This slide deck has been prepared by Palladium for Bioregioning Tayside.

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Bioregioning
Tayside
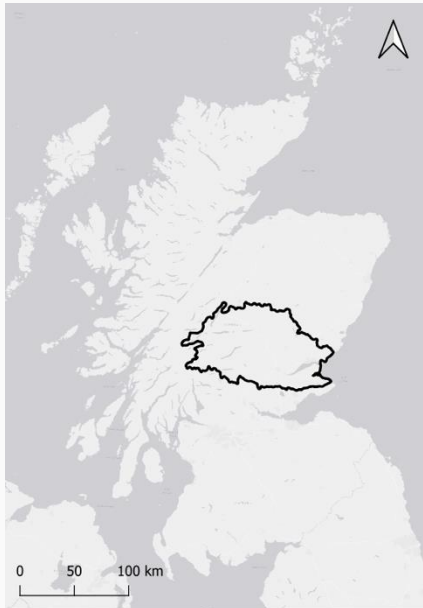
Table of contents

Overview of the River Tay System

01

Context: The Tay Bioregion represents a significant opportunity for nature restoration

In this study, we assess the potential to restore nature in Dochart & Lyon, Earn & Isla sub-catchments of the Tay System

Bioregioning Tayside

Project location

The Tay Bioregion covers over 721k hectares (7,210 sq km) of land extending from Dundee to Rannoch moor in SE Scotland. In this study, we assess the potential for restoring nature via the generation of ecosystem services (woodland carbon sequestration, peatland carbon retention, water quality improvement and biodiversity uplift) in three sub-catchments:
- o Dochart and Lyon
- o Earn
- o Isla

0   50   100 km

View looking north into the Isla sub-catchment
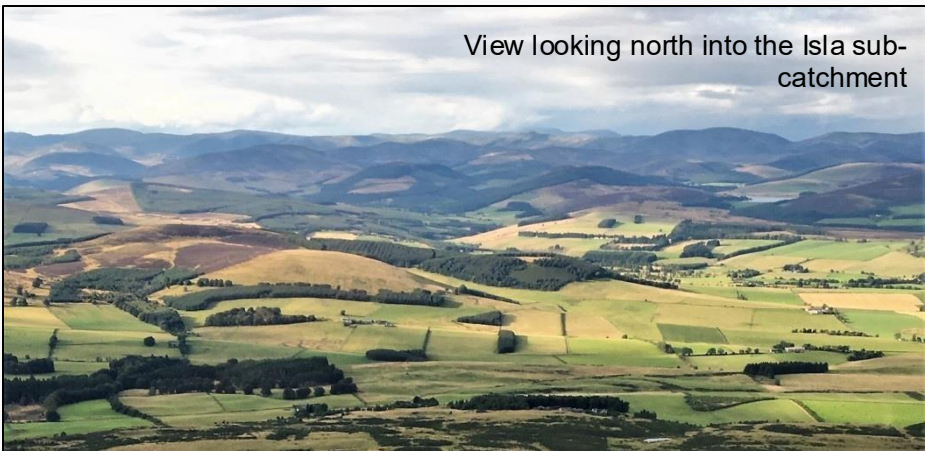
Boundaries: The Tay System and the three selected sub-catchments.

Tay catchment

Rannoch moor

Isla

Dochart and Lyon

Earn

Dundee

0   10   20 km
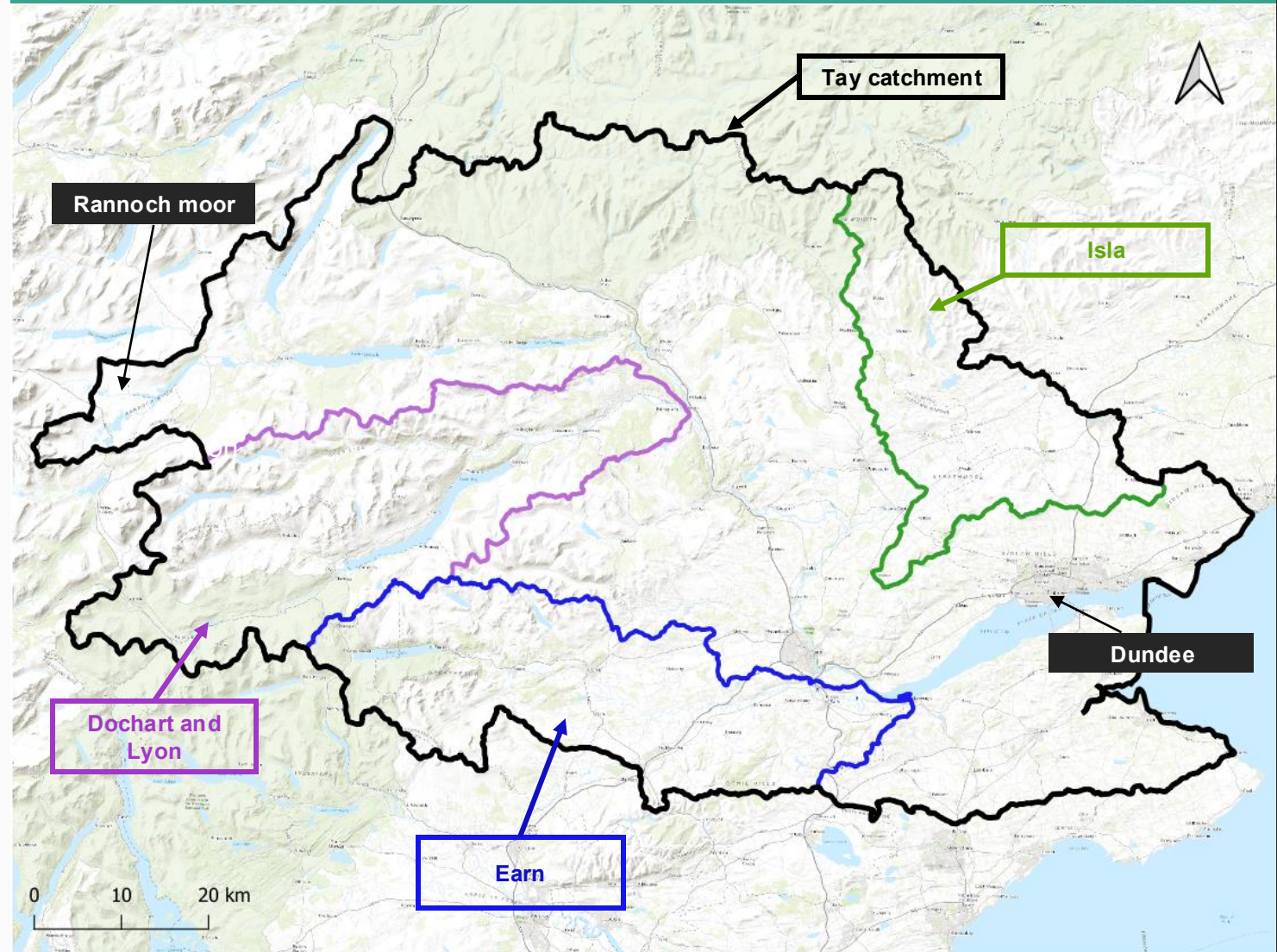
Baseline: The Tay Bioregion is predominantly covered by acid grasslands and heathland
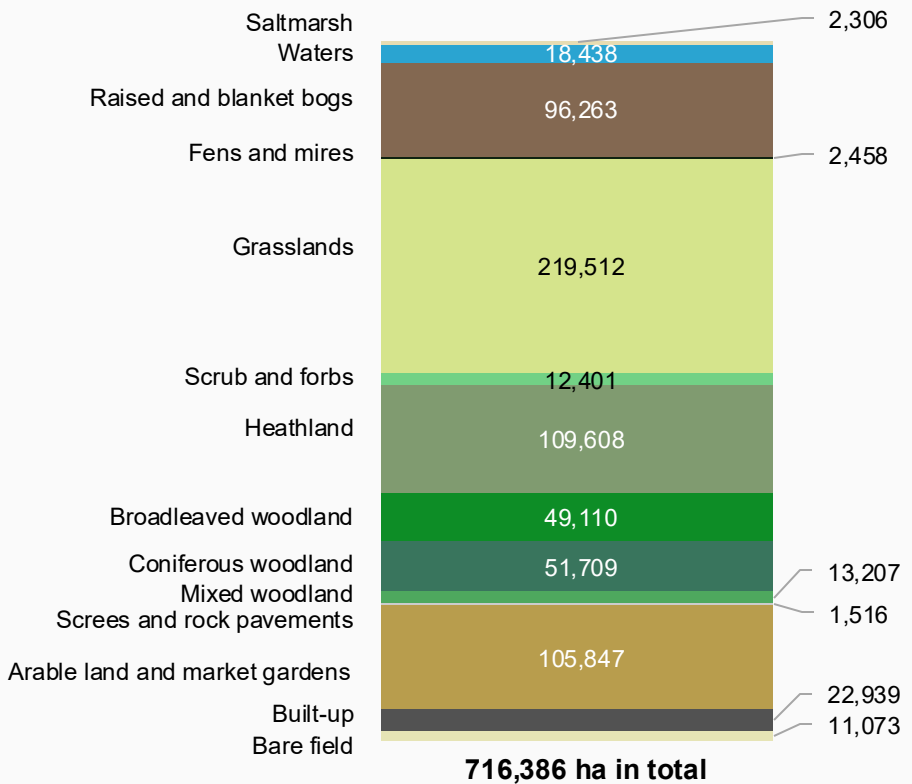
The following slide provides details on existing land cover and features.
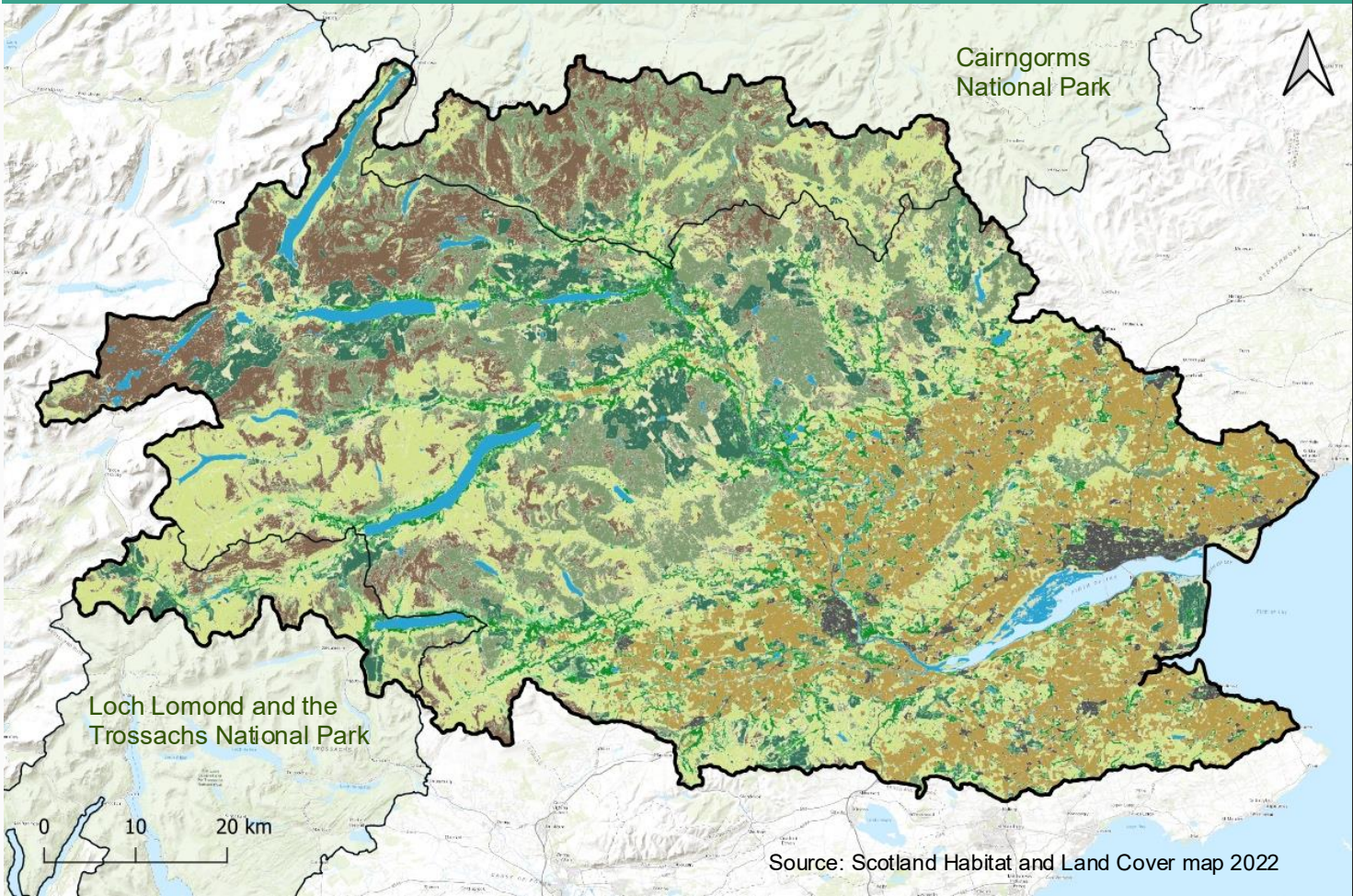
Bioregioning Tayside

Land cover in the Bioregion

The Tay Bioregion features upland terrain and bog habitats in the north, extending southward from the Cairngorms National Park. This landscape gradually transitions into fertile agricultural land in the southeastern valley. Grassland is the dominant habitat in the Bioregion, covering over 30% of the total area, followed by heathland covering 15%.

Distribution of land cover by habitat (ha)

Habitat	Value
Saltmarsh	2,306
Waters	18,438
Raised and blanket bogs	96,263
Fens and mires	2,458
Grasslands	219,512
Scrub and forbs	12,401
Heathland	109,608
Broadleaved woodland	49,110
Coniferous woodland	51,709
Mixed woodland	13,207
Screes and rock pavements	1,516
Arable land and market gardens	105,847
Built-up	22,939
Bare field	11,073

716,386 ha in total

Baseline: Current habitats on the Tay catchment

Cairngorms National Park

Loch Lomond and the Trossachs National Park

0   10   20 km

Source: Scotland Habitat and Land Cover map 2022

Legend

- Saltmarsh, dunes and sandy shores
- Water
- Scrub and forbs
- Raised and blanket bogs
- Fens and mires
- Grasslands
- Heathland
- Broadleaved woodland
- Coniferous woodland
- Mixed woodland
- Scree, rock pavements and outcrops
- Arable land and market gardens
- Built-up
- Bare field

Baseline: The area is contrasted either side of the Highland Boundary Fault, with land of high agricultural production in the South, and rough grazing in the North of the Bioregion.

Land capacity for Agriculture

Land capable of supporting arable agriculture

Class 1 - Land capable of producing a very wide range of crops with no physical limitation affecting agricultural use

Class 2 - Land capable of producing a very wide range of crops with minor physical limitation affecting agricultural use

Class 3.1 - Land capable of producing a moderate range of crops with no physical limitation affecting agricultural use (cereal, grass, potatoes and vegetables)

18% of the area

Land capable of supporting mixed agriculture

Class 3.2 - Land capable of producing a moderate range of crops, with grass within the rotation

Class 4.1 - Land capable of producing a narrow range of crops, mainly grass

Class 4.2 - Land primarily suited to grassland

17% of the area

Land capable of supporting Improved Grassland

Class 5.1 - Land capable of use as improved grassland with minor difficulties

Class 5.2 - Land capable of use as improved grassland with physical limitations

Class 5.3 - Land capable of use as improved grassland, deterioration can be rapid

*14% of the area*

Land capable of supporting only Rough Grazing

Class 6.1 - Land is capable of only rough grazing, high value vegetation

Class 6.2 - Land is capable of only rough grazing, moderate value vegetation

Class 6.3 - Land is capable of only rough grazing, low value vegetation

Class 7 - Land od very limited agricultural value, restricted to very poor rough grazing

48% of the area

Built-up area

Unclassified

3% of the area

Baseline: Current land capacity for agriculture in the Tay Bioregion

Highland Boundary Fault

0   10   20 km
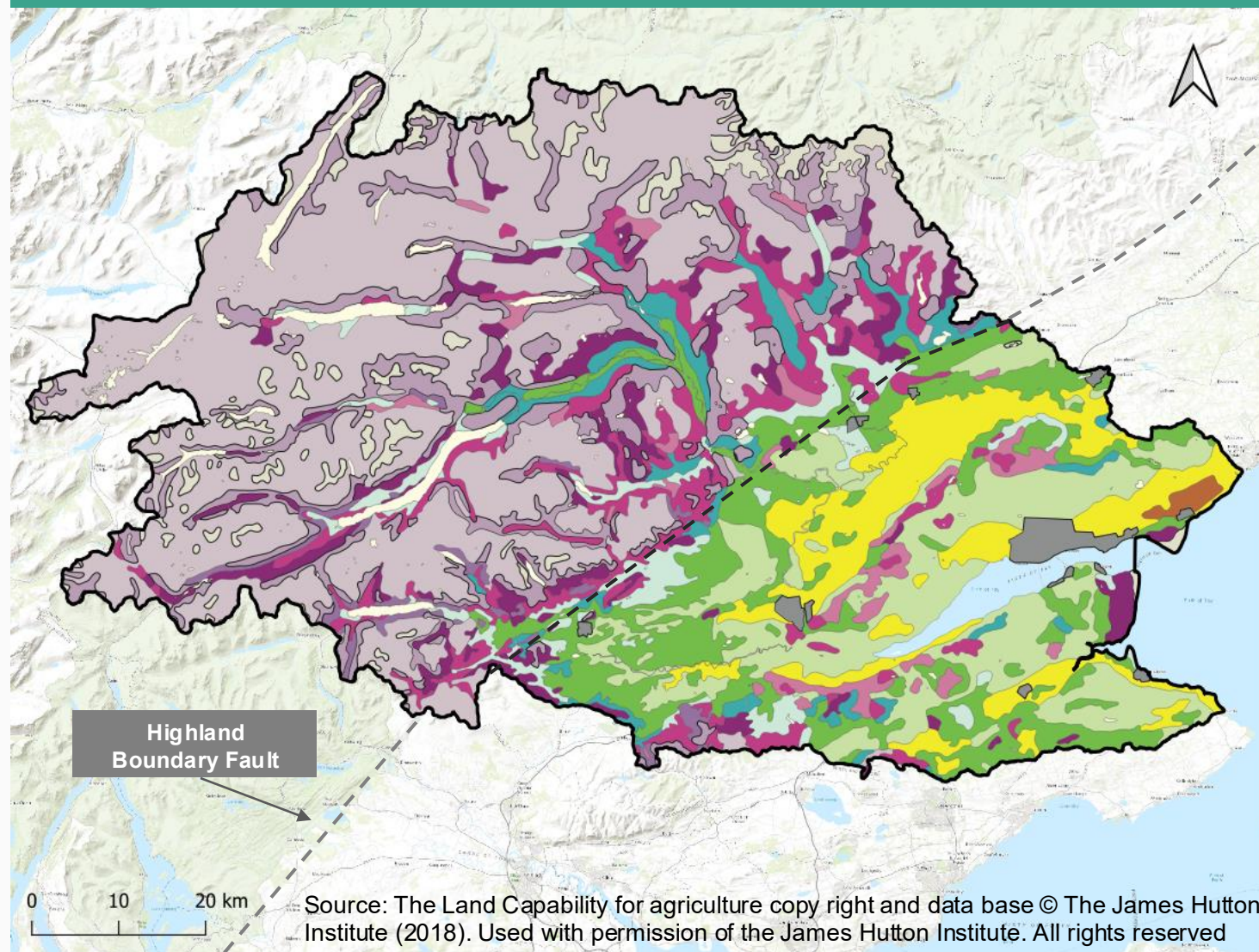
Source: The Land Capability for agriculture copy right and data base © The James Hutton Institute (2018). Used with permission of the James Hutton Institute. All rights reserved
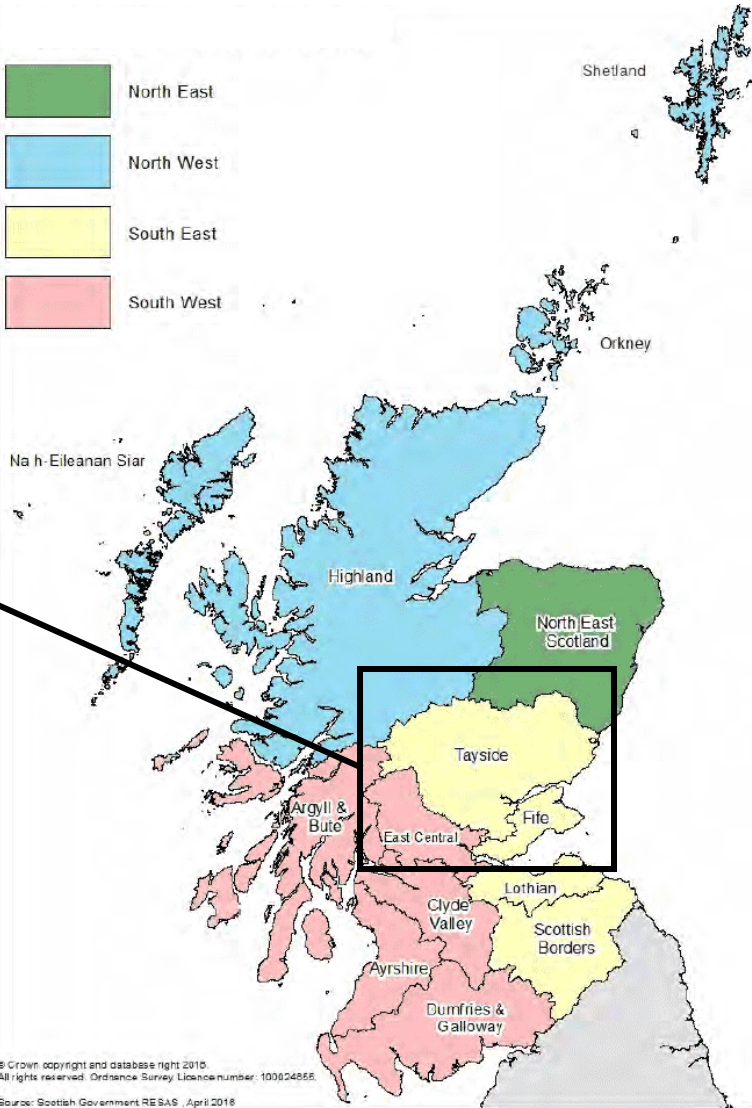
Bioregioning Tayside

Baseline: Based on the results from the Scottish Agricultural Census conducted in 2024, there is a majority of cattle and sheep farms within Less Favoured areas in the Tay Bioregion.

Bioregioning Tayside

Table of the area per farm type for the Tay Bioregion, June 2024

Main Farm Type	Agricultural area (hectare)	Percentage
General cropping	112,393	19.4%
General cropping; forage	78,897	13.6%
Less Favoured Areas (LFA) Cattle & Sheep	303,120	52.3%
Mixed holdings	41,257	7.1%
Non-LFA Cattle & Sheep	10,757	1.9%
Specialist cereals	21,734	3.8%
Specialist dairy	971	0.2%
Specialist horticulture & permanent crops	8,591	1.5%
Specialist pigs	114	0.0%
Specialist poultry	489	0.1%
Unclassified	744	0.1%
All	**579,068**	**100%**

Note: The boundaries used by the Scottish Government for the annual agricultural census do not perfectly align with the boundaries used in this report. As a result, the figures in the table above are indicative of land use.

