



EASTER INCH MOSS AND SEAFIELD LAW LOCAL NATURE RESERVE

Hydrological Survey

FINAL

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1.0 INTRODUCTION

Ironside Farrar Ltd was appointed by Central Scotland Forest Trust to carry out a hydrological survey of the Easter Inch Moss and Seafield Law Local Nature Reserve. The extent of the site is shown on Drawing 4467/101.

The survey was to assist with a parallel study by Ironside Farrar Ltd to develop a 5 year Management Report for April 2011 to March 2016.

The survey was to focus on the raised bog and wetland, identify existing water resources within the LNR and their sustainability, the condition of drainage in controlling water levels, the ability of the wetland to store water, an assessment of whether these conditions are optimal for current habitat sustainability and future target habitat (particularly if new tree planting is introduced) and recommendations or actions identified for the future.

The survey comprised the following:

- Walkover surveys in January / February 2011;
- Review of existing aerial photography and OS map data;
- Review of SEPA flood mapping data.

Also incorporated was information from the tree survey and habitat surveys carried out by Ironside Farrar Ltd in 2010 / 2011.

2.0 TOPOGRAPHY

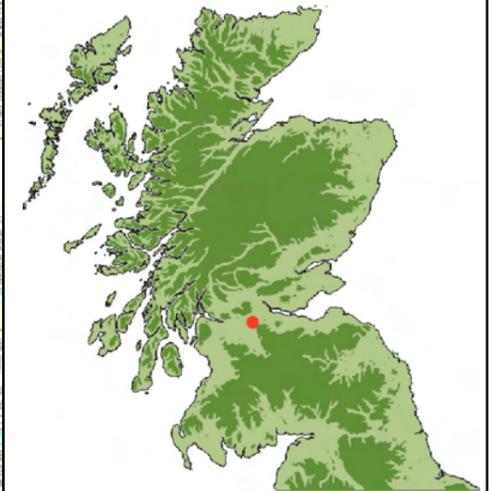
From 1:25,000 scale ordnance mapping the topography of the site can be described as follows:

The western half of the site, i.e. the Moss area, is broadly flat typically 160 m Above Ordnance Datum (AOD). To the north the site rises slightly to around 165 m AOD before falling back down towards the M8 Motorway. To the south the site rises again this time to around 170 m AOD along the line of the A705 before falling more steeply towards the River Almond.

The eastern half of the site is dominated by the Seafield Law Bing which rises steeply from the eastern edge of the Moss. To the south of the bing lies a gently undulating area of woodland plateau and scattered scrub. The site falls gently towards the south east following the route of the Dean Burn to approximately 155 m AOD and to the north east following an unnamed burn to approximately 150 m AOD.

Contours are shown on Drawing 4467/105.

