Loch Kemp Storage - EIA Report

Appendix 10.4: Freshwater Lichen Survey Report

November 2023

ash

ash design + assessment
Suite 2/3, Queens House
19 St Vincent Place
Glasgow, G1 2DT

Tel: 0141 227 3388
Fax: 0141 227 3399

Email: info@ashglasgow.com
Web:
www.ashdesignassessment.com

Freshwater Lichen Survey at the Proposed Loch Kemp Pumped Storage Scheme

Updated March 2023

[redacted]

Report for ASH design+assessment

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Summary

Loch Kemp Storage Ltd. (“the Applicant”), is proposing to construct a 600 Megawatt (MW) Loch Kemp Pumped Storage Scheme (hereafter referred to as “the Proposed Development”), located within the Dell Estate, E. Inverness-shire, approximately 13 km to the north-east of Fort Augustus. The site location of the Proposed Development is shown on Figure 1.

This lichen survey was commissioned to identify lichens and lichenicolous fungi within, or in close proximity to Loch Kemp, including three watercourses, one of which will be directly affected by the Proposed Development. A follow-on survey was also commissioned to investigate nearby lochans and lochs in order to evaluate whether species found around and in Loch Kemp were present in the locality outside of the Proposed Development area.

Habitat quality for freshwater lichens was assessed using the Aquatic Watercourses Quality Index (AQUI) and the Rocky Lake Shores Threatened, Near Threatened and Notable Species Indices (Sanderson *et al*. 2018, JNCC Guidelines for the Selection of Biological SSSIs 2018). All three watercourses, Loch Kemp and a surveyed section of Loch Knockie meet or exceed the threshold scores for potential SSSI designation.

Loch Kemp and surrounding heathland which is planned for development, supports two the following species which were not located anywhere else in the area during these surveys: *Porina interjungens* (NT, NS) and the Nationally Scarce *Micarea viridileprosa, Polychidium muscicola* and *Thelocarpon epibolum.*

The heathland lichens within the Proposed Development area at Loch Kemp were assessed using the Heathland Moorland and Coastal Index (HMCHI) with a score of 32, well above the threshold of 20 for potential SSSI. No other area assessed scored above the threshold for potential SSSI designation. However, two sites came close: Lochan Nan Nighean and Lochan Scristan with scores of 17 and 18 respectively. All of the HMCHI species found in the Loch Kemp area were also found at other locations outside of the Proposed Development area.

The flooding of the habitat around Loch Kemp will subject the existing freshwater and non-freshwater species to a rapid filling and emptying regime to a maximum of 28 m above the current conditions. Such changes will almost certainly destroy these lichen communities together with the freshwater sponge, which currently experience changes of occasional and often slow changes in water levels of tens of centimeters only. It is well known that large drawdown zones in lakes and reservoirs do not support diverse freshwater lichen assemblages due to the rapidly changing conditions which the lichens cannot adapt to (Gilbert 2000, Gilbert 2001, Gilbert and Giavarini 2001. Lichenologist Oliver Gilbert states: '*There are many examples of lakes very poor aquatic lichens as a result of damming or water abstraction'* Gilbert 2001 in Fletcher (ed) 2001.

Disturbance of ground conditions during installation of the Proposed Development is also likely to cause changes to the conditions in Loch Kemp and the Allt an Sluichd e.g., movement of rocks and an increase sediment loads. Changes in water chemistry are also possible at the time of installation of the eight dams, especially if large amounts of un-weathered concrete are used in their construction. It is recommended that the concrete is pre-weathered (where possible) to reduce the effect of 'alkaline

shock' on the aquatic ecosystem. Significant species found on the Allt an Sluichd include *Cryptothele rhodosticta* (DD, NR, Sc), *Rhizocarpon amphibium* (DD, NR, Sc) and the British Endemic *Strigula confusa* (NR, Sc, IR). The latter two species were not found anywhere else in the areas surveyed and *Cryptothele rhodosticta* was only found here and at the other Proposed Development site of Loch Kemp, so particular care should be taken not to cause changes in the water flow and quality on the Allt an Sluichd.

If the Proposed Development is consented, then consideration should be given to attempt to translocate species of conservation concern from Loch Kemp to suitable habitats elsewhere. It is also highly recommended that monitoring is undertaken to assess the impacts on the lichen assemblages and translocated species, in order to inform best practice for any similar developments in the future.

Citation: Douglass, J.R. 2022. Freshwater lichen survey at the proposed Loch Kemp pumped storage scheme. Report for ASH design+assessment.

Cover photo: *Rhizocarpon amphibium* (DD, NR, Sc). Allt an Sluichd.

Introduction

This lichen survey was commissioned to identify lichens and lichenicolous fungi within, or in close proximity to Loch Kemp, including three watercourses one of which would be directly affected by the Proposed Development.

The Proposed Development involves a pumped storage scheme with Loch Kemp as the upper reservoir and Loch Ness as the lower reservoir, connected by underground tunnels. The site location of the Proposed Development is shown on Figure 1. It is anticipated that Loch Kemp will have eight dams constructed around it to create the inundation area up to around 28m above the existing high water level. The Allt an Sluichd is the only watercourse likely to be directly affected by the Proposed Development, as it is the only one which drains directly from Loch Kemp (which will form the upper reservoir).

The flow from the Allt an Sluichd is to be regulated to mimic normal flow during construction and operation of the Proposed Development. A gauge is already installed at the site, near the outflow from Loch Kemp, to monitor flow levels for this watercourse. The other watercourses were surveyed at the behest of NatureScot in order to gain an understanding of the species present in the area to compare with the area directly affected by the Proposed Development.

Background

Freshwater Lichens

Upland streams and rivers usually fill and discharge rapidly and may be referred to as ‘flash’ watercourses. They are exposed to extremes in temperatures and can go from a trickle to a torrent in rapid succession. During summer, water levels can evaporate to a trickle. The surface water which enters the burn is often warm during the summer months while the ground water from springs is cool. Water in open exposed channels may heat considerably if exposed to the sun. This water will then cool as it makes its way through deep shaded ravine sections.

The lichen flora along a watercourse will subtly change according to a number of factors including:

- temperature,
- rainfall,
- geology,
- water chemistry and PH,
- nutrient status, including levels of reactive nitrogen deposition,
- depth,
- width and length of ravines and open sections,
- moisture supply and shade,
- tree canopy cover,
- woodland type, and
- length of ecological continuity (certain lichens have a limited capacity to disperse and colonise).

Watercourses can support lichens which are rare on a nationally and international scale due to the restricted nature of their habitat requirements.

The channelling of water, particularly in steep sections and during heavy downpours, can create a considerable scouring force particularly during spate events. The rapid movement of water over stone surfaces also imbues high levels of oxygen into the water. Smaller stones, and rocks are shifted around and down the watercourse depending on their size and position. These rocks are not able to support slow growing lichens but may become covered in faster growing algae or cyanobacteria. Upland burns receive nutrients from rain, dead plant material and sheep, deer & bird droppings washed in from the catchment area. However, these watercourses are often nutrient poor and acidic due to the peatland through which they cut.

The nature of the underlying and superficial geology is particularly important in relation to the lichen flora it can support with basic and intermediate rocks usually supporting a more diverse flora.

The overall size of the watercourse will also have an influence on the lichen flora. Larger watercourses will have a greater surface area for which lichens can colonise and survive together with a greater potential for microhabitat diversity. Orange (2017) notes: '*gently shelving boulder surfaces or bedrock, especially where they dip below base-flow level, often tended to support notable species*'.

Gradient can also be an important factor influencing the lichen flora. Areas with a gentle gradient will have less scouring than steeper sections and are more likely to be covered with mosses thus reducing available habitat for lichens.

Addition nutrients come from dead vegetation including tree leaves and animals, such as invertebrates and larger animals including sheep and deer. Lower down the watercourse, in areas of higher densities of woodland the input of nutrients from leaves is increased. Further down the valley still, the rivers into which these watercourses discharge are augmented by fertilisers or from the droppings of large populations of sheep and cattle and from house and farm drains.

A number of authors have attempted to categorise the zonation of lichens in rivers depending on the degree of submergence e.g., Gilbert and Giavarini 1997 & Gilbert 2000; Demars and Britton 2011 & Thus and Schutz 2009. These zones are described below:

Aquatic zone: lichens which are able to grow submerged for a period of one year or more in their whole distribution area.

Amphibious zone: species which can tolerate long periods of exposure to air and inundation and for species which are permanently submersed only in parts of their distribution range.

Splash zone: These lichens are only occasionally inundated during high flows and spate events. They have the capacity to survive in a habitat which experiences strong flow forces during spate events. These species may also require high humidity levels and frequent to occasional splashing.

Terrestrial zone: Lichens with a low tolerance of submersion but often grow within close proximity to water bodies. These lichens can grow on a variety of substrata including rocks, dead or living plants or soil.

Heathland Lichens

Oliver Gilbert (2000) describes the differences between heath and moorland below with additions by the surveyor [in brackets]:

'Heaths occur in dry parts of the country, are subject to periodic droughts, and are usually found on light mineral soils. They are clearly the product of human activities and need management; if neglected they turn into woodland. Moors occur in high rainfall areas and are underlain by wet, acid peat; they are not so evidently an artefact and are more stable…. Although originally the result of progressive podsolization following forest destruction and, therefore, man-made, both communities [heather-dominated heaths and moors] have had several thousand years in which to develop a rich and distinctive lichen flora…. Their decline set in at the end of the seventeenth century as a result of innovations in farming… More survives in Britain than elsewhere, giving us a special responsibility to study and conserve them…. Though heathland lichen communities are dominated by the genus *Cladonia*, other terricolous species are usually present'…... Many heather moors are managed by rotational burning to promote the dominance of heather…. Ward [1970] reported the first appearance of *Cladonia* squamules after two or three years, of thalli with podetia after three or four years, and maximum development in the tenth year when the lichen cover reached 66% with a mean of 8 lichen species per 4m² (Gilbert 2000). It appears that 'cool burn' fires during the winter months are important in maintaining lichen biodiversity. Unburnt areas of heath/moor nearby allow 'seeding' of lichen propagules. This method may provide optimum conditions for lichen diversity (Davies and Legg 2009, Sanderson 2010 & Gilbert 2000).

The lichen flora of both heathlands and moorlands is often similar but some species show preferences with [*Cladonia borealis*], *C. cornuta, C. sulphurina* [*C. zopfii*]*, Icmadophila ericetorum, Omphalina hudsoniana, O. luteovitellina, Pycnothelia papillaria, Trapeliopsis gelatinosa* and *T. glaucolepidea* showing a preference for northern moorlands. Sanderson (2010) describes the use of cool controlled burns during the winter months as significant in producing a diverse heathland lichen flora 'lichen regeneration [following a cool burn] is rapid, presumably from surviving propagules. The thalli of most species do not survive burns, but abundant regrowth of new squamules from bare humus occurs in the second spring after a burn. *Cladonia strepsilis* thalli can actually directly survive and regrow. The burns also clear away competing, late-succession mosses which mowing does not. In contrast after hot wild fires lichen colonization appears to occur by colonization from beyond the burnt area and has been shown to take about 13 years (Coppins and Shimwell 1971).

Geology: The predominant bedrock at these sites is Granodiorite from the Foyers Igneous Complex (a plagiogranite with plagioclase being the dominant feldspar present); formed during the Silurian c. 419 million years ago. Local environment previously dominated by intrusions of silica-rich magma. There are also elements of Gairbeinn Pebbly Psammite and Micaceous Glen Doe Psammite. Both metamorphic in nature and formed approximately 541 to 1000 million years ago. These were originally sedimentary rocks, altered by low-grade metamorphism (Allaby 2013 & BGS 2022).

Methodology

Survey were undertaken on the dates (as shown on Figure 2):

- 11th & 14th July 2022 at Allt à Chinn Mhonaich.
- 12th July 2022 at the unnamed stream which drains from the Lochan à Choin Uire.
- 13th July 2022 at Allt an Sluichd.
- Loch Kemp was surveyed on 4th (half day) and 5th December 2022 with a short additional (2 hour) survey undertaken on 27th March 2023.
- Lochan à Choin Uire (2 hours) 27th Feb 2023.
- Lochn Nan Nighean (3 hours) 27th Feb 2023.
- Lochan Scristan 28th Feb 2023.
- Loch Paiteag (2 hours) 1st March 2023.
- Peninsula in N. section of Loch Knockie (half day) 1st March 2023.

The watercourses, lochs and lochans were subject to rapid walk over surveys. A number of 'spot checks' were made. Species lists were made in a notebook (100 mg paper and/or waterproof paper notebook) and photographs were taken using a Samsung 10 note phone camera and a submersible Olympus TG4 camera. Many of the crusts are difficult to identify by gross morphology alone, so some specimens were taken using a 1lb hammer and 9inch tungsten carbide tipped chisel, for further microscopic analysis.

A X 10 illuminated hand lenses was used to aid identification. The following 'spot test' chemicals were also used to aid identification:

- Sodium hydroxide (10% caustic soda in water),

- Sodium hypochlorite (household bleach), and
- para-phenylenediamine.

Water levels were favorably low. Conditions during the surveys in December and Feb/March were frosty and very cold.