Source: Scottish Agricultural Census: June 2024

North East

North West

South East

South West

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Source: Scottish Government RESAS , April 2016

Opportunity for peatland restoration: There are over 121,000 hectares of deep peat with the potential need to be restored in the Tay Bioregion

Opportunity to restore damaged peatland

- There is an estimated **121,645 hectares** of deep peat mapped in the Tay catchment, of which 59.8k ha is within Class 1 and 61.8k ha within Class 2, all mainly located on the North-West

- The full extent and condition of the deep peat is not currently recorded in publicly available data or mapping.

- To obtain this information, comprehensive on-site surveys will need to be conducted.

- If peatlands are degraded with evidence of added drainage, signs of erosion, or the formation of gullies, they are in need of restoration. Restoration efforts can significantly reduce the carbon emissions that are emitted from damaged habitats.

- When peatlands are restored, they can also help retain water, improve overall water quality, and support a wide variety of species.

Source: James Hutton Institute (1987)

Peatland restoration opportunity: Areas classified as peatland and/or as deep peat

0   10   20 km

Legend

Areas of peat
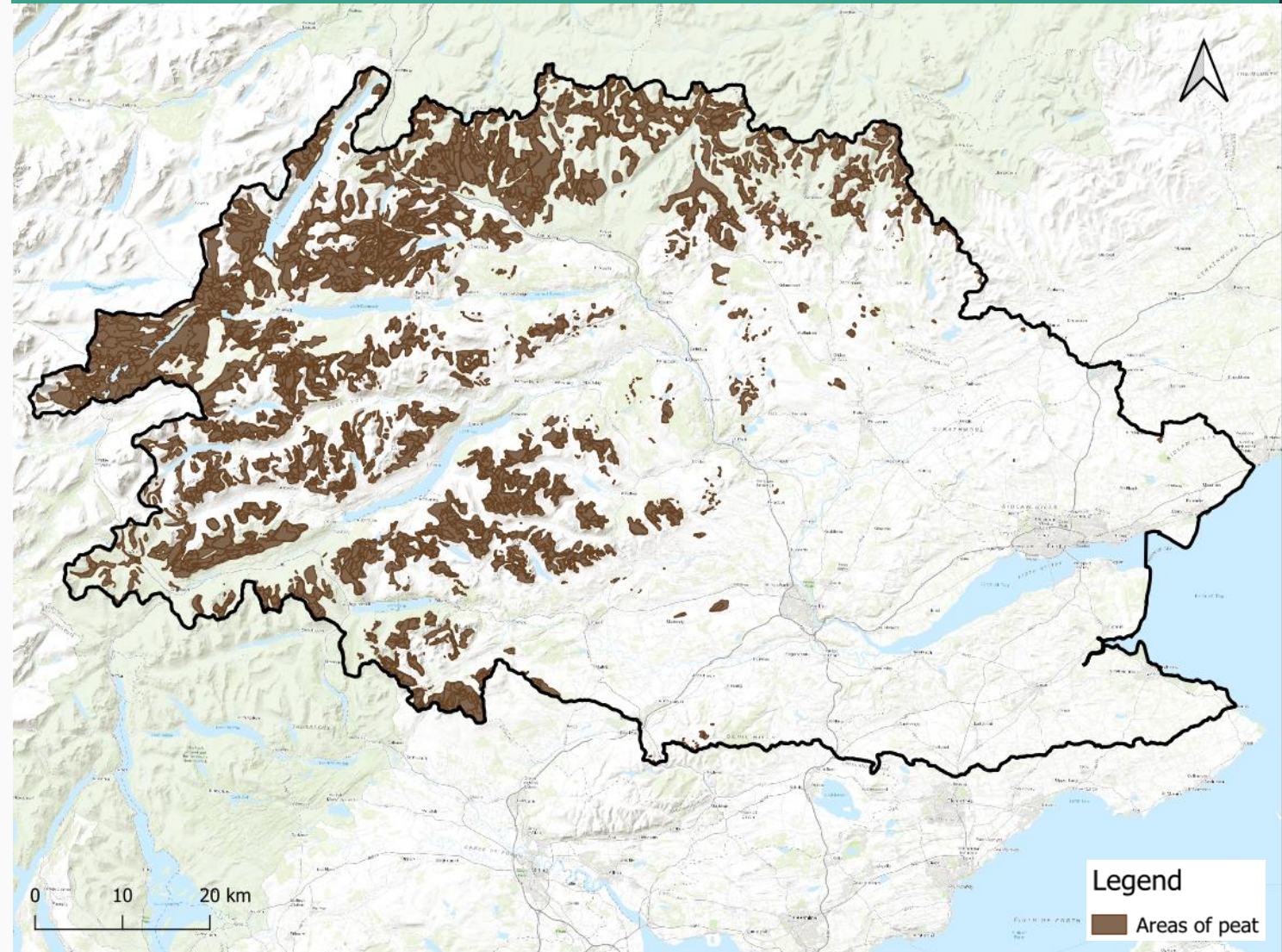
Opportunity for Riparian corridor improvement: There is a total of 55,665 hectares of recommended riparian corridor in the Tay Bioregion for nature restoration.

## Riparian corridors cover the area around watercourses

- There is a total of 55,665 hectares of recommended riparian corridor in the catchment.

- The Riparian Corridor is a buffer zone that extends from the banks of all natural watercourses in Scotland. The Riparian Corridor buffer has 3 size categories: 10 m 15 m, and 30 m. The size of the buffer is determined by the width of each watercourse

- In total, the riparian corridor buffer zone adds 20 m, 30 m or 60 m to the width of each river channel.

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity.
Scotland water quality data is accessible on the Water Classification Hub.

Map of the recommended riparian corridors in Tay catchment

0   10   20 km

© SEPA

Recommended riparian corridor
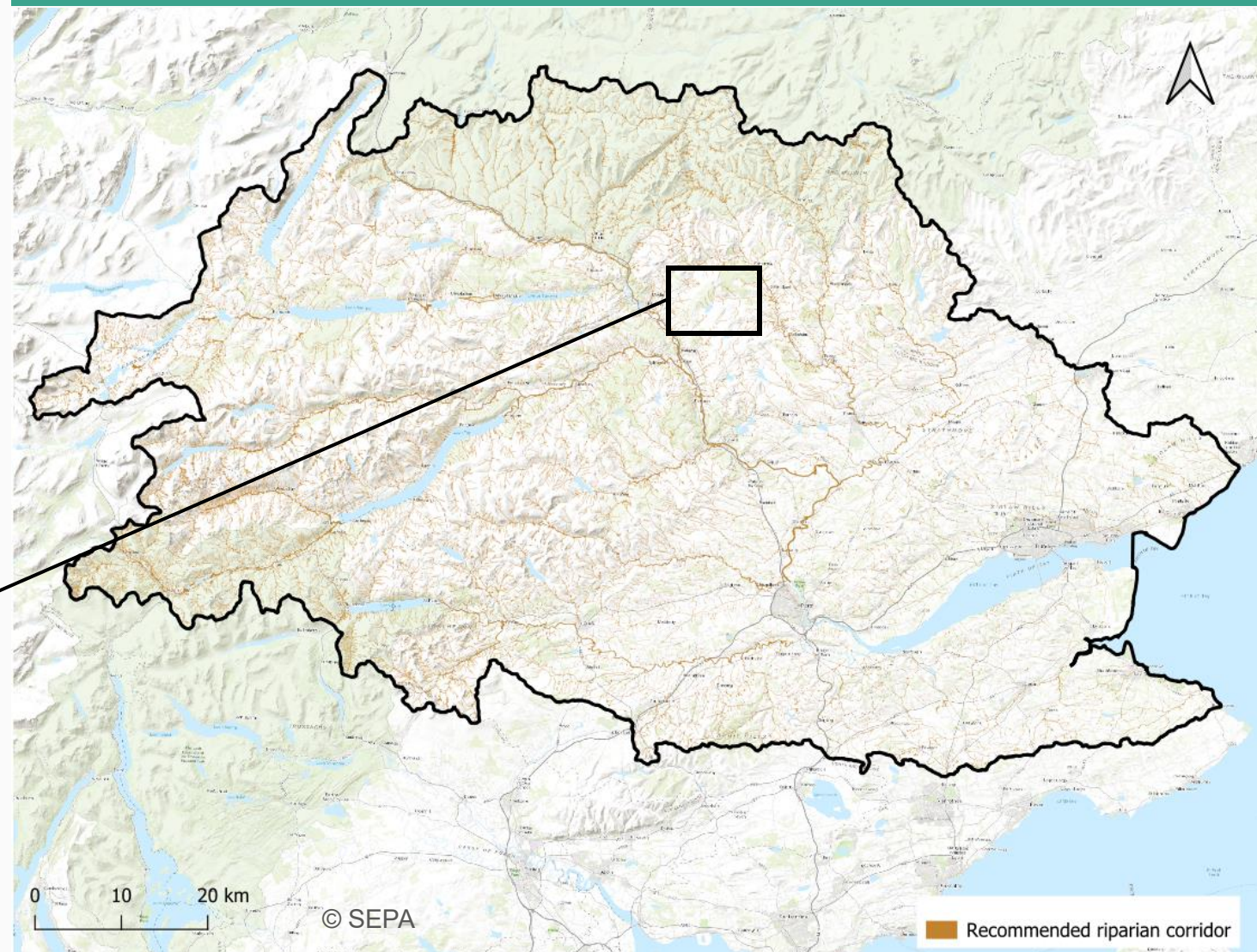
Water quality: There are 232 rivers and canals in the Bioregion, of which 42 are classified with either a 'Poor' or 'Bad' overall quality rating, primarily from hydromorphological alterations

Overall water quality classification

- The quality of the surface water is varied, with 42 waterbodies classified as Poor or Bad by SEPA, **primarily due to historical physical alterations** impacting the overall hydrology or ecology.

Classification distribution of the rivers and canals:

| 23	90	77	31	11

■ High ■ Good ■ Moderate ■ Poor ■ Bad

- The hydrological and ecological condition of the rivers and canals might be improved as a result of surrounding habitat restoration but present very limited opportunities of direct financing.

- The existing mechanisms to finance water quality improvement are mainly around offsetting phosphate and nitrate levels.

- Both nutrients currently present low levels of risk for all water bodies (see Water Classification Hub)

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity.
Scotland water quality data is accessible on the Water Classification Hub.

Map of the overall water quality on the Tay catchment

0   10   20 km

© SEPA

Legend
River quality classification
— High
— Good
— Moderate
— Poor
— Bad
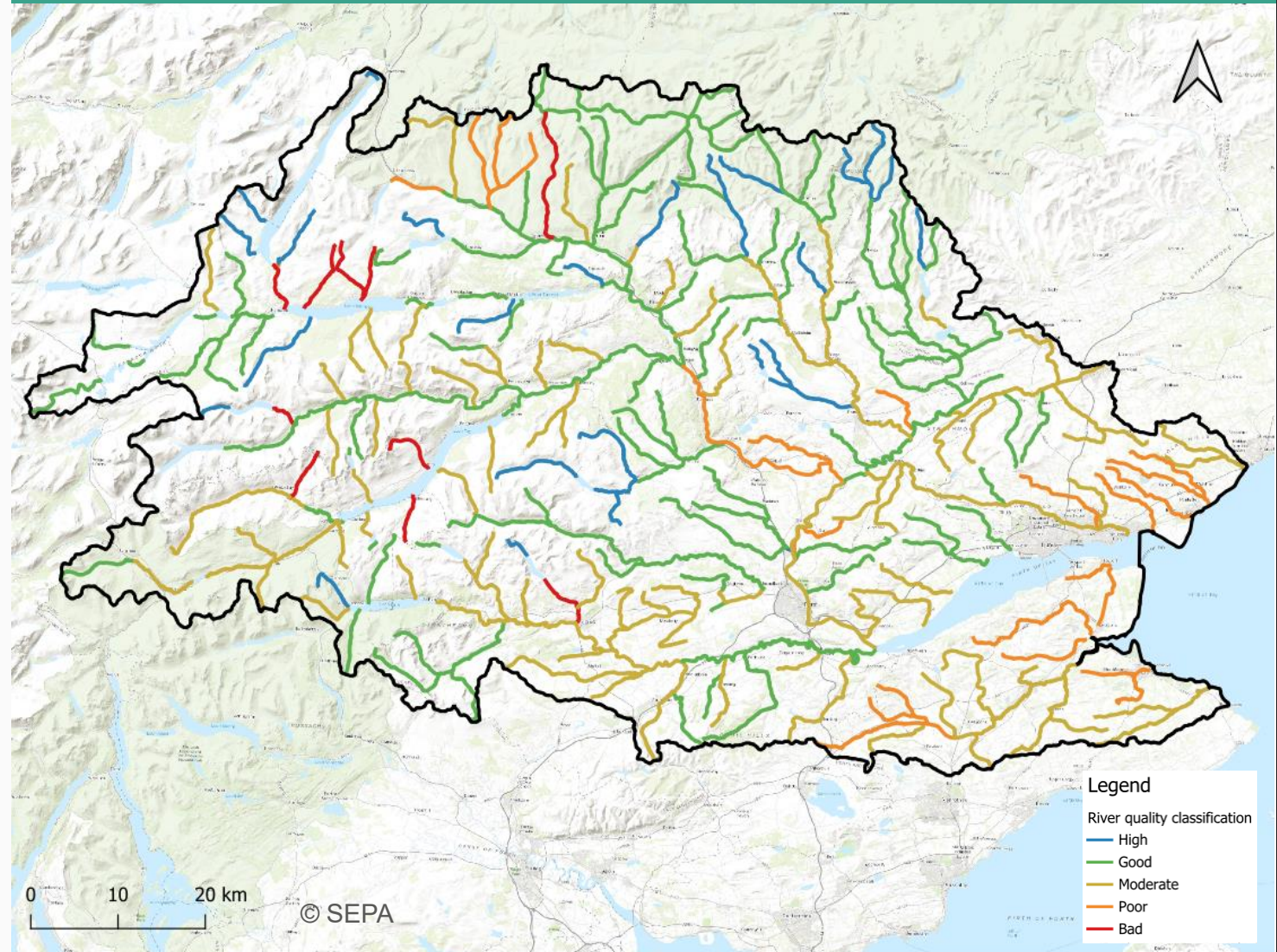
Flood risk: There is a total of 123,000 hectares classified as vulnerable to flooding, within which, circa 18,000 hectare have a flood risk management plan.

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Most areas vulnerable to flooding are in the Eastern areas of the Bioregion.

- There are 25 sites classified as vulnerable areas to flooding in the Tay catchment

- The footprint of this area covers 123,300 hectares in total.

- Within these identified vulnerable areas, a total of 18,280 hectares have a Flood risk management plan.

- Scotland's flood risk management plans aim to reduce the impact of flooding on communities, with a focus on coordinated efforts across various authorities to address the increasing risks due to climate change.

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity.
Scotland water quality data is accessible on the Water Classification Hub.

**Map of the vulnerable areas to flooding in Tay catchment**

© SEPA 2022

0   10   20 km

Legend
Potentially vulnerable areas to flooding
Flood Risk Management areas
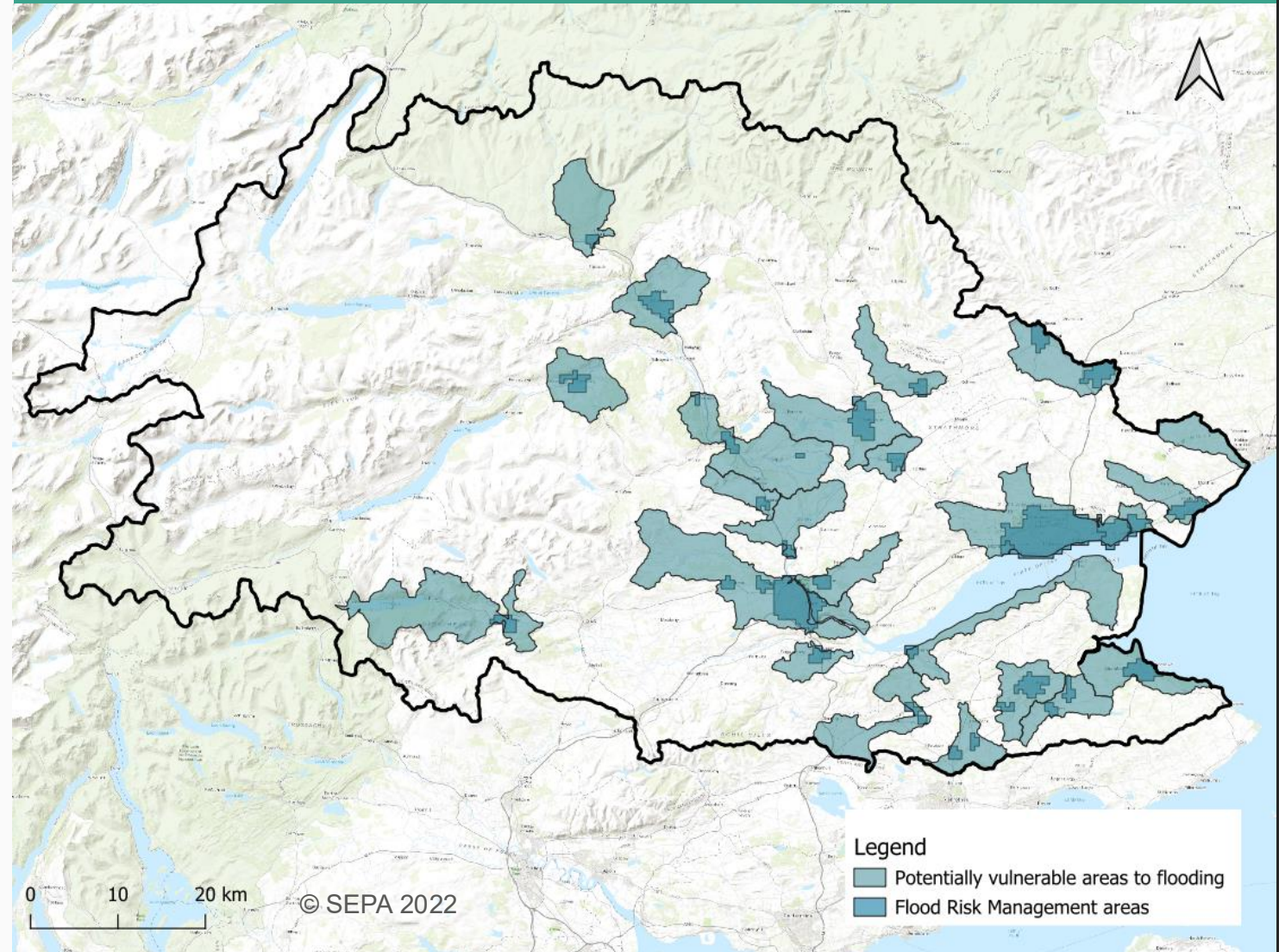
Designated areas: Over 20% of the Tay Bioregion is under designation for ecological or scientific importance – circa 160k hectares

Land designations

- **Sites of Specific Scientific Interest** (SSSI): There are 324 registered SSSI sites, including the Forest of Clunie and Beinn a' Ghlo

- **Special Area of Conservation** (SAC): There are 35 sites with this designation, including the majority of catchment rivers and Rannoch Moor

- **Nature Reserves**: There are 5 sites classified as nature reserves such as Beinn Ghlas

- -

- These designations demonstrate the existing biodiversity value of the catchment and emphasise the need for preservation and restoration of these important features.

- Targeted habitat restoration and creation can improve habitat connectivity and enhance species diversity and abundance, making the ecosystems more resilient to threats from climate change and invasive species.

- Land use change in and around designated areas must be carefully managed and should align with the primary conservation objectives for the areas. Comprehensive ecological planning and opportunity mapping with stakeholder engagement at its core, can weave together the varying ecosystem needs and deliver long lasting environmental and societal benefits.

Designated areas: Map of the main designated areas in Tay catchment

Rannoch Moor

Beinn a' Ghlo

Forest of Clunie

Designated areas
- SSSI
- SAC
- Nature Reserves

0   10   20 km
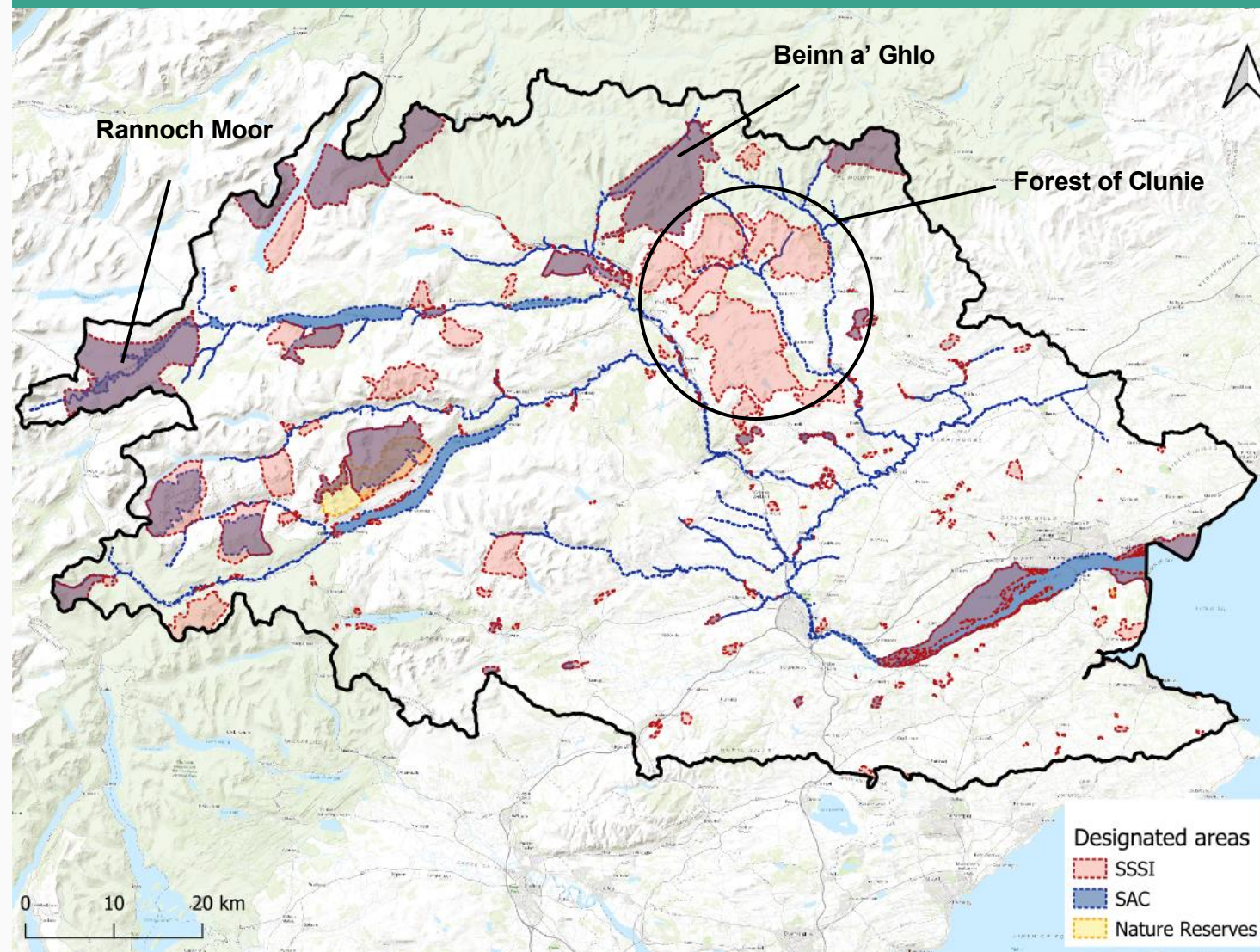
Opportunity to support nature restoration in Dochart and Lyon sub-catchment
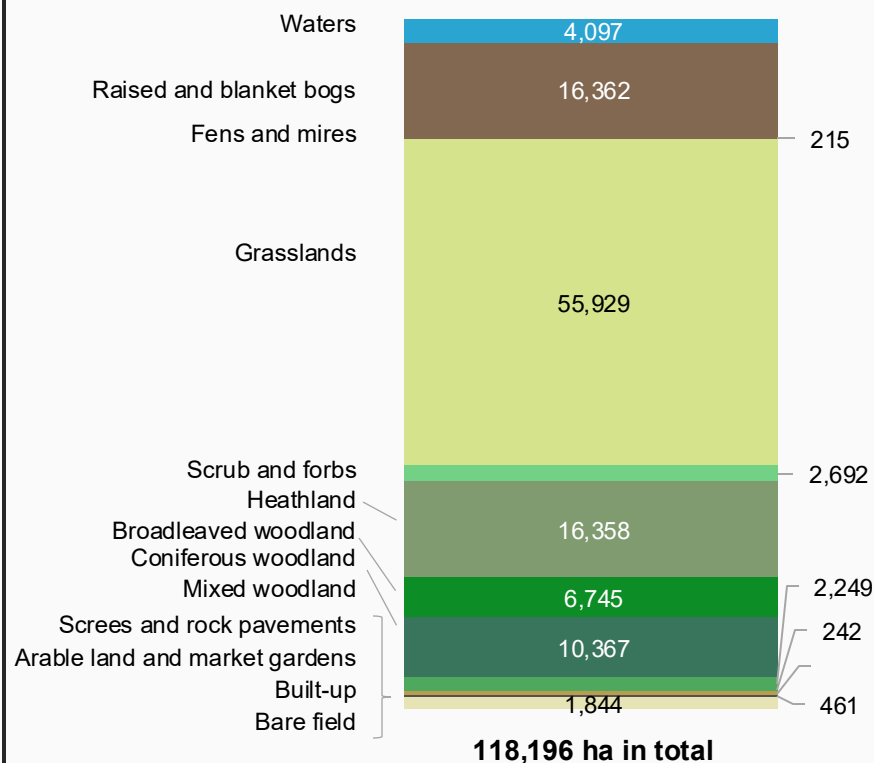
02

Baseline: Dochart and Lyon sub-catchment is mainly covered by grassland habitat

It is characterised by a mixtured of upland and lowland habitats, with expansive areas of moorland, grassland, and coniferous forestry in the uplands, and pockets of native woodland, wetlands, and agricultural land in the lower valleys.