**Easter Inch Moss
& Seafeld Law
Local Nature Reserve**



National Context

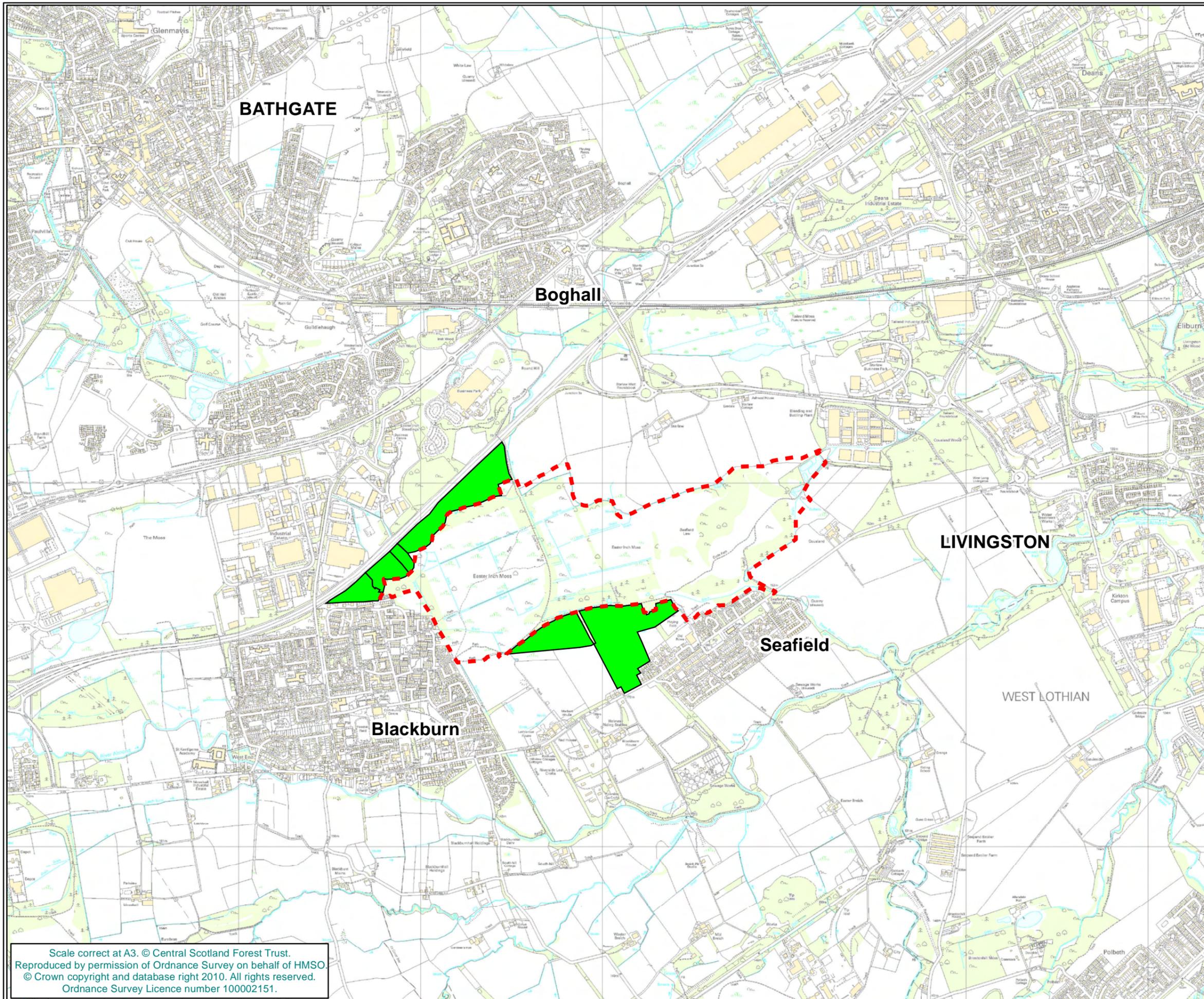
Legend

-  Site Boundary
-  Potential Tree Planting Opportunities

Dwg No 4467_101



Site Plan



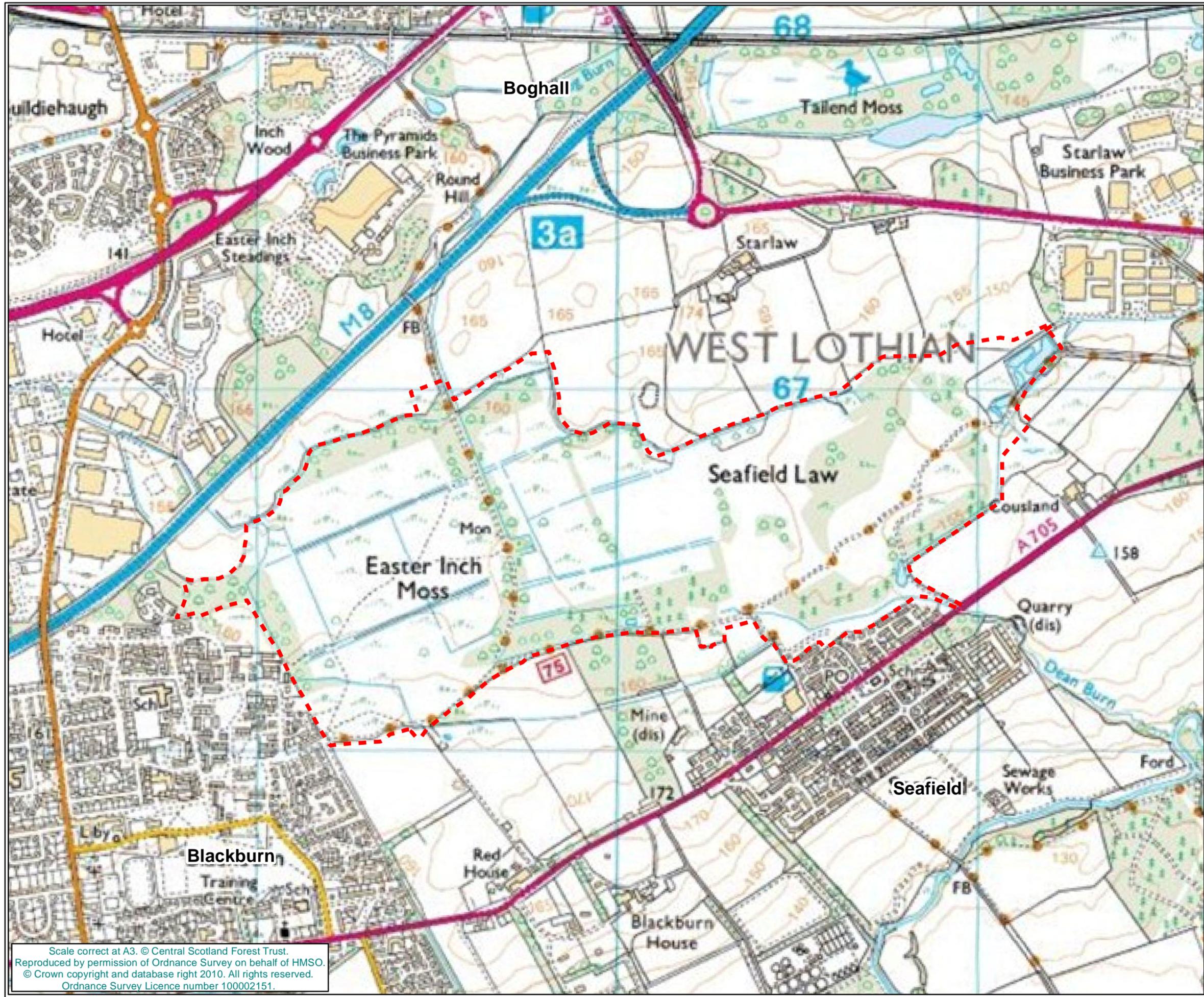
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Easter Inch Moss & Seafeld Law
Local Nature Reserve



Legend

 Site Boundary



Dwg No 4467_105



Site Boundary and
25k OS Base

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3.0 SITE SURVEY

The site survey comprised a series of walkover surveys and visual assessments of the existing water features within the Local Nature Reserve. No archive data relating to water features was made available by the client and no site investigation was carried out. Informal discussions with the Local Nature Reserve Management Group have, however, assisted the understanding of the site's hydrology.

It should be noted that due to client deadlines and freezing weather conditions the site survey was carried out over a short period of time in February / March 2011. It can, therefore, only be regarded as a 'snapshot' of the hydrological regime.

The main hydrological features are identified in Drawing No. 4467/401 and referred to below:

- Easter Inch Moss;
- Dean Burn;
- North Drain;
- West Drain;
- South Drain;
- East Drain;
- Culvert A;
- Culvert B;
- Culvert C;
- A705 Culvert;
- French Drain Network (Gas Vents?).

Each of these is discussed in more detail below.

3.1 Easter Inch Moss

The Moss covers an area of around 80 hectares and, therefore, detailed assessment of its hydrology is difficult from a single visual survey. The following is, however, clear:

- The majority of the Moss has been worked at some time and a series of ditches and ridges cut through the Moss sub-dividing it into various compartments. The National Cycle Network (NCN) cycle route also bisects the Moss into eastern and western areas.
- The ditches are not always continuous and sections discharge at different points to the various drains which bound the Moss. As a result each of these compartments will likely have a different hydrology. This is evident by the different underfoot conditions observed during the walkover which range from very dry to very wet (and impassable by foot).
- The topographical information from OS Plans would suggest that the Moss is essentially a local high spot and, therefore, its water catchment area is effectively its own boundaries. No watercourses or land currently drains towards the Moss.
- Water does, however, leave the site via 4 watercourses / drains i.e.:
 - West Drain;
 - North Drain;
 - South Drain;