Water levels were monitored for the River Morriston at Levishie which discharges into Loch Ness. These levels were around 0.5 m in February/March 2023; 0.4 m during survey work in December 2022 and considerably lower in July 2022.

The *Guidelines for Selection of Biological SSSIs* were revised in 2018 and a new chapter covering Lichens was published (Sanderson *et al*. 2018). This includes an Acid Watercourses Quality Index (AQUI) used here to assess lichen assemblages on the three watercourses; a Rocky Lake Shore, Threatened Near Threatened and Notable Index (TNTN) used to assess Loch Kemp and a Heathland, Moorland and Coastal Heath Index (HMCHI) used to assess the heathland around Loch Kemp.

Ten figure GPS readings were recorded for species of conservation importance. Location photographs for each sub-site were taken. DAFOR abundance was recorded. A BLS spreadsheet was also produced of all lichens recorded in each of the 1 km squares visited.

Key to abbreviations

DD = Data Deficient (species with insufficient data to be placed on the Red List but whose habitat is restricted and may potentially be Red List Species).
E = Endemic.
EN = Endangered (IUCN Red List Species)
L = member of the *Lobarion* community (old woodland indicator species).
M = Metallophyte.
Lic = Lichenicolous fungus.
NE = not evaluated.
NR = Nationally Rare (Woods & Coppins 2012).
NS = Nationally Scarce (Woods & Coppins 2012).
NT = Near Threatened (IUCN Red List Species).
P = UK BAP Priority Species.

Sc = Species of principal Importance for Biodiversity in Scotland. Nature Conservation Act (Scotland) 2004.
TBC = Specimen to Be Confirmed.
VU = Vulnerable (IUCN Red List Species)

Watercourse Zone

A = amphibious
S = Splash Zone
T = Terrestrial

DAFOR Codes used in the excel spreadsheet list

D = Dominant
A = Abundant
F = Frequent
O = Occasional
R = Rare

Value of lichen at the study-site based scale

H = High
VH = Very High

Nomenclature follows BLS Taxon Dictionary 2022: Lichen Taxon Dictionary | The British Lichen Society.

Conservation status follow Wood and Coppins 2012.

Results

All three watercourses and Loch Kemp surpassed the Acid Watercourses Quality Index (AQUI) threshold score and may be considered for SSSI designation.

A species of unidentified *Aspicilia* was found on all three watercourses. This species has not been yet been evaluated (NE) but has been noted at other sites in Scotland and requires further investigation.

A species resembling *Placynthium pannariellum* aff. (NE) but without lobes was also found at Loch Kemp, Loch Knockie and Lochan nan Nighean. This species requires further investigation.

Verrucaria anziana (NE) appears to have a scattered but widespread distribution in Scotland but appears uncommon elsewhere in the UK. This species was found on all three watercourses.

A freshwater sponge tentatively identified as *Spongilla lacustris* was found on the Allt à Chinn Mhonaich and on Loch Kemp. This should be investigated further by a specialist. Its conservation value has been placed in the very high category as a precaution. It is not anticipated that the flow of the Allt à Chinn Mhonaich will be impacted by the Proposed Development as it is not an outflow from Loch Kemp.

The indices scoring tables and conservation value tables used to assess the surveyed sites are detailed below:

Table 1. AQUI scores for all three surveyed watercourses

Watercourse	AQUI Score	Bonus species	Total AQUI score incl. bonus species
Allt a Chinn Mhonaich	13	2	15
stream west of Lochan à Choin Uire	11	0	11
Allt an Sluichd	9	2	11

AQUI Threshold for consideration for SSSI = 11.

Table 2. TNTN Rocky Lake Shore Species found at Loch Kemp and nearby lochs and lochans.

Species	**Status**	**TNTN Score**	**Kemp**	**Uire**	**Nighean**	**Scristan**	**Paiteag**	**Loch Knockie, peninsula in N. section**
Geology			Granodiorite and Psammite	Granodiorite	Psammite	Granodiorite	Psammite	Granodiorite and Psammite
Aspicilia aquatica	NS	1	X			X		X
Catillaria chalybeia var. *chloropoliza*	NE NS	1	X					X
Collema glebulentum	NS	1						X
Cryptothele rhodosticta	DD NR IR	1	X					
Dermatocarpon meiophyllizum	NS	1						X
Parmeliella triptophylla	Sc IR	1	X					
Phaeophyscia sciastra	NS	1	X					X
Placynthium flabellosum	NS	1	X					X
Placynthium pannariellum aff.	NE		X		X			X
Polychidium muscicola	NS	1	X					
Porina guentheri var. *lucens*	NS	1	X					
Porina interjungens	NT NS	2	X					
Rhizocarpon infernulum f. *sylvaticum*	NS	1						X
Verrucaria aethiobola	NS	1				X		
Verrucaria anziana	NS	1		X	X			
Verrucaria rosula	NR	1	X			X		X
TNTN Scores (threshold for potential SSSI designation = 6)			**11**	**1**	**1**	**3**	**0**	**8**

Table 3. Heathland, Moorland and Coastal Index species found near Loch Kemp and surrounding area

Species	Status	Location
Cetraria aculeata		K C N T
Cetraria muricata		K N
Cladonia bellidiflora		K N
C. borealis	DD NR	M S K
C. carneola	NS	K T P
C. cervicornis subsp. *cervicornis*		S
C. chlorophaea s.lat*		K
C. ciliata var. *ciliata*		M K N T
C. ciliata var. *tenuis*		M S K T
C. coccifera s. lat.*		M S K P E C
C. coccifera s. str.	DD NS	K N T
C. cornuta		K
Cladonia crispata var. *cetrariiformis*		K C N T
C. cyathomorpha	NS	K E P
C. diversa		K N
C. fimbriata		K C
C. floerkeana		K C N T P
C. furcata		S K T P
C. glauca		K
C. gracilis		K C N T
*C. merochlorophaea** (*chlorophaea* group)	NS	K C N T
C. polydactyla		K P
C. portentosa		M U K C N T
C. pyxidata		M U S
C. ramulosa		K C N
C. rangiferina		K T N
C. rangiformis		K
C. squamosa s.lat*		U C T P
C. squamosa var. *squamosa*		S K
C. strepsilis		K C N
C. subcervicornis		M U K C T
C. subulata		K
C. sulphurina		K
C. uncialis subsp. *biuncialis*		K N T C
C. uncialis subsp. *uncialis*	NT NS Sc	K P T
C. verticillata		T
C. zopfii	NS	K C
Pycnothelia papillaria		K N T

Site: K = Loch Kemp; M = Allt a Chinn Mhonaich; S = Allt an Sluichd; U = stream W. of Lochan a Choin Uire, Lochan a Choin Uire = C, Lochan Nan Nighean = N, Lochain Scristan = T, Loch Paiteag, = P, Loch Knockie N. section = E

*if both s.lat and s.str. are found at one site count only as 1.

Table 4. HMCHI Scores for heathland near Loch Kemp and nearby streams, lochs and lochans

Species	MHCI Score
Loch Kemp	32
Allt a Chinn Mhonaich	7
Allt an Sluichd	7
stream W. of Lochan a Choin Uire	4
Lochan a Choin Uire	13
Lochan Nan Nighean	17
Lochan Scristan	18
Loch Paiteag	8
Loch Knockie, Peninsula in N. section	2

Total HMCHI scores: Scores over 20 should be considered for potential SSSI designation

Table 5. Species of high or very high conservation value for Allt à Chinn Mhonaich

Species	Status	Value of lichen at the study-site based scale	Substrate	Watercourse zone	Notes
Cladonia borealis	DD	H	Sax+Bry	S/T	Probably under recorded due to confusion with other similar species and often just recorded as *Cladonia coccifera* s.lat.
Collemopsidium angermannicum	NT, NS	VH	Sax	A	Scattered UK distribution, but often difficult to detect and consequently probably overlooked in some cases.
Leptogium burgessii	Sc, IR, L	VH	Sax + Bry, Sax	S/T	Very scarce/local overall on site and the Proposed Development passes through core populations.
Micarea ternaria	NR	H	Sax	N/A	Found on the main track, some distance from the watercourse. A rare species with a scattered distribution in the UK. Care needs to be taken not to disturb this species. Particularly if there are road widening operations in the area.
Nevesia (*Fuscopannaria*) *sampaiana*	NT, NS, P, Sc, L, IR	VH	Cort.	T	On ash and hazel.
Parmeliella triptophylla	Sc, IR, L	H	Sax	S/T	This species is relatively rare on rocks but was occasionally recorded on rocks in the splash/terrestrial zone at this site.
Placynthium asperellum (TBC)	NT, NR, Sc	VH	Sax	A	There are a few difficult species within this genus including this one. This specimen studied by J.R. Douglass & B.J. Coppins and is being sent to taxonomist Alan Orange (National Museum of Wales) for further analysis.
Rhizocarpon caesium	DD, NS, Sc	VH	Sax	A	A rare species mostly confined in the UK to NW Scotland. There are a couple of records from the Lake District and

					scattered records from Western Ireland.
Sticta sylvatica	Sc, IR, L	H	Sax+Bry	S/T	On mossy rock
Strigula stigmatella s.lat	DD, NS	VH	Sax	S	A rare species requiring further taxonomic work. A specimen is being sent to taxonomist Alan Orange (National Museum of Wales) for further analysis.
Freshwater sponge possibly *Spongilla lacustris*	?NS	VH	Sax	Aquatic	On submerged rocks. The surveyor has very limited knowledge of this species of freshwater sponge. A specialist should be sought to identify this species and evaluate its rarity and the impact of the Proposed Development on this species. Andy Acton (2012) mentions this species: *S. lacustris* is thus Nationally Scarce on the basis of available knowledge. Timi's work on freshwater lochs in the 1980s did not record *S. lacustris* in the Great Glen area or east of the Great Glen (pers. comm.) Another communication with Tristan Hatton-Ellis (at the Countryside Council for Wales) reads: 'It is likely that sponges are under-recorded in freshwaters. I quite commonly have divers contact me with photographs of freshwater sponges... I also quite often see small sponge colonies growing on or under stones in rivers….'.

Table 6. Species of high or very high conservation Value for Allt an Sluichd

Species	Status	Value of lichen at the study-site based scale	Substrate	Watercourse zone	Notes
Cladonia borealis	DD	H	Sax+Bry	S/T	Probably under recorded due to confusion with other similar species and often just recorded as *Cladonia coccifera* s.lat.
Cryptothele rhodosticta	DD, NR, IR	VH	Sax	A/S	Very rarely recorded in Britain. Only recently detected in Scotland (Berneray, Outer-Hebrides). Very rare also in Wales and Ireland. 'Reported from various places in the world but name often misapplied' (Smith *et. al* 2009).
Fuscopannaria ignobilis	VU, NS, P, Sc, S8	VH	Cort	T	On ash on small island in middle of watercourse. A very rare species with a preference for wayside trees, especially ash and tends to be found in much drier areas than other *Pannaria* species. The entre British population of this species resides in Scotland and is particularly localised within the Great Glen area.
Nevesia (*Fuscopannaria*) *sampaiana*	NT, NS, P, Sc, L, IR	VH	Cort.	T	On ash on small island in middle of watercourse.
Pseudocyphellaria norvegica	NS, P, Sc, L, IR	VH	Sax+Bry	T	3 patches on massive mossy boulder very close to watercourse.
Rhizocarpon amphibium	DD, NR, Sc	VH	Sax	A	A scattered and mainly western Scotland. Rare in W. England and Wales. Not yet recorded in Ireland.
Strigula confusa	NR, E, Sc, IR	VH	Sax	S	A very rare endemic species with a mostly NW distribution.

Table 7. Species of high conservation Value for watercourse west of Lochan à Choin Uire

Species	Status	Value of lichen at the study-site based scale	Substrate	Watercourse zone	Notes
Leptogium cyanescens	Sc, IR	H	Sax+Bry	S/T	On rock.
Nephroma laevigatum	Sc, L, IR	H	Sax+Bry	S/T	On rock.
Parmeliella triptophylla	Sc, L, IR	H	Sax	S/T	This species is relatively rare on rocks but was occasionally recorded on rocks in the splash/terrestrial zone at this site.
Rhizocarpon caesium	DD, NS, Sc	VH	Sax	A	A rare species mostly confined in the UK to NW Scotland. A couple of records from the Lake District and scattered records from Western Ireland.
Stereocaulon glareosum	NT, NR, Sc, M	VH	Terr	N/A	Found on the main track, some distance from the watercourse. A rare species of sandy or gravely soil. Known from the Scottish N & C. highlands & Mid Wales. Care needs to be taken not to disturb this small and vulnerable population. Particularly if there are road widening operations in the area.
Sticta sylvatica	Sc, L, IR	H	Sax+Bry	S/T	On mossy rock.