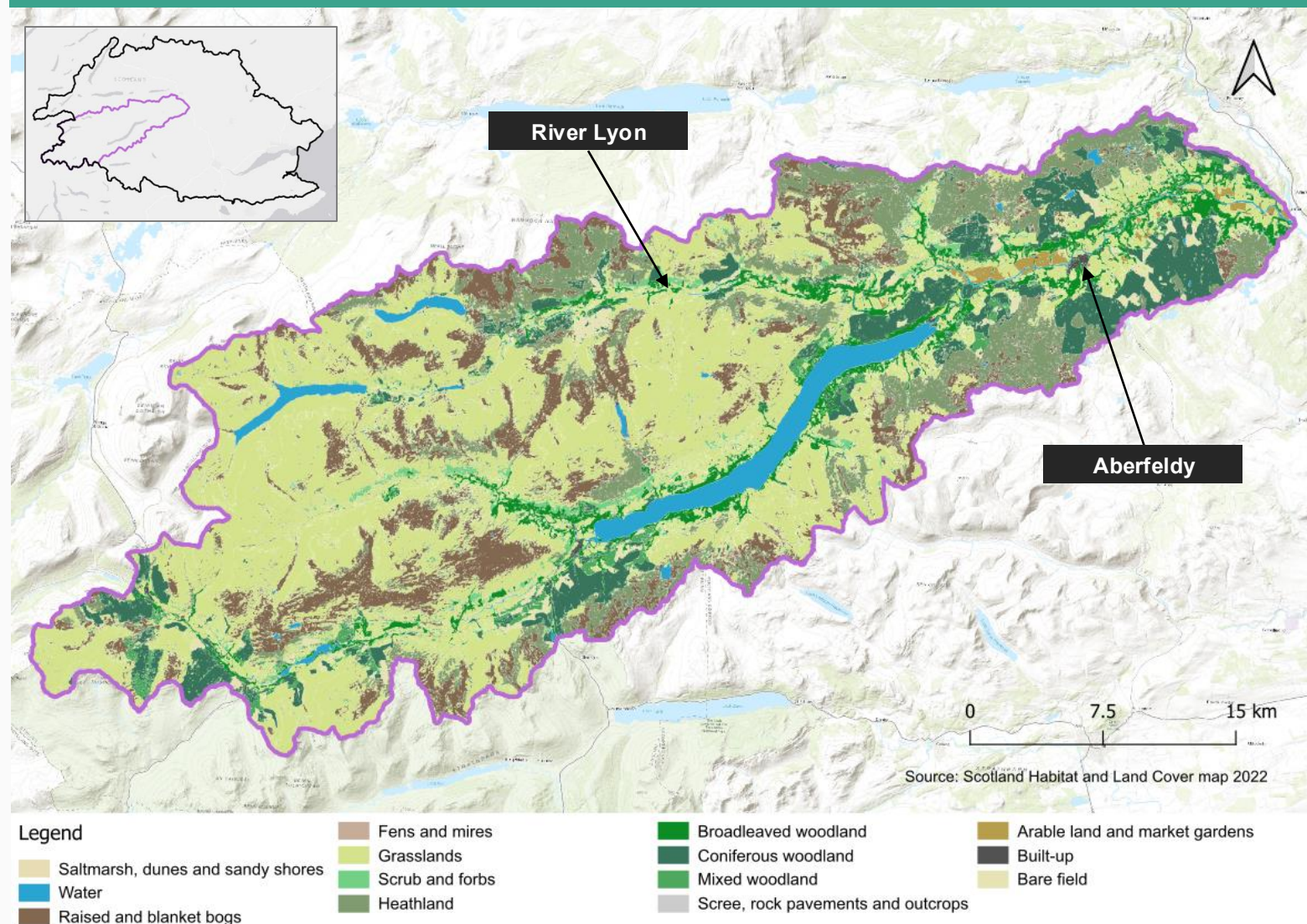**Bioregioning Tayside**

State of land cover

The area primarily consists of dry grassland habitat, covering nearly 50% of the total sub-catchment. Woodland habitat is relatively fragmented, with broadleaved woodlands amounting to only 6%, predominantly flanking the water features.

Distribution of land and cover by habitat (ha)

Habitat	Value (ha)
Waters	4,097
Raised and blanket bogs	16,362
Fens and mires	215
Grasslands	55,929
Scrub and forbs	2,692
Heathland	16,358
Broadleaved woodland	
Coniferous woodland	
Mixed woodland	6,745
Screes and rock pavements	2,249
Arable land and market gardens	242
Built-up	10,367
Bare field	1,844
	461

118,196 ha in total

Baseline: Current habitats on the Dochart and Lyon sub-catchment

River Lyon

Aberfeldy

0   7.5   15 km

Source: Scotland Habitat and Land Cover map 2022

Legend

- Saltmarsh, dunes and sandy shores
- Water
- Scrub and forbs
- Raised and blanket bogs
- Fens and mires
- Grasslands
- Heathland
- Broadleaved woodland
- Coniferous woodland
- Mixed woodland
- Scree, rock pavements and outcrops
- Arable land and market gardens
- Built-up
- Bare field

Constraints to woodland creation: Land that is either unsuitable or less suited to woodland creation was identified, based on sensitivity constraints and eligibility criteria for woodland carbon credit accreditation.

Narrowing down areas of woodland creation opportunity

The woodland opportunity area was determined by narrowing down the total site to the area that did not fall under any of the following constraints:

- **Eligibility constraints:** Areas with cultural designations (e.g. scheduled monuments), growing forests; area planned for forest; area that underwent tree felling in the past 25 years; areas of deep peat and peatland to protect key biodiversity and carbon stocks; and habitat that cannot support woodland creation (water, scree slopes, etc)

- **Sensitivity constraints:** Areas where woodland creation is less likely to be suitable and therefore excluded from the initial wide-scale assessment: areas of high altitude (above 450m), and land most suited for arable cropping.

Together, the eligibility and sensitivity constraints for woodland creation cover **94,681 hectares.**

Note: Land with existing sensitivities and eligibility constraints means woodland planting is either not appropriate or may require special measures or further data gathering to ensure it is suitable for the location. This woodland opportunity mapping has been undertaken in line with the **UK Forestry Standard guidance** and **Woodland Carbon Code** eligibility criteria for woodland creation.

Constraints: Key constraint areas for woodland creation

Legend
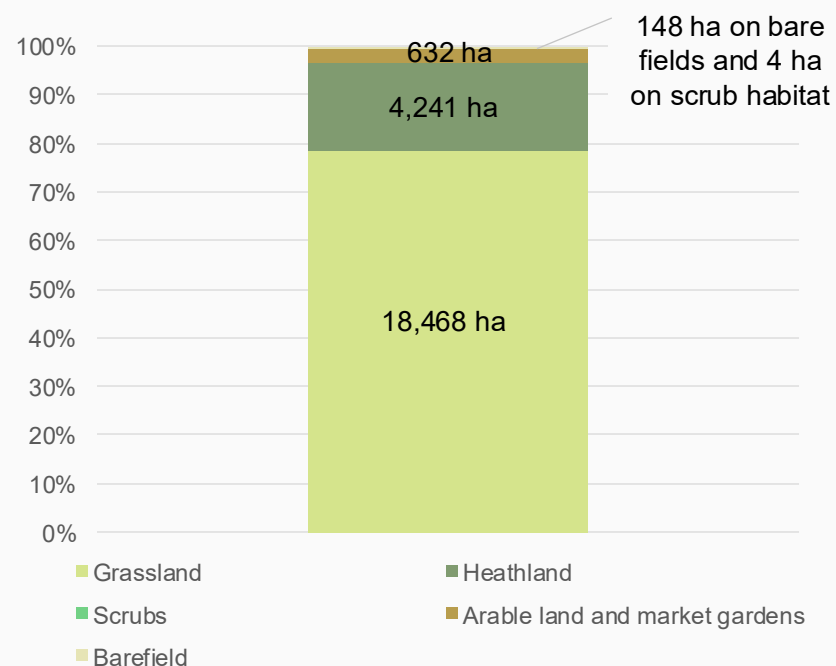- Eligibility constraints
- Sensitivity constraints
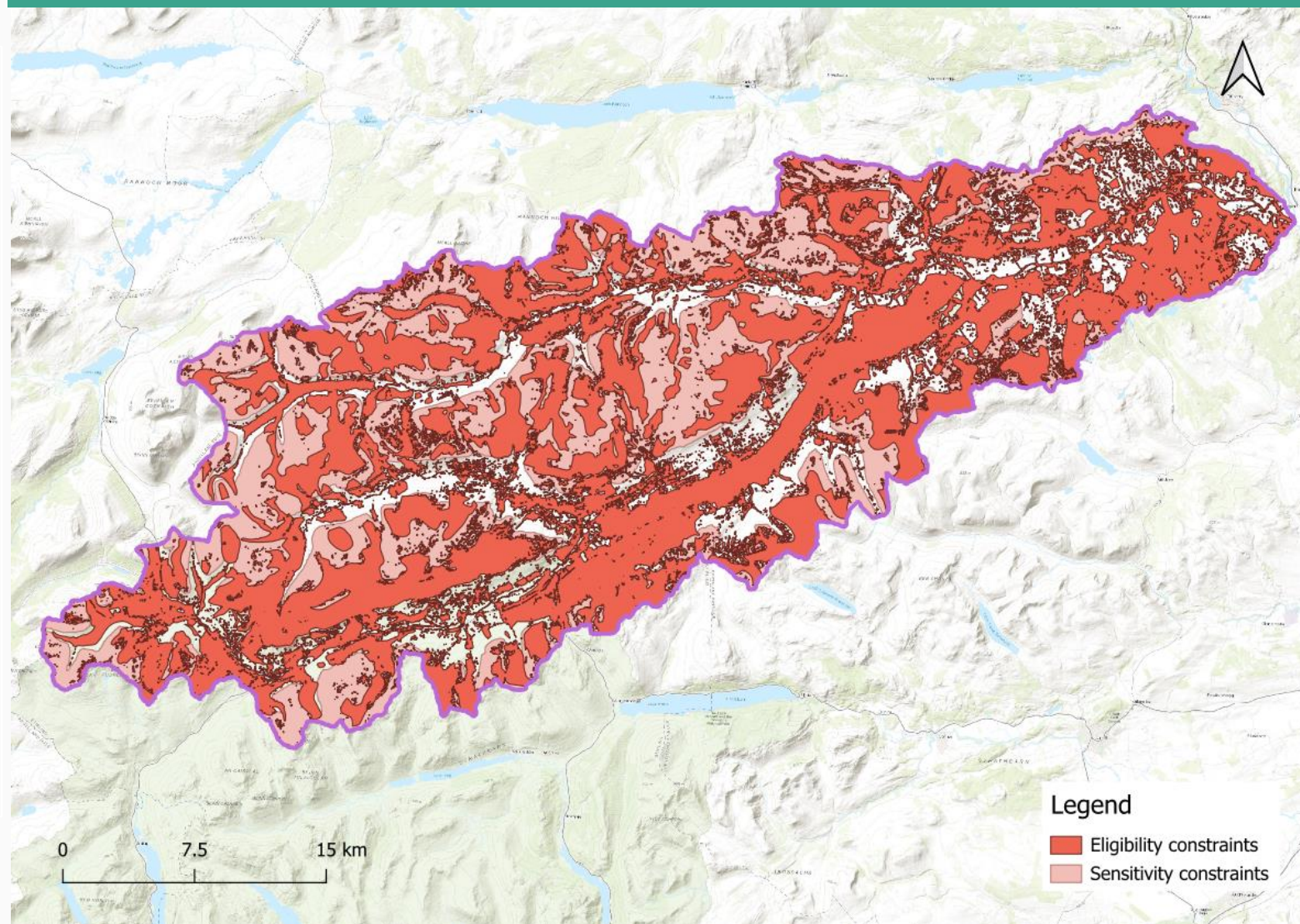
Opportunity for woodland creation: We estimate that up to 23,000 hectares of new broadleaf woodland could be created in the Dochart and Lyon sub-catchment

Bioregioning Tayside

Woodland opportunity area

- After accounting for the mapped constraints, **23,515 hectares** present potential opportunity for woodland creation in the sub-catchment.

- Nearly 80% of this opportunity area is existing grassland, which is typically a preferential habitat for woodland creation.

Distribution of the existing habitats that can be converted to woodland (in hectares (ha))

632 ha

4,241 ha

148 ha on bare fields and 4 ha on scrub habitat

18,468 ha

Legend:
- Grassland
- Heathland
- Scrubs
- Arable land and market gardens
- Barefield

Woodland opportunity: Map of woodland creation potential in the Dochart and Lyon area

0   7.5   15 km

Legend

Woodland creation opportunity
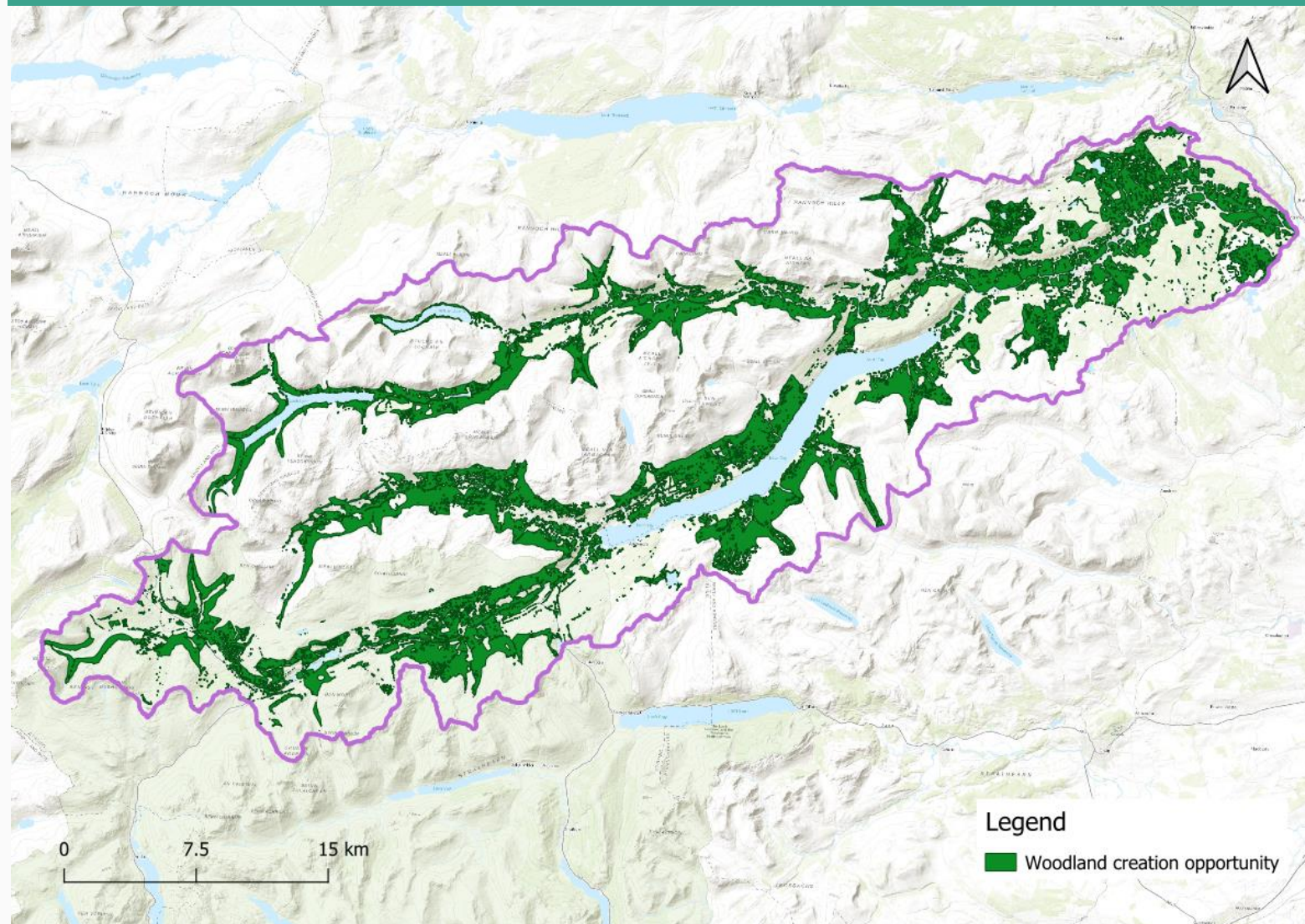
Opportunity for woodland creation: A north-east view of the maximum mapped woodland creation opportunity in the Dochart and Lyon sub-catchment
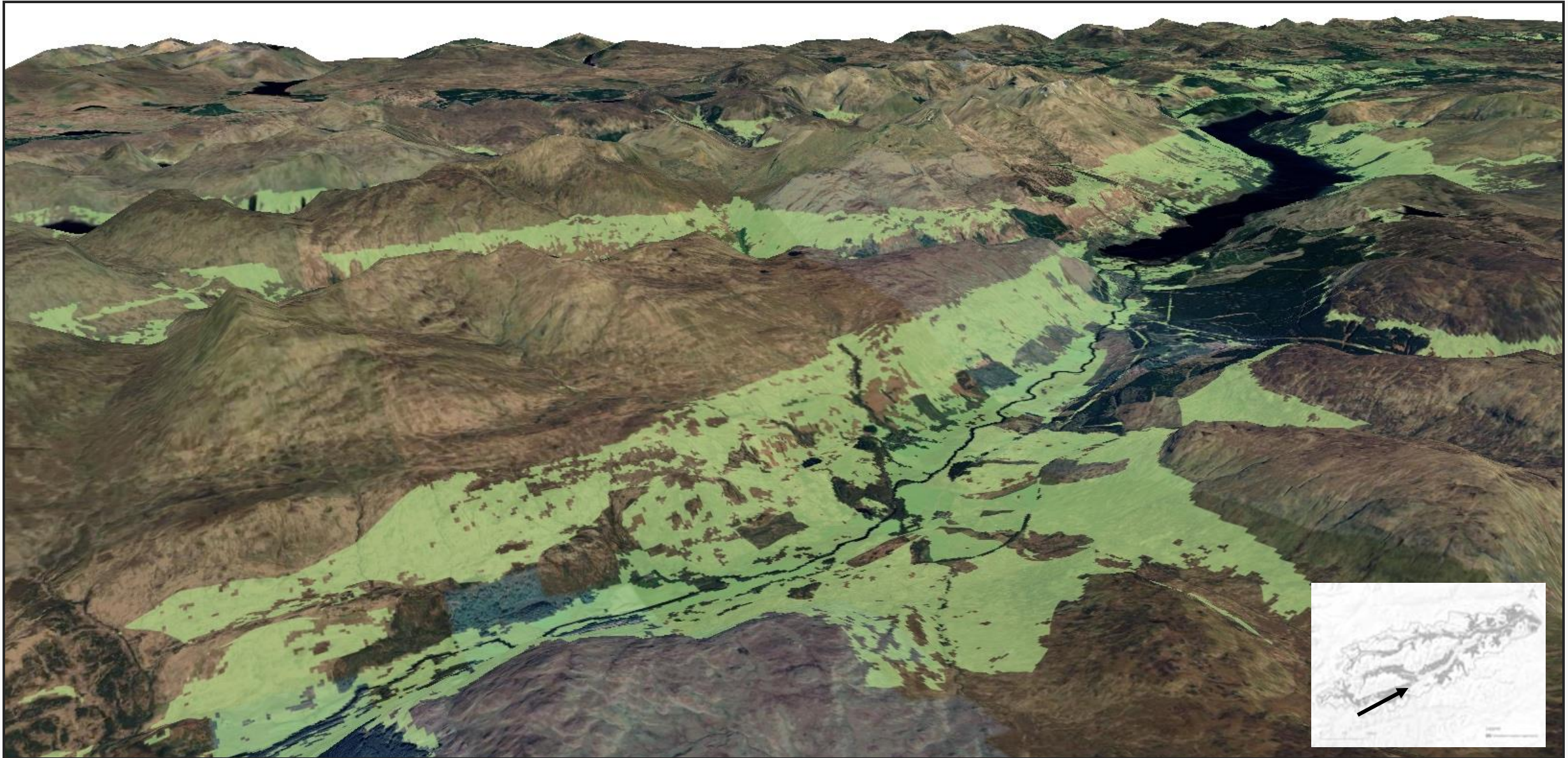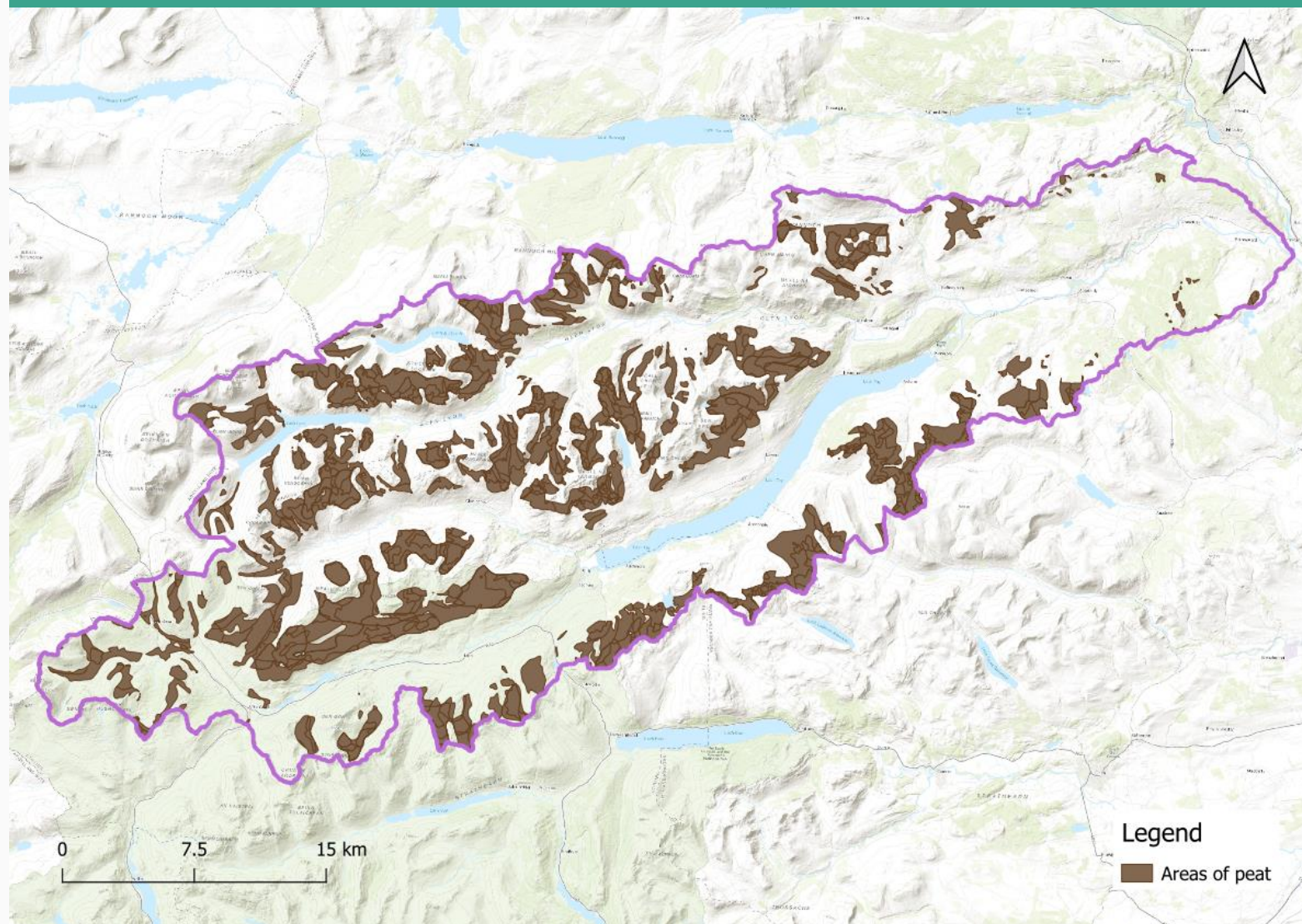
Opportunity for peatland restoration: There are approximately 27,000 hectares of deep peat with the potential need to be restored in the Dochart and Lyon sub-catchment

Bioregioning Tayside

Opportunity to restore damaged peatland

- There is an estimated **26,992 hectares** of deep peat mapped in the Dochart and Lyon sub-catchment, of which:
    - 11,300 ha within Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat.
    - 15,692 ha within Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat.

