



Scottish and Southern Energy Ltd

VIKING WIND FARM FRESHWATER PEARL MUSSEL SURVEY

Confidential

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NON-TECHNICAL SUMMARY

BACKGROUND

Scotland is a global stronghold for the freshwater pearl mussel *Margaritifera margaritifera* (L.), a species which is now fully protected under the Wildlife and Countryside Act (1981) (as amended) of Great Britain. It is also listed on Annexes II and V of the EC Habitats Directive (Council Directive 92/43/EEC) and Appendix III of the Bern Convention. Recent estimates suggest that Scotland holds perhaps half of the world's known remaining viable populations.

The Viking Energy Partnership (VEP: a partnership between Scottish & Southern Energy (SSE) and Viking Energy Limited) is developing a proposal for a 554MW, 154 turbine wind farm on Mainland, Shetland. The planning application will be accompanied by an Environmental Statement (ES), part of which includes this detailed freshwater pearl mussel survey report.

In 2002, a chance finding by a local crofter of live mussels in Shetland led to the discovery of a reproductively viable freshwater pearl mussel population in atypical peat dominated fen habitat. The freshwater pearl mussel is not known to occur in the proposed Viking Wind Farm area, but the species was identified by Scottish Natural Heritage (SNH) during scoping work as potentially occurring at the site due to the aquatic habitats present. As a consequence, EnviroCentre Ltd was commissioned by the VEP to carry out this targeted freshwater pearl mussel survey to contribute to the ES on the Viking Wind Farm site.

MAIN FINDINGS

- On 6-10th May and 11th July 2008, 47 watercourse sections at the proposed Viking Wind Farm were surveyed using a standard methodology for the presence of freshwater pearl mussels.
- No live or dead freshwater pearl mussels were found in any of the watercourse sections surveyed.
- Small patches of potentially suitable substrate along with host salmonid fish were present in some reaches surveyed. Most burns surveyed held habitat that was completely unsuitable for freshwater pearl mussels.
- The conservation implications of these findings are discussed and recommendations made.

1. INTRODUCTION

1.1 Aim

To undertake a riverbed survey of selected watercourses for the endangered freshwater pearl mussel *Margaritifera margaritifera* (L.), in relation to a planning application for the proposed Viking Wind Farm, Mainland, Shetland.

1.2 Background

During the past 100 years, the freshwater pearl mussel *M. margaritifera* has declined throughout its Holarctic range to such an extent that it is now listed as an endangered species (IUCN 1991). Scotland is a major European and global stronghold for *M. margaritifera*, with recent estimates suggesting that Scotland holds perhaps half of the world's known remaining viable populations (Cosgrove *et al.* 2000a; Young *et al.* 2001a). However, the species has declined in Scotland, with gross industrial and agricultural pollution, over-exploitation by pearl fishermen, decline in salmonid host stocks (the short parasitic larval stage of freshwater pearl mussel is entirely dependent upon salmon and trout fry) and physical river bed habitat degradation due to hydro-electric operations and small-scale river engineering works (Cosgrove *et al.*, 2000a).

The freshwater pearl mussel is a species which is now fully protected under the Wildlife and Countryside Act (1981) of Great Britain. It is also listed on Annexes II and V of the EC Habitats Directive and Appendix III of the Bern Convention. The freshwater pearl mussel is listed in the UK Biodiversity Action Plan as a 'Priority Species' requiring the implementation of a Species Action Plan dedicated to its survival (Biodiversity Steering Group 1995).

The freshwater pearl mussel is not known to occur in the proposed Viking Wind Farm area, but the species was identified by Scottish Natural Heritage (SNH) during scoping work as potentially present at the site. As a consequence, EnviroCentre Ltd was commissioned by the Viking Energy Partnership (VEP) to carry out this targeted freshwater pearl mussel survey to inform the Viking Wind Farm Environmental Impact Assessment (EIA) process.

1.3 Freshwater pearl mussel habitat requirements

Freshwater pearl mussels are found in fast flowing rivers, with detailed studies on Scottish freshwater pearl mussel populations suggesting that optimum water depths of 0.3-0.4m and optimum current velocities of 0.25-0.75ms⁻¹ at intermediate water levels are most suitable (Hastie *et al.* 2000). River bed substratum characteristics appear to be the best physical parameters for describing freshwater pearl mussel habitat. Freshwater pearl mussels prefer stable cobble/boulder dominated substrate with some fine substrate that allows the mussels to burrow (Cosgrove *et al.* 2000b). Adult and juvenile mussels tend to have similar habitat 'preferences', although adults are found over a wider range of physical conditions and juveniles appear to be more exacting in their requirements and sensitivity to environmental disturbance (Hastie *et al.* 2000). Juvenile mussels require fine stable sediments, particularly clean sand and gravel.

Freshwater pearl mussels live buried or partly buried in the beds of clean, fast-flowing unpolluted streams and rivers and subsist by inhaling and filtering for the minute organic particles on which they feed (Cosgrove *et al.* 2000b). Of specific importance to freshwater pearl mussel survival are levels of silt, suspended solids, calcium and chemical compounds generally associated with enrichment (eutrophication) i.e. nitrate, phosphate and biological oxygen demand (Bauer 1983).