Table 8. Species of high or very high conservation value for Loch Kemp

Species	Status	Value of lichen at the study-site based scale	Substrate	Watercourse /Heathland (He) zone	Notes
Cladonia borealis	DD, NR	H	Terr	He	Probably under recorded due to confusion with other similar species and often just recorded as *Cladonia coccifera* s.lat. Also recorded for Allt an Sluichd *and* Allt à Chinn Mhonaich.
Cladina carneola	NS	H	Terr	He	Normally occurring in the Scottish Highlands in ancient Caledonian pine woods and more rarely on moorland and blanket bogs. This is an interesting addition to the moorland lichen community here.
Cladonia coccifera s.str.	DD, NS	H	Terr	He	A member of the *C. coccifera* aggregate. This species has a scattered distribution in Britain occurring in 'upland moorland habitats and high-quality lowland heaths' Sanderson 2021.
Cladonia merochlorophaea	NS	H	Terr	He	A member of the *Cladonia grayi* group. This species is distinctive in having a pinkish brown medulla (best seen in older podetia) and C+ wine red reaction. Occurring in moorland, acidic heathland and lignum. This species has a wide distribution across Britain and is probably somewhat under recorded due to its similarity with other members of this group.
Cladonia cyathomorpha	NS	H	Terr	He	Described as 'a notable species' by Sanderson (2021). This species has a mostly western distribution in the UK and its occurrence in this habitat is unusual and is an interesting addition to the diverse terricolous community occurring at this site.
Cladonia uncialis subsp. *uncialis*	NT, NS, Sc	VH	Terr	He	Probably under recorded due to confusion with *C. uncialis* subsp. *biuncialis* but still a good indicator of old heathland/moorland habitat. Only recorded for Loch Kemp moorland.
Cladonia zopfii	NS	H	Terr	He	In Britain this species occurs mostly in the Scottish Highlands and appears to be declining and has been 'lost over large areas of Britain…. Surviving populations appear dependent on combinations of extensive but locally heavy range grazing, controlled burning and accidental and occasional soil disturbance.' (Sanderson 2021).
Cryptothele rhodosticta	DD, NR, IR	VH	Sax	A/S	Very rarely recorded in Britain. Only recently detected in Scotland (Berneray, Outer-Hebrides). Very rare also in Wales and Ireland. 'Reported from various places in the

					world but name often misapplied' (Smith *et. al* 2009). Also recorded for Allt an Sluichd.
Placynthium pannariellum aff.	?	VH	Sax	A/S	*P. pannariellum* is rarely recorded in Britain. Only recorded for Loch Kemp.
Porina interjungens	NT, NS	VH	Cort.	T	A relatively rare species. Similar to other *Porina* species e.g., *P. guentheri*. and requires microscopic examination for confirmation. Only recorded for Loch Kemp.
Pycnothelia papillaria	?	H	Terr	He	A species in considerable decline with its threat status in the UK likely to change. Sanderson (2021) describes the occurrence of this species below: 'Found on acid peat, humic layers over leached, very acid soils or shallow humus over rock in heathlands and moorlands. This lichen is found on firm, sometimes compacted, black humus and it is absent from both bare mineral soil or loose fibrous humus. It is light demanding and is strongly dependent on grazing, fire or disturbance to maintain open conditions… This species is highly threatened across the European lowlands from the Netherlands to Latvia and is also suffering a severe decline south of the Scottish Highlands, except in the New Forest. It is assessed as Near Threatened in Wales. In the New Forest it is still widespread and locally abundant with traditional heathland management providing frequent well-lit hard humus surfaces. The main positive factors are extensive but locally heavy range grazing, controlled burning and accidental and occasional soil disturbance. Air pollution is also implicated is some losses but it has been equally lost from clean air areas where traditional management has stopped. Probably much less threatened in the northern uplands but could decline with abandonment of tradition moorland management.
Freshwater sponge possibly *Spongilla lacustris*	?NS	VH	Sax	Aquatic	On submerged rocks. The surveyor has very limited knowledge of this species of freshwater sponge. A specialist should be sought to identify this species and evaluate its rarity and the impact of this Proposed Development on this species. Andy Acton (2012) mentions this species: *S. lacustris* is thus Nationally Scarce on the basis of available knowledge. Timi's work on freshwater lochs in the 1980s did not record *S. lacustris* in the Great Glen area or east of the Great Glen (pers. comm.) Another communication with Tristan Hatton-Ellis (at the Countryside Council for Wales) reads: 'It is likely that sponges are under-recorded in freshwaters. I quite commonly have divers contact me with photographs of freshwater sponges... I also quite often see small sponge colonies growing on or under stones in rivers….'.

Table 9. Main target areas on the three watercourses supporting rare freshwater lichens (as shown in Figure 3a and 3b)

Target Note number	Value of tree/rock for lichens at the study-site based scale	Species present incl. notes	Habitat	Location	EASTING	NORTHING
942	VH	Veteran ash: *N. sampaiana, R. amplissima, P. triptophylla, L. pulmonaria, L. scrobiculata, S. fuliginosa* (as *S. ciliata*), *P. collina, P. parvula, S. sylvatica, P. rubiginosa. River rocks L. burgessii, S. sylvatica, P. pezizoides.*	Rock in river and Ash at edge of river and river rocks	Allt à Chinn Mhonaich	245390	816082
1086	VH	*Fuscopannaria ignobilis, N. sampaiana, L. pulmonaria, L. burgessii, Mycobilimbia pilularis, P. triptophylla, R. virens, N. laevigatum, P. rubiginosa, P. conoplea* (all on ash) plus *Porina guentheri* var*. lucens* on *rocks*	On ash near river and rocks in river	Allt an Sluichd	246854	817457
1087	VH	*Pseudocyphellaria norvegica, Lepraria membranacea* (on boulder) *Schismatomma* umbrinum (underhang of boulder at edge of river) *Porina guentheri* var*. lucens, V. anziana* on rocks in the river. *L. pulmonaria, S. sylvatica, R. virens* on hazel	Massive rocky boulder by river Hazel & rocks in & near the river	Allt an Sluichd	246878	817405
1088	VH	*L. burgessii, C. chalybeia* var. *chloropoliza, P. triptophylla*	Rock in river	Allt à Chinn Mhonaich	245323	816142
1089	VH	*Stereocaulon glareosum*	On northern edge of track	Track near stream west of Lochan à Choin Uire	246311	816560
1090	H	*Micarea ternaria*	on stones in track	Track near Allt à Chinn Mhonaich	245512	816108
1091	VH	Freshwater sponge sp. *V. anziana, V. rosula, C. borealis*	Rock in river	Allt à Chinn Mhonaich	245912	815715
1092	VH	Freshwater sponge sp*. V. rosula, E. verrucisporus* on *I. lacustris.*	Rock in river	Allt à Chinn Mhonaich	245865	815729
1093	VH	Freshwater sponge sp. *Porina guentheri* var. *lucens*	Rock in river	Allt à Chinn Mhonaich	245874	815724

1094	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245820	815786
1095	H	*Collemopsidium angermannicum*	Rock in river	Allt à Chinn Mhonaich	245564	816048
1096	VH	*Strigula stigmatella*	Rock in river	Allt à Chinn Mhonaich	245656	816018
1097	H	*Rhizocarpon caesium, P. flabellosum, V. cernaensis, P. pezizoides, S. sylvatica*	Rock in river	Allt à Chinn Mhonaich	245657	816022
1098	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245578	816054
1099	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245669	816003
1100	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245564	816048
1101	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245351	816124
1102	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245353	816123
1103	H	*Rhizocarpon caesium*	Rock in river	Allt à Chinn Mhonaich	245657	816022
1104	H	*R. caesium, V. anziana, P. guentheri var. lucens, V. aethiobola*	Rock in river	Allt à Chinn Mhonaich	245383	816081
1105	H	*R. caesium, V. anziana, P. guentheri* var. *lucens, V. aethiobola, P. flabellosum, R. infernulum f. sylvaticum*	Rock in river	Allt à Chinn Mhonaich	245351	816124
1106	H	*Aspicilia sp. P. flabellosum on rocks in river. P. collina, L. pulmonaria, P. multipuncta, P. triptophylla, C. atropurpurea, N. sampaiana, P. occidentalis, R. amplissima* on hazel	Rock in river	Allt à Chinn Mhonaich	245347	816128
1107	VH	*Placynthium asperellum* aff. TBC. *P. flabellosum, V. anziana*	Rock in river	Allt à Chinn Mhonaich	245595	816045
1108	H	*R. caesium, Peltigera polydactylon, P. pezizoides, V. aethiobola, Catillaria chalybeia var. chloropoliza*	Aquatic boulders	Stream west of Lochan à Choin Uire	245895	816587
1109	H	*R. caesium*	Rock in river	Stream west of Lochan à Choin Uire	245716	816604

1110	H	*Cryptothele rhodosticta, P. flabellosum, Aspicilia* sp., *Porina guentheri* var. *lucens, Porpidia flavocruenta, Porpidia hydrophila*	Rock in river	Allt an Sluichd	246875	817224
1111	H	*Cladonia borealis*	On several boulders in and near the river	Allt an Sluichd	246887	817247
1112	H	*Rhizocarpon amphibium, P. flabellosum*	On several boulders in the river	Allt an Sluichd	246887	817247
1113	H	*Rhizocarpon amphibium with Endococcus rugulosus, Porina guentheri var. lucens, C. borealis, D. luridum*	On several boulders in the river	Allt an Sluichd	246891	817248
1114	H	*Cryptothele rhodosticta, Porina guentheri var. lucens, Porpidia rugosa, Rhizocarpon infernulum subsp. sylvaticum*	Rock in river	Allt an Sluichd	246908	817359
1115	VH	*Strigula confusa, Bacidia carneoglauca, Schismatomma umbrinum, Protopannaria pezizoides*	Rocks in and near river	Allt an Sluichd	246906	817403

Key: H = High, VH = Very High.

Table 10. Main target areas supporting rare freshwater lichens (as shown in Figure 3c) and heathland lichens (as shown in Figure 4) at Loch Kemp

Target Note number	Value of tree/rock for lichens at the study-site based scale	Species present incl. notes	Habitat	EASTING	NORTHING
1116	H	High HMCHI score including *Cladonia borealis* and *Micarea viridileprosa.*	Moorland	247238	816274
1117	H	*Cladonia borealis*	Moorland	247204	816310
1118	H	*Cladonia carneola*	Moorland	247204	816310
1119	VH	*Cladonia coccifera* s.str. Very High HMCHI Score.	Moorland	246903	816104
1120	H	*Cladonia cyathomorpha.* High HMCHI score for this area.	Moorland	247227	816370
1121	VH	*Cladonia merochlorophaea* plus *C. zopfii.* Very High HMCHI Score.	Moorland	246903	816104
1122	H	*Cladonia zopfii.*	Moorland	246691	816309
1123	VH	*Cladonia zopfii.* Very High HMCHI Score.	Moorland	246919	816083
1124	H	High MHCI score for this area including a wide variety of *Cladonia* species.	Moorland	247082	816606
1125	VH	*Cladonia coccifera* s.str, *C. merochlorophaea, C. sulphurina*, *C. strepsilis, Pycnothelia papillaria, Umbilicaria polyrrhiza, Xanthoparmelia mougeotii*. Very High HMCHI Score for this area.	Moorland	246925	816083
1126	VH	Very High HMCHI Score plus *Thelocarpon epibolum*.		246925	816083
1127	VH	*Cryptothele rhodosticta.*	Freshwater	247182	816463
1128	VH	*Placynthium pannariellum* aff.	Freshwater	247187	816460
1129	VH	*Porina interjungens*	Freshwater	246600	816558
1130	VH	Freshwater sponge possibly *Spongilla lacustris*	Freshwater	247197	816351
1131	VH	Freshwater sponge possibly *Spongilla lacustris*	Freshwater	247182	816462
1132	VH	Freshwater sponge possibly *Spongilla lacustris*	Freshwater	247207	816445

1133	VH	Freshwater sponge possibly *Spongilla lacustris*	Freshwater	247192	816458
1134	VH	Freshwater sponge possibly *Spongilla lacustris*	Freshwater	246682	816304

Key: H = High, VH = Very High.

Conclusions

This lichen survey was commissioned in relation to identify freshwater lichens and lichenicolous fungi within, or in close proximity to Loch Kemp, the site of a Proposed Development (as shown in Figure 1).

Habitat quality for freshwater lichens was assessed using the Aquatic Watercourses Quality Index (AQUI) and the Rocky Lake Shores Threatened, Near Threatened and Notable Species Indices (Sanderson *et al*. 2018, JNCC Guidelines for the Selection of Biological SSSIs 2018). All three watercourses, Loch Kemp and a surveyed section of Loch Knockie meet or exceed the threshold scores for potential SSSI designation.

Overall, the best watercourse site was Allt a Chinn Mhonaich with an AQUI score of 15. This site also supports a freshwater sponge species (possibly *Spongilla lacustris,* which requires specialist advice) together with four Near Threatened species, two Data Deficient and two Nationally Rare.

The next best watercourse site was Allt an Sluichd with and AQUI of 11 plus one Vulnerable, one Schedule 8, two Data Deficient and three Nationally Rare. The stream west of Lochan à Choin Uire comes in third but with an AQUI of 11, it still meets the threshold for potential SSSI notification and includes a Data Deficient species.

The freshwater lichen flora of Loch Kemp supports two IUCN Near Threatened species *Porina interjungens*, and the Nationally Scarce *Polychidium muscicola*. Neither of these species were found anywhere else in the area. In addition, the

freshwater sponge tentatively identified as *Spongilla lacustris* was also frequently found around the loch and at Allt an Sluichd. It is recommended that some of the surrounding lochs are surveyed by a freshwater sponge specialist, to see if the species occur only on Loch Kemp or if they represent more isolated populations within this area.