**Easter Inch Moss
& Seafeld Law
Local Nature Reserve**

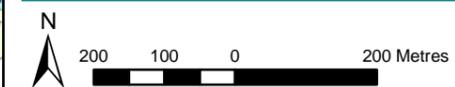


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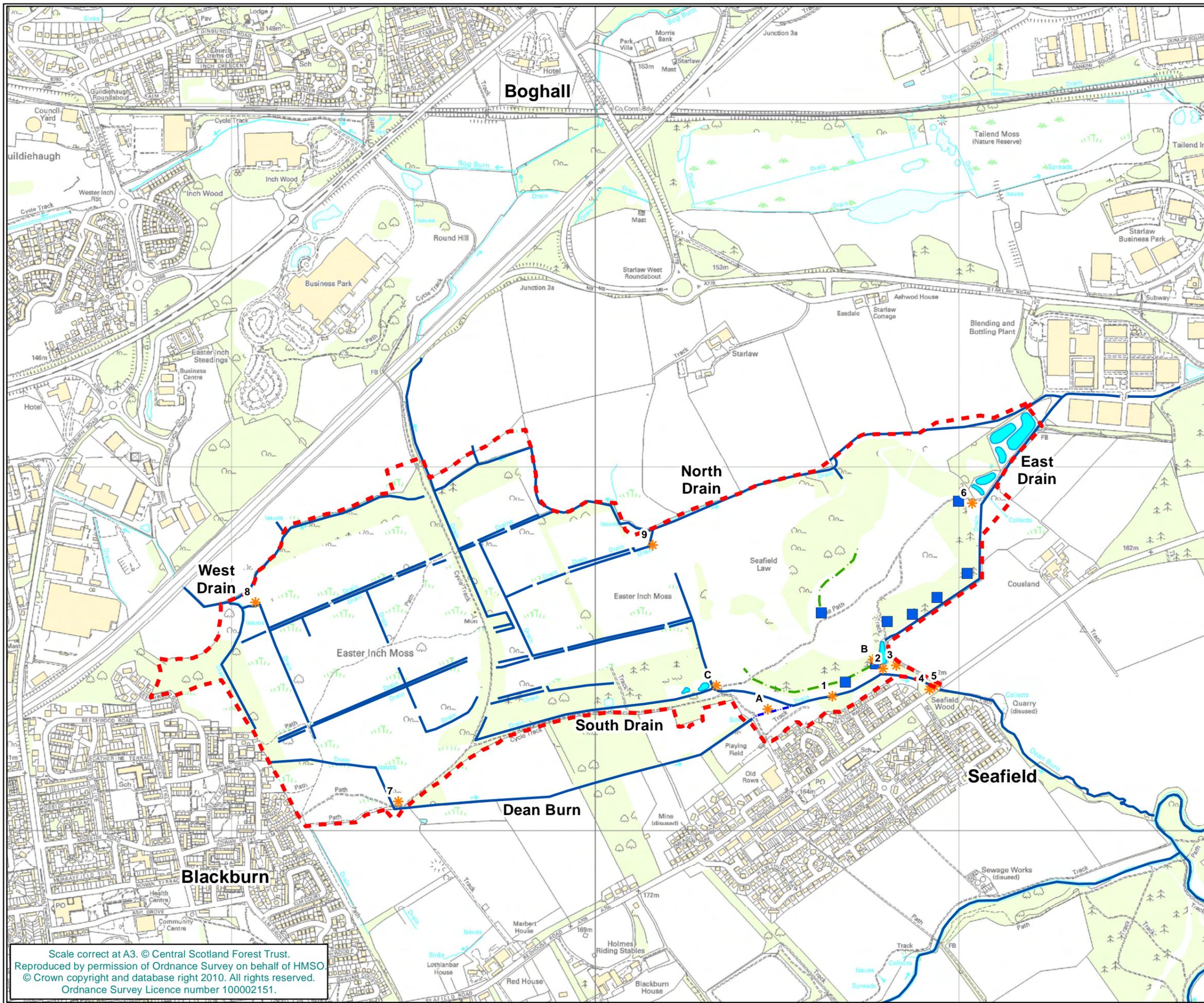
- - - Site Boundary
- Watercourse / Drain
- - - Culvert
- - - French Drain
- Existing Ponds
- Manholes
- * Drainage Features

- A - Culvert A
- B - Culvert B
- C - Culvert C
- 1 - Assumed outlet from WWPS
- 2 - Pond Overflow
- 3 - Redundant septic tank
- 4 - Blue MDPE Outfall (possibly from scour valve)
- 5 - Plastic Outfall
- 6 - Plastic Outfall
- 7 - Path Crossing
- 8 - Fallen Tree
- 9 - Raised Bog