1.4 Freshwater pearl mussel host requirements

Freshwater pearl mussels have a short parasitic larval phase on the gills of suitable host fish. The larvae (glochidia) of *M. margaritifera* are very host-specific and can only complete their development on Atlantic salmon *Salmo salar* or brown trout *Salmo trutta*. Usually juvenile fish (fry and parr) are utilised (Young & Williams 1984). The presence of freshwater pearl mussels in any river therefore depends on salmonid host fish availability. It is usually considered necessary for migratory salmonids to be present within a catchment for freshwater pearl mussels to be present. This is typically the case, however occasionally, where historical river captures have occurred, pearl mussel populations are sometimes isolated from present day migratory salmonids e.g. by impassable waterfalls, and have survived this isolation by utilising host resident brown trout. Thus, all sites capable of containing native salmonids can potentially hold freshwater pearl mussel populations.

1.5 Historic occurrence

In 2002, a chance finding by a local crofter of live mussels in Shetland led to the discovery of a reproductively viable freshwater pearl mussel population in atypical peat dominated fen habitat (Cosgrove and Harvey 2005). The Shetland Biological Records Centre commissioned a study of the site and a number of other Shetland burns that might potentially hold unsurveyed and unknown pearl mussel populations (Cosgrove and Harvey 2003). Despite surveying some apparently suitable burns, no other freshwater pearl mussel populations were discovered.

Unfortunately, the threat of illegal pearl fishing destroying the unique Shetland population is considered high and so the location of the known population should remain confidential to safeguard the site. The freshwater pearl mussel is not known to occur within the Viking Wind Farm study area but, in consultation with SNH, a precautionary approach has been adopted to ensure that any potential mussel habitat likely to be impacted upon is surveyed prior to the start of any construction works.

2. METHODOLOGY

The following survey was carried out with an appropriate Animal Conservation Licence (No. 8436) issued by SNH under the terms and conditions of the Wildlife and Countryside Act 1981.

2.1 Site selection

Scottish & Southern Energy (SSE) provided a detailed map with proposed turbine locations, access tracks, borrow pits, anemometers, switching stations and site compound/lay down areas. Survey site selection was based around this plan and knowledge of the species' habitat and host fish requirements. Sites that were considered too steep or inaccessible to hold salmonids and hence mussels and sites within unsuitable habitat have been considered but were not recommended for further study.

On the basis that no known freshwater pearl mussel populations existed within the proposed Viking Wind Farm development area, survey effort was directed towards establishing the status (presence or absence) of freshwater pearl mussels in every watercourse potentially affected by the development (within 50m of watercourses with salmonids). Potential suitability was based on a combination of known historical sites, likely topography and habitat requirements of freshwater pearl mussels. One of the surveyors (Peter Cosgrove) had surveyed some of the watercourses around the Viking area previously. Many of the small burns and tributaries in the area were too steep or inaccessible to hold salmonids. Furthermore, several of the smaller unnamed burns were ephemeral in nature, completely drying out during the summer in some years, and were therefore wholly unsuitable and were not identified for further study. Taking these considerations into account, the following 47 potentially permanent watercourses, which are within 50m of where construction is proposed, were selected for further survey. The names of the watercourses referred to are based on 1:10,000 Ordnance Survey maps.

Delting (13 sites)

- Burn of Oxnabool, ca. HU402706 – track crossing between T14 & T32;
- Burn of Easterbutton, ca. HU396702 – northern track crossing between T14 & T13;
- Burn of Easterbutton, ca. HU397691 – southern track crossing between T18 & T21;
- Burn of Westerbutton, ca. HU394701 – track crossing between T14 & T13;
- Burn of Skelladale, ca. HU390688 – track crossing between T28 & T30;
- Burn of Skelladale, ca. HU392676 – track crossing between T28 & T30;
- Burn of Skelladale, ca. HU393675 – track crossing between T28 & T30;
- Burn of Skelladale, ca. HU389673 – track crossing between T28 & T30;
- Burn of Skelladale, ca. HU386671 – track crossing between T28 & T30;
- Burn of Moorfield, ca. HU424717 – southern track crossing between T171 & T1;
- Burn of Moorfield, ca. HU425723 – northern track crossing between T1 & A968 road;
- Stenswall Burn, ca. HU430724 – track crossing between T1 & A968 road; &
- Stenswall Burn tributary, ca. HU432726 – track crossing between T1 & A968 road.

Collafirth (4 sites)

- Seggie Burn, ca. HU421661 – track crossing between T36 & T42;
- Seggie Burn, ca. HU426662 – track crossing between T36 & T38;

- Seggie Burn, ca. HU428660 – track crossing between T38 & T39; &
- Unnamed burn at Easter Scord, ca. HU416662 – borrow pit.