During the freshwater survey of the loch (walking between spot check areas) it became apparent that the heathland lichens around Loch Kemp were of significant interest to deserve a rapid assessment. They were assessed using the Heathland Moorland and Coastal Index (HMCHI) (Sanderson *et al*. 2018) with a score of 32, well above the threshold of 20 for potential SSSI designation. The Proposed Development site supports the Near Threatened (NT) Scottish Biodiversity list species (Sc) *Cladonia uncialis* subsp. *uncialis* (NS, Nationally Scarce) together with the Nationally Rare (NR) Data Deficient (DD) *Cladonia borealis,* the Nationally Scarce: *Cladonia carneola*, *C. coccifera* (DD)*, C. merochlorophaea, C. zopfii, Micarea viridileprosa* and *Thelocarpon epibolum.* Many of these species are in decline in across large areas of the UK and Europe due to changes in land management and developments.

Further sections of heathland were surveyed in February/March 2023 and no other areas exceeded the HMCHI threshold for potential SSSI designation, although two sites came close: Lochan Nan Nighean and Lochan Scristan with scores of 17 and 18 respectively. All of the HMCHI species found in the Loch Kemp area were also found at other locations not designated for development during this survey.

Aquatic, amphibious and splash zone assemblages at this site, some of which are rare and of national or international significance would be most at threat of habitat loss

as they occupy highly restricted and specialized niches. Any reduction in water quality and flow rate is likely to have a significant impact on these species, which require either constant, frequent or occasional inundation or wetting provided by the natural flow regime (Orange 2017, Demars & Britton 2011 & Douglass and Coppins (in prep)).

The flooding of the rock habitat around the loch will subject the existing freshwater and non-freshwater species to a rapid filling and emptying regime to a maximum of 28 m above the current conditions. Such changes will almost certainly destroy these lichen communities together with the freshwater sponge, which currently experience changes of occasional and often slow changes in water levels of tens of centimeters only. It is well known that large draw down zones in lakes and reservoirs do not support diverse freshwater lichen assemblages due to the rapidly changing conditions which the lichens cannot adapt to (Gilbert 2000, Gilbert 2001, Gilbert and Giavarini 2001. Lichenologist Oliver Gilbert states: '*There are many examples of lakes very poor aquatic lichens as a result of damming or water abstraction'* Gilbert 2001 in Fletcher (ed) 2001.

Disturbance of ground conditions during installation of the Proposed Development is also likely to cause changes to the conditions in Loch Kemp and the Allt an Sluichd e.g., movement of rocks and an increase sediment loads. Changes in water chemistry are also possible at the time of installation of the dams, especially if large amounts of un-weathered concrete are used in their construction. It is recommended that as much of the concrete as possible is pre-weathered to reduce the effect of alkaline shock on the aquatic ecosystem.

Significant species found on the Allt an Sluichd include *Cryptothele rhodosticta* (DD, NR, Sc), *Rhizocarpon amphibium* (DD, NR, Sc) and the British Endemic *Strigula*

confusa (NR, Sc, IR). The later two species were not found anywhere else in the areas surveyed, and *Cryptothele rhodosticta* was only found here and at the other Proposed Development site of Loch Kemp, so particular care should be taken not to cause changes in the water flow and quality on the Allt an Sluichd.

Some corticolous species with an IUCN threat category were also recorded if they were growing within close proximity of the watercourse. These include *Fuscopannaria ignobilis* (VU, NS, P, Sc, S8), *Nevesia* (*Fuscopannaria*) *sampaiana* (NT, NS, UK BAP, Sc, L, IR) and *Parmeliella testacea* (NT, NS, UK BAP, Sc, L, IR). A notable lichen assemblage was also found on birch on the west side of the loch including *Protoparmelia ochrococca* (NS). Andy Acton (2022) has produced a separate report on the woodland.

Other lichen species growing in the terrestrial zone on rocks and trees may also be responding to a local increase in humidity levels, which could change if water flow is reduced (Orange 2017, Brinker 2015, Richardson 2013 & Demars & Britton 2011 & Douglass and Coppins (in prep). It is therefore recommended that natural flow conditions are mimicked as much as possible for the outflow into the Allt an Sluichd.

Particular care needs to be taken to avoid disturbance to populations of *Micarea ternaria* (NR) and *Stereocaulon glareosum* (NT, NR, Sc) on the main access tracks. Several notable species were also found on trees near the loch and along the watercourses.

If the Proposed Development is consented, it is highly recommended that monitoring is undertaken to help assess any specific impacts on species of

conservation concern in order to identify potential mitigation measures for future pumped storage schemes.

Acknowledgements

I would like to thank the following people for their assistance:

Jennifer Skrynka & Rebecca Rae.

Brian Coppins, Neil Sanderson and Alan Orange for help with some species ID's.

Andy Acton for his GIS mapping work and checking through the report.

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Appendix I: Notable Species

Table 8. Freshwater and other notable saxicolous species found on the three watercourses and Loch Kemp.

Site: K = Loch Kemp; M = Allt a Chinn Mhonaich; S = Allt an Sluichd; U = stream W. of Lochan Choin Uire.
Position in watercourse: A = Amphibious, S = Splash zone, T = Terrestrial.

Taxa	Status	Site	AQUI	Position in watercourse	Notes
Agonimia tristicula		S K		S/T	
Aspicilia sp.		M U S		S	Unidentified *Aspicilia* sp.
Aspicilia aquatica	NS	K		A/S	
Aspicilia caesiocinerea		M K		S	
Baeomyces rufus		M S K		T	
Bacidia carneoglauca	NS	S	AQUI	T	
Bacidia viridifarinosa		K		S	
Bryobilimbia ahlesii	NS	M U		A	
Carbonea vorticosa	NS	K		T	
Catillaria chalybeia var. *chloropoliza*	NE NS	M U K		A	
Cladonia borealis	DD NR	M S		T	
Collemopsidium angermannicum	NT NS	M	AQUI	A	
Cryptothele rhodosticta	DD NR IR	S K	AQUI (Bonus)	A	
Dermatocarpon luridum		S K	AQUI	A	
Dimerella lutea		U			
Endococcus verrucisporus (Lic on *Ionaspis lacustris*).	NE NR	M U		A	
Ephebe lanata		M U S K		A	
Ionaspis lacustris		M U S K		A	
Kalaallia reactiva (Lic on Ionaspis lacustris)	NR	S		A	

Leptogium burgessii	Sc L IR	M S		T/S	
Leptogium cyanescens	Sc IR	U		T/S	
Leptogium gelatinosum		M		T/S	
Leptogium lichenoides		M		T/S	
Loxospora elatina		K		T	
Micarea lignaria var. *lignaria*		U		T	
Nephroma laevigatum	SC L IR	U		T	
Ochrolechia tartarea		M U S K		T	
Parmeliella triptophylla	Sc L IR	M U K		T	
Peltigera horizontalis L		M U		T	
Peltigera polydactylon	NS	M U	AQUI	S/T	
Phaeophyscia sciastra	NS	K		A/S	
Physcia caesia		S		T	
Placynthium flabellosum	NS	M U S K	AQUI	A	
Placynthium asperellum	NT NR Sc	M	AQUI Bonus	A	
Placynthium pannariellum aff.	?	K			TBC
Polyblastia cruenta		M U	AQUI	A	
Polychidium muscicola	NS	K		S	
Endococcus rugulosus (Lic on *Rhizocarpon amphibium*)	NE NR	S		A	
Porina guentheri var. *lucens*	NS	M U S	AQUI	A	
Porina interjungens	NT NS	K		A	
Porina lectissima		M U S K	AQUI	A	
Porpidia cinereoatra		M S		T	
Porpidia flavocruenta	NS	S		T	
Porpidia hydrophila		U S K	AQUI	A	
Porpidia macrocarpa f. *macrocarpa*		M U S		T	
Porpidia melinodes	NS	M K		T	
Porpidia rugosa		S		T	
Porpidia soredizodes		U		S/T	
Porpidia striata	NS	K		T	
Porpidia tuberculosa		M U S		T	
Protopannaria pezizoides		M U S	AQUI	T	

Protoparmelia ochrococca	NS	K		T	
Pseudocyphellaria norvegica	NS UK BAP Sc L IR	S		T	
Rhizocarpon amphibium	DD NR Sc	S	AQUI	A	
Rhizocarpon caesium	DD NS Sc	M U	AQUI	A	
Rhizocarpon infernulum f. *sylvaticum*	NS	M S		T	
Rhizocarpon lavatum		M U S K	AQUI	A	
Rinodina fimbriata	NS	M	AQUI	S	
Schismatomma umbrinum	NS	U S		T	
Staurothele fissa		M K	AQUI	A	
Stereocaulon vesuvianum var. *nodulosum*	NS	K		T	
Sticta sylvatica	Sc L IR	M U S		T	
Strigula confusa	NR E Sc IR	S	AQUI (Bonus)	A/S	
Strigula stigmatella	NE, NS	M	AQUI (Bonus)	S	This species needs further taxonomic work.
Thelotrema lepadinum		S K		T	
Thelidium pluvium	NS	M U	AQUI	A	
Trapelia elacista	NE	M K		S/T	
Trapelia glebulosa		U		T	
Trapelia placodioides		M U K		S/T	
Umbilicaria polyrrhiza		K		T	
Varicellaria lactea		S K		T	
Verrucaria aethiobola	NS	M U S	AQUI*	A	
Verrucaria anziana	NE NS	M U S	AQUI*	A	
Verrucaria cernaensis		M	AQUI*	A	
Verrucaria margacea		U	AQUI*	S	
Verrucaria rosula	NS	M U K	AQUI*	S/A	

* Three or more taxa = 1 point.

AQUI score for Allt a Chinn Mhonaich = 13 + 2 bonus species = 15.

AQUI score for stream west of Lochan à Choin Uire = 11.

AQUI score for Allt an Sluichd = 9 + 2 Bonus species = 11.

Rocky lake shores TNTN score for Loch Kemp = 11.

Appendix II. Site Photographs

Allt à Chinn Mhonaich

Plate 1. Location of freshwater sponge. Several patches were found in this locality. Allt a Chinn Mhonaich. NH 45912 15715. View direction west.

Plate 2. Freshwater sponge in photo above. These sponges are difficult to identify and it is best to consult an expert on identification and conservation status. A small specimen was taken and can be provided if required.

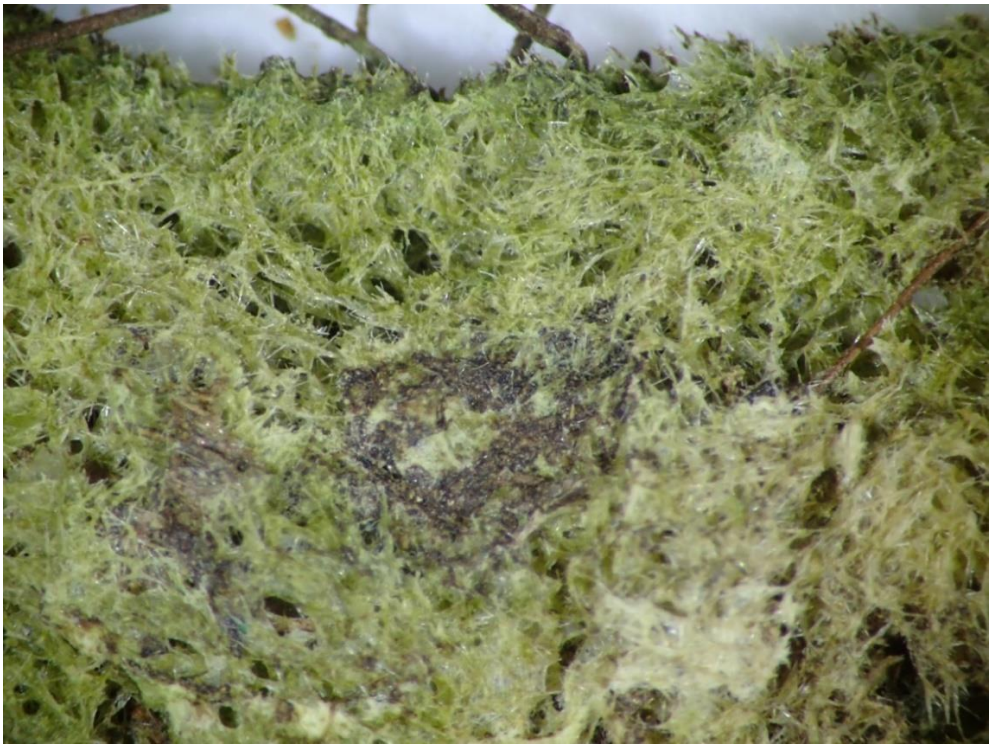


Plate 3. Specimen of Freshwater Sponge taken from the above site. x10 magnification.

Plate 4. Location of freshwater sponge. Several patches were found in this locality. NH 45865 15729. View direction WNW.

Plate 5. Freshwater sponge in photo above.