- The full extent and condition of the deep peat is not currently recorded in publicly available data or mapping.

- To obtain this information, comprehensive on-site surveys will need to be conducted across each of the sub-areas.

- If peatlands are degraded with evidence of added drainage, signs of erosion, or the formation of gullies, they are in need of restoration. Restoration efforts can significantly reduce the carbon emissions that are emitted from damaged habitats.

- When peatlands are restored, they can also help retain water, improve overall water quality, and support a wide variety of species.

Source: James Hutton Institute (1987)

Peatland restoration opportunity: Areas classified as peatland and/or as deep peat

Legend

■ Areas of peat

0   7.5   15 km

Water quality: There are 42 rivers and canals in the sub-catchment, of which 7 are classified with either a 'Poor' or 'Bad' overall quality rating, primarily from hydromorphological alterations

Bioregioning Tayside

Overall water quality classification

- The quality of the surface water is varied, with 7 waterbodies classified as Poor or Bad by SEPA, **primarily due to historical physical alterations** impacting the overall hydrology or ecology.

Classification distribution of the rivers and canals:

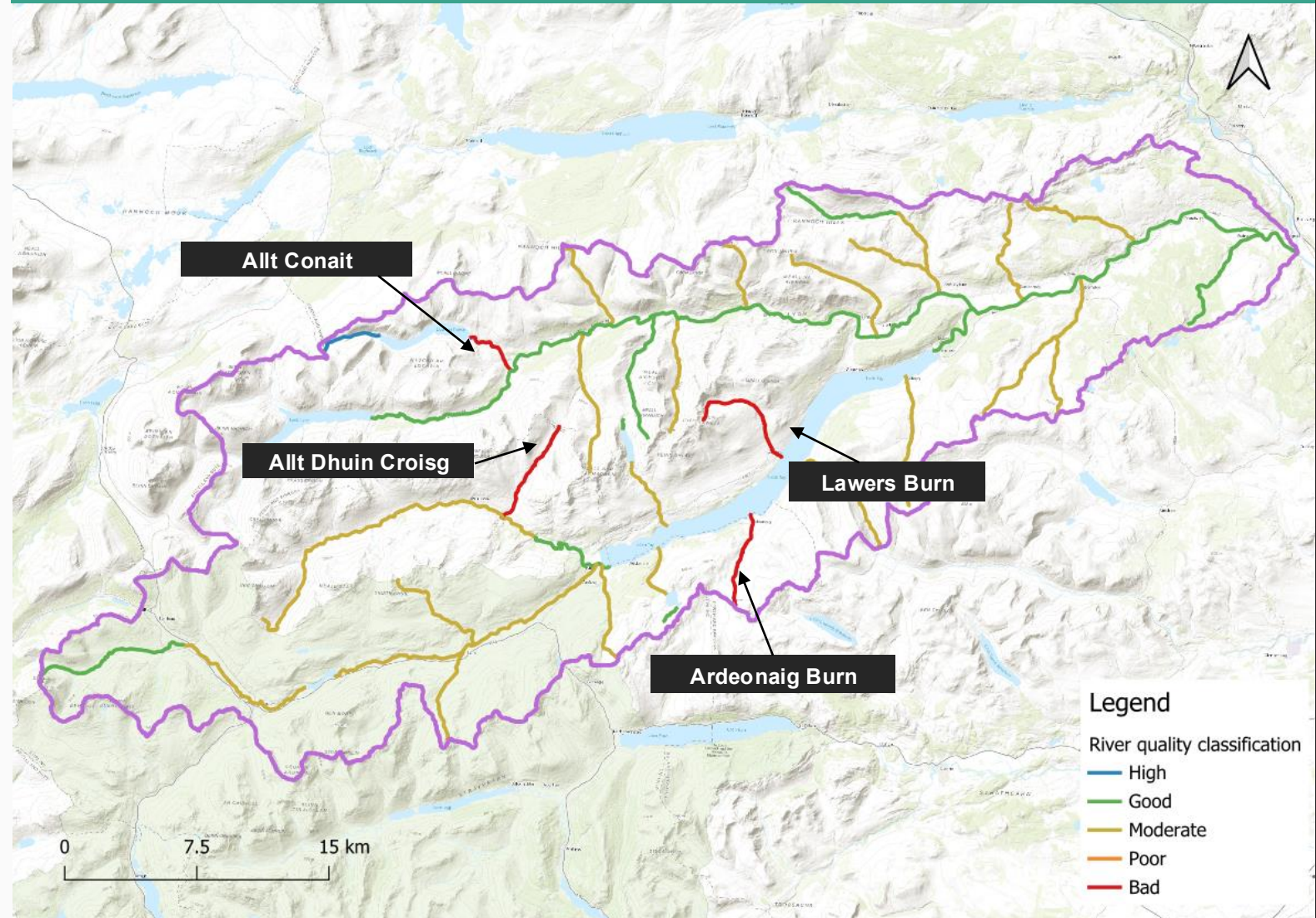| 1 | 13 | 21 | 3 | 4 |

■ High ■ Good ■ Moderate ■ Poor ■ Bad

- The hydrological and ecological condition of the rivers and canals might be improved as a result of surrounding habitat restoration but present very limited opportunities of direct financing.

- The existing mechanisms to finance water quality improvement are mainly around offsetting phosphate and nitrate levels.

- Both nutrients currently present low levels of risk for all water bodies (see Water Classification Hub)

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity.
Scotland water quality data is accessible on the Water Classification Hub.

Map of the overall water quality in Dochart and Lyon sub-catchment

Allt Conait

Allt Dhuin Croisg

Lawers Burn

Ardeonaig Burn

0   7.5   15 km

Legend
River quality classification
— High
— Good
— Moderate
— Poor
— Bad

Natural flood management: Circa 4,600 hectares, or 4% of the area, is at risk of flooding every 10 years in the Dochart and Lyon sub-catchment
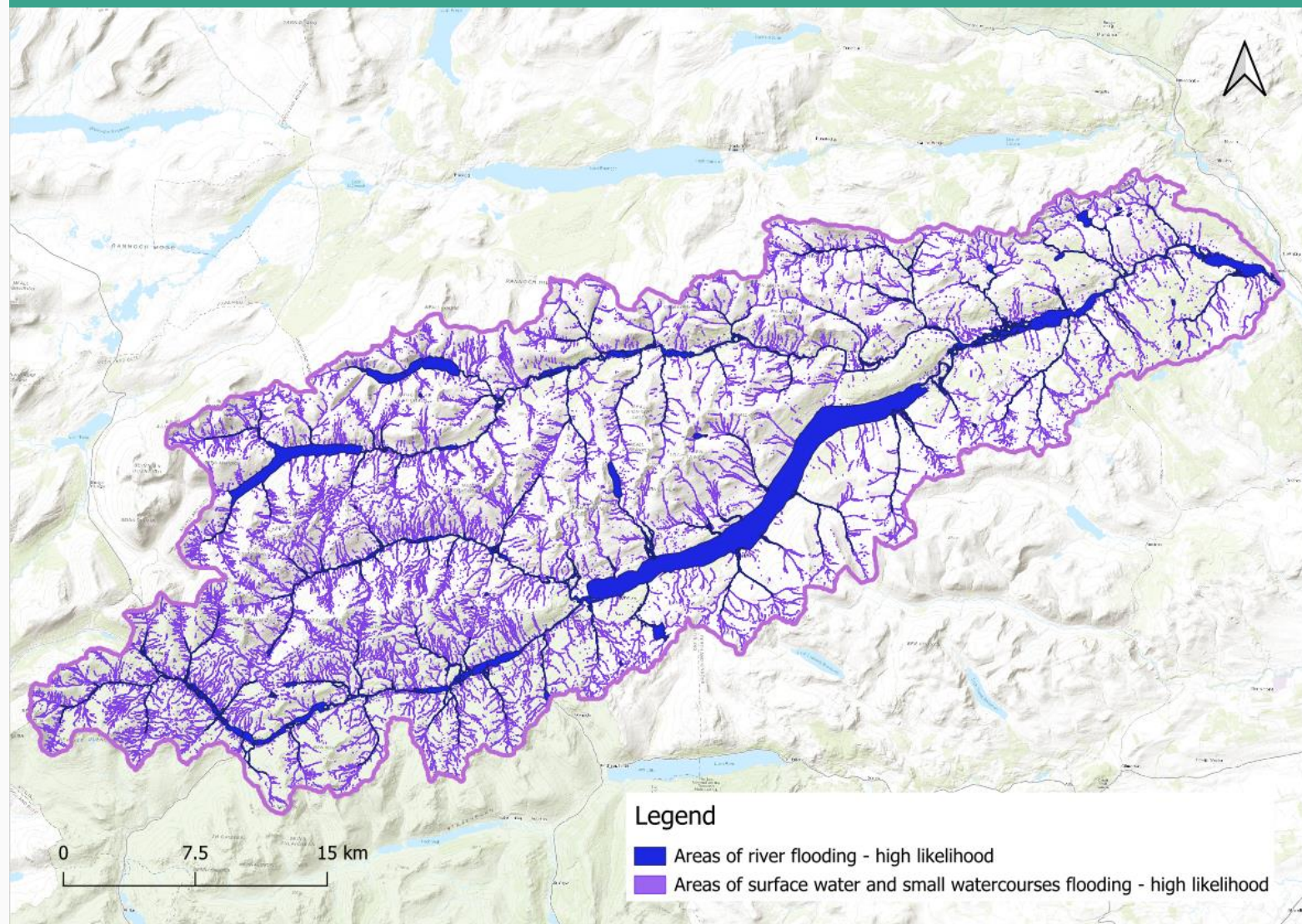
Opportunity for Natural Flood Management (NFM)

- The adjacent map shows areas mapped by SEPA with a 10% risk of flooding, representing the highest likelihood rating of flood risk from either a river or surface water.

- This means that the identified areas have an average probability of flooding once every 10 years.

- In the Dochart and Lyon sub-catchment, there is an estimated **4,597 hectares** that flood on average every 10 years.

- In areas where engineered flood control methods are not economically viable, NFM presents a alternate solution for mitigating flood risks at the catchment scale.

- Creating woodlands and restoring degraded peatlands can help reduce soil runoff, increase floodplain storage and manage sediments more effectively.

- The success of NFM projects depend significantly on the catchment's topography and land use, as well as the number of people and properties at risk from flooding. This should be mapped and assessed accordingly.

Source: SEPA 2023. This SEPA product is licensed under the Open Government Licence version 3.0.

The river climate change scenario has been defined by the United Kingdom Climate Projection 2009 (UKCP09) predictions for 2080s high emissions 67th percentile.

Map of the areas with a high likelihood of flooding in Dochart and Lyon

0   7.5   15 km

Legend
- Areas of river flooding - high likelihood
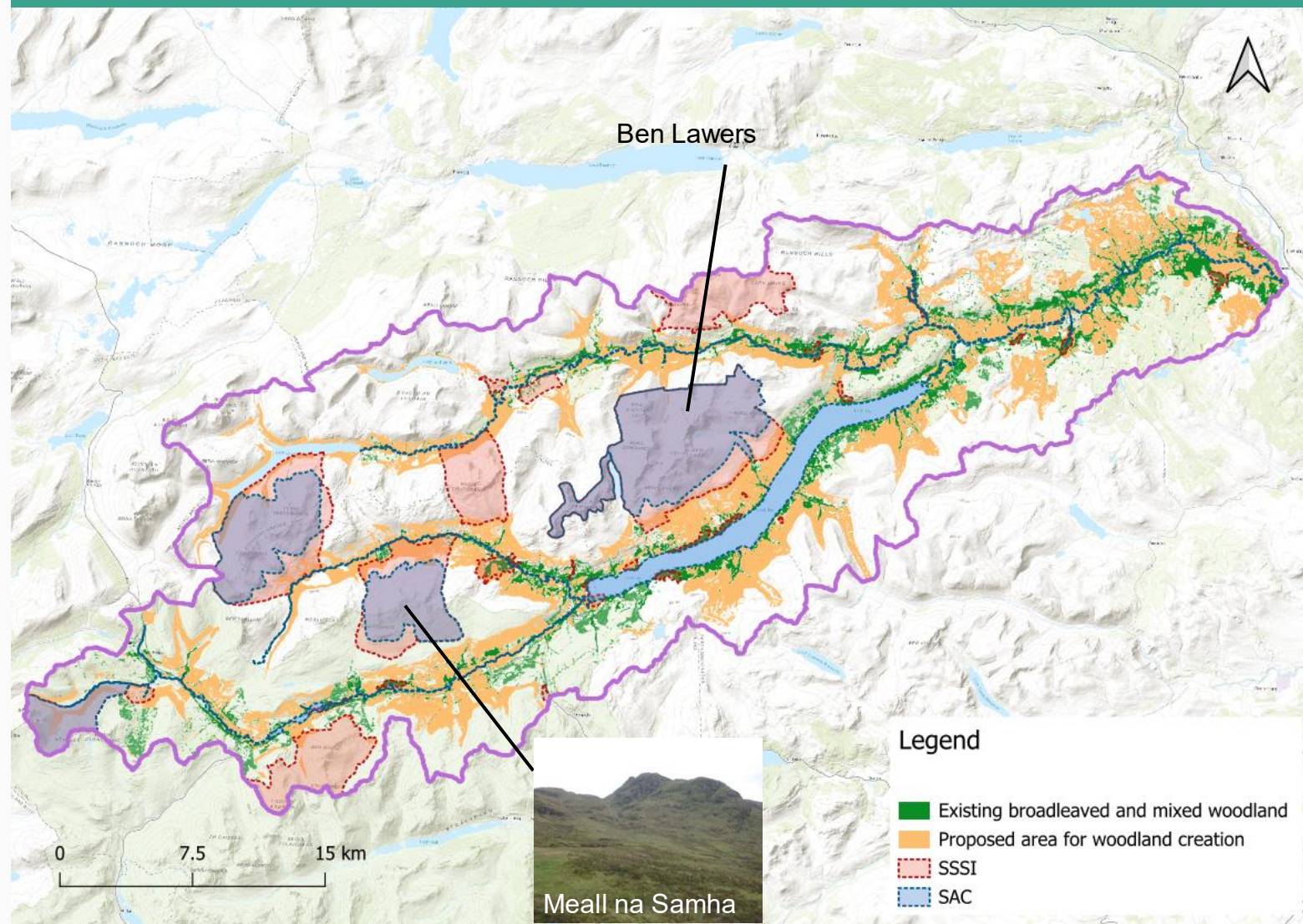- Areas of surface water and small watercourses flooding - high likelihood

Biodiversity: Expanding the woodland will boost connectivity, increase biodiversity and enhance the condition of sites designated for their environmental features

Bioregioning Tayside

Boosting biodiversity

- There are currently circa 9,000 hectares of existing broadleaved and mixed woodland in the Dochart and Lyon sub-catchment, mainly located along the water bodies.

- This sub-catchment hosts multiple areas designated for the richness of the upland montane assemblage, consisting of species-rich calcareous grassland, montane scrub, fen marsh, heath, inland rock and bogs and alpine heath.

- An increase in locally suitable wooded habitat in targeted areas can support overall catchment biodiversity and reduce the vulnerability of degraded or over-grazed areas within and surrounding the designated regions.

- The SSSI and SAC areas can also benefit directly from peatland restoration, if any degradation is identified.

Map of the opportunity for woodland expansion in relation to designated sites

Ben Lawers

Meall na Samha

Legend

- Existing broadleaved and mixed woodland
- Proposed area for woodland creation
- SSSI
- SAC

0   7.5   15 km

Biodiversity: There is the potential to create up to 2,160 hectares of riparian woodland, which could act as ecological corridors and carbon sinks across the area

Bioregioning Tayside

There is the opportunity to enhance biodiversity in the area by increasing the connectivity between fragmented woodland habitats

- Out of the 23k hectares of potential woodland creation, there is an opportunity to create up to **2,160 hectares** of riparian woodland within a 100-metre buffer zone from an existing river or canal.

- This represents ~9% of the maximum woodland creation potential in the area.

- Riparian woodlands are effective for connecting fragmented habitats along rivers, allowing species like water voles, beavers, and invertebrates to move freely and thrive.

- These wooded corridors also shade waterways, helping to regulate water temperature, which is important for supporting fish populations.

- Riparian woodlands improve water quality by reducing runoff from nearby farmed land and filtering pollutants, benefiting a wide range of wildlife.

Map of potential for riparian woodland creation in the Dochart and Lyon area

Legend

Areas of potential riparian woodland creation

0   7.5   15 km
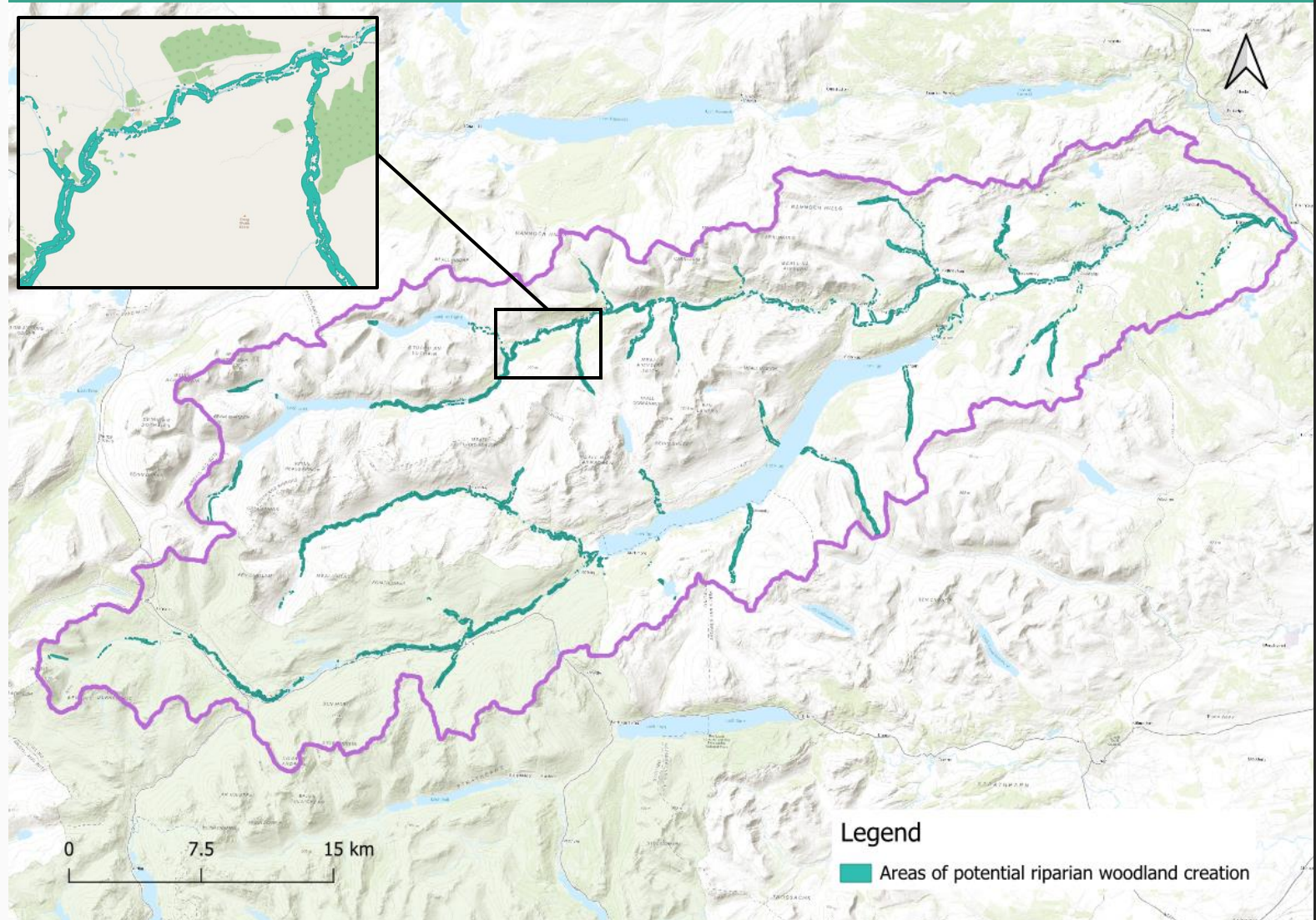
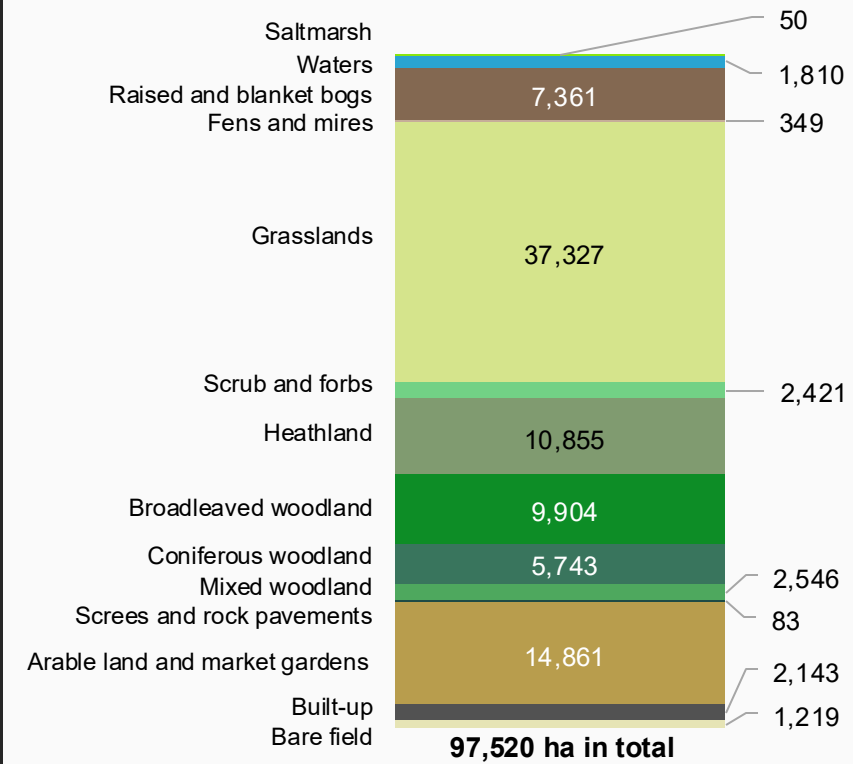Opportunity to support nature restoration in Earn sub-catchment