Nesting (18 sites)

- Wester Filla Burn, ca. HU419609 – track crossing between A970 road & T62;
- Easter Filla Burn, ca. HU422604 – track crossing between T64 & T67/T63;
- Easter Filla Burn, ca. HU424615 – track crossing between T52 & T49;
- Thomas Jamieson's Burn, ca. HU430623 – track crossing between T47 & T70;
- Gossawater Burn, ca. HU437623 – western track crossing between T66 & T48;
- Gossawater Burn, ca. HU438623 – eastern track crossing between T66 & T48;
- Gossawater Burn tributary, ca. HU439622 – northern track crossing between T48 & T51;
- Gossawater Burn tributary, ca. HU439618 – southern track crossing between T48 & T51;
- Burn of Crookadale, ca. HU425557 – track crossing between T138 & T145;
- Gill Burn, ca. HU435559 – track crossing between T139 & T137;
- Burn of Quoys tributary, ca. HU443556 – track crossing between T147 & T143;
- Burn of Quoys, ca. HU446558 – track crossing between T143 & T131;
- Burn of Quoys, ca. HU448560 – track crossing between T143 & T140;
- Unnamed inflow burn into Loch Skellister, ca. HU461566 – track crossing between T130 & B9075 road;
- Burn of Forse, ca. HU450580 – track crossing between T87 & T115;
- Burn of Forse, ca. HU438580 – track crossing between T105 & T79;
- Burn of Grunnafirth, ca. HU455586 – track crossing between T109 & T93; &
- Unnamed inflow burn into Quinni Loch, ca. HU446591 – track crossing between T43 & T40/37.

Kergord (12 sites)

- Burn of Forse, ca. HU390614 – track crossing between T72 & B9071 road;
- Red Burn, ca. HU389579 – track crossing between T98 & T91;
- Red Burn, ca. HU384573 – borrow pit;
- Burn of Truggles Water, ca. HU368544 – track crossing between T157 & T159;
- Unnamed inflow burn into Truggles Water, ca. HU375544 – track crossing between T156 & T160;
- Burn of Atlascord, ca. HU379533 – track crossing between T165 & T168;
- Unnamed inflow burn into Maa Water, ca. HU380546 – track crossing between T154 & T156;
- Unnamed inflow burn into Maa Water, ca. HU380547 – track crossing between T154 & T156;
- Unnamed inflow burn into Maa Water, ca. HU381548 – track crossing between T154 & T153;
- Unnamed inflow burn into Lamba Water, ca. HU384554 – track crossing between T146 & T153;
- Unnamed inflow burn into Lamba Water, ca. HU385555 – track crossing between T146 & T153; &

- Burn of Droswall, ca. HU400557 – track crossing between T111 & B9075 road.

2.2 Survey methodology

A team of two experienced fieldworkers carried out the survey to optimise search efficiency and for Health and Safety reasons. The burn location closest to the proposed construction work was identified for each watercourse (as listed in section 2.1). On some occasions this was more than one location per watercourse, for example the Burn of Skelladale (and tributaries) had five potential crossing points.

Where Health and Safety considerations allowed, the watercourse was entered and searched for freshwater pearl mussels, using an adapted version of the standardised survey methodology for site specific assessments, as described in Cosgrove and Young (1998) and Young *et al.* (2001b) and recommended by SNH. Searches were carried out 100m upstream and 500m downstream from the proposed site of construction activity. Thus, if one construction crossing was planned, 600m of the watercourse was surveyed or twice that if two burn crossings were planned on the same watercourse but in different locations etc.

A general survey was made of the watercourse and its substrate types within the survey site, by walking along the river bank and/or by wading in the water. The aim was to identify specific areas that were most likely to harbour mussels using information on their habitat preferences from previous studies and experience. Once an apparently suitable area was found, the watercourse was entered at the nearest point and a search conducted, concentrated in the most favourable substrate types so as to optimise search efficiency. To ensure compatibility with other surveys, searches were:

- Made using a glass-bottomed viewing bucket.
- Conducted under favourable conditions i.e. bright light, clear water, low flow regime.
- In water sufficiently shallow for safe wading.
- In an upstream direction, checking favourable sites e.g. in the shelter of cobbles, boulders or overhanging banks.
- Made of loose debris and trailing weed, which was moved gently aside.

Negative results: If no mussels were found in a specific search area, then the search was moved to other suitable areas within the survey site. Even if mussels were not found anywhere in the survey site, site information was still recorded on a standard recording form as described below.

Site details included an eight figure grid reference, average width and depth, substrate composition (based on the widely used Wentworth Scale (1922), e.g. cobble, pebble, granule, coarse and fine sand etc.), main types of adjacent land-use, bankside vegetation, evidence of impacts, and details of any discussions with local people concerning the river. If potentially suitable, at least one representative photograph was taken to indicate the typical burn section surveyed.

Experience of surveying for freshwater pearl mussels in Shetland in 2002 led to an additional search technique being employed in this survey under certain limited circumstances. In some Western Isle sites and the only known Shetland site, freshwater pearl mussels were found hidden underneath overhanging peat banks and overgrown fen habitat. The ledges underneath overhanging banks held important, sometimes the entire populations of freshwater pearl mussels, and these would be missed by standard visual search methodologies. Therefore, where overhanging banks or fen habitats with ledges were suspected of being present within in the 500m downstream and 100m upstream survey reach, surveyors carried out a "blind" search using their hands to feel for hidden mussels on any such ledges.

2.3 Factors affecting the presence of freshwater pearl mussels

An attempt was made to identify factors that might have affected the presence or occurrence of freshwater pearl mussels at the sites surveyed. These were determined by a combination of the following sources: direct observation of river habitat condition, personal communications with local land managers and fishery proprietors, previous personal experience of impacts on other Scottish freshwater pearl mussel populations and published and unpublished historical sources.