Plate 6. Position of *Rhizocarpon caesium* (AQUI, DD, NS, Sc). Several thalli were found on boulders along this section of Allt a Chinn Mhoinaich (e.g., on the section of boulder outlined in yellow). This species together with *R. amphibium* are amphibious and are usually found in a tight (c. 30 – 40cm) amphibious zone in well-lit situations, in upland to montane flash streams/rivers. NH 45820 15786. View direction west.

Plate 7. Boulder in photo above supporting *Rhizocarpon caesium*. Allt a Chinn Mhonaich. NH 45820 15786.

Plate 8. Patches of *Rhizocarpon caesium* on boulder in photo above. Allt a Chinn Mhonaich. NH 4582 1578.

Plate 9. Patches of *Rhizocarpon caesium* on boulder in photo above. These thalli appeared to have necrotic pale patches, possibly due to prolonged exposure. The rimose cracking, slightly thinner thallus and more convex apothecia distinguish this species from *R. amphibium* in the field. Microscopic differences also differ with 1 septate spores (muriform in *R. amphibium*). Epithecium brown with some blue/green, K – (red/brown K + purple/red in *R. amphibium*). Allt a Chinn Mhonaich. NH 4582 1578.

Plate 10. The lichenicolous fungus *Endococcus verrucisporus* (NE, NR, black dots on the pale thallus of *Ionaspis lacustris.* Growing next to *Rhizocarpon lavatum* (AQUI) with large black apothecia with a thick exciple. Allt a Chinn Mhonaich. NH 4582 1578.

Plate 11. *Verrucaria aethiobola* (AQUI, NS). Allt a Chinn Mhonaich. NH 4582 1578.

Plate 12. *Verrucaria rosula* (AQUI, NS). Allt a Chinn Mhonaich. NH 4582 1578.

Plate 13. Position of *Strigula stigmatella* (NR, E, Sc, IR). Allt a Chinn Mhonaich. NH 45656 16018.

Plate 14. *Strigula stigmatella* (NR, E, Sc, IR) on boulder in photo above. Allt a Chinn Mhonaich.

Plate 15. Position of *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on ash bough. This ash also supports the IR, Sc species *Lobaria amplissima, L. pulmonaria, L. scrobiculata, Pannaria rubiginosa, Parmeliella parvula, P. triptophylla, Peltigera collina* and *Sticta ciliata.* The rocks here also support: *Leptogium burgessii* (Sc, IR)*, Porina guentheri* var. *lucens* (AQUI, NS), *Protopannaria pezizoides* (AQUI)*, Sticta sylvatica* (Sc, IR) and *Verrucaria aethiobola* (AQUI, NS). Allt a Chinn Mhonaich. NH 45390 16082. View direction ENE.

Plate 16. Position of *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on hazel. Allt a Chinn Mhonaich. NH 45347 16128.

Plate 17. Position of *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on hazel. Allt a Chinn Mhonaich.

Allt an Sluichd

Plate 18. Position of *Cryptothele rhodosticta* (DD, NR, IR) on large boulder. Allt an Sluichd. NH 46875 17224. View direction N.

Plate 19. *Cryptothele rhodosticta* forming dark purplish patches on large boulder. NH 46875 17224. Allt an Sluichd. NH 46875 17224. View direction NW.

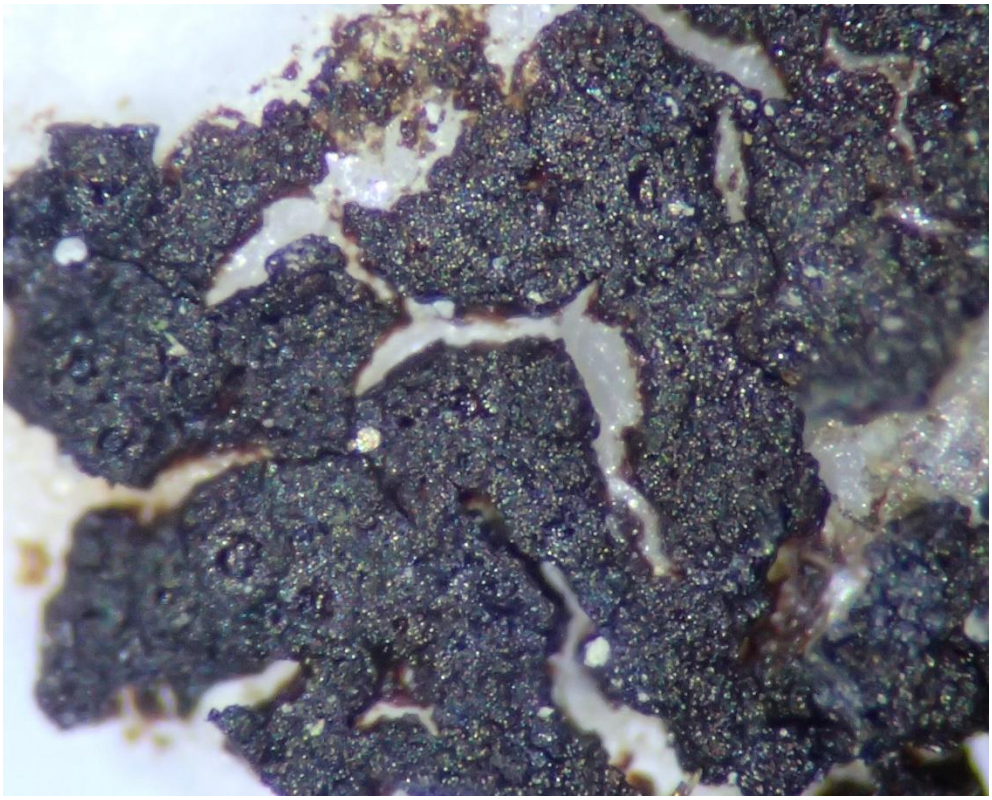


Plate 20. Fertile *Cryptothele rhodosticta* collected from large boulder above. NH 46875 17224. Allt an Sluichd. NH 46875 17224.

Plate 21. Several boulders along this section support *Rhizocarpon amphibium* (AQUI, DD, NR). Allt an Sluichd. NH 46887 17247 to NH 46891 17248. This was the only time this species was encounted during these surveys. View direction SW.

Plate 22. *Rhizocarpon amphibium* (AQUI, DD, NR, Sc) with *Rhizocarpon lavatum* (AQUI bottom, right). Allt an Sluichd. NH 46887 17247.

Plate 23. Position of *Leptogium burgessii* (Sc, IR)*, Placynthium flabellosum* (AQUI, NS) and *Porina guentheri* (AQUI, NS). Allt an Sluichd. NH 46815 17516. View direction SE.

Plate 24. An interesting lichen zonation with the normally terrestrial species *Leptogium burgessii* (Sc, IR) in the splash zone and *Placynthium flabellosum* (AQUI, NS) and *Porina guentheri* var. *lucens* (AQUI, NS) in the amphibious zone just below with *Ionaspis lacustris* and *Ephebe lanata*. Allt an Sluichd. NH 46815 17516.

Plate 25. Position of *Strigula confusa* (NR, E, Sc, IR) on cobble. Allt an Sluichd. NH 46906 17403. View direction SE.

Plate 26. *Strigula confusa* (NR, E, Sc, IR). Allt an Sluichd. NH 46906 17403.

Plate 27. Position of *Pseudocyphellaria norvegica* (NS, UK BAP, Sc, L, IR). Allt an Sluichd. NH 46878 17405.

Plate 28. Position of *Pseudocyphellaria norvegica* thalli on boulder in photo above.

Plate 29. Upper patch of *Pseudocyphellaria norvegica* thalli on boulder in photo above.

Plate 30. Middle patch of *Pseudocyphellaria norvegica* thalli on boulder in photo above.

Plate 31. Lower patch of *Pseudocyphellaria norvegica* thalli on boulder in photo above.

Plate 32. Position of *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on ash. This ash also supports the following IR, Sc species which are of International Responsibility and of principal Importance for Biodiversity in Scotland; Nature Conservation Act (Scotland) 2004: *Leptogium burgessii, Lobaria pulmonaria, L. virens, Nephroma laevigatum, Parmeliella triptophylla* together with *Lobarion* species *Mycobilimbia pilularis.* Allt an Sluichd. NH 46854 17457. View direction NW.

Plate 33. Position of *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on ash. Allt an Sluichd. NH 46854 17457.

Plate 34. *Nevesia sampaiana* (NT, NS, UK BAP, Sc, L, IR) on ash. Allt an Sluichd. NH 46854 17457.

Plate 35. Position of *Fuscopannaria ignobilis* (VU, NS, UK BAP, Sc, S8) on ash. Allt an Sluichd. NH 46854 17457. View direction WNW.

Plate 36. *Fuscopannaria ignobilis* (VU, NS, UK BAP, Sc, S8) on ash at position in photo above. Allt an Sluichd. NH 46854 17457.

Plate 37. *Fuscopannaria ignobilis* (VU, NS, UK BAP, Sc, S8) on other side of ash in photos above. Allt an Sluichd. NH 46854 17457. View direction ESE.

Plate 38. *Fuscopannaria ignobilis* (VU, NS, UK BAP, Sc, S8) on ash at position in photo above. Allt an Sluichd. NH 46854 17457.

Stream west of Lochan à Choin Uire.

Plate 39. Position of small population of *Stereocaulon glareosum* (NT, NR, Sc, M) on main track leading to Lochan à Choin Uire. Any adjustments to the track should avoid damage of this very small section. This may involve widening on the opposite (west) side rather than on both (if widening is necessary in the first place). NH 46311 16560. View direction N.

Plate 40. Detail of small population of *Stereocaulon glareosum* (NT, NR, Sc, M) in photo above.

Plate 41. *Stereocaulon glareosum* (NT, NR, Sc, M) in photo above.

Plate 42. Fertile *Stereocaulon glareosum* (NT, NR, Sc, M) collected from the site above. The pinkish white cephalodia on the main stem contain Nostoc.

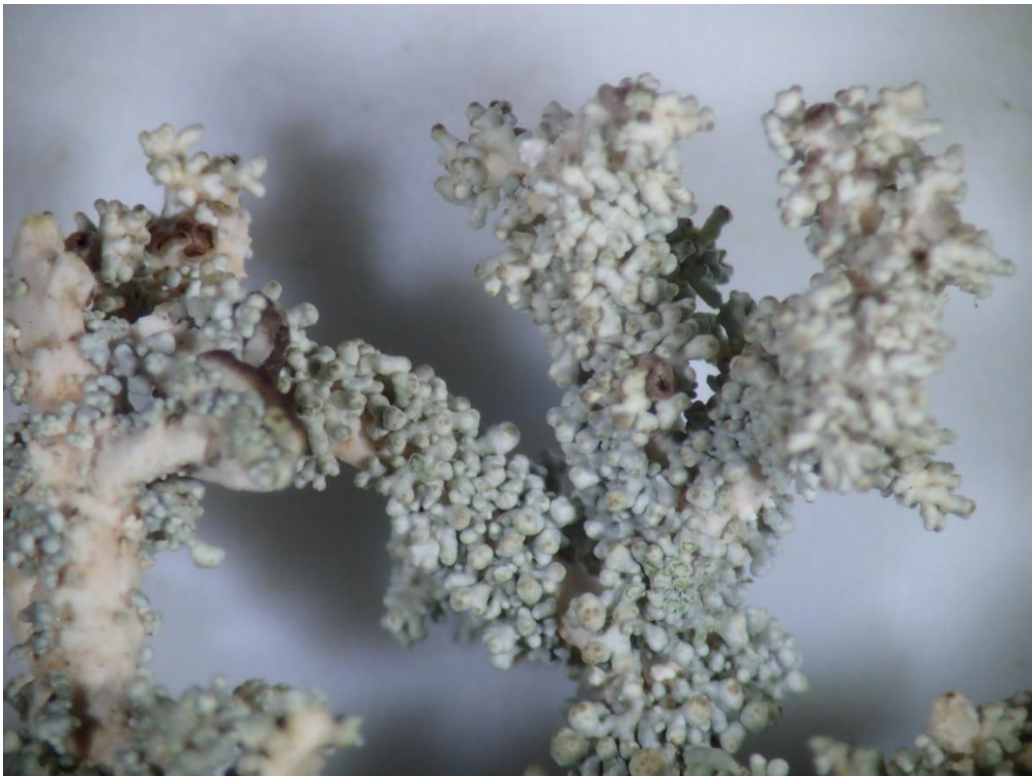


Plate 43. Fertile *Stereocaulon glareosum* (NT, NR, Sc, M) collected from the site above.

Plate 44. Position of *Rhizocarpon caesium* (AQUI, DD, NS, Sc) on watercourse west of Lochan à Choin Uire. Other species found at this sub-site include *Catillaria chalybeia* var. *chloropoliza* (NS), *Porina guentheri* var. *lucens* (AQUI, NS) and *Verrucaria anziana* (AQUI, NE).

Plate 45. *Rhizocarpon caesium* growing with *Catillaria chalybeia* var. *chloropoliza*, *Porina guentheri* var. *lucens* and *Ionaspis lacustris* and small boulder above.

