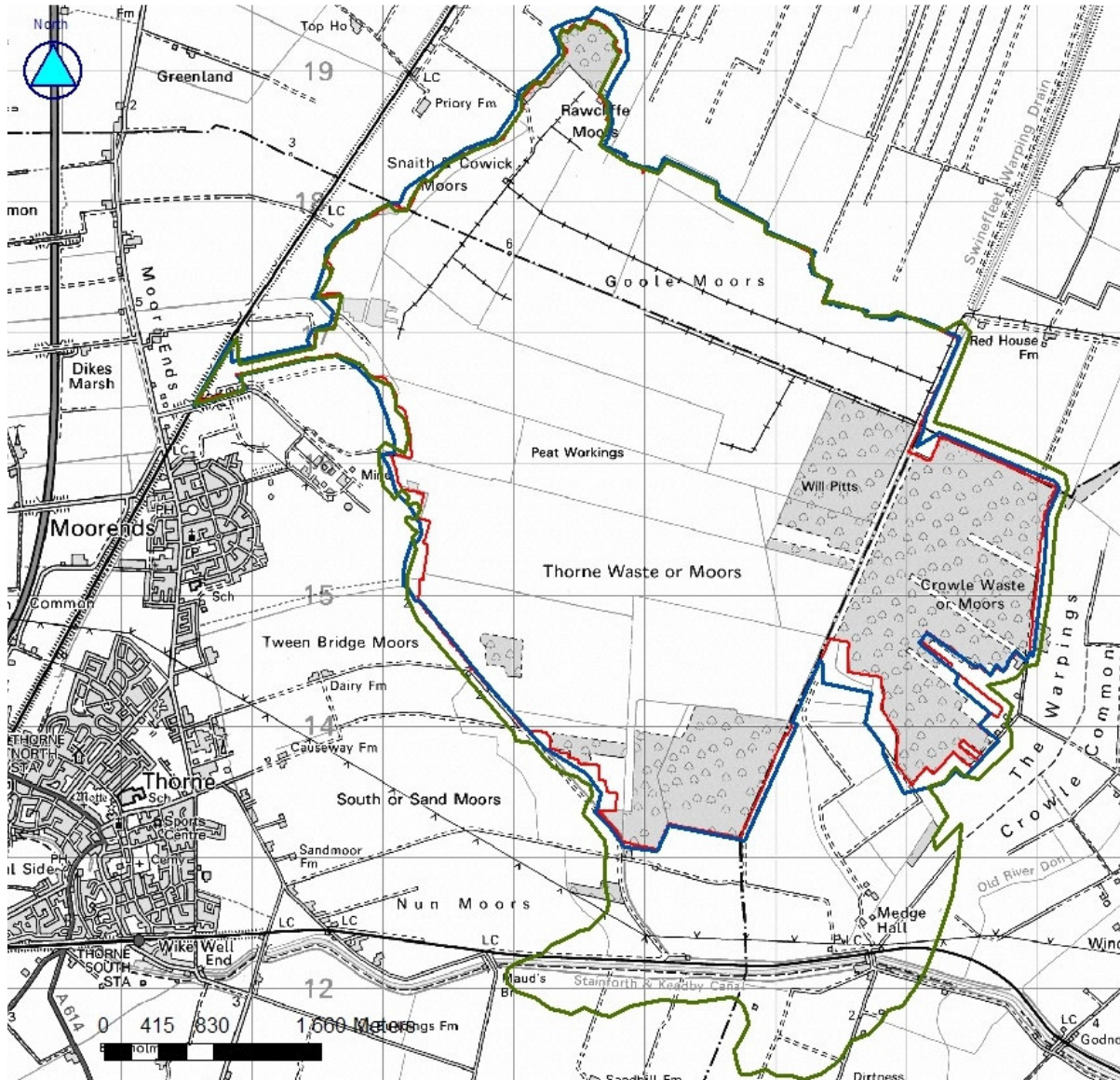


Figure 1-5: Surface water Discharge Points

Groundwater

There are several points when the boundary drain acts to lower the watertable in the peat on the site. Under Natural England guidelines, areas where drains act to lower the watertable on the bog should form part of the Hydrological Protection Zone (HPZ). During this study, the current Natural England proposed HPZ has been reviewed and suggestions has been made

to where it could be adjusted, given the finding of this study. This has resulted in a smaller overall proposed HPZ, though slightly larger in key locations, such as Northern Goole Moors, where the boundary ditch was observed to drain the bog.