03

Baseline: Earn sub-catchment is mainly covered by grassland, crops and arable plots

The following slide provides details on existing land cover.
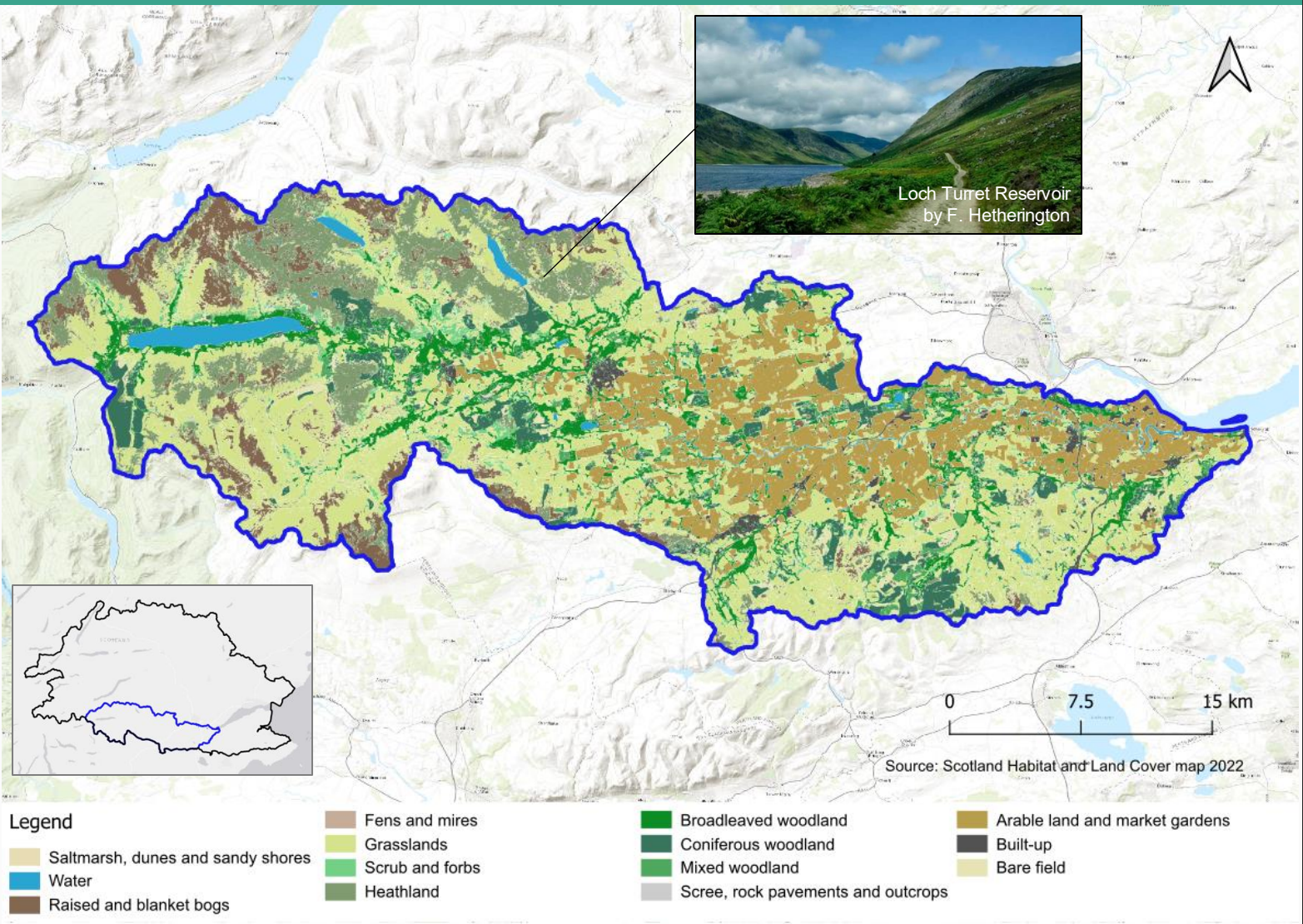
Bioregioning Tayside

State of land cover

The Earn catchment features a variety of habitats and land uses; the west is home to mostly natural environments including peaty bogs, heathlands and water bodies, and in the east, more land is used for agricultural purposes. Grasslands remain the dominant habitat.

Distribution of land and cover by habitat (ha)

Habitat	ha
Saltmarsh	50
Waters	1,810
Raised and blanket bogs	7,361
Fens and mires	349
Grasslands	37,327
Scrub and forbs	2,421
Heathland	10,855
Broadleaved woodland	9,904
Coniferous woodland	5,743
Mixed woodland	2,546
Screes and rock pavements	83
Arable land and market gardens	14,861
	2,143
Built-up	1,219
Bare field	

97,520 ha in total

Baseline: Current habitats on the Earn sub-catchment

Loch Turret Reservoir by F. Hetherington

0   7.5   15 km

Source: Scotland Habitat and Land Cover map 2022

Legend

- Saltmarsh, dunes and sandy shores
- Water
- Raised and blanket bogs
- Fens and mires
- Grasslands
- Scrub and forbs
- Heathland
- Broadleaved woodland
- Coniferous woodland
- Mixed woodland
- Scree, rock pavements and outcrops
- Arable land and market gardens
- Built-up
- Bare field

Constraints to woodland creation: Land that is either unsuitable or less suited to woodland creation was identified, based on sensitivity constraints and eligibility criteria for woodland carbon credit accreditation

Bioregioning Tayside

Narrowing down areas of woodland creation opportunity

The woodland opportunity area was determined by narrowing down the total site to the area that did not fall under any of the following constraints:

– **Eligibility constraints:** Areas with cultural designations (e.g. scheduled monuments), growing forests; area planned for forest; area that underwent tree felling in the past 25 years; areas of deep peat and peatland to protect key biodiversity and carbon stocks; and habitat that cannot support woodland creation (water, scree slopes, etc)

– **Sensitivity constraints:** Areas where woodland creation is less likely to be suitable and therefore excluded from the initial wide-scale assessment: areas of high altitude (above 450m), and land most suited for arable cropping.

Together, the eligibility and sensitivity constraints to woodland creation **cover 60,460 hectares**.

Note: Land with existing sensitivities and eligibility constraints means woodland planting is either not appropriate or may require special measures or further data gathering to ensure it is suitable for the location. This woodland opportunity mapping has been undertaken in line with the **UK Forestry Standard guidance** and **Woodland Carbon Code** eligibility criteria for woodland creation

Sources: Ordonnance Survey UK (2023); NatureScot (2022); Historic Environment Scotland (2023); UK Forestry (2022); Scottish Forestry (2022); FGS woodland creation claim (2023); James Hutton Institute (1987)

Constraints: Key constraint areas for woodland creation

Legend
- Eligibility constraints
- Sensitivity constraints
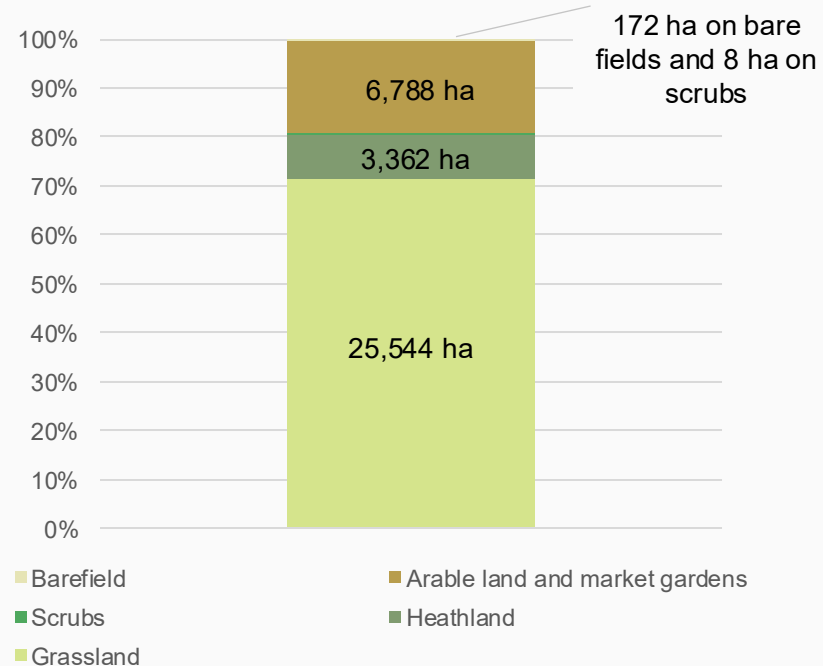
0   7.5   15 km
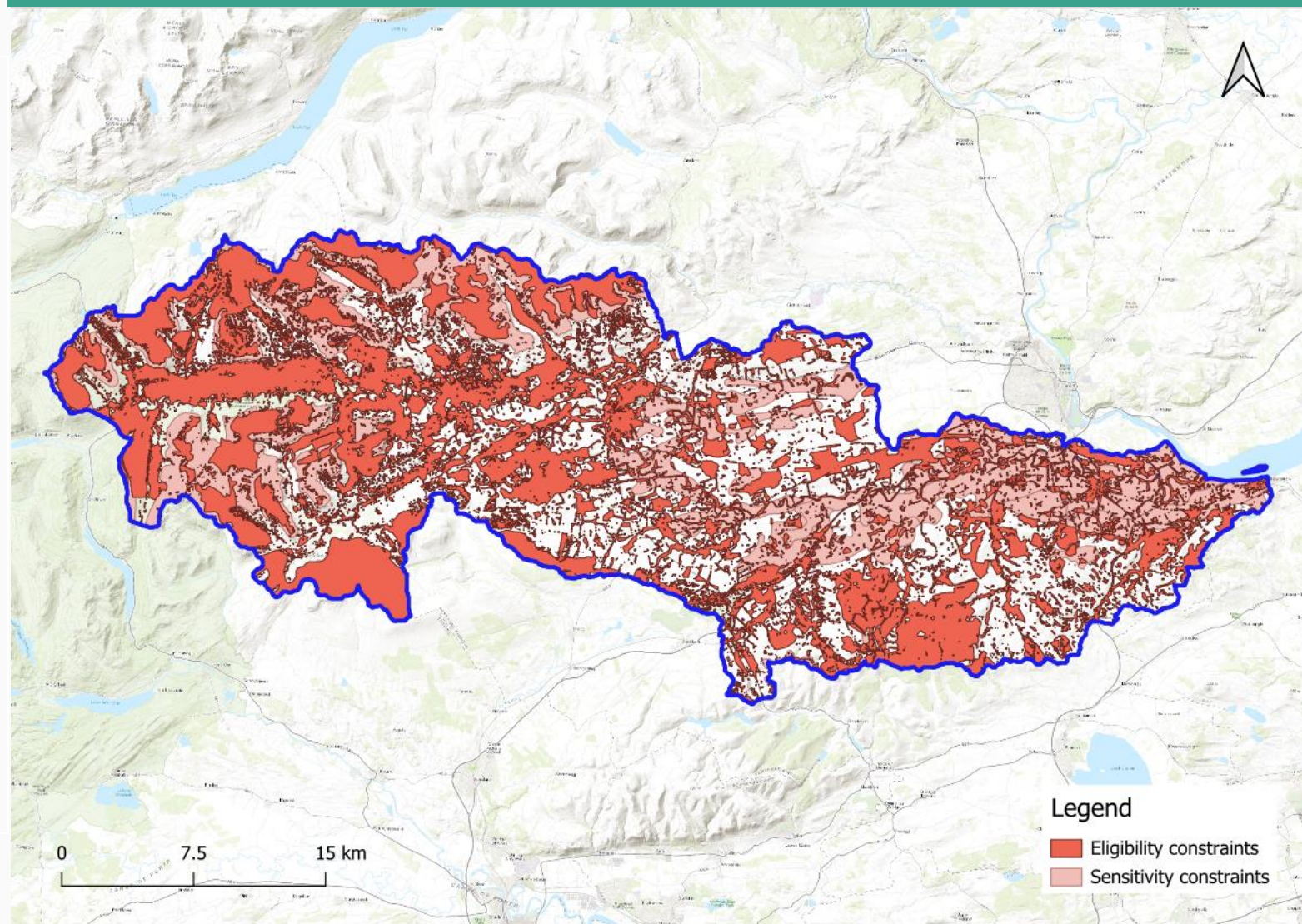
Opportunity for woodland creation: We estimate that a maximum of 36,000 hectares of new broadleaf woodland could be established in the Earn sub-catchment

Bioregioning Tayside

Woodland opportunity area

- After accounting for these constraints, **36,060 hectares** have been identified for woodland creation in the Earn sub-catchment.

- A total of 70% of the proposed new woodland can be established on existing grassland and circa 20% on agricultural land mapped with non-high productivity soil.

Distribution of the existing habitats that can be converted to woodland (in hectares)

172 ha on bare fields and 8 ha on scrubs

6,788 ha
3,362 ha
25,544 ha

Legend:
- Barefield
- Scrubs
- Grassland
- Arable land and market gardens
- Heathland

Woodland opportunity: Map of woodland creation potential in the Earn sub-catchment

0   7.5   15 km

Legend
■ Woodland creation opportunity
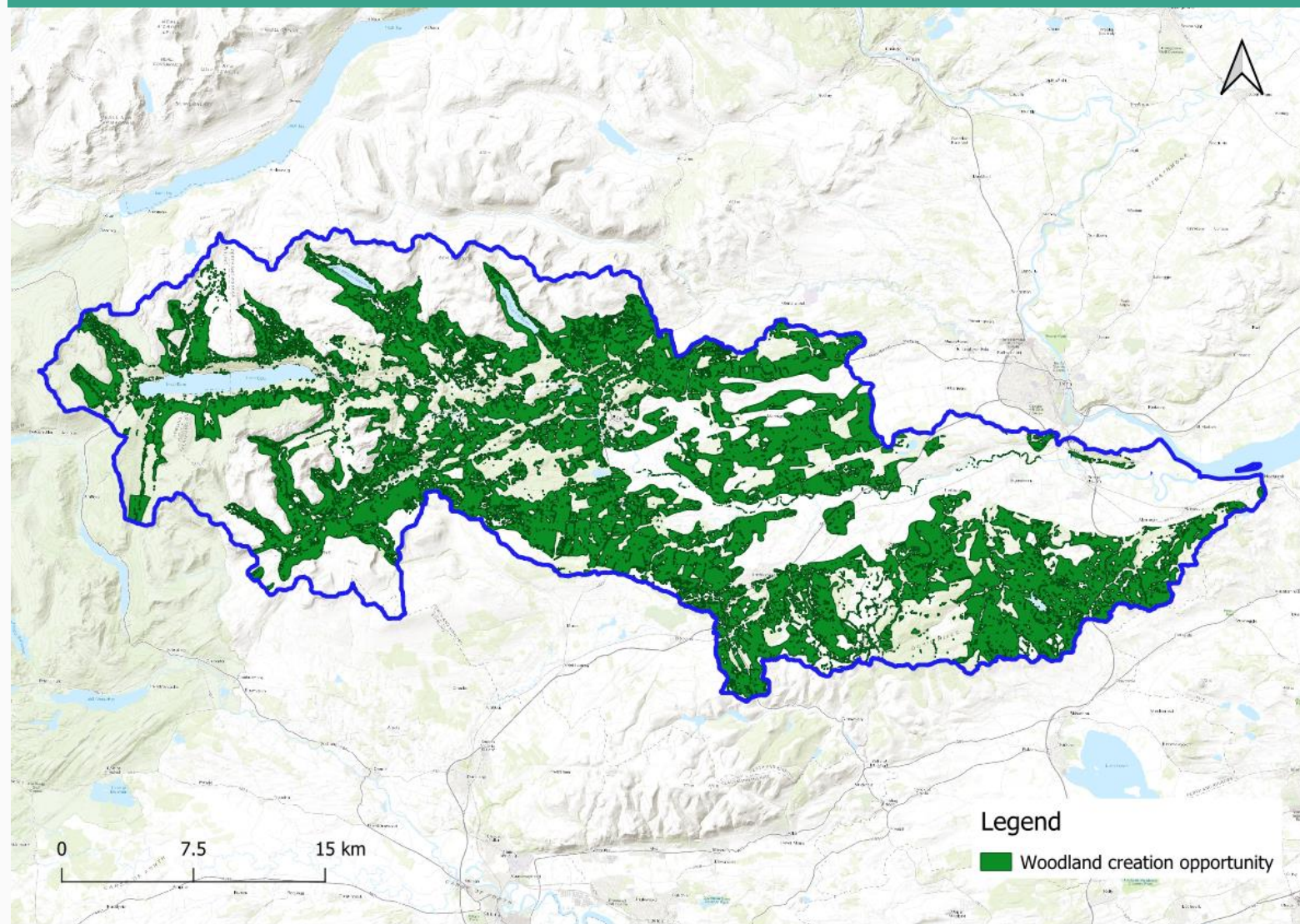
Opportunity for woodland creation: A north-west facing view of the maximum woodland creation opportunity in the Earn sub-catchment
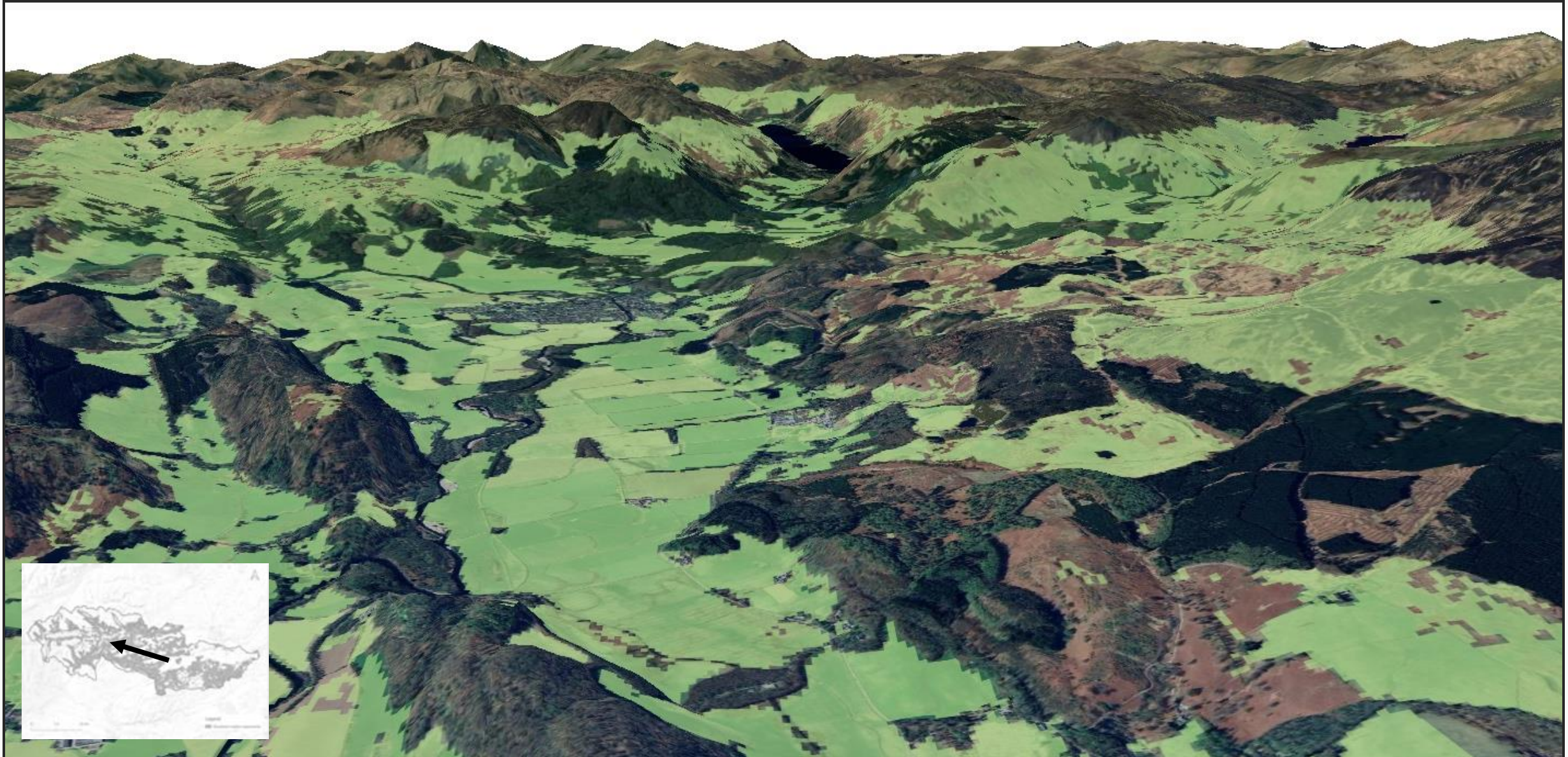
Opportunity for peatland restoration: There are approximately 11,000 hectares of deep peat with the potential need to be restored in the Earn sub-catchment

Opportunity to restore damaged peatland

- There is an estimated **11,036 hectares** of deep peat in the Earn sub-catchment, of which:
  - 6,593 ha within Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat.
  - 4,443 ha within Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat.

- The full extent and condition of the deep peat is not currently recorded in publicly available data or mapping.

- To obtain this information, comprehensive on-site surveys will need to be conducted across each of the sub-areas.

- If peatlands are degraded with evidence of added drainage, signs of erosion, or the formation of gullies, they are in need of restoration. Restoration efforts can significantly reduce the carbon emissions that are emitted from damaged habitats.