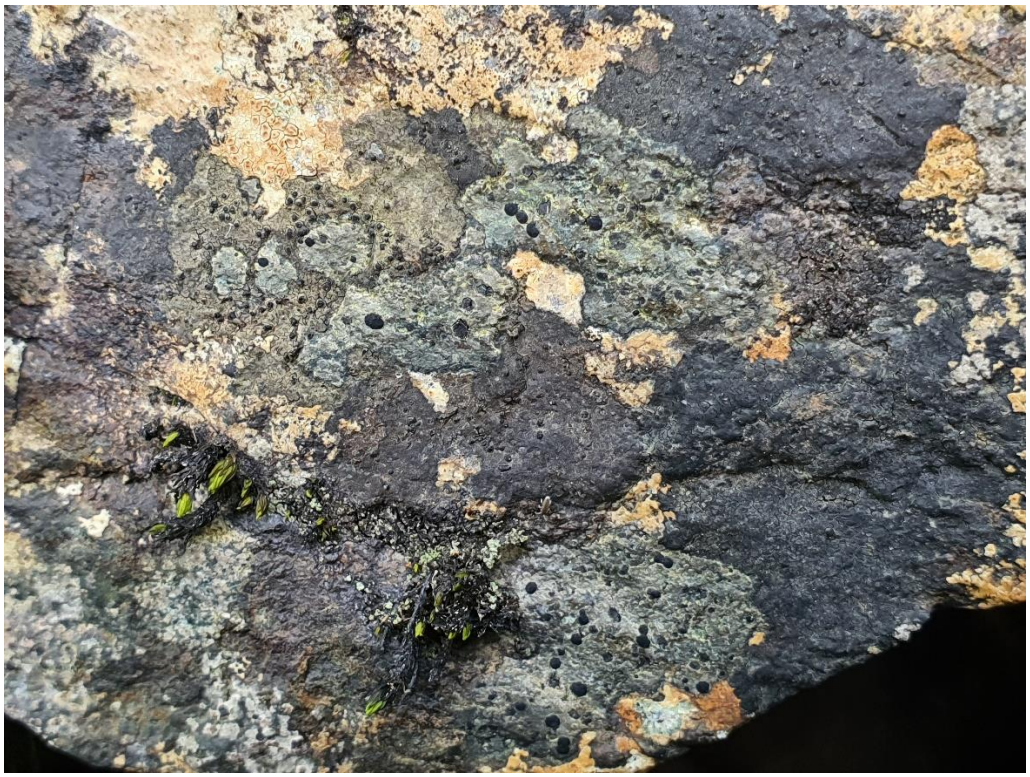


Plate 46. *Rhizocarpon caesium* growing with *Catillaria chalybeia* var. *chloropoliza*, *Porina guentheri* var. *lucens* and *Ionaspis lacustris* and small boulder above.

Plate 47. Position of *Parmeliella triptophylla* (Sc, IR). NH 45759 16597. Watercourse west of Lochan a Choin Uire.

Plate 48. Position of *Parmeliella triptophylla* (Sc, IR). Watercourse west of Lochan à Choin Uire. NH 45628 16613.

Plate 49. *Parmeliella triptophylla* (Sc, IR, L) in the splash/terrestrial zone on boulder in photo above. Species found on boulders in this area include *Leptogium cyanescens* (IR, Sc, L) also in the splash/terrestrial and the following species in the amphibious zone: *Porina guentheri* var. *lucens* (AQUI, NS), *Verrucaria anziana* (NE, NS, AQUI) and *V. rosula* (NR, NE, AQUI). Watercourse west of Lochan à Choin Uire. NH 45628 16613.

Loch Kemp

Plate 50. Position of *Phaeophyscia sciastra* (NS). This species was found only at Loch Kemp during these surveys. NH 47199 16350. View direction N.

Plate 51. *Phaeophyscia sciastra* (NS) on boulder in photo above.

Plate 52. *Phaeophyscia sciastra* (NS) on boulder in photo above.

Plate 53. Small peninsula outcrop supporting *Polychidium muscicola* (NS) at yellow arrow, *Parmeliella triptophylla* (NS Sc IR) at red arrow. *Aspicilia aquatica* (NS) was also found on this outcrop. NH 47195 16333. View direction N.

Plate 54. *Polychidium muscicola* (NS) at yellow arrow in photo above. There are several thalli on this outcrop associated with patches of moss.

Plate 55. *Parmeliella triptophylla* (NS Sc IR) at red arrow.

Plate 56. The dark cracked thalli of *Parmeliella triptophylla* (NS Sc IR) at red arrow in photo above.

Plate 57. East side of Loch Kemp near fishing chalet, showing the position of *Aspicilia aquatica* (DD, NR) and *Verrucaria rosula* (NR) at yellow arrow (NS 47228 16445) together with *Carbonea vorticosa* (NS) and *Catillaria chalybeia* var. *chloropoliza* (NS), *Cryptothele rhodosticta* (DD, NR, IR), *Placynthium pannariellum* aff., *Porpidia melinodes* (NS) at red arrow (NH 47187 16460). Several patches of the freshwater sponge (possibly *Spongilla lacustris*) were also found in this area on submerged rocks. View direction WNW.

Plate 58. *Cryptothelle rhodosticta* (DD, NR, IR) growing with *Ephebe lanata* on rock at edge of loch. NH 47182 16463. View direction WSW.

Plate 59. *Cryptothelle rhodosticta* (purple/brown crust, DD, NR, IR) growing with *Ephebe lanata* on rock in photo above.

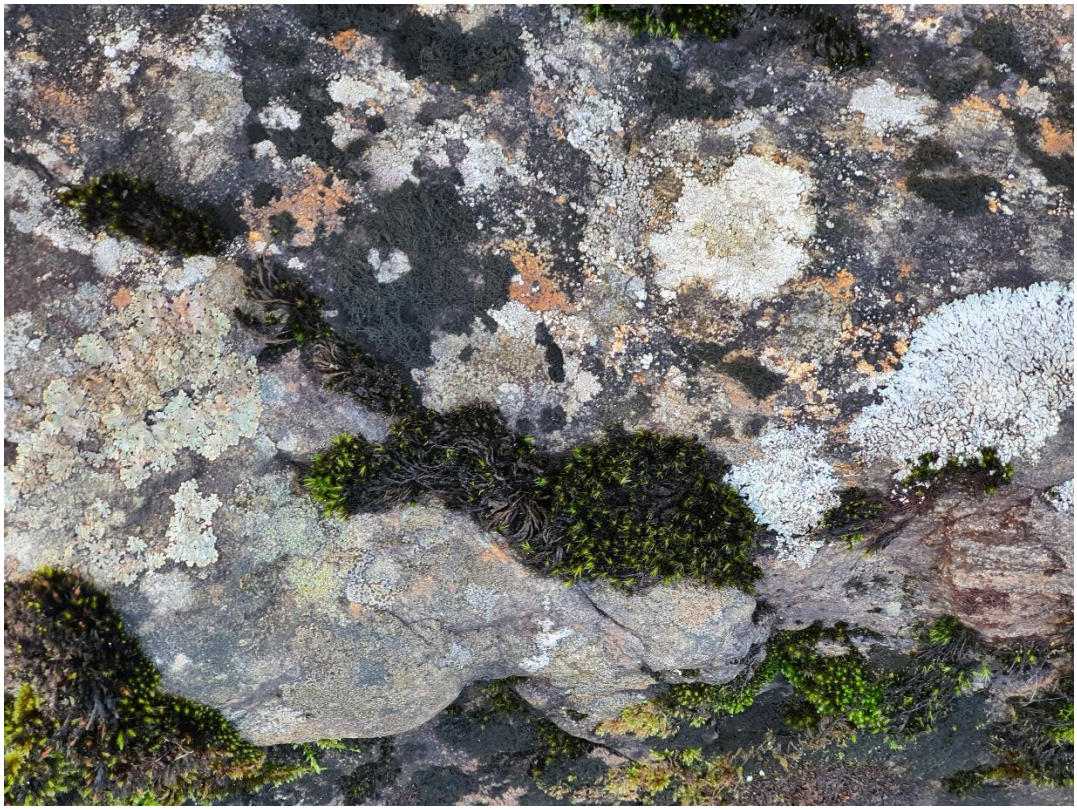


Plate 60. Rock supportinng *Placynthium pannarellum* aff. NH 47187 16460.

Plate 61. *Placynthium pannarellum* aff. on rock in photo above.

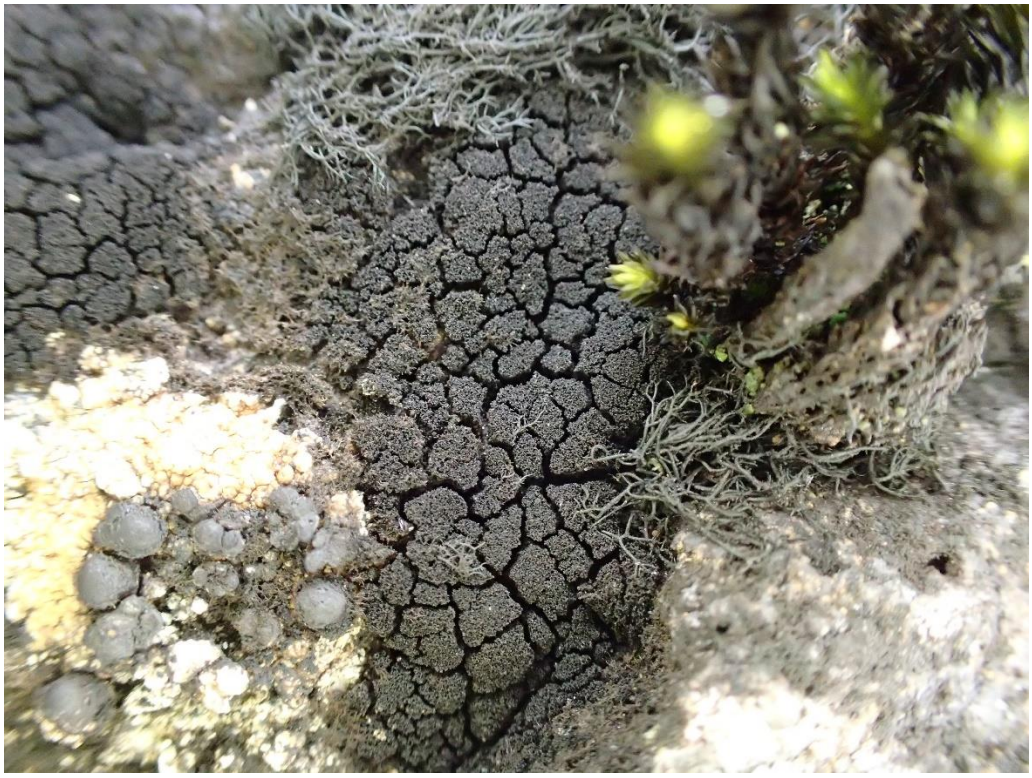


Plate 62. *Placynthium pannarellum* aff. on rock in photo above.

Plate 63. Northern point of Loch Kemp near the outlet to Allt an Sluichd supporting the freshwater *Spongilla lacustris*?, *Dermatocarpon luridum, Ephebel lanata, Ionaspis lacustris, Placynthium flabellsoum* (NS), *Porina lectissima, Rhizocarpon lavatum* and *Staurothele fissa*. NH 46753 16845. View direction NNE. Photo taken 13th July 2022.

Plate 64. West side of Loch Kemp showing position of *Porina interjungens* (NT, NS) and *Verrucaria rosula* (NR). View direction N.

Plate 65. West side of Loch Kemp showing position of the Near Threatened *Porina interjungens* (NS) on rocks along the loch edge and within a few centimeters of the water level. NH 46600 16558. *Verrucaria rosula* (NR) was found on rocks nearby. View direction N.

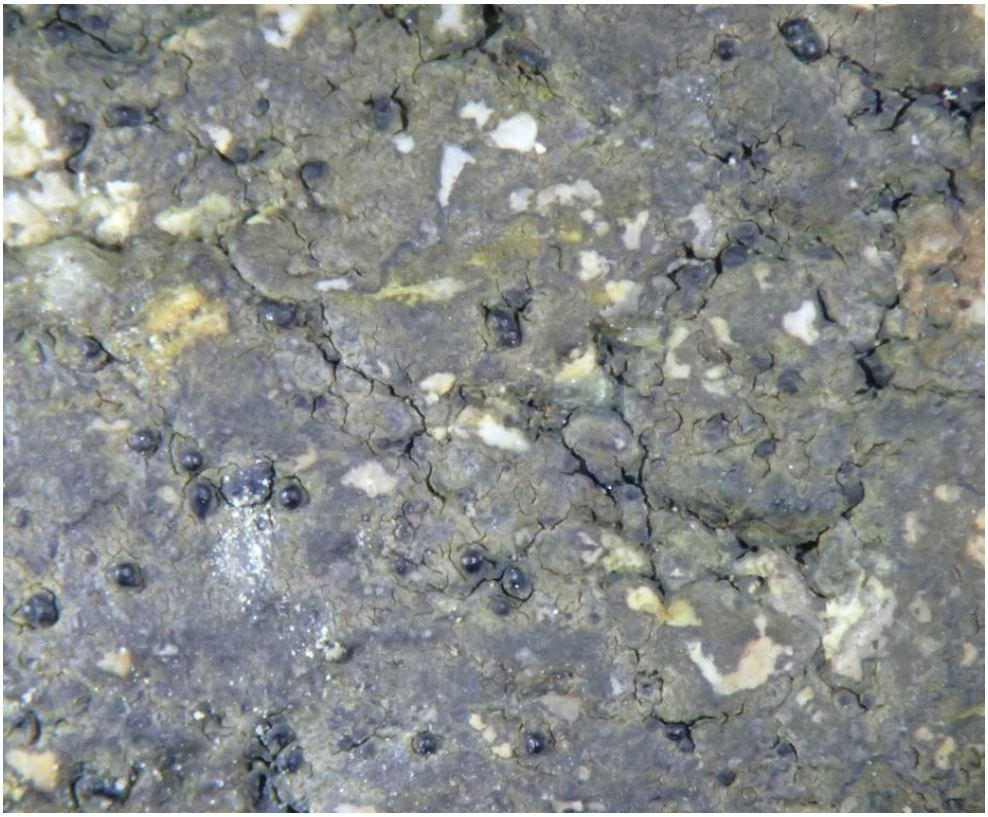


Plate 66. Near Threatened *Porina interjungens* (NS) found on rocks in photo above.