Dwg No 4467_401



**Drainage -
Existing Survey**



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- Dean Burn.
- Water levels were low in the majority of drains / ditches and water flows were also low or non-existent. It is expected that during high rainfall water levels and flows in these ditches are significantly higher.
- Whilst difficult to confirm without detailed measurements or long-term monitoring it would be reasonable to assume that there is a gradual constant drawdown of water from the Moss with replenishment of water levels during each rainfall event. As a result water levels will likely fluctuate with the seasons with a general lowering of the water table during the summer months. This is backed up by anecdotal evidence from the management group.
- The many ditches around the site will speed up the drawdown process, however, the lack of maintenance of the ditches has resulted in numerous blockages from silt, fallen trees and other debris. This is clearly reducing the effectiveness of the ditches and helping raise the water table in the Moss.
- The ditches only appear to reduce the water table in their immediate vicinity as water was observed at the surface of the Moss in many locations.
- The eastern half of the Moss is identified in the SEPA flood records as liable to flooding as are sections of the North Drain and the farmland to the north.
- Within the Moss Area are several ponds some of which have been created relatively recently as part of restoration / improvement works. These ponds (and nearby ditches) have areas of deep standing water with surrounding unstable (peat) areas. These areas could be potentially hazardous and we would recommend that a risk assessment be carried out to determine if action is required. We note the other formal ponds are completely fenced off on the Nature Reserve due to this risk. Whilst fencing would be undesirable (at least aesthetically) some form of edge treatment may be appropriate.

3.2 Dean Burn

The Dean Burn appears to originate from the south west corner of the Moss where it collects water via a concrete drain crossing under the adjacent cycle track. The Burn leaves the Nature Reserve at this point passing through adjacent farmland and Seafield Playing Fields before re-entering the site near the Old Rows car park. The Burn passes through a Culvert (Section 3.7) at this point before returning to an open ditch where it joins the South Drain (Section 3.5). The Burn continues along the southern edge of the site in a deep sided ditch before leaving the site via a Culvert below the A708 (Section 3.10).

Water levels in the Burn were relatively low during the inspection with low flows throughout. The deep sided Burn does, however, have capacity to carry significant flows during wet weather limited only by the two culverts.

Evidence of fly tipping / litter was noted along the Burn with debris partially blocking sections or used as makeshift crossing points. The fly-tipping was worst adjacent to the Old Rows Playing Field (just outwith the Nature Reserve Boundary).

Several outlets and other features were also noted along the Burn. These are detailed on Drawing No. 4467/401 and as noted below:

1. Assumed outlet for WWPS

A 300 mm diameter concrete pipe outfalls into the Burn. This was not running during the inspection but it appears to originate from the nearby Heather Park Waste Water Pumping Station. It is assumed this is an emergency overflow to the Dean Burn. Given this is a Local Nature Reserve it is recommended that Scottish Water be consulted on the frequency and nature of any discharge from the WWPS to review whether this is impacting adversely on the watercourse.

2. Pond Overflow

A 150 mm diameter outfall was noted at the southern end of the middle pond. It is assumed this is a simple overflow device for the pond, however, no records were available to confirm this. Scour from the outfall has resulted in some pipe sections collapsing. This is obviously progressing towards the pond and remedial works are recommended to prevent a breach of the pond or undermining of its perimeter fence.

3. Redundant Septic Tank

A redundant septic tank was recorded adjacent to the Burn which presumably overflows to the Burn. The tank had no cover during the inspection. We would recommend that the cover be replaced or the tank removed / infilled as a matter of urgency.

4. Blue MDPE Pipe

A small diameter pipe outfalls to the Burn close to the A705. This sort of pipe is normally associated with fresh water and it is likely that this is an overflow from the nearby Scottish Water scour valves on the main road. The pipe was not running during the inspection.

5. Plastic Outfall

A 150 mm diameter plastic pipe outfall to the Burn close to the A705. It is assumed this is associated with local land drainage. The pipe was not running, however, minor scouring was noted around the outlet.

3.3 North Drain

This drain appears to originate at the north west corner of the Moss area and from this point flows northwest and easterly along the site boundary.

The ditch is deep sided (over 4 m in places) and collects drainage ditches from the Moss and from the farmland to the north.

Water levels were generally very low in the ditch and in places several metres below the adjacent ground level of the Moss. The ditch was relatively flat along its length and water movements were minimal in places. The ditch appears to flow westerly and easterly from its apparent origin. The ditch steepens slightly as it leaves the site to the north and also along the northern edge of the bog where water flows are more evident.