3. SURVEY RESULTS

The 47 watercourses at the proposed Viking Wind Farm site were surveyed for freshwater pearl mussels on 6-10th May 2008 and on 11th July 2008 by a team of two experienced freshwater pearl mussel surveyors, comprising Peter Cosgrove and Steve Jackson. The water level was very low, water clarity was good, and the weather was mixed cloud/sun and bright light providing optimal surveying conditions. The surrounding habitat and land-use comprised of wet heath/blanket bog and rough grassland for sheep and occasional cattle grazing.

No live mussels or empty/dead freshwater pearl mussel shells were found within any of the 49 watercourses searched across the survey area.

3.1 Delting

Burn of Oxnabool

The channel of the Burn of Oxnabool was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU402706.

Grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU402706		Partly stable		0.2		0.1		Blanket bog/heath	
Photo ref:	24	Bedrock	Boulder	Cobble	Pebble	Granule	C sand*	F sand*	Peat
Substrate %:			10	20	20	20			30
Comments:	The first 200m downstream of the planned crossing is Burn of Oxnabool, which was wholly unsuitable. The lower 300m surveyed was below the confluence with the Burn of Laxobigging, which had small patches of stable and suitable substrate and held salmonids.								

*C sand = Coarse sand, F sand = Fine sand

The channel of the Burn of Oxnabool was unsuitable for freshwater pearl mussels and the downstream Burn of Laxobigging was partly suitable, largely based on substrate composition. No mussels were found during searches of either watercourse. Host salmonid fish were found during searches of the Burn of Laxobigging channel survey reach. Labelled photographs are provided in Appendix 1.

Burn of Easterbutton

The channel of the Burn of Easterbutton was surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU396702 and HU397691.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU396702. Downstream crossing		Partly stable		1m		0.1m		Blanket bog/heath	
Photo ref:	25	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:				10	20	10	10		50
Comments:	Small, peaty burn with patches of stable and potentially suitable substrate. Iron-rich peaty deposits with brown/orange algae covering the substrate.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU397691. Upstream crossing		Unstable		0.2m		0.1m		Blanket bog/heath	
Photo ref:	22	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:				10	20	10	10		50
Comments:	Tiny, steep-sided unsuitable torrential burn. Salmonids present.								

The lower channel of the Burn of Easterbutton was partly suitable for freshwater pearl mussels, largely based on substrate composition and adequate suitable water flows. However the shallow and tiny upper reaches were unsuitable and the iron rich peaty deposits and algae suggested the substrate and perhaps water quality would not have been suitable for freshwater pearl mussels. No mussels were found during searches. Host salmonid fish were found during searches of the upstream channel. Labelled photographs are provided in Appendix 1.

Burn of Westerbutton

The channel of the Burn of Westerbutton was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU394701.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU394701		Unstable peat		0.2		0.1		Blanket bog/heath	
Photo ref:	23	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:									100
Comments:	Tiny, shallow peat dominated channel which occasionally disappeared underground. Wholly unsuitable. No salmonids recorded.								

The channel of the Burn of Westerbutton was unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel and a lack of suitable water flows suggested unsuitable salmonid habitat. Labelled photographs are provided in Appendix 1.

Burn of Skelladale

The tributary channels of the Burn of Skelladale were surveyed in five 600m sections, corresponding with the proposed track crossings at ca. HU390688, HU392676, HU393675, HU389673 and HU386671.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU390688		N/A						Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:	N/A								
Comments:	Dry channel. No photo taken.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
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HU392676		N/A						Blanket bog/heath	
Photo ref:	19	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Wet mossy seepage. No proper burn to survey. No fish recorded.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU393675		Unstable		1.5m		0.2m		Blanket bog/heath	
Photo ref:	20	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			+	+	5	5			90
Comments:		Tiny, shallow peat dominated tributary burn. Large areas of peat collapse onto channel form. Wholly unsuitable. No fish recorded.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU389673		N/A						Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Despite appearing on the O/S map, this tributary burn was not present on the ground. No photo taken.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU386671		Unstable		0.5m		0.1m		Blanket bog/heath	
Photo ref:	21	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			+	20	30	+			50
Comments:		Tiny, shallow unstable tributary of the Burn of Skelladale. No fish recorded.							

The tributary channels of the Burn of Skelladale were completely unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during any searches. Host salmonid fish were not found during searches of the tributary channels, although they were noted in the main channel of the Burn of Skelladale. Labelled photographs are provided in Appendix 1.

Burn of Moorfield

The channel of the Burn of Moorfield was surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU425723 (northern) and HU424717 (southern).

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU425723		Mainly unstable		0.5m		0.1m		Blanket bog/heath	
Photo ref:	PC 1	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		30	30	20	10	5	5		
Comments:		Unsuitable substrate, with some partly stable patches with macrophytes. Steep(ish), tumbling burn, likely to be torrential during spates. Dark peaty water. No fish seen, marginal fish habitat present.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian	
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								vegetation	
HU424717								Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Wetted burn did not exist at this proposed crossing point.							