- When peatlands are restored, they can also help retain water, improve overall water quality, and support a wide variety of species.

Source: James Hutton Institute (1987)

Peatland opportunity: Areas classified as peatland and/or as deep peat

Legend

Areas of peat
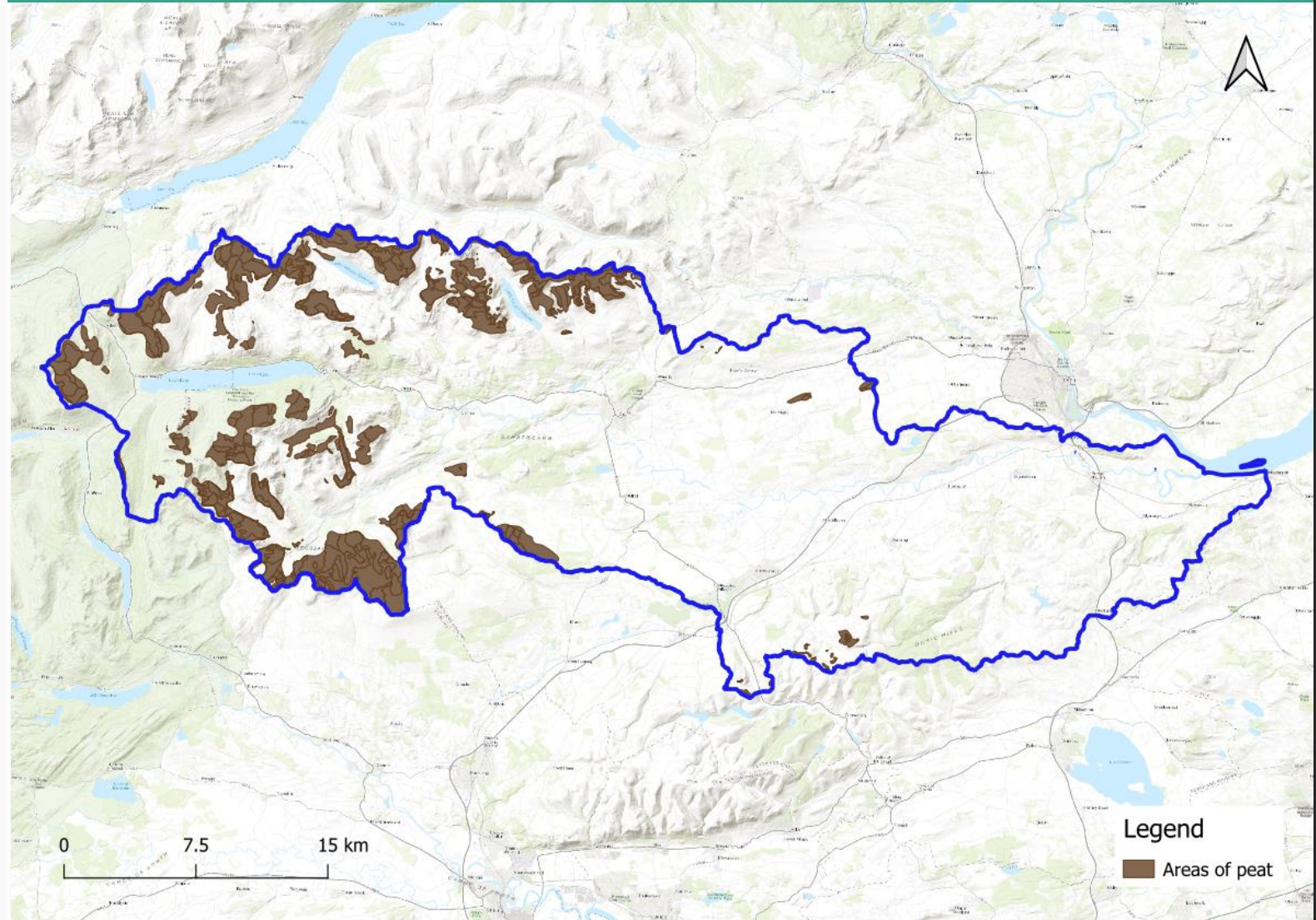
Water quality: There are 28 rivers and canals in the Earn sub-catchment, of which only two are classified with an overall water quality either 'Poor' or 'Bad'.

Bioregioning Tayside

Overall water quality classification

- The quality of the surface water is considered by SEPA as largely moderate or above in the catchment. Lower ratings are due to <u>historical physical alterations</u> impacting the overall <u>hydrology or ecology of the watercourse.</u>

Classification distribution of the rivers and canals:

| 2	10	14	1	1

■ High ■ Good ■ Moderate ■ Poor ■ Bad

- The hydrological and ecological condition of the rivers and canals might be improved as a result of surrounding habitat restoration but present very limited opportunities of direct financing.

- The existing mechanisms to finance water quality improvement are mainly around offsetting phosphate and nitrate levels.

- Both nutrients currently present low levels of risk for all water bodies (see Water Classification Hub)

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity.
Scotland water quality data is accessible on the Water Classification Hub.

Map of the overall water quality in the Earn sub-catchment

Turret Burn

Legend

River quality classification
— High
— Good
— Moderate
— Poor
— Bad

0   7.5   15 km
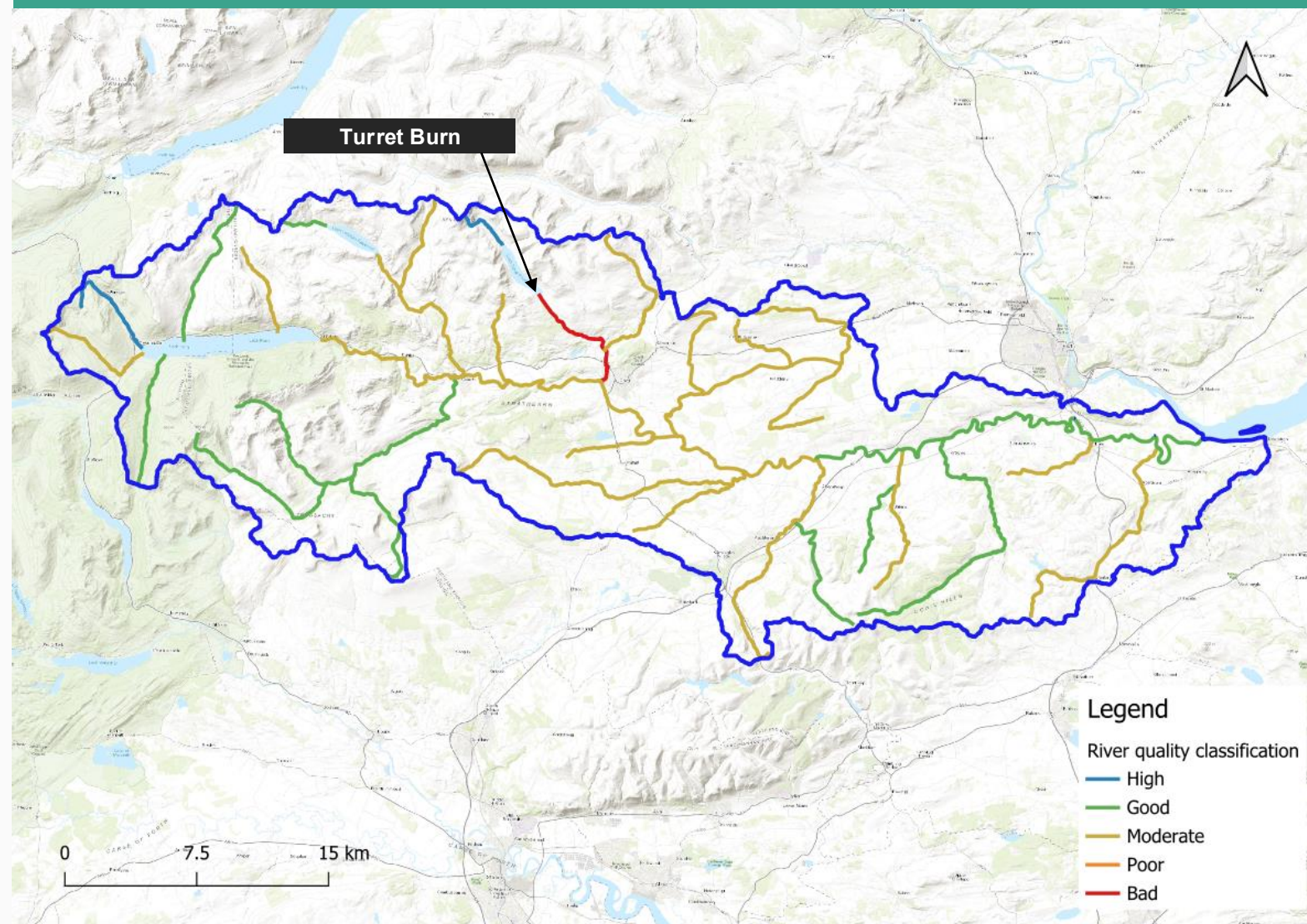
Natural Flood Management: The Earn sub-catchment is at risk of flooding every 10 years on a total area of 1,233 hectares, representing circa 1% of the sub-catchment
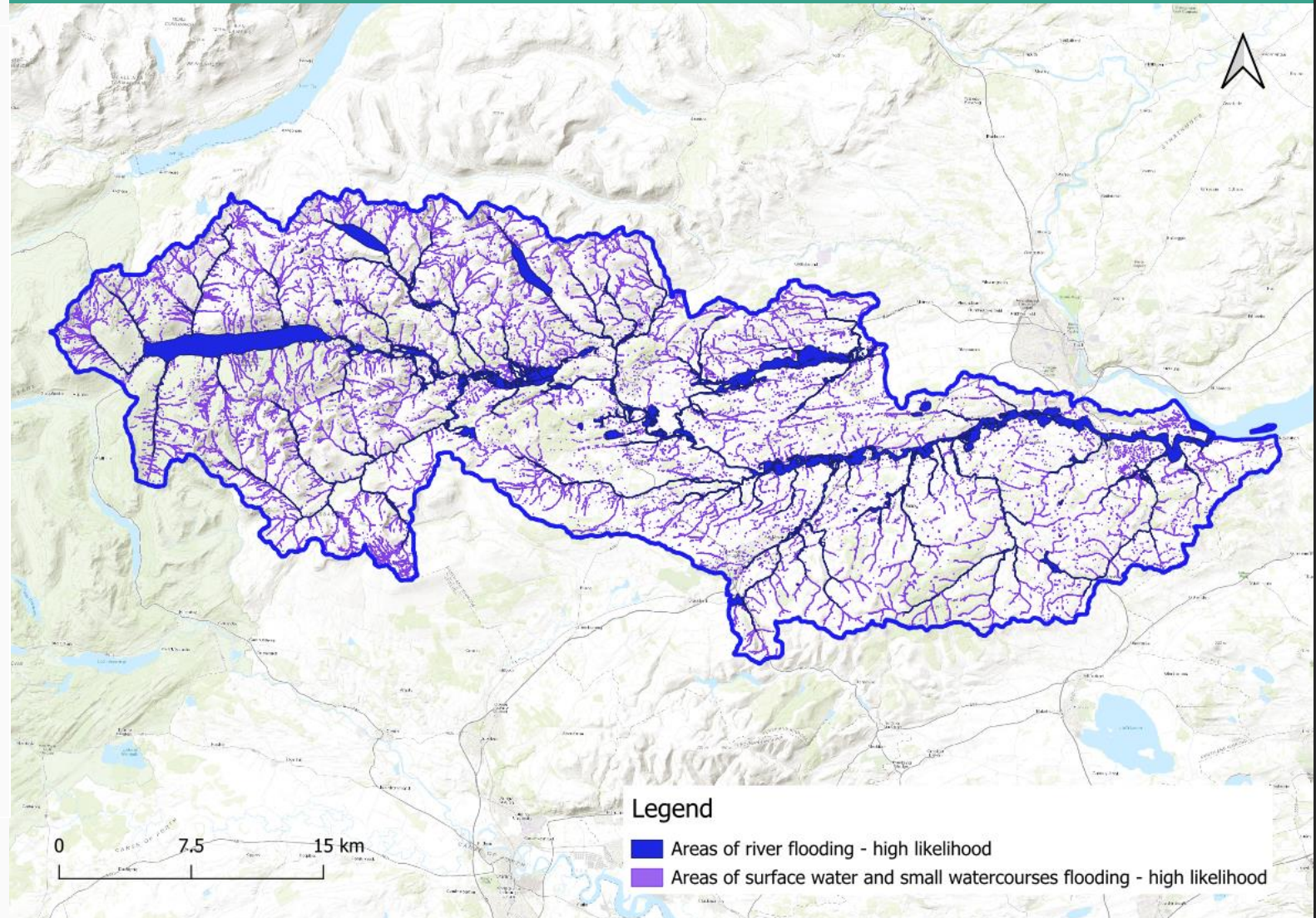
Bioregioning Tayside

Opportunity for Natural Flood Management (NFM)

- The adjacent map shows areas with a 10% risk of flooding rated by SEPA, indicating the highest rated likelihood of flood risk from either a river or surface water.

- This means that the identified areas have an average probability of flooding once every 10 years.

- In the Earn sub-catchment, there is an estimated **1,233 hectares** that flood on average every 10 years.

- n areas where engineered flood control methods are not economically viable, NFM presents a alternate solution for mitigating flood risks at the catchment scale.

- Creating woodlands and restoring degraded peatlands can help reduce soil runoff, increase floodplain storage and manage sediments more effectively.

- The success of NFM projects depends significantly on the catchment's topography and land use, as well as the number of people and properties at risk from flooding. This should be mapped and assessed accordingly.

Map of the areas with a high likelihood of flooding in the Earn sub-catchment

0   7.5   15 km

Legend
- ■ Areas of river flooding - high likelihood
- ■ Areas of surface water and small watercourses flooding - high likelihood

Biodiversity: Expanding woodland will boost connectivity, biodiversity, and enhance the condition of sites designated for their environmental features.

Boosting biodiversity with habitat restoration and improving connectivity

- There are currently 12.5k hectares of existing broadleaved and mixed woodland in the Earn sub-catchment, mainly located along the water bodies.

- This sub-catchment hosts areas designated for their biodiversity importance such as Ben Chonzie, characterised by moorland, blanket mire and montane heath.

- Increase locally suitable woodland habitat cover can have a positive effect across the entire landscape, helping to increase resilience of the interconnected ecosystems and promote species diversity, with knock on effects on habitats at higher elevations, like blanket bogs and montane heaths.

Map of the opportunity for woodland expansion in relation to designated sites

Ben Chonzie

Legend

|	
🟩	Existing broadleaved and mixed woodland
🟧	Proposed areas for woodland creation
⬛	SSSI
⬛	SAC

0   7.5   15 km
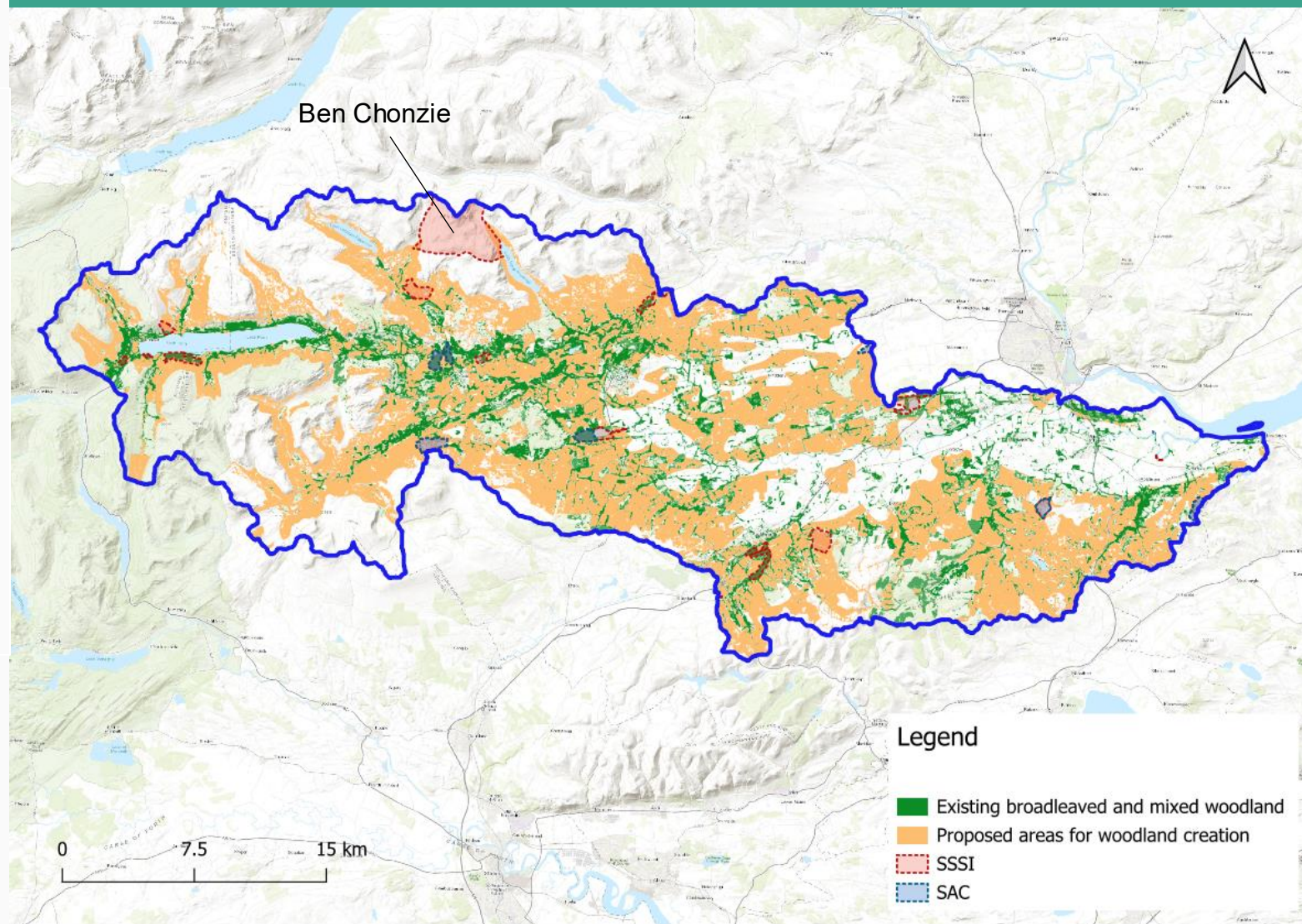
Biodiversity: Up to 2,380 hectares of riparian woodland could be established in the sub-catchment, strengthening habitat corridors and supporting aquatic environments

Bioregioning Tayside

There is the opportunity to enhance biodiversity in the area by increasing the connectivity between fragmented woodland habitats

- Out of the 36k hectares of potential woodland creation, there is an opportunity to create up to **2,380 hectares** of riparian woodland within a 100-metre buffer zone from an existing river or canal.

- It equals to over 6% of the maximum woodland creation potential in the area.

- Riparian woodlands are vital for connecting fragmented habitats along rivers, allowing species like water voles, beavers, and invertebrates to move freely and thrive.

- These wooded corridors also shade waterways, helping to regulate water temperature, which is crucial for supporting fish populations.

- Riparian woodlands improve water quality by reducing runoff from nearby farmed land and filtering pollutants, benefiting a wide range of wildlife.

Map of the opportunity for riparian woodland creation in the Earn sub-catchment

Legend

Areas of potential riparian woodland creation

0   7,5   15 km
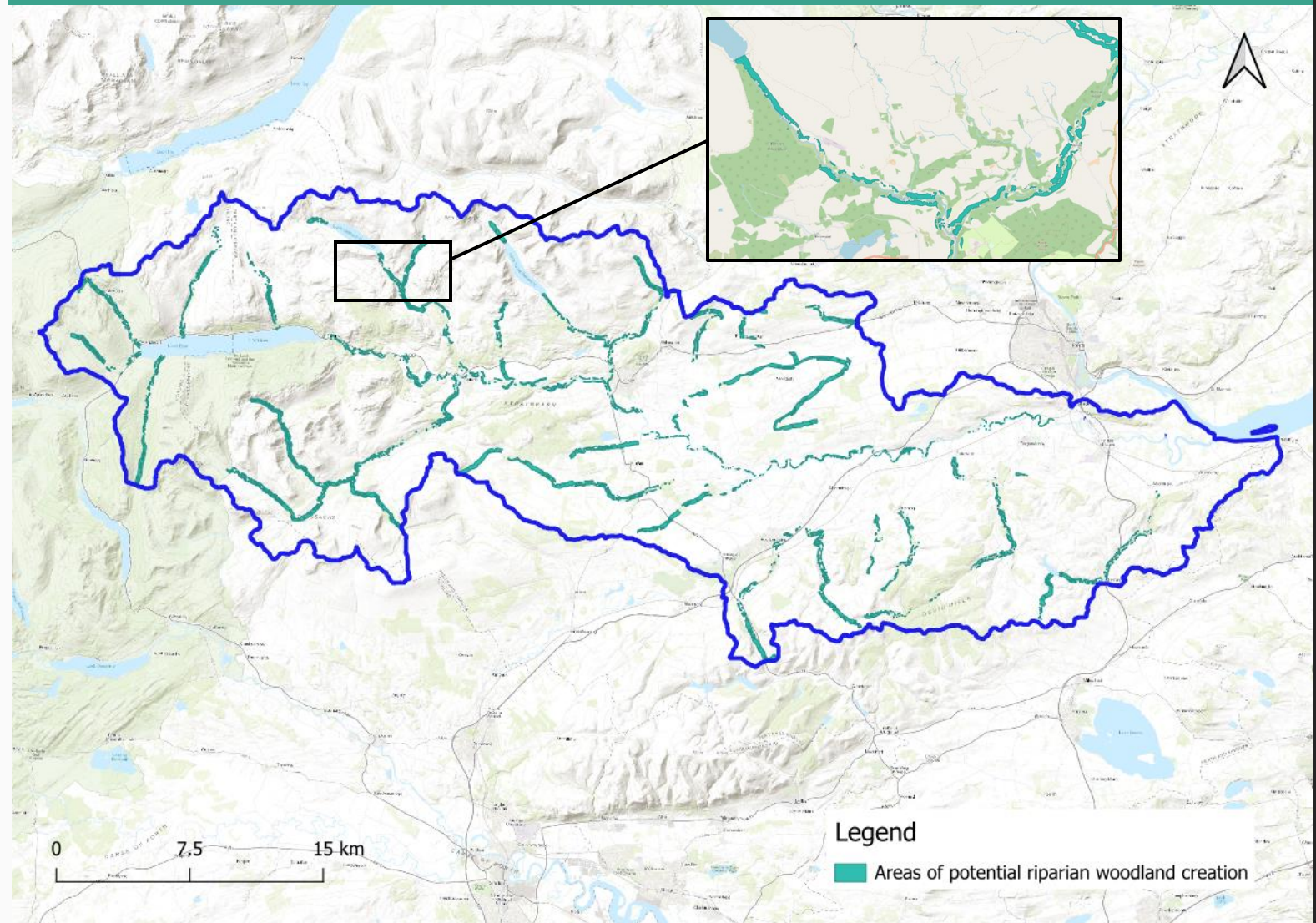
Opportunity to support nature restoration in the Isla sub-catchment
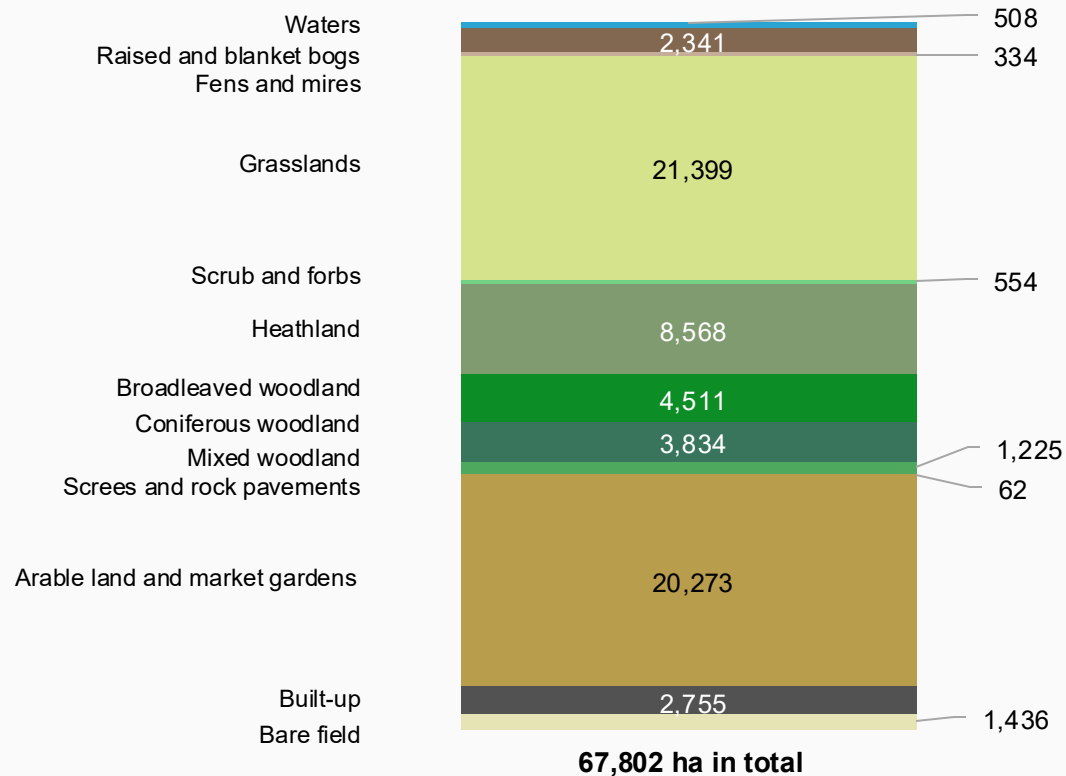
04