3.4 West Drain

This appears to originate in the north west corner of the Moss and collects water from the drainage ditches that cut through the Moss in that area. The drain falls gently from this point to a culvert underneath the M8.

An uprooted tree was noted to be partially blocking the drain near the edge of the Moss. As a result water levels immediately upstream were approximately 500 – 600 mm higher than the drain. Removal of this tree would likely result in an increased drawdown of water from the Moss in the immediate vicinity.

3.5 South Drain

This appears to originate at the south of the Moss and collects water from the drainage ditches that cut through the Moss in that area. The ditch runs at very shallow falls to the east passing through Culvert C (Section 3.9) before meeting the Dean Burn (Section 3.2).

The ditch had standing water along much of its length.

3.6 East Drain

This appears to originate just east of the middle pond and collects run-off from the adjacent woodland and farmland. The ditch runs along the eastern boundary of the site past several SUDS ponds before joining the North Drain (Section 3.3) just outwith the Local Nature Reserve Boundary.

The drain was relatively dry during the inspection with only low flows observed. The ditch appears to be entirely separate from the Sustainable Urban Drainage System (SUDS) ponds which are at a higher water level.

The drain meets another V-channel just upstream of the SUDS pond. This collects water from a small 150 mm diameter land drain which appears to be part of the French Drain Network (Section 3.11).

The ditch is relatively deep along its length, however, does broaden out in an area upstream of the SUDS ponds. This area would appear to flood during high rainfall.

3.7 Culvert A

This is a 1050 mm diameter concrete culvert with brick headwalls. The culvert is approximately 120 m long and carries an upstream section of the Dean Burn.

The culvert was relatively clear although some fly-tipped debris was observed. Water flows were light during the inspection. The culvert was 50% submerged at the downstream outlet. The culvert has no grills at either headwall and is in close proximity to a public footpath. The landfill site and the peat bog are both sources of potentially hazardous gases and an accessible confined space such as this culvert presents a high risk of asphyxiation. We would recommend that a grill is fitted as a matter of urgency.

3.8 Culvert B

This is a 1000 mm diameter steel pipe with a brick headwall. The purpose of the culvert is unclear but it appears to be the outlet from the French Drain network (Section 3.11).

The culvert was partially silted (20%) with standing water in the adjacent ditch.

The culvert has no grill at the outlet, however, it is relatively inaccessible. As Culvert A, however, this confined space is in close proximity to the landfill site and the peat bog. There is, therefore, a high risk of asphyxiation due to potentially hazardous gases. We would recommend a grill is fitted as a matter of urgency.

3.9 Culvert C

This is a 1200 mm diameter concrete culvert which acts as a bridge crossing of the South Drain for the cycle track. The culvert has steel grills at either side but no headwall.

The culvert itself was clear, however, a build up of silt / debris on the upstream side to approximately 25% has raised water levels immediately upstream.

The culvert is clearly a throttle point for a lot of the ditches from the Moss and is clearly helping slow water seepage from the Moss. Clearing the culvert grill would result in quicker draining of the Moss and also the adjacent temporary pond created upstream.

3.10 A705 Culvert

This is a 1500 mm diameter stone built culvert below the A705 carriageway. The culvert has a metal grill covering most of the inlet, however, one of the vertical bars was missing.

Immediately upstream of the culvert is a galvanised steel trash screen and handrail which was clear of debris.

Two 150 mm diameter pipes discharge to the burn through the culvert headwall. It is assumed these are from road drainage. The gully above the culvert was choked and evidence of scour from the carriageway was also noted.

We would recommend that the gully be cleared and the grill repaired.

3.11 French Drain Network

A series of stone (french) drains and manhole chambers were identified in the eastern and northern areas of the site around the bing. It is suspected that these are part of the venting system for the natural landfill site, however, they will also carry surface / groundwater across the site.

Without access to detailed records it is difficult to understand these completely, however, they appear to follow the edge of the landfill site to the north of the Dean Burn and the East Drain. Two other sections were noted at the toe of the Seafield Law Bing.

During the survey one chamber was overflowing into the East Drain (near Cousland).

A second outfall, comprising a 150 mm diameter plastic pipe, to an open ditch at the eastern end of the site was noted.

Approximate locations of the chambers and drain runs are recorded, however, vegetation cover may mean these observations are incomplete.