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Figure 1-6 Natural England Proposed HPZ and the Adjusted Proposed HPZ (Green = Natural England Proposed HPZ, Blue = proposed adjustments and Red = SSSI site boundary)

In Figure 1-6, in areas where the adjusted proposed HPZ deviates from the site boundary, it is believed the drains in these areas are lowering groundwater on the site and discharging groundwater to the surrounding drainage system.

1.5.2 Impact on the Proposed Restoration Scheme on the Surrounding Land

Modifications to the Drainage Regime

The proposed restoration plan will have two main impacts on the surrounding land and the IDB drainage systems;

- The existing Natural England pump which discharges water to the Swinefleet Warping Drain would be replaced by a new pumping system based on automated telemetry. This would maintain relatively high water levels within the main ditches all year, whilst still maintaining the capacity to deal with large rainfall events. The capacity of this system will be subject to discussions with the Engineer to the relevant IDBs
- Increasing the number of discharge points from the system by reopening ditches that breach the North West Rand at NGR 472057, 418769 (Creykes Gate) and 470476, 417290 (Durham's Warping Drain). At the detailed design stage the impact on the downstream catchment and pumping stations will be assessed. This will include an assessment of suitable maximum consented discharge rates.

Both these changes are designed to aid in the management of the drains on the milled area (Figure 1-3) and allow a more flexible drainage system to be run.

Other Control Structures

In addition to the proposed changes to the way the milled area drainage is managed, there will be three new adjustable control structures on major discharge locations; two of which would replace existing structures. These locations are;

- Angle Drain (below Will Pitts Scrape) at NGR 474405, 414697;
- Southern Boundary Drain at NGR 471282, 415150;
- North East Corner of Crowle Moors at NGR 476144, 415823.

At these locations adjustable weirs will be installed to better control the rate of discharge off site. The setting of suitable maximum discharge rates from these structures will be informed by on-site monitoring and discussed with the Engineer to the relevant IDBs.

Lagg Creation Area

In intact lowland raised mires, lagg habitats form a semi wet transition habitat from the main peat mass to the surrounding land. Around Thorne Moors, much of this habitat has been agriculturally improved and drained. The review of the HPZ (see Figure 1-6) has identified areas where the agricultural drains lower the watertable on-site. Under the restoration plan it is proposed that many of these areas be reverted to lagg habitat. In general, lagg creation areas consist of;