Plate 67. Birch woodland supporting a number of species including: *Bryoria fuscescens, Loxospora elatina* (fertile)*, Megalaria pulverea, Ochrolechia tartarea, Protoparmelia ochrococca* (NS) and *Thelotrema lepadinum.* NH46678 16303.

Plate 68. Fertile *Protoparmelia ochrococca* (NS) on birch in photo above.

Plate 69. Fertile *Loxospora elatina* on birch in photo above.

Plate 70. Position of freshwater sponge *Spongilla lacustris*? plus *Dermatocarpon luridum*. NH 46682 16304. View direction S.

Plate 71. Freshwater sponge *Spongilla lacustris*?. on a rock at site above, temporarily lifted from the water to photograph.

Plate 72. Heathland and low embedded outcrops supporting a wide diversity of heathland species including: *Cladonia coccifera* s.str (NS, DD), *C. merochlorophaea* (NS), *C. rangiferina* and *Pycnothelia papillaria.* All of these species contribute to the Heathland, Moorland and Coastal Heathland Index (HMCHI). Following a rapid survey, the heathland around Loch Kemp was found to supports an HMCHI of at least 32 which is above the threshold of 20 for which a site could be considered for SSSI designation.

Plate 73. *Pycnothelia papillaria* a moorland species and HMCHI scorer, which is in decline in many areas of Britain.

Plate 74. *Cladonia* species (all HMCHI scorers) on heathland west side of Loch Kemp.

Plate 75. Burgundy rimed pixie cups *Cladonia merochlorophaea* (HMCHI, NS) among other *Cladonia* species on moorland west side of Loch Kemp.

Plate 76. *Cladonia coccifera* s.str. (NS, DD, HMCHI) on moorland, west side of Loch Kemp.

Plate 77. The moorland/heathland shade form of *Cladonia squamosa* var. *squamosa* (HMCHI) with widely flaring cups, growing with *Cladonia floerkeana* (HMCHI) one of the 'red matchstick' *Cladonias*. West side of Loch Kemp.

Plate 78. *Cladonia zopfii* (NS, HMCHI) occasional to locally frequent on moorland around Loch Kemp.

Lochan à Choin Uire

Plate 79. The main lichen interest for the lochan is concentrated around the main outcrop (center, right). Notable species include *Cladonia zopfii* (NS), *Clauzadeana macula* (NS) and *Verrucaria anziana* (NS)

Lochan Nan Nighean

Plate 80. The heathland in this area was close to the threshold for potential SSSI designation and supports the HMCHI species including *Cladonia coccifera* s.str. (NS)*, C. rangiferina* and *Pycnothelia papillaria*. The boulders scree (left) supports *Hypotrachyna sinuosa* (IR) and the rocks in the lochan support *Placynthium pannariellum* aff. *Verrucaria anziana* (NS) and *V. rosula* (NR).

Lochan Scristan

Plate 81. This lochan is mostly soft-edged with only a few boulders and outcrops supporting freshwater species including *Aspicilia aquatica* (NR), *Verrucaria aethiobola* (NS) and *V. rosula* (NR). The nearby heathland was more productive and came close to the threshold for potential SSSI designation, supporting a number of notable species including; *Cladonia carneola* (NS), *coccifera* s.str. (NS), *Cladonia macrophylla* (NS), *C. rangiferina, C. uncialis subsp. uncialis* (NT, NS, SC) and *Pycnothelia papillaria.*

Loch Paiteag

Plate 82. This loch has a limited number of boulders and outcrops within the freshwater zone. The outcrops fall steeply into the loch and it was only safe to access them at a couple of points. Freshwater species recorded include: *Ephebe lanata, Hymenelia lacustris* and *Rhizocarpon lavatum*. The surrounding heathland supports a few notables including *Cladonia carneola* (NS), *C. borealis* (DD, NR) and *C. uncialis* subsp*. uncialis* (NT, NS, Sc).

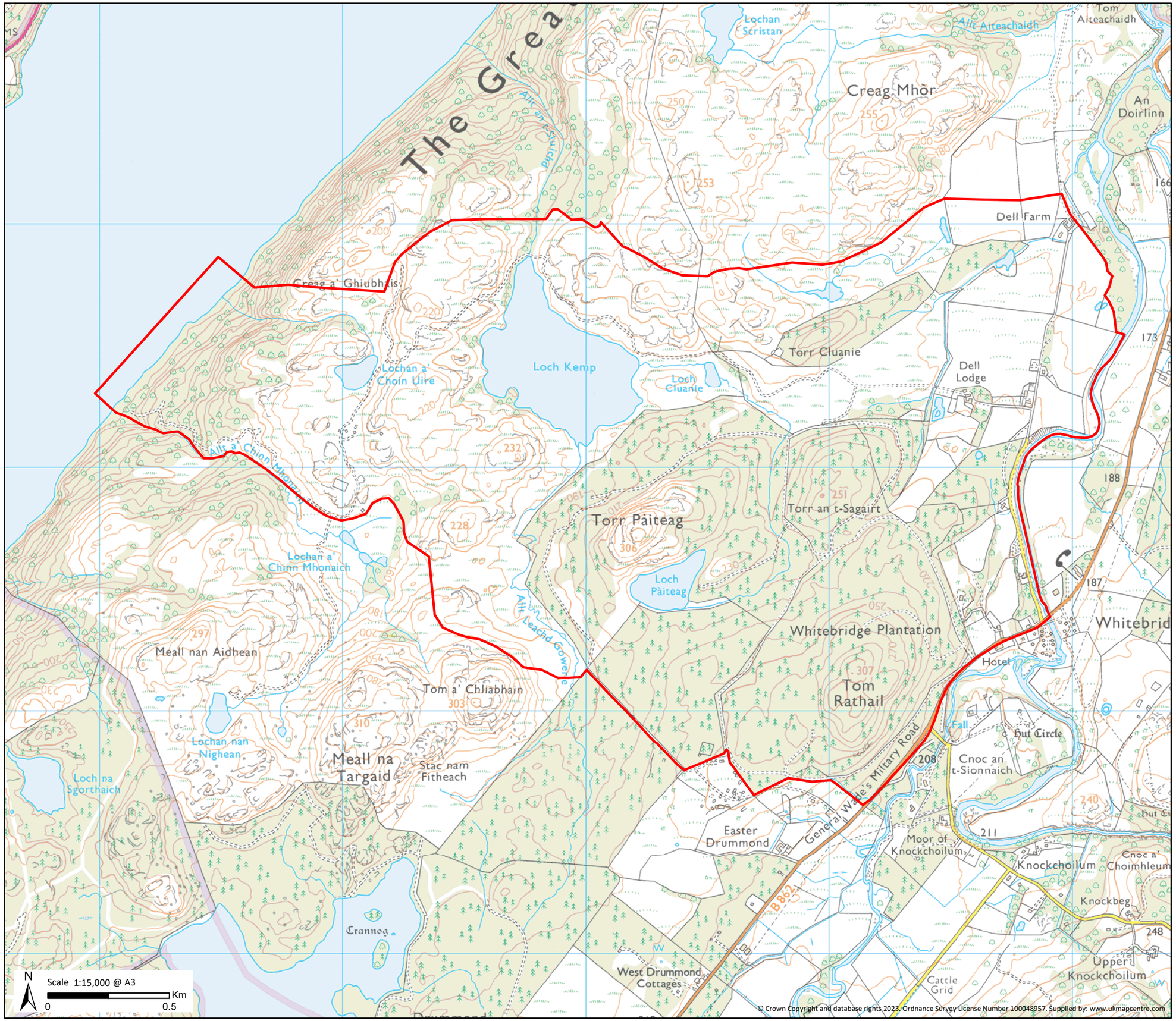
Loch Knockie (NE Peninsula)

Plate 83. This is the only other loch or lochan beside Loch Kemp to exceed the threshold for potential SSSI designation and supports a number of species not found anywhere else during this survey including *Collema glebulentum* (NS), *Dermatocarpon meiophyllizum* (NS) and *Rhizocarpon infernulum* f. *sylvaticum* (NS). Other notables include *Aspicilia aquatica* (NR), *Catillaria chalybeia* var. *chloropoliza* (NS), *Cladonia cyathomorpha* (NS), *Placynthium flabellosum* (NS), *P. pannariellum* aff., *Hypotrachyna sinuosa* (IR) and a very large population of *Phaeophyscia sciastra* (NS).

Plate 84. Large patches of *Phaeophyscia sciastra* (NS) on boulders at Loch Knockie. Only a single individual of this species was found on Loch Kemp (the only other site for this species, during this survey).

Plate 85. The Nationally Scarce *Phaeophyscia sciastra* on a boulder in Loch Knockie.

Appendix III. Figures



Key

Site Boundary

Loch Kemp Storage
EIA Report

Figure 1
Site Location

Drawn by: SK **Date:** 14/11/2023

Drawing: 120019-D-ALS1-1.0.0

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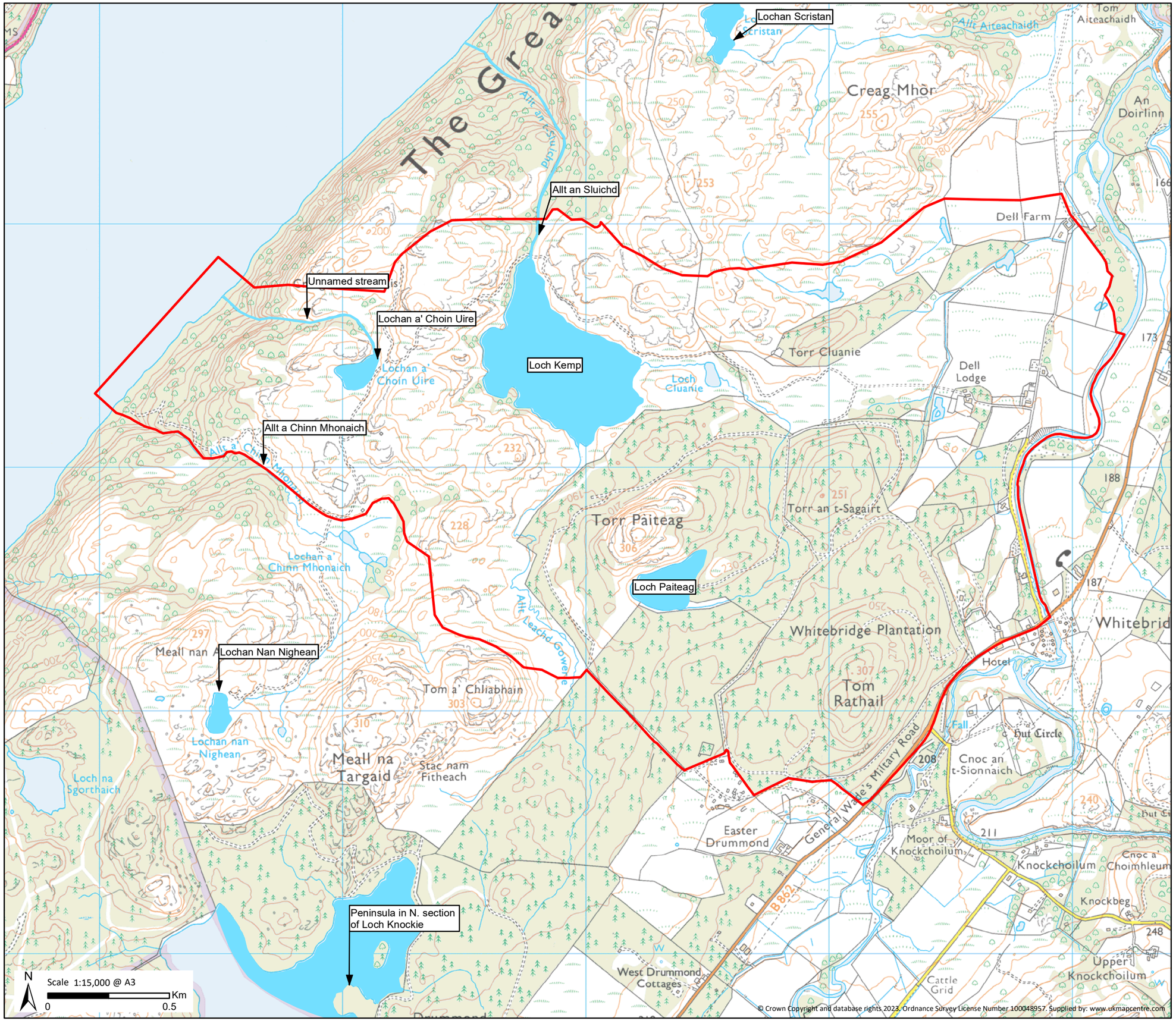