4.0 MANAGEMENT RECOMMENDATIONS

Management recommendations have been divided into three main sections:

- Works Requiring Immediate Action;
- Bog Restoration Works;
- Longer Term Actions.

4.1 Works Requiring Immediate Action

Several of the drainage structures on the site present a current hazard and we would recommend that these are addressed as a matter of urgency. These are as follows:

- Culvert A and Culvert B are large diameter pipes with no grills to prevent access. The peat bog and landfill site are both potential gas sources and, therefore, there is a real risk of asphyxiation in both these Culverts. We would recommend that grills are fitted immediately.
- An old septic tank is located in woodland adjacent to one of the paths. The cover of the tank is missing and should be replaced immediately to avoid accidental falls into the tank. Given the tank is redundant consideration should be given to removing / infilling the tank to prevent this issue reoccurring.
- There are several deep ponds and ditches in close proximity to public footpaths. These are man-made structures and, therefore, there is a responsibility on the site's owners to ensure they do not represent a significant hazard. We would recommend a risk assessment be carried out and consideration given to appropriate signage or edge treatment.

4.2 Bog Restoration Works

The client has expressed a desire to restore the original raised bog as far as possible and Ironside Farrar Ltd have scoped some works that could be considered to achieve this. In preparing these proposals the following issues have been considered:

- The main drainage ditches are clearly drying out across areas of the Moss. Despite this there are areas which remain wet with the water table at or near the surface.
- The drier areas of the Moss do make it accessible to walkers (and also less desirable users i.e. off-road bikes). Raising water levels may make larger areas of the Moss inaccessible.
- The understanding of the hydrological regime is based on a short 'snapshot' survey. Longer term monitoring is required to fully understand the site.
- The Moss is already divided into a series of compartments by the drainage ditches and ridges cut through it.
- Access to the site will be restricted to low ground pressure plant and certain areas are inaccessible by all vehicles.

With this in mind Ironside Farrar Ltd propose a phased approach to the Bog restoration. This would allow the effects of any restoration to be monitored (and adjusted) to maximise its effectiveness. It would also allow other issues (e.g. public access) to be monitored and consulted on.

Drawing 4467/402 shows a notional phasing boundary. Phase 1 area has been selected as it is closest to the existing unmodified raised bog and offers the best opportunity for success. This Phase 1 area can be further divided into at least 5 additional 'cells' each of which should be tackled incrementally.

We believe that the water table can be raised by blocking selected drains from the Moss. Given the access conditions we would suggest that locally felled trees could be used to dam the ditches fairly easily reinforced with locally sourced excavations. The felling operations would also assist in the bog restoration works. Notional locations for these dams are shown on Drawing 4467/402, however, we would recommend these are reviewed on site as works progress.

After completion of a 'cell' we would recommend a reasonable standstill period to monitor and check the effectiveness of the works and allow adjustments as necessary.

4.3 Longer Term Actions

The following tasks should be considered as part of any ongoing management review of the site:

- **Fly-tipping**

Fly-tipping was evident in significant quantities around the Dean Burn at the Old Rows Playing Fields and in and around the drainage ditches by Rowan Drive, Blackburn. The tipped materials are slowly migrating into the site and are a significant blight on the local amenity. Debris in the watercourses may also affect water quality in these areas. We would recommend that regular clean-up of these be carried out and that consideration be given to monitoring this area and / or introducing measures to restrict tipping.

- **Scottish Water Outfall**

As noted earlier there is a possible storm water overflow to the Dean Burn. It is not known how often this is used but it is possible it could affect water quality in the Dean Burn particularly given the Local Nature Reserve designation and the flora / fauna present on the site. We recommend some further investigation into the effect of this discharge to see whether any improvements are desirable.

- **Groundwater / Peat Level Monitoring**

As discussed earlier there is only anecdotal evidence on the peat and water level across the bog. We would recommend that consideration be given to establishment of long-term monitoring stations and a recording regime to include fluctuations in water levels. This could also be done in conjunction with the Bog Restoration Works to monitor their effectiveness. Any changes in hydrology of a Moss such as this will take several years to show any real trends and, therefore, we would recommend a simple system that could be monitored by volunteers. This could also offer educational opportunities to local schools.