The channel of the Burn of Moorfield was unsuitable for freshwater pearl mussels, largely based on substrate composition. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Stenswall Burn

The channel of the Stenswall Burn was surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU430724 and HU432726.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU430724		Unstable		0.5m		0.1m		Blanket bog/heath	
Photo ref:	PC 2	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		30	30	20	10	5	5		
Comments:		Tiny, iron/algae rich – completely unsuitable. Lots of macrophytes. Dark iron-rich peaty water and algae made viewing difficult. No fish seen.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU432726		Unstable		0.2m		0.05m		Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		30	40	20	5	5			
Comments:		Tiny tributary of tiny burn. Unsuitable. No fish seen.							

The channel of the Stenswall Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition, low flows and possibly poor water quality associated with iron and algae. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

3.2 Collafirth

Seggie Burn

Two tributaries and the main channel of the Seggie Burn were surveyed in three 600m sections, corresponding with the proposed track crossings at ca. HU421661, HU426662 and HU428660.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU421661		Partly stable		0.5m		0.1m		Blanket bog/heath	
Photo ref:	SJ 1	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:						20	20	10	50

Comments:	Occasionally disappears underground. Partly suitable substrate in places, no fish seen, but potentially suitable salmonid habitat present.
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Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU426662		Stable		0.05m		0.3m		Blanket bog/heath	
Photo ref:	SJ 2	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:					5	10	10		75
Comments:		Tiny tributary that disappears underground in places. Substrate stable and potentially suitable in places. No fish seen. Iron/peat rich.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU428660		N/A		0.05m		0.1m		Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:				5	5	10	10		70
Comments:		Tiny tributary that disappears underground in places. Substrate partly stable and potentially suitable in places, but very low flows (dries out?). No fish seen. No photo taken.							

The channel of the Seggie Burn was partly suitable for freshwater pearl mussels, largely based on suitable substrate composition and suitable water flows in the lower reaches. No mussels were found during searches. Host salmonid fish were not found during searches of the tributaries or main channel, but habitats present suggest fish might be present. Labelled photographs are provided in Appendix 1.

Unnamed burn at Easter Scord

The channel of the unnamed burn at Easter Scord was surveyed in one 600m section, corresponding with the proposed borrowpit adjacent to the watercourse at ca. HU416662.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU416662		Unstable		1m		0.1m		Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Very small unnamed tributary burn. Torrential, unstable and wholly unsuitable. Perhaps dries out during very low flows? No fish seen. No photo taken.							

The channel of the unnamed burn at Easter Scord was wholly unsuitable for pearl mussels largely based on substrate composition and unsuitable low water flows. No mussels were found during searches. Host salmonid fish were not found during searches.

3.3 Nesting

Wester Filla Burn

A tributary channel of the Wester Filla Burn was surveyed in one 600m section (which extended downstream into the main stem), corresponding with the proposed track crossing at ca. HU419609.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU419609		N/A		<0.1m		<1cm		Blanket bog/heath	
Photo ref:	31	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			5	20					75
Comments:	Dry peat channel with tiny 1cm deep flow. Next to no water, wholly unsuitable (dries out?).								

A tributary of the Wester Filla Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the tributary. Labelled photographs are provided in Appendix 1.

Easter Filla Burn

The channel of the Easter Filla Burn was surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU422604 and HU424615.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU424615, lower section		Unstable		2m		0.1m		Blanket bog/heath	
Photo ref:	30	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		10	25	40	20	5			
Comments:	Small, shallow unstable and unsuitable burn in the lower reaches and tiny and wholly unsuitable in the upper reaches. A possible salmonid was seen.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU422604, upper section		N/A		1m		<0.1m		Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:	N/A								
Comments:	Little proper water flow. Unstable predominately dry channel. Wholly unsuitable.								

The main channel of the Easter Filla Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. One possible host salmonid fish was noted during downstream searches of the channel. Labelled photographs are provided in Appendix 1.

Thomas Jamieson's Burn

The channel of Thomas Jamieson's Burn was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU430623.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU430623		Unstable		1m		0.2m		Blanket bog/heath	

Photo ref:	29	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:					30	15	15		40
Comments:	Upper reach a wet mossy flush, without any proper channel. Proper channel with substrate begins where photo taken (HU4313862590). Salmonids present.								

The channel of Thomas Jamieson's Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were found during searches of the mid-lower channel, which flows into Seawater Burn and then Laxo Burn. Labelled photographs are provided in Appendix 1.

Gossawater Burn

The channel of the Gossawater Burn was surveyed in four 600m sections, corresponding with the proposed track crossings at ca. HU437623, HU438623, HU439622 and HU439618.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU437623 – unnamed tributary parallel to Gossawater Burn		Peat		<0.1m		0.1m		Blanket bog/heath	
Photo ref:	28	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:									100
Comments:	Wet, peaty/mossy surface channel that disappears into peat for considerable lengths. Wholly unsuitable. No salmonids.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU438623		Unstable		3m		0.1m		Blanket bog/heath	
Photo ref:	27	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		15	25	40	15	5			
Comments:	Predominantly unsuitable substrate, but some patches of potentially suitable habitat, esp. close to Laxo Burn confluence. Salmonids present in lower reaches.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU439622		N/A		<1m		<0.1m		Blanket bog/heath	
Photo ref:	None	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:	N/A								
Comments:	Tiny, predominantly dry unnamed and unsuitable tributary channel.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU439618		N/A		N/A		N/A		Blanket bog/heath	
Photo ref:	None	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:	N/A								
Comments:	Tiny, dry unnamed and unsuitable tributary channel.								