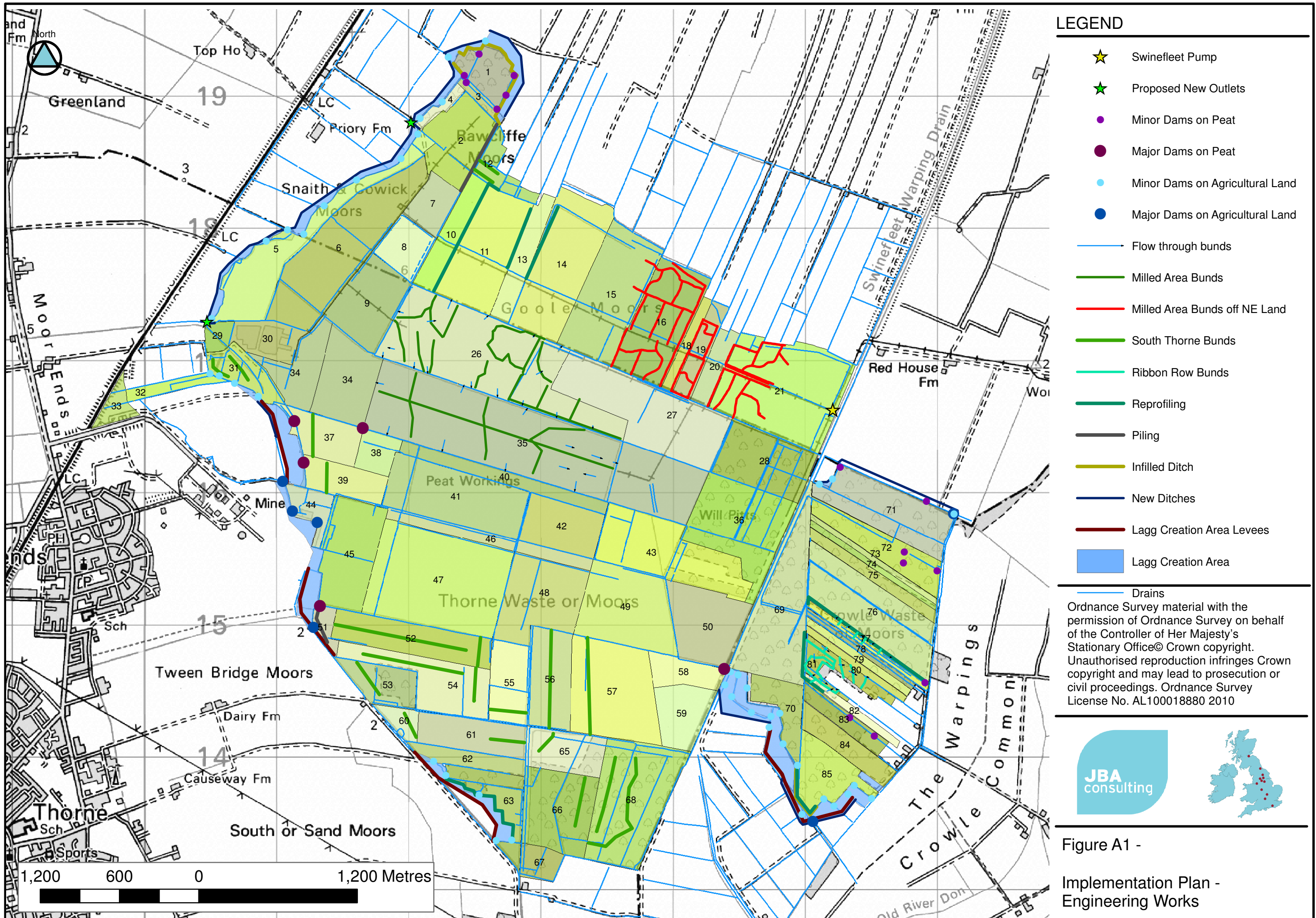
- Blocking boundary drains;
- Building levees where required;
- Reinstating agricultural boundary drains away from the bog edge in locations where they will no longer receive input from the bog;
- Allowing the area in between the site boundary and new drains to form a buffer zone of intermediary habitat.

It is hoped that this will have two impacts; firstly to reduce drainage from the boundary of the site to maintain high groundwater tables on-site; and secondly reduce the volume of groundwater discharging from the site to the surrounding agricultural drains, especially reducing peak flows through attenuation.

Appendices

A. Additional Figures

Figure A 1: Implementation Plan - Engineering Works
Figure A 2: Implementation Plan - Scrub Clearance



LEGEND

- ★ Swinefleet Pump
- ★ Proposed New Outlets
- Minor Dams on Peat
- Major Dams on Peat
- Minor Dams on Agricultural Land
- Major Dams on Agricultural Land
- Flow through bunds
- Milled Area Bunds
- Milled Area Bunds off NE Land
- South Thorne Bunds
- Ribbon Row Bunds
- Reprofiling
- Piling
- Infilled Ditch
- New Ditches
- Lagg Creation Area Levees
- Lagg Creation Area

Drains
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Figure A1 -
 Implementation Plan -
 Engineering Works



LEGEND

Proposed Scrub Clearance

- Wood Type**
- Dense
 - Less dense
 - Scattered trees
 - Management Compartments

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Figure A2 -
Implementation Plan -
Scrub Clearance





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