Key

- Site Boundary
- Waterbody
- Water course

Loch Kemp Storage
EIA Report

Figure 2
Watercourses and waterbodies surveyed

Drawn by: SK **Date:** 14/11/2023
Drawing: 120019-D-ALS2-1.0.0

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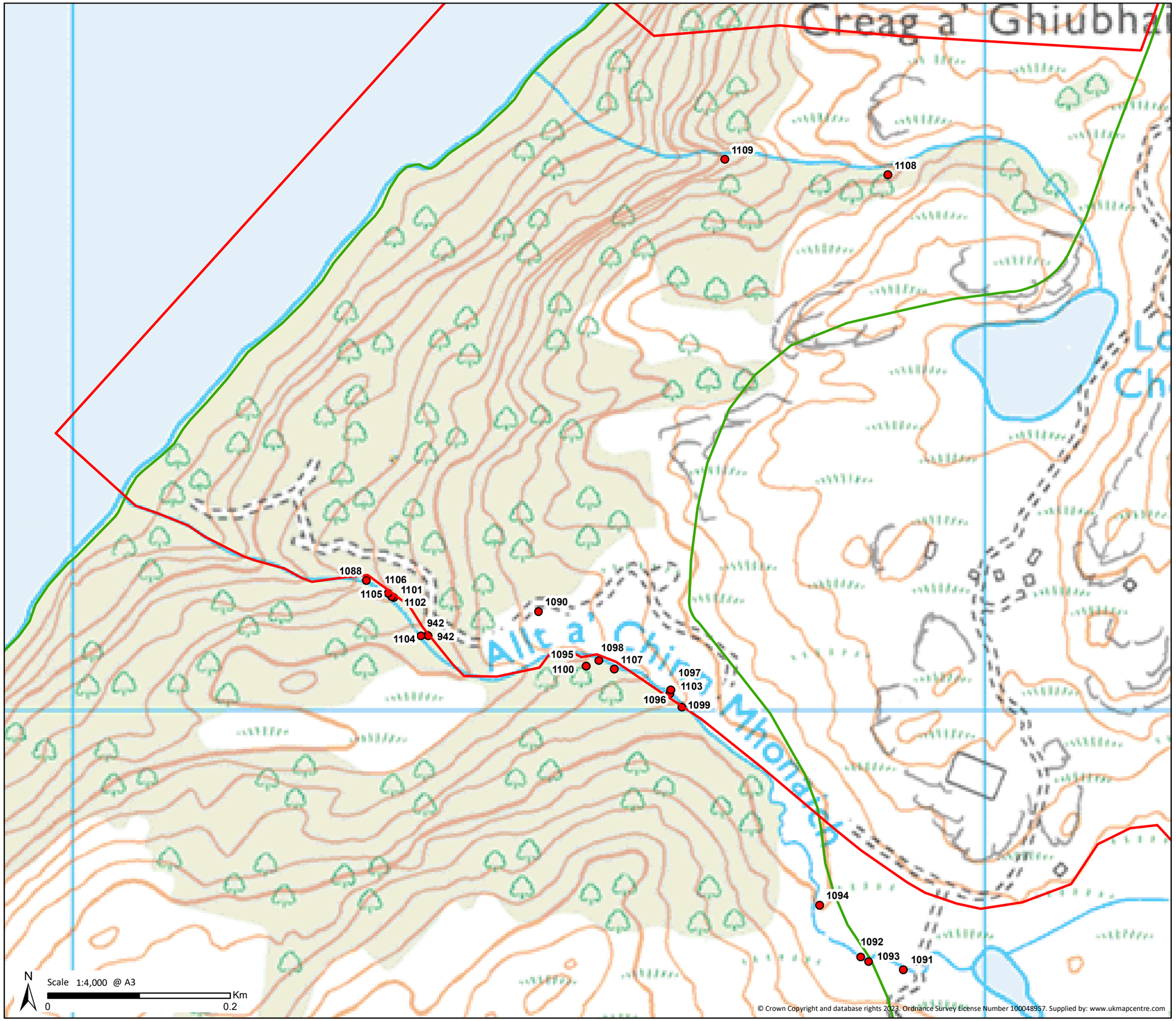

Key

- Site Boundary
- Location of Lichen Recordings
- Ness Woods SAC

Loch Kemp Storage
EIA Report

Figure 3a
Main target areas supporting rare freshwater lichens

Drawn by: SK **Date:** 14/11/2023
Drawing: 120019-D-ALS3a-1.0.0

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Key

- Site Boundary
- Location of Lichen Recordings
- Ness Woods SAC

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Figure 3b
Main target areas supporting rare freshwater lichens

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Drawing: 120019-D-ALS3b-1.0.0

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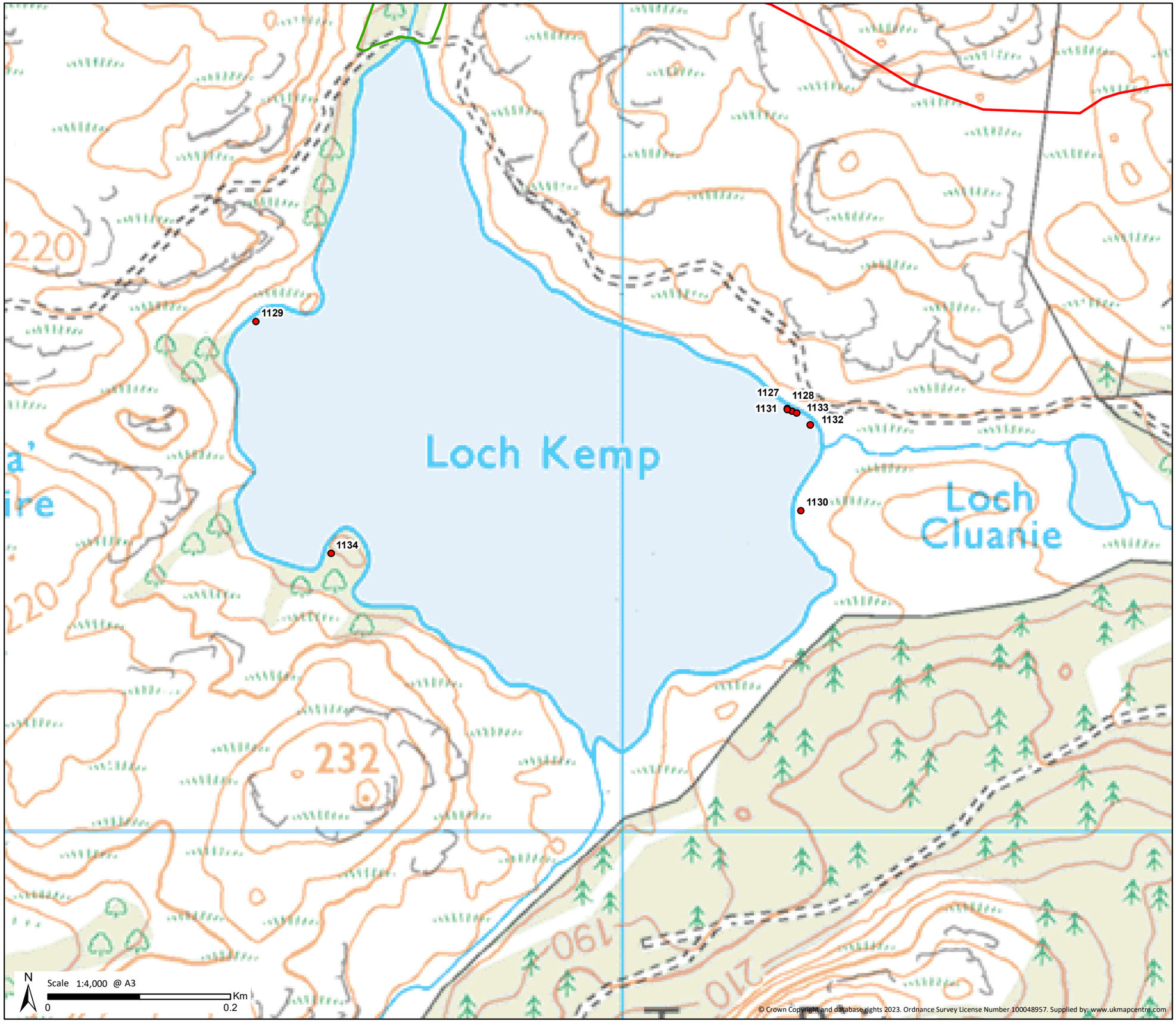

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Key

- Site Boundary
- Location of Lichen Recordings
- Ness Woods SAC

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Figure 3c
Main target areas supporting rare freshwater lichens

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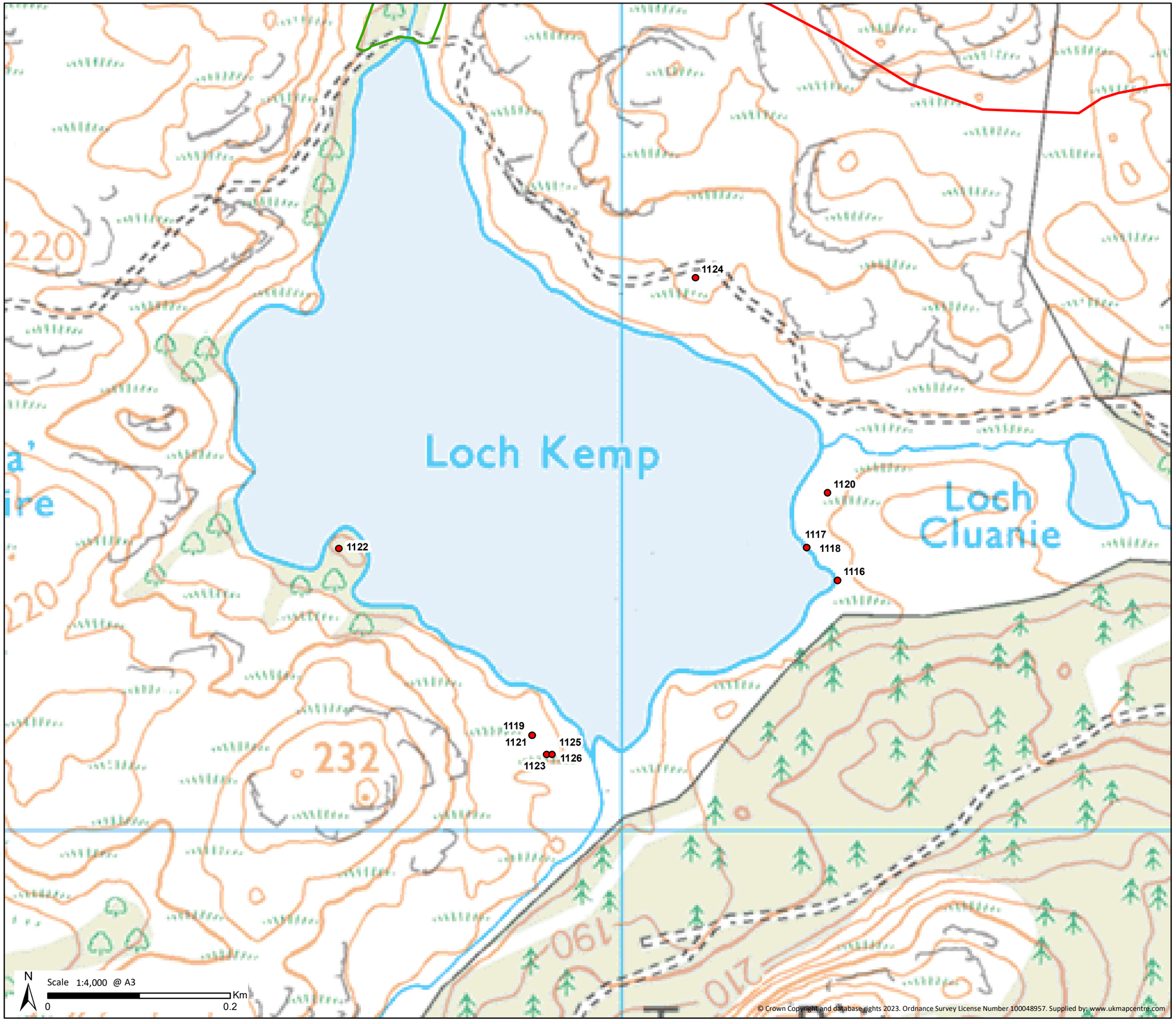

Key

- Site Boundary
- Location of Lichen Recordings
- Ness Woods SAC

Loch Kemp Storage
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Figure 4
Main target areas supporting rare heathland lichens

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