The main channel of the Gossawater Burn was mainly unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows, particularly in the upper tributary reaches. No mussels were found during searches. Host salmonid fish were only found during searches in the lower channel, close to the Laxo Burn. Labelled photographs are provided in Appendix 1.

Burn of Crookadale

The channel of the Burn of Crookadale was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU425557. The 600m sections changed character significantly, so the data are divided below.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU425557 Upper section		Unstable, tiny patches of stable substrate		1m		0.2m		Blanket bog/heath	
Photo ref:	SJ12/13	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:				+	10	10	5	+	75
Comments:		Peat dominated channel with tiny patches of potentially suitable substrate. No fish seen. Channel often disappears underground for several metres before reappearing downstream.							

Main grid reference Upper section		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU424553 Lower section		Unstable with small patches of stable substrate		1m		0.1m		Blanket bog/heath	
Photo ref:	SJ12/13	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:				20	10	10	5	+	55
Comments:		Peat dominated channel with tiny patches of mixed size potentially suitable substrate. Salmonid fish seen.							

The channel of the Burn of Crookadale was potentially partly suitable for freshwater pearl mussels, largely based on substrate composition. No mussels were found during searches. Host salmonid fish were found during searches of the lower channel. Labelled photographs are provided in Appendix 1.

Gill Burn

The channel of the Gill Burn was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU435559.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU435559		Unstable		1.5m		0.2m		Blanket bog/heath	
Photo ref:	SJ9/10	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat

Substrate %:		15	30	30	10	5		10	
Comments:	Small-tiny burn. No salmonids seen. Unsuitable.								

The channel of the Gill Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Burn of Quoys

The channel of the Burn of Quoys was surveyed in three 600m sections, corresponding with the proposed track crossings at ca. HU443556, HU446558 and HU448560.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU443556		N/A		0.5m		0.1m		Blanket bog/heath	
Photo ref:	SJ 8	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Wholly unsuitable wet sphagnum flush – not a burn. N/A							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU446558		N/A		<0.1m		<0.1m		Blanket bog/heath	
Photo ref:	SJ 6	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Sphagnum rich wet mossy channel. Wholly unsuitable due to lack of open water flows.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU448560		Unstable		1.5m		0.1m		Blanket bog/heath	
Photo ref:	SJ 4/5	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		40	20	30	10	+			
Comments:		Unsuitable substrate, very low flows (probably dries out?).							

The channel of the Burn of Quoys was unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows in all tributaries searched. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Unnamed inflow burn into Loch Skellister

The channel of the unnamed burn was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU461566.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU461566		N/A		0.1m		1cm		Blanket bog/heath	
Photo ref:	SJ 1-3	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		No substrate or channel, just wet sphagnum flush. N/A							

The channel of the unnamed inflow burn was unsuitable for freshwater pearl mussels, based on lack of suitable water flows and no substrate. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Burn of Forse

The channel of the Burn of Forse was surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU450580 and HU438580.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU450580 lower crossing		Partly stable, lots of unstable subs		3m		0.2m		Blanket bog/heath	
Photo ref:	17	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		30	15	30	20	5	+		
Comments:	Very patchy habitat, mainly unstable and unsuitable, but with some small pockets of suitable substrate. Lots of salmonids present.								

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU438580 upper crossing		Partly stable		2m		0.2m		Blanket bog/heath	
Photo ref:	15-16	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		30	20	20	20	5	5		
Comments:	Patches of stable and potentially suitable substrate. Salmonids present								

The channel of the Burn of Forse was potentially suitable in places for freshwater pearl mussels, largely based on substrate composition and suitable water flows. No mussels were found during searches. Host salmonid fish (lots in places) were found during searches of the channel. Labelled photographs are provided in Appendix 1.

Burn of Grunnafirth

The channel of the Burn of Grunnafirth was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU455586.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU455586		Unstable		2m		0.2m		Blanket bog/heath	
Photo ref:	None	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		25	15	20	20	10	10		
Comments:	Mainly unstable and unsuitable substrate, very small patches of partly stable substrate. Lots of salmonids present.								

The channel of the Burn of Grunnafirth was unsuitable for freshwater pearl mussels, largely based on substrate composition. No mussels were found during searches. Lots of host salmonid fish were found during searches of the channel.

Unnamed inflow burn into Quinni Loch

The channel of the unnamed inflow burn was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU446591.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU446591		N/A						Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		The burn channel in the search area was dry and hence completely unsuitable.							

The channel of the unnamed burn was unsuitable for freshwater pearl mussels, largely based on the lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel.

3.4 Kergord

Burn of Forse

The channel of the Burn of Forse was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU390614.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU390614		Unstable		1.5m		<0.1m		Blanket bog/heath	
Photo ref:	32	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		70	15	15					
Comments:		Steep, 'spatey' bedrock dominated channel. Completely unstable and wholly unsuitable. Tiny water flows when surveyed, but mainly dry. No salmonids seen.							