Baseline: Isla sub-catchment is mainly covered by grassland, crops and gardens

Farming is a significant land use in the sub-catchment – circa 30% is classified as arable use alone.
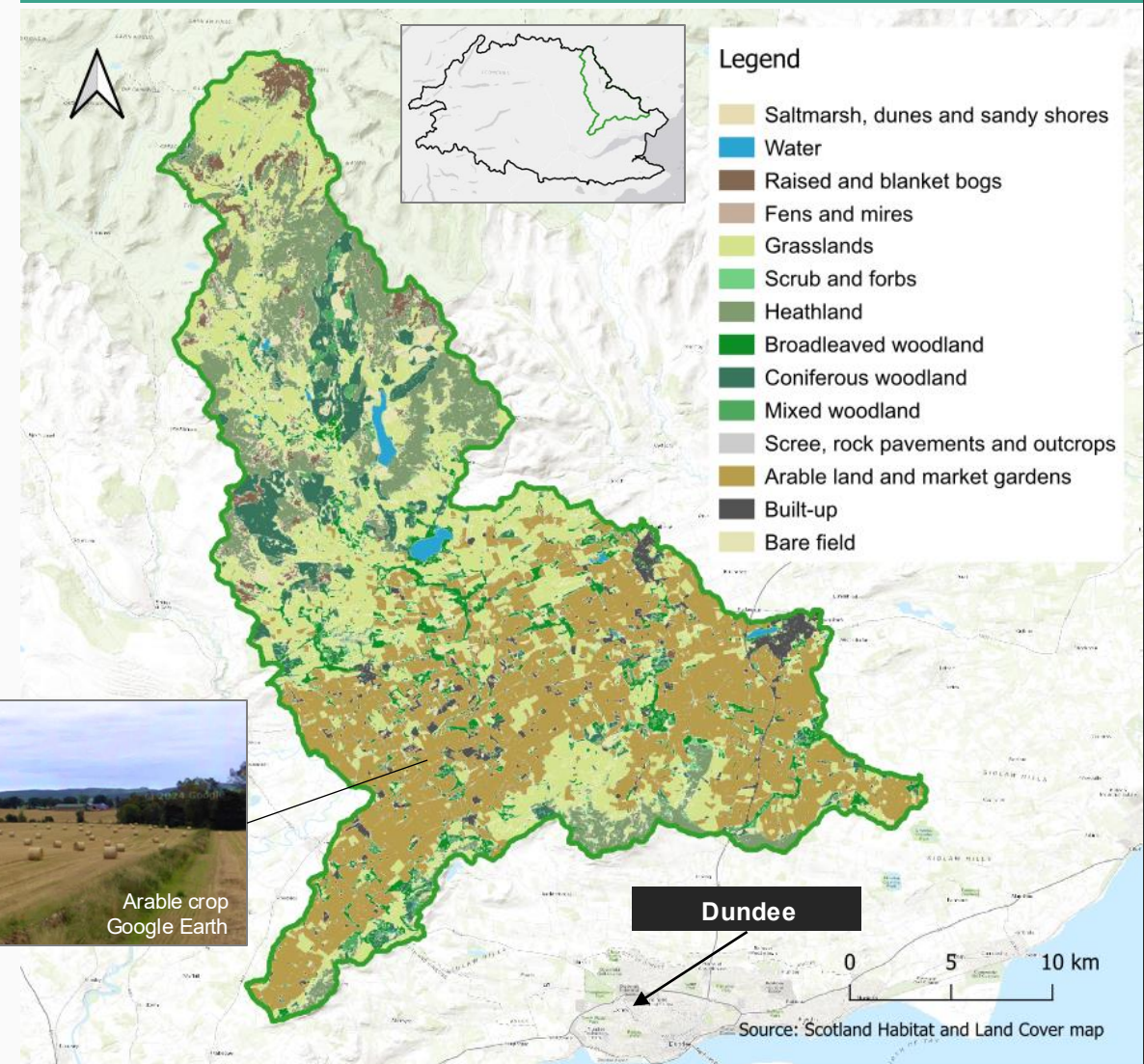
Land cover and habitats

The Isla sub-catchment, the smallest of the three profiled, is located in the east of the Tay region and covers nearly 68,000 hectares. It features diverse land cover, with heathland in the northern region and productive farmland for crops, fruits and vegetables in the south. Together with grassland, these areas make up over 60% of the sub-catchment; this presents potential for the integration of additional natural habitats.

Distribution of land and cover by habitat (ha)

Habitat	ha
Waters	508
Raised and blanket bogs	2,341
Fens and mires	334
Grasslands	21,399
Scrub and forbs	554
Heathland	8,568
Broadleaved woodland	4,511
Coniferous woodland	3,834
Mixed woodland	1,225
Screes and rock pavements	62
Arable land and market gardens	20,273
Built-up	2,755
Bare field	1,436

67,802 ha in total

Baseline: Current habitats in the Isla sub-catchment

Legend
- Saltmarsh, dunes and sandy shores
- Water
- Raised and blanket bogs
- Fens and mires
- Grasslands
- Scrub and forbs
- Heathland
- Broadleaved woodland
- Coniferous woodland
- Mixed woodland
- Scree, rock pavements and outcrops
- Arable land and market gardens
- Built-up
- Bare field

Arable crop
Google Earth

Dundee

0   5   10 km

Source: Scotland Habitat and Land Cover map

Constraints to woodland creation: Land that is either unsuitable or less suited to woodland creation was identified, based on sensitivity constraints and eligibility criteria for woodland carbon credit accreditation

Bioregioning Tayside

Narrowing down areas of woodland creation opportunity

The woodland opportunity area was determined by narrowing down the total site to the area that did not fall under any of the following constraints:

– **Eligibility constraints:** Areas with cultural designations (e.g. scheduled monuments), growing forests; area planned for forest; area that underwent tree felling in the past 25 years; areas of deep peat and peatland to protect key biodiversity and carbon stocks; and habitat that cannot support woodland creation (water, scree slopes, etc)

– **Sensitivity constraints:** Areas where woodland creation is less likely to be suitable and therefore excluded from the initial wide-scale assessment: areas of high altitude (above 450m), and land most suited for arable cropping.

Together, the eligibility and sensitivity constraints to woodland creation **cover 42,217 hectares.**

Note: Land with existing sensitivities and eligibility constraints means woodland planting is either not appropriate or may require special measures or further data gathering to ensure it is suitable for the location. This woodland opportunity mapping has been undertaken in line with the **UK Forestry Standard guidance** and **Woodland Carbon Code** eligibility criteria for woodland creation

Sources: Ordonnance Survey UK (2023); NatureScot (2022); Historic Environment Scotland (2023); UK Forestry (2022); Scottish Forestry (2022); FGS woodland creation claim (2023); James Hutton Institute (1987)

Constraints: Key constraint areas for woodland creation

Legend
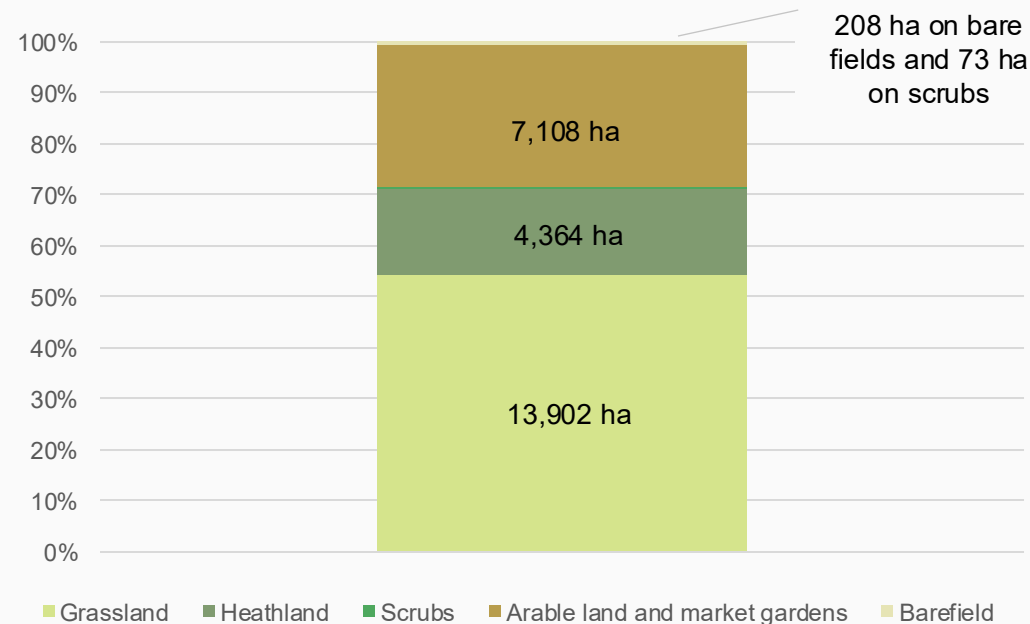- Eligibility constraints
- Sensitivity constraints
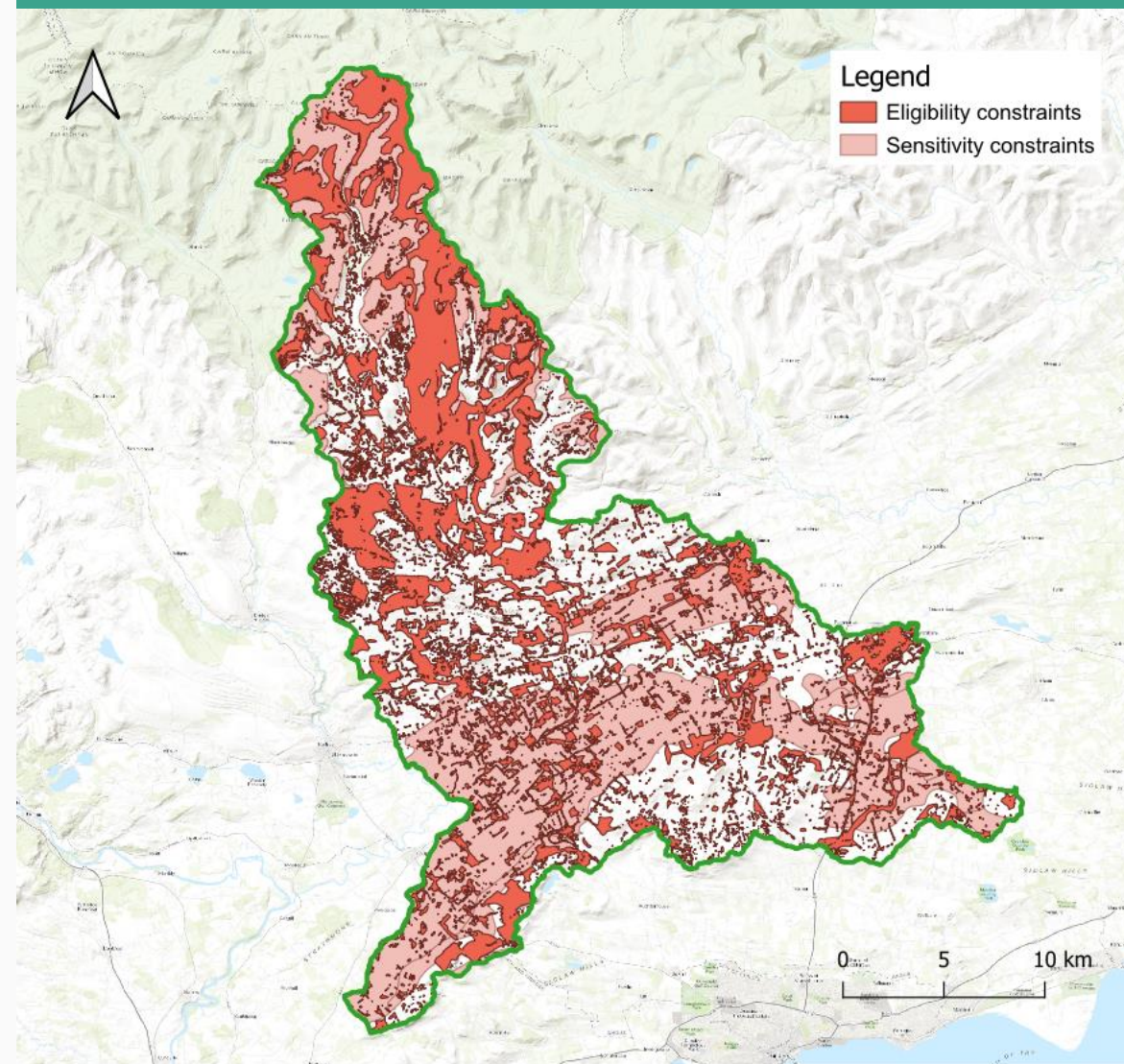
Opportunity for woodland creation: We estimate that a maximum of 25,000 hectares of new broadleaf woodland could be created in the Isla sub-catchment
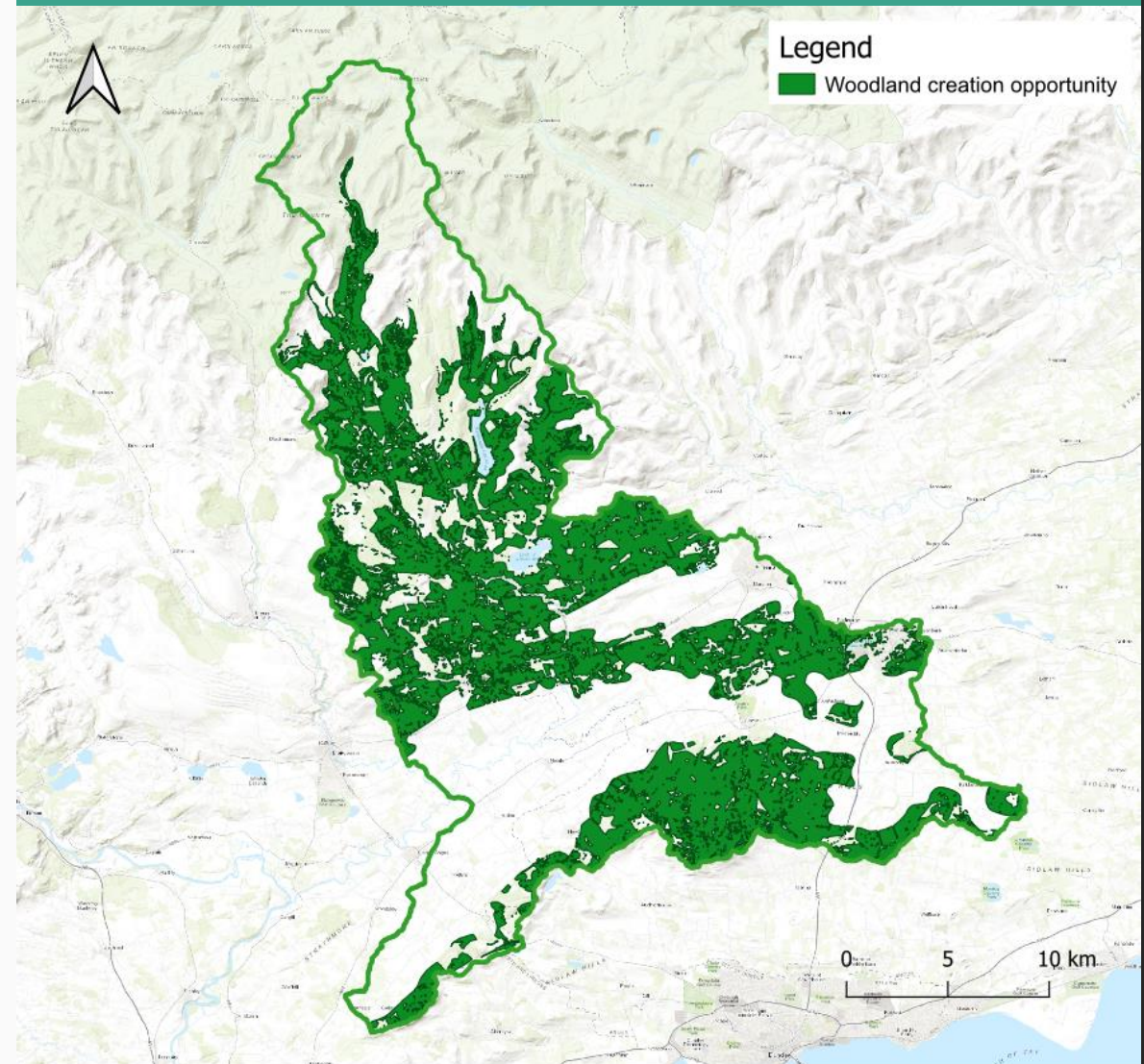
Bioregioning Tayside

Woodland opportunity area

- After accounting for the constraints, **25,585 hectares** present scope for woodland creation within the Isla sub-catchment.

- Over half of the proposed new woodland can be established on existing grassland; circa 30% on agricultural land with mapped non-high productive soil and over 17% on heathland.

Distribution of the existing habitats that can be converted to woodland (in hectares)

208 ha on bare fields and 73 ha on scrubs

7,108 ha

4,364 ha

13,902 ha

Legend: Grassland · Heathland · Scrubs · Arable land and market gardens · Barefield

Woodland opportunity: Map of woodland creation potential

Legend
- Woodland creation opportunity

0   5   10 km

Opportunity for woodland creation: A north facing view of the maximum woodland creation opportunity in the Isla sub-catchment
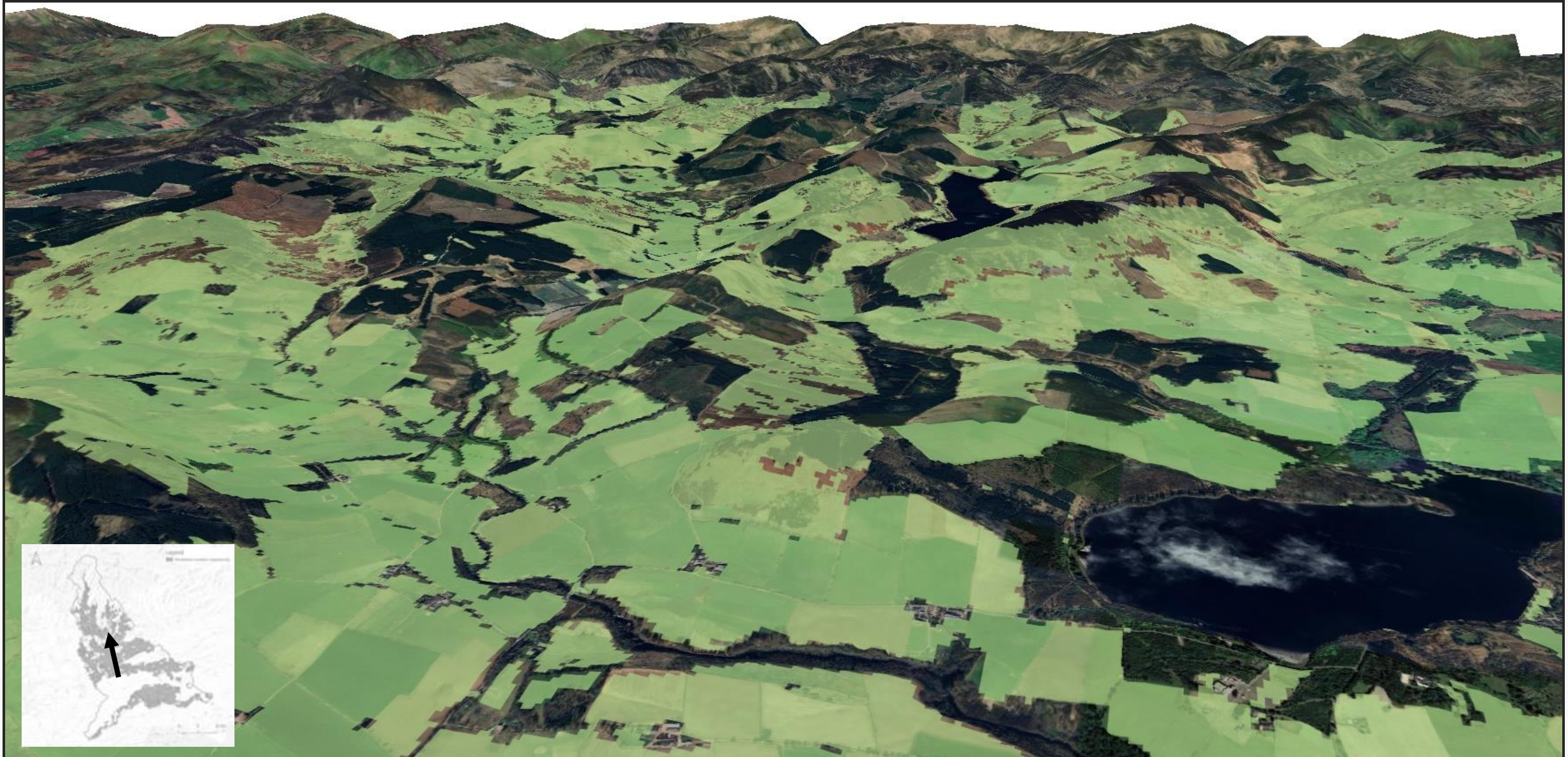
Opportunity for peatland restoration: There are approximately 3,100 hectares of deep peat with the potential need to be restored in the Isla sub-catchment.