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Local Nature Reserve**



Legend

-  Site Boundary
-  Bog Restoration Areas
-  Fly Tipping / Litter Hotspots
-  Drainage Works / Repairs
-  Install / Repair Grills
-  Stop Up Drains

A - Improve Culvert / Pond Edge/ Path Crossing. Consider flow control

B - Review discharge from PS with Scottish Water.

C - Repair outfall.

D - Seal / remove Septic Tank

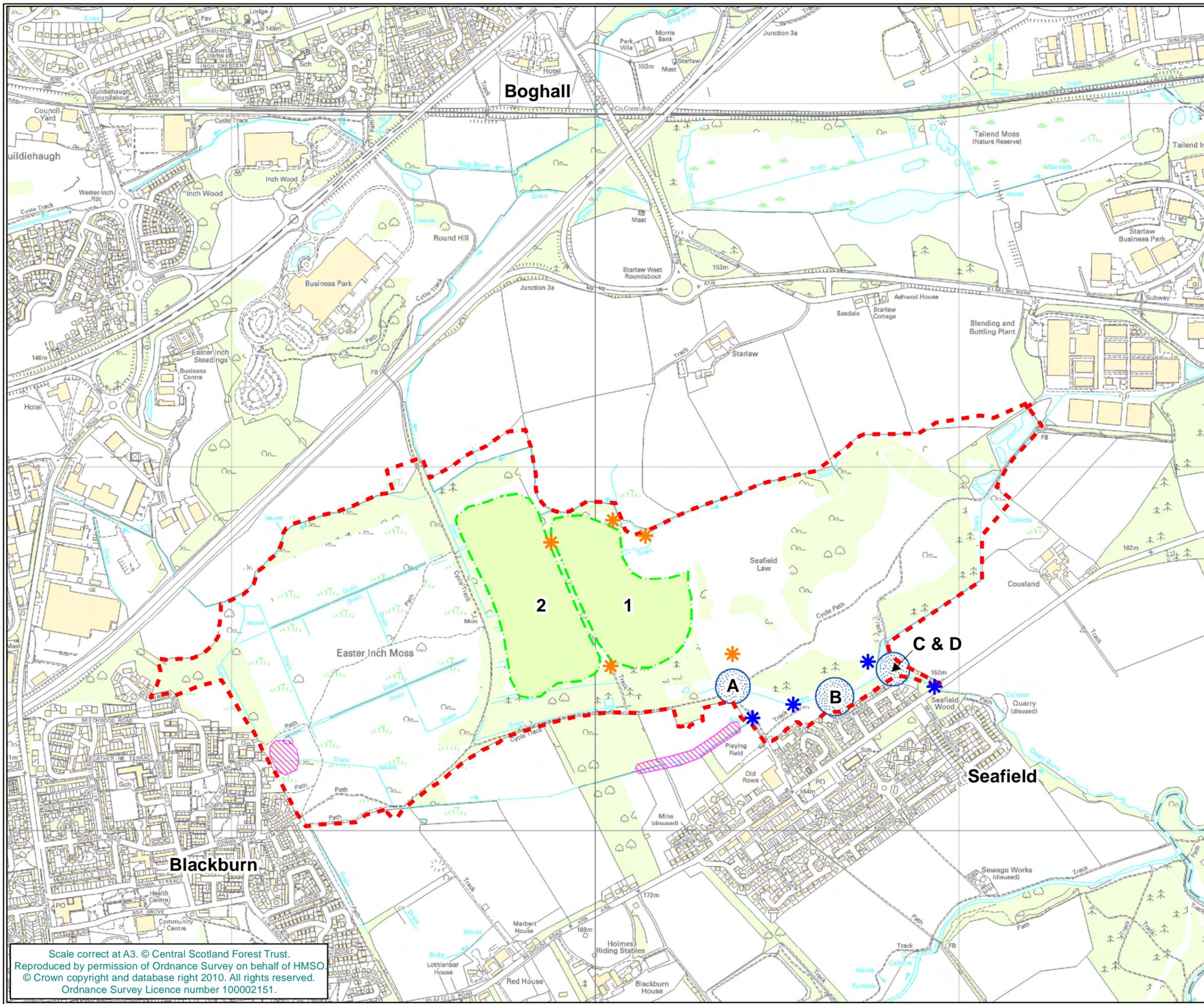
1 - Bog Restoration Phase 1

2 - Bog Restoration Phase 2

Dwg No 4467_402



**Drainage -
Proposed Management
Works**



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