The channel of the Burn was unsuitable for freshwater pearl mussels, largely based on unstable bedrock dominated substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Red Burn

The channel of the Red Burn was surveyed in two 600m sections, corresponding with the proposed track crossing at ca. HU389579 and the Borrow pit at ca. HU384573.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU389579		N/A		N/A		N/A		Blanket bog/heath	
Photo ref:	N/A	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Unable to find permanent water flows at this location.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
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HU384573		Unstable/bedrock		2m		0.1m		Blanket bog/heath	
Photo ref:	16	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		35	35	20	10				
Comments:		Borrowpit location probably greater distance from burn than appeared on plans. Nevertheless, Red Burn searched and found to be torrential and 'spatey'. Unsuitable. No fish recorded, but lower unsurveyed reaches looked potentially suitable for fish.							

The channel of the Red Burn was unsuitable for freshwater pearl mussels, largely based on substrate composition. No mussels were found during searches. Host salmonid fish were not found during searches of the channel, but were later seen in the Red Burn outwith survey area. Labelled photographs are provided in Appendix 1.

Burn of Truggles Water

The channel of the Burn of Truggles Water was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU368544.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU368544		Stable		3m		0.1m		Blanket bog/heath	
Photo ref:	7	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:		20	50	10	15	5	+		
Comments:		Stable substrate, with many patches of potentially suitable habitat. Lots of salmonids present.							

The channel of the Burn of Truggles Water was suitable for freshwater pearl mussels, largely based on substrate composition, high densities of host fish and suitable water flows. No mussels were found during searches. Labelled photographs are provided in Appendix 1.

Unnamed inflow burn into Truggles Water

The channel of the unnamed burn was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU375544.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU375544		Bedrock/stable		1m		0.1m		Blanket bog/heath	
Photo ref:	3	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			10	30	30	20			10
Comments:		Small, unsuitable, iron/algae rich burn. Salmonids present in lowest 50m just above loch.							

The channel of the unnamed burn was unsuitable for freshwater pearl mussels, largely based on substrate composition and water quality. No mussels were found during searches. Host salmonid fish were found during searches of the lowest part of the channel. Labelled photographs are provided in Appendix 1.

Burn of Atlascord

The channel of the Burn of Atlascord was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU379533.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU379533		N/A		<0.1m		0.1m		Blanket bog/heath	
Photo ref:	2	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Collapsed and eroded banks covered water. Consequently water quality very poor, with thick layer of peat and brown algae covering entire substrate. Wholly unsuitable. No fish seen.							

The channel of the Burn of Atascord was completely unsuitable for freshwater pearl mussels, largely based on substrate composition, algae and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Unnamed inflow burn into Maa Water

The channel of the unnamed burn was surveyed in three 600m sections, corresponding with the proposed track crossings at ca. HU380546, HU380547 and HU381548.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU380546		Stable		1m		0.1m		Blanket bog/heath	
Photo ref:	8	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			5	10	30	20			35
Comments:		Small, shallow, stable burn. Brown algae covered all substrate making it appear unsuitable for pearl mussels. No fish recorded.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU380547				1m		<0.1m		Blanket bog/heath	
Photo ref:	None	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Tiny, brown algae dominated channel. Wholly unsuitable.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU381548		N/A		N/A		N/A		Blanket bog/heath	
Photo ref:	None	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Burn channel does not exist during dry conditions.							

The three unnamed burn channels into Maa Water were unsuitable for freshwater pearl mussels, largely based on substrate composition, thick brown algae and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channels. Labelled photographs are provided in Appendix 1.

Unnamed inflow burns into Lamba Water

The channels of two unnamed burns into the Lamba Water were surveyed in two 600m sections, corresponding with the proposed track crossings at ca. HU384554 and HU385555.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU384554		N/A		0.05m		0.01m		Blanket bog/heath	
Photo ref:	10	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %: N/A									
Comments:		Tiny, 1cm surface runoff channel over moss, not proper channel. No salmonids. Wholly unsuitable.							

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU385555		N/A		N/A		<0.5m		Blanket bog/heath	
Photo ref:	13	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:			20						80
Comments:		Not proper burn. Deep peat channel, some boulders with brown algae rich trickle of water. Wholly unsuitable. No fish present.							

Two unnamed burns were unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel. Labelled photographs are provided in Appendix 1.

Burn of Droswall

The channel of the Burn of Droswall was surveyed in one 600m section, corresponding with the proposed track crossing at ca. HU400557.

Main grid reference		Substrate stability		Width (m)		Depth (m)		Land use/riparian vegetation	
HU400557		Unstable		0.2m		0.1m		Blanket bog/heath	
Photo ref:	18	Bedrock	Boulder	Cobble	Pebble	Granule	C sand	F sand	Peat
Substrate %:									100
Comments:		Drainage ditch through peat. No suitable substrate or flows. Ditch disappeared underground in several locations.							

The channel of the Burn of Droswall was completely unsuitable for freshwater pearl mussels, largely based on substrate composition and lack of suitable water flows. No mussels were found during searches. Host salmonid fish were not found during searches of the channel and the substrate being 100% peat was unsuitable for host fish. Labelled photographs are provided in Appendix 1.

3.5 Habitat assessment summary

The following table summarises the habitat assessment of the 600m survey reaches in terms of potential suitability for *M. margaritifera*. Habitat suitability assessments have been divided into three broad categories: (i) Unsuitable, (ii) Partly suitable (occasional patches of suitable habitat), and (ii) Suitable. Most survey reaches were unsuitable, with a small number of survey reaches having marginal areas or partly suitable habitats. Only one watercourse, the Burn of Truggles, held plenty of potentially suitable *M. margaritifera* habitat.

Viking watercourse	Habitat unsuitable	Habitat partly suitable	Habitat suitable
Burn of Oxnabool (Burn of Laxobigging)	X	(x)	
Burn of Easterbutton		X	
Burn of Skelladale tributaries	X		
Burn of Moorfield	X		
Stenswall	X		
Seggie Water		X	
Unnamed burn at Easter Scord	X		
Wester Filla Burn tributary	X		
Easter Filla Burn	X		
Thomas Jamieson Burn	X		
Gossawater Burn	X	X?	
Burn of Crookadale		X	
Gill Burn	X		
Burn of Quoys	X		
Unnamed Loch Skellister inflow burn	X		
Burn of Forse		X	
Burn of Grunnafirth	X		
Unnamed Quinni Loch inflow burn	X		
Burn of Forse	X		
Red Burn	X		
Burn of Truggles			X
Burn of Atlascord	X		
Unnamed Maa Water inflow burn	X		
Unnamed Lamba Water inflow burn	X		
Burn of Droswall	X		

4. DISCUSSION

4.1 Conservation status of sites

The 47 watercourses searched during this survey were all relatively shallow and easily accessible in terms of depth, with no sections too deep to survey using standard shallow-water survey methods. No live or dead freshwater pearl mussels were found anywhere within the survey area. Based on these findings, obtained under ideal surveying conditions, freshwater pearl mussels appear to be absent from the sections of watercourses surveyed within the Viking study area.

The sample based survey methodology used does not search every square metre of river bed, so it is conceivable that a tiny number of freshwater pearl mussels may have remained undetected somewhere e.g. perhaps hidden under boulders or over-hanging banks or even downstream of the 600m survey sections. However, the use of two experienced surveyors working in parallel meant that almost the entire main channel of each watercourse section was thoroughly searched and given that no evidence of freshwater pearl mussels (e.g. old shells on channel bars etc.) was found, it is unlikely (although theoretically possible) that freshwater pearl mussels occur in the watercourses surveyed.

The lack of significant amounts of potentially suitable habitat in almost all sites surveyed also suggests that freshwater pearl mussels are unlikely to be present. The few small patches of marginal or potentially suitable habitat were thoroughly searched and no signs of *M. margaritifera* were found.

4.2 Factors influencing the distribution of freshwater pearl mussels

The habitat requirements of freshwater pearl mussels are relatively well known (see section 1.3) and it is clear that mussels need a constant flow of clean unpolluted water to survive, along with populations of host fish and suitable substrate habitats. Water quality (when flows were sufficient) appeared suitable in most of the watercourses surveyed, but perhaps not so in some iron rich peaty tributary burns. Host fish were confirmed present in the following 11 watercourses surveyed, so these could, at least theoretically, hold freshwater pearl mussels:

- Burn of Oxnabool (Laxobigging) – Delting;
- Burn of Easterbutton – Delting;
- Burn of Skelladale - Delting;
- Easter Filla Burn - Nesting;
- Thomas Jamieson's Burn – Nesting;
- Gossawater Burn – Nesting;
- Burn of Crookadale – Nesting;
- Burn of Forse – Nesting;
- Burn of Grunnafirth – Nesting;
- Red Burn – Kergord; and
- Burn of Truggles Water – Kergord.

Cosgrove (1997) carried out a review of published and anecdotal historical accounts of Scottish freshwater pearl mussel records including all known records from Scotland. With what is now known about historic pearl fishing pressure in Scotland, any accessible sites like those next to human habitation may well have been destructively pearl fished and exhausted rapidly many hundreds of years ago, before biological records were kept, by locals keen to make some money from selling pearls. It is clear from recorded history and field signs that the Viking study area has been used by humans for many centuries. This might explain the apparent absence of freshwater pearl mussels from apparently suitable sites. An alternative explanation, supported by observation of only patchy marginal habitat, is that freshwater pearl mussels never occurred in these watercourses. There is no direct evidence to support which explanation may be correct.

4.3 Recommendations

The current survey failed to find any evidence of live or dead freshwater pearl mussels in the 47 watercourses surveyed. There do not appear to be any freshwater pearl mussels in the vicinity of the proposed Viking Wind Farm development foot-print. Although not every square metre of river bed was surveyed it is unlikely, but theoretically possible, that hidden mussels remain undiscovered in the watercourses surveyed. Any undiscovered mussels would need a healthy population of host salmonid fish population to survive and thrive.

River engineering and construction activities within or close to watercourses have the potential to damage habitat or kill freshwater pearl mussels (Cosgrove and Hastie 2001). Therefore, as a precautionary measure (as well as standard good environmental practice) it is important that any construction activities associated with the proposed Viking Wind Farm do not detrimentally impact on host salmonids. Special care and attention should be paid when working around all watercourses, but especially those known to hold host salmonid fish. For example, detailed pollution prevention plans and construction method statements should be agreed with the Scottish Environment Protection Agency (SEPA).

Now fully protected, it is theoretically possible that freshwater pearl mussel populations in the North of Scotland and Shetland might recover and eventually (re)colonise those Viking watercourses with healthy salmonid populations.

5. REFERENCES

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