Bioregioning Tayside

Opportunity to restore damaged peatland

- There is an estimated **3,162 hectares** of deep peat in the Isla sub-catchment, of which:
    - 1,737 ha within Class 1 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value
    - 1,425 within Class 2 - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas of potentially high conservation value and restoration potential

- The full extent and condition of the deep peat is not currently recorded in publicly available data or mapping.

- To obtain this information, comprehensive on-site surveys will need to be conducted across each of the sub-areas.

- If peatlands are degraded with evidence of added drainage, signs of erosion, or the formation of gullies, they are in need of restoration. Restoration efforts can significantly reduce the carbon emissions that are emitted from damaged habitats.

- When peatlands are restored, they can also help retain water, improve overall water quality, and support a wide variety of species.

Source: James Hutton Institute (1987), Carbon and peatland 2016 map

Peatland opportunity: Areas classified as peatland and/or as peat

Legend
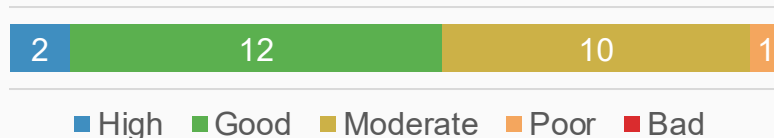Areas of peat

0   5   10 km
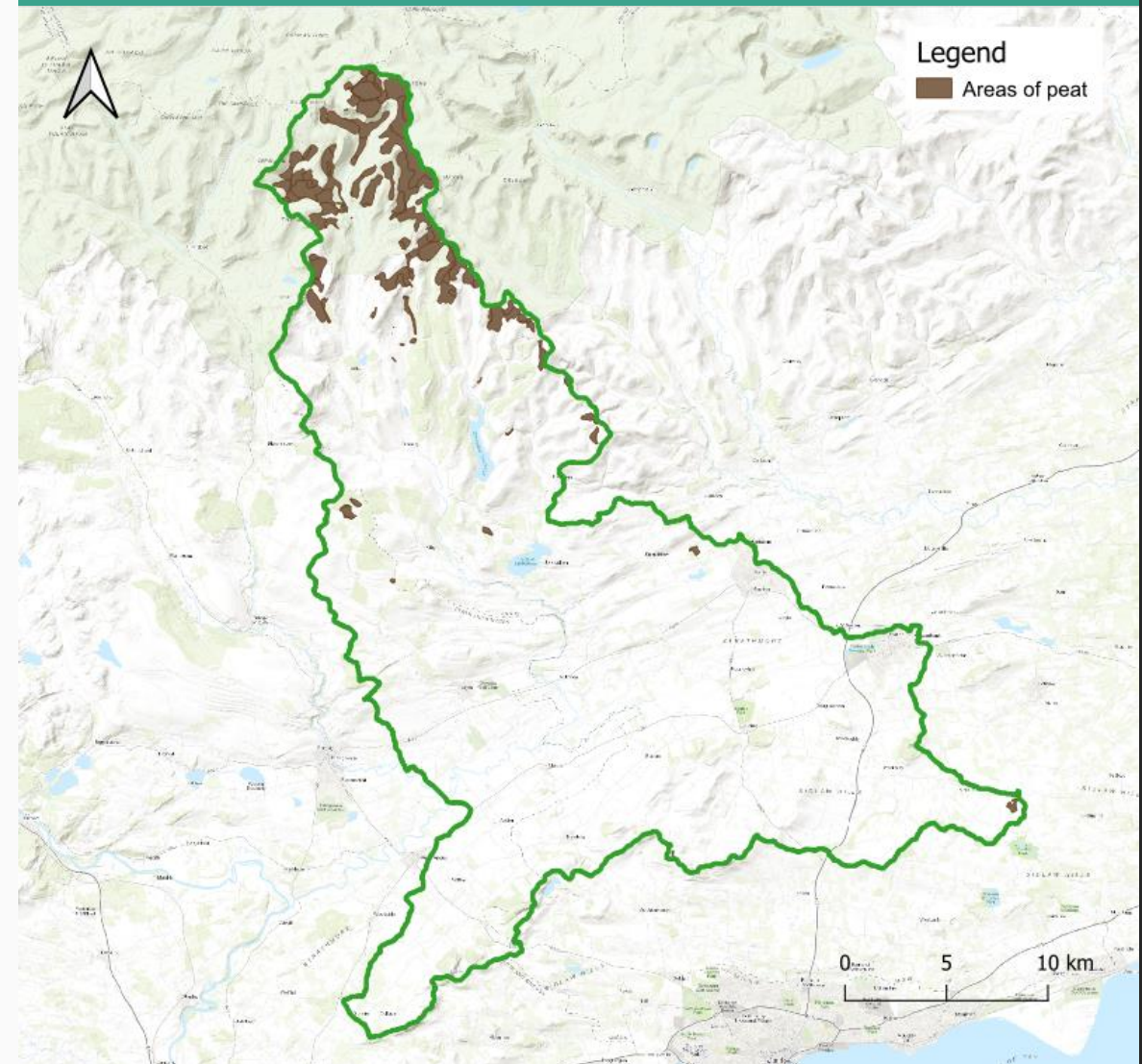
Water quality: Of the 25 rivers and canals in the Isla sub-catchment, 24 are classified as being of 'Moderate' or higher in quality by SEPA

Overall water quality classification

- The water quality in this sub-catchment is broadly of good quality.
- 1 of the sub-catchment's waterbodies is classified as Poor – this is due to <u>historical physical alterations</u> impacting the overall <u>hydrology.</u>

Classification distribution of the rivers and canals:

| 2	12	10	1

■ High ■ Good ■ Moderate ■ Poor ■ Bad

- The hydrological and ecological condition of the rivers and canals might be improved as a result of surrounding habitat restoration but present very limited opportunities of direct financing.

- The existing mechanisms to finance water quality improvement are mainly around offsetting phosphate and nitrate levels. Both nutrients currently present low levels of risk for all water bodies (see Water Classification Hub)

Source: Scottish Environment Protection Agency (SEPA)
SEPA is the lead agency for the River Basin Management Planning (RBMP) in Scotland that delivers water frameworks including the monitoring the water environment by assessing water quality and quantity. Scotland water quality data is accessible on the Water Classification Hub.

Map of the overall water quality in the Isla sub-catchment

Legend
River quality classification
— High
— Good
— Moderate
— Poor
— Bad
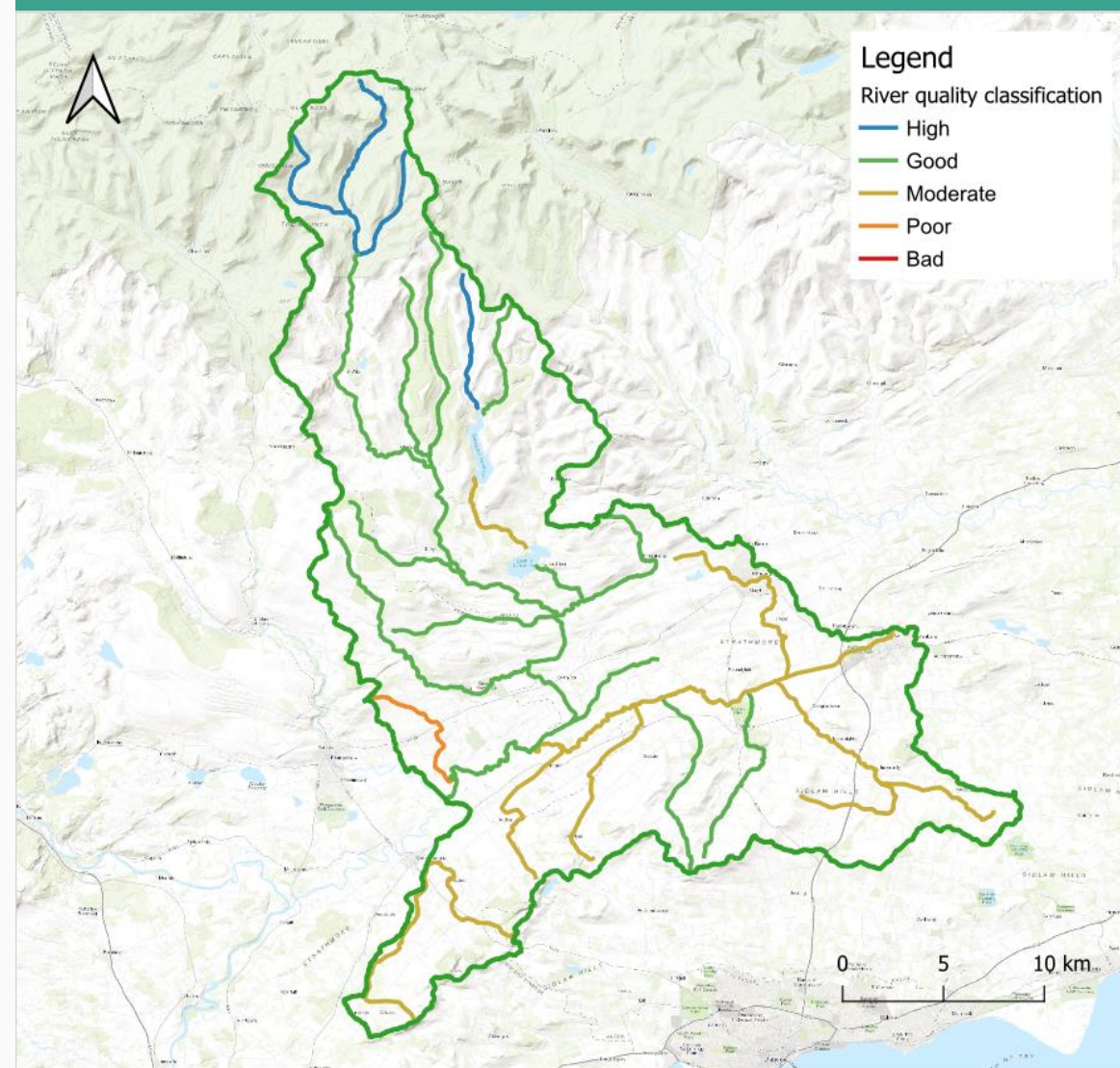
Natural Flood Management: A total area of 3,582 hectares, representing circa 5% of the sub-catchment, is at risk of flooding every 10 years
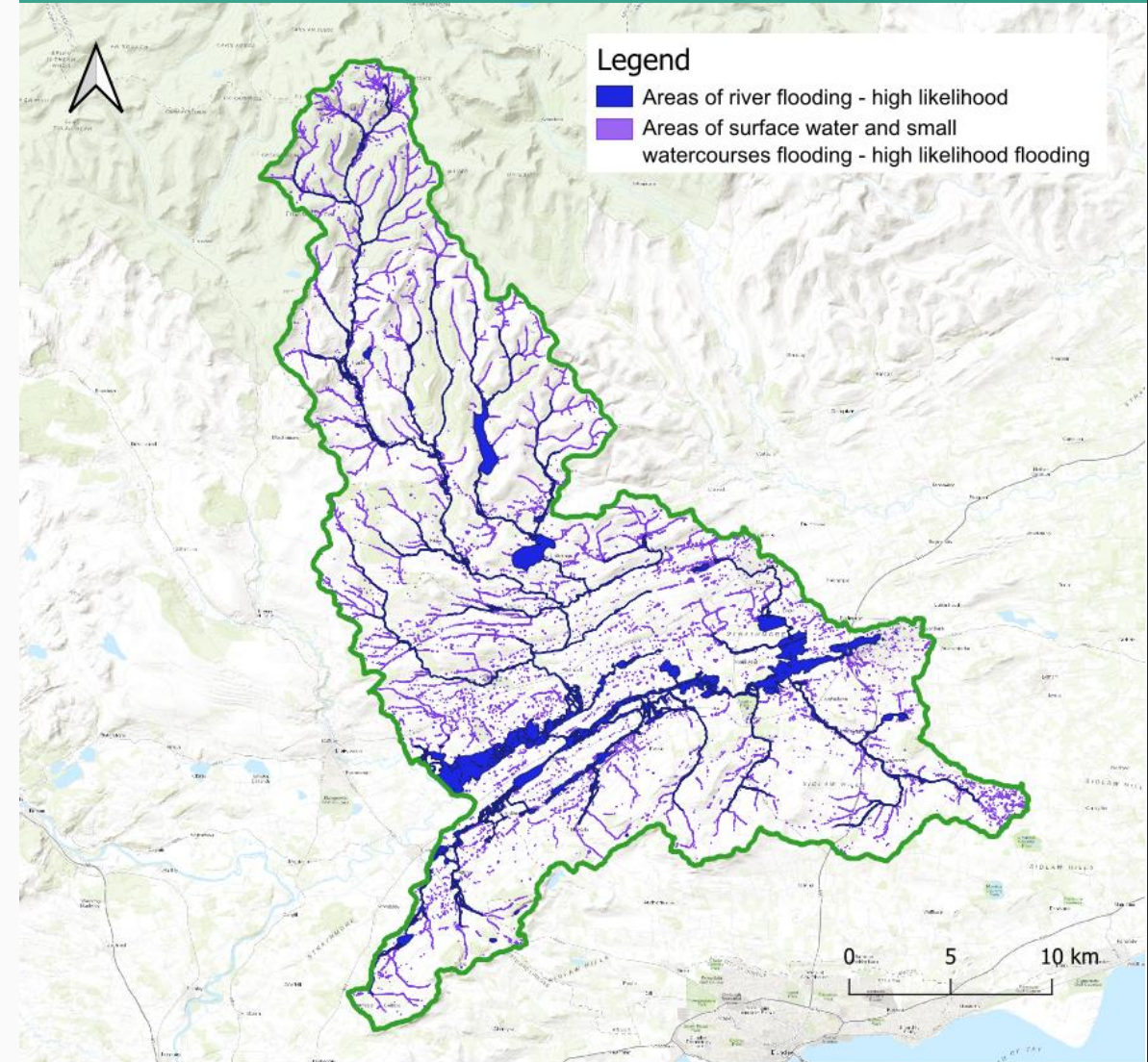
Opportunity for Natural Flood Management (NFM)

- The adjacent map shows areas with a 10% risk of flooding rated by SEPA, indicating the highest rated likelihood of flood risk from either a river or surface water.

- This means that the identified areas have an average probability of flooding once every 10 years.

- In the Isla sub-catchment, there is an estimated **3,582 hectares** that flood on average every 10 years.

- n areas where engineered flood control methods are not economically viable, NFM presents a alternate solution for mitigating flood risks at the catchment scale.

- Creating woodlands and restoring degraded peatlands can help reduce soil runoff, increase floodplain storage and manage sediments more effectively.

- The success of NFM projects depends significantly on the catchment's topography and land use, as well as the number of people and properties at risk from flooding. This should be mapped and assessed accordingly.

Source: SEPA 2023. This SEPA product is licensed under the Open Government Licence version 3.0.

The river climate change scenario has been defined by the United Kingdom Climate Projection 2009 (UKCP09) predictions for 2080s high emissions 67th percentile.

Map of the areas with a high likelihood of flooding in the Isla sub-catchment

Legend
- Areas of river flooding - high likelihood
- Areas of surface water and small watercourses flooding - high likelihood flooding
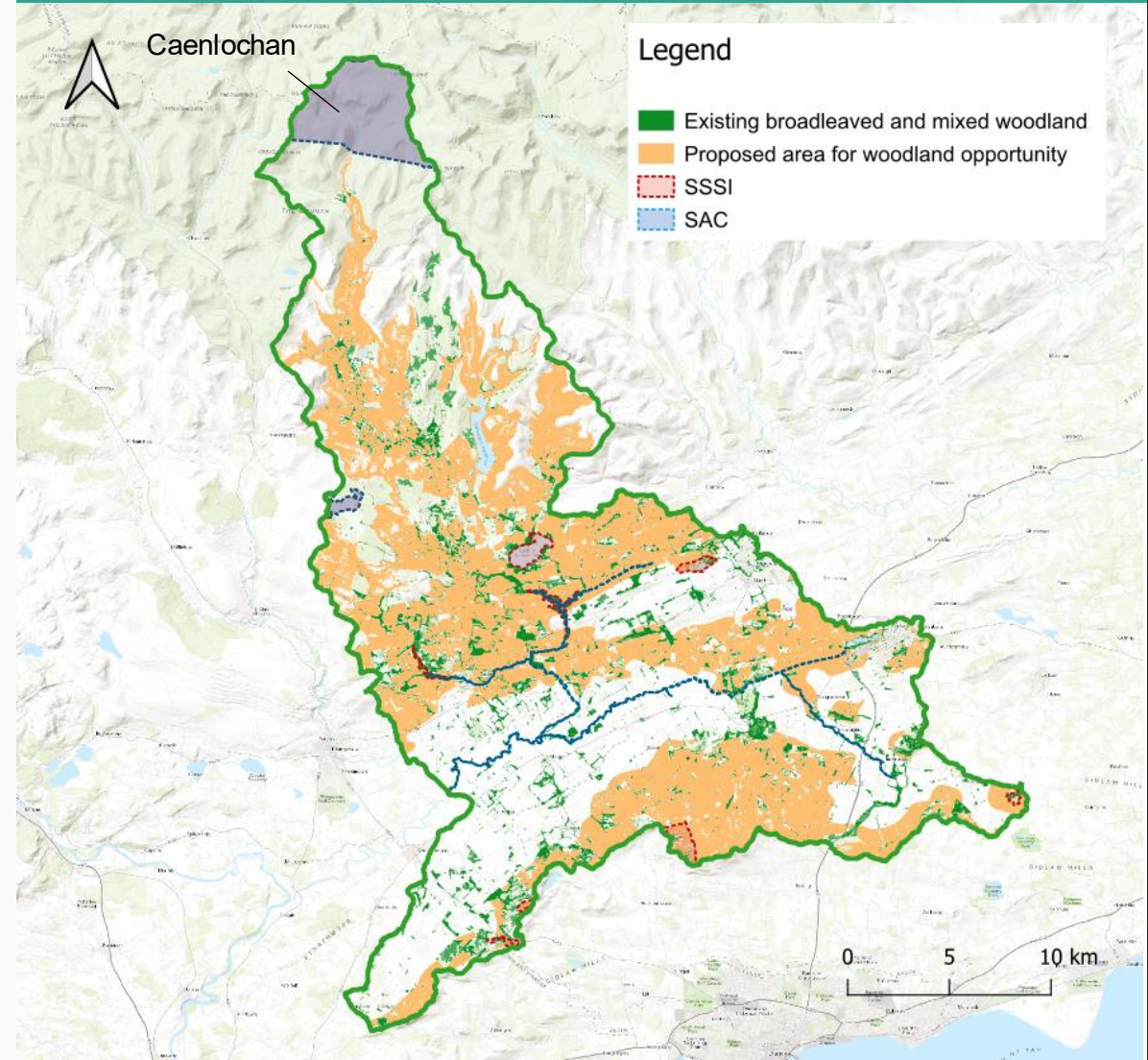
0   5   10 km

Biodiversity: Expanding native woodland will boost connectivity, biodiversity, and enhance the condition of sites designated for their environmental importance

Bioregioning Tayside

Increase in connectivity potential

- There are currently 5.7k hectares of existing broadleaved and mixed woodland in the Isla sub-catchment, and an **opportunity to increase this footprint by over 4 times without impacting the most productive agricultural land in the valley of the catchment.**

- Isla hosts areas designated for their biodiversity importance. A notable one is Caenlochan, characterised mainly by its subalpine dry heath.

- The site encompasses an extensive area of upland plateau, corries and glens at the southernmost extent of the Cairngorm mountain massif. The site is of importance for its variety of upland habitats and vegetation, its rare invertebrate and plant species and its breeding bird populations

- Species diversity and abundance will be supported by an increase in in-tact, locally suitable woodland habitat. Careful planning of woodland design and distribution will help to create habitat corridors between disconnected patches of existing woods.

Map of the opportunity for woodland expansion in relation to designated sites

Caenlochan

Legend

Existing broadleaved and mixed woodland
Proposed area for woodland opportunity
SSSI
SAC

0   5   10 km

Biodiversity: Up to 2,200 hectares of native riparian woodland could enhance landscape connectivity and protect and support healthy aquatic ecosystems

There is the opportunity to enhance biodiversity in the area by increasing the connectivity between fragmented woodland habitats

- Of the 25.5k hectares of potential woodland creation, there is the opportunity to establish up to **2,200 hectares** of riparian woodland within a 100-metre buffer zone from an existing river or canal.

- This is the equivalent of 8% of the maximum woodland creation potential in the area.

- These wooded corridors shade waterways, helping to regulate water temperature, which is important for aquatic organisms.

- Riparian woodlands also improve water quality by reducing runoff from nearby farmed land and filtering pollutants, benefiting a wide range of wildlife.

Map of the opportunity for riparian woodland creation

Legend
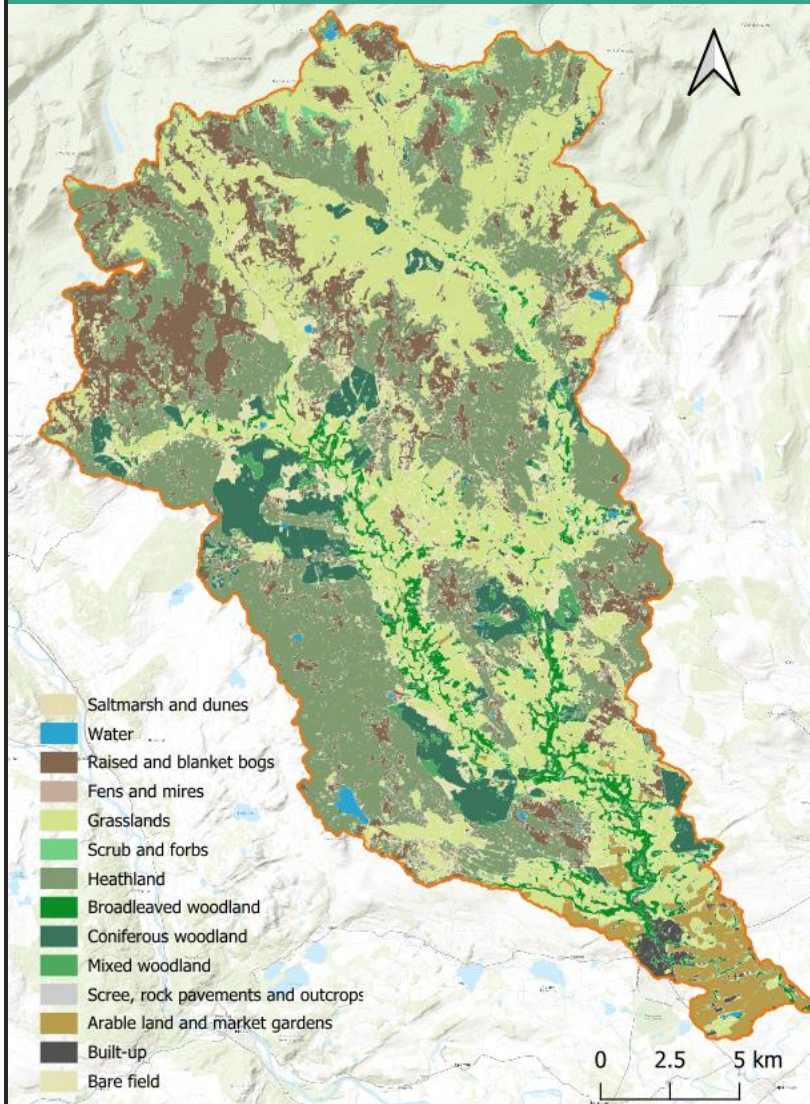Areas of potential riparian woodland creation

0   5   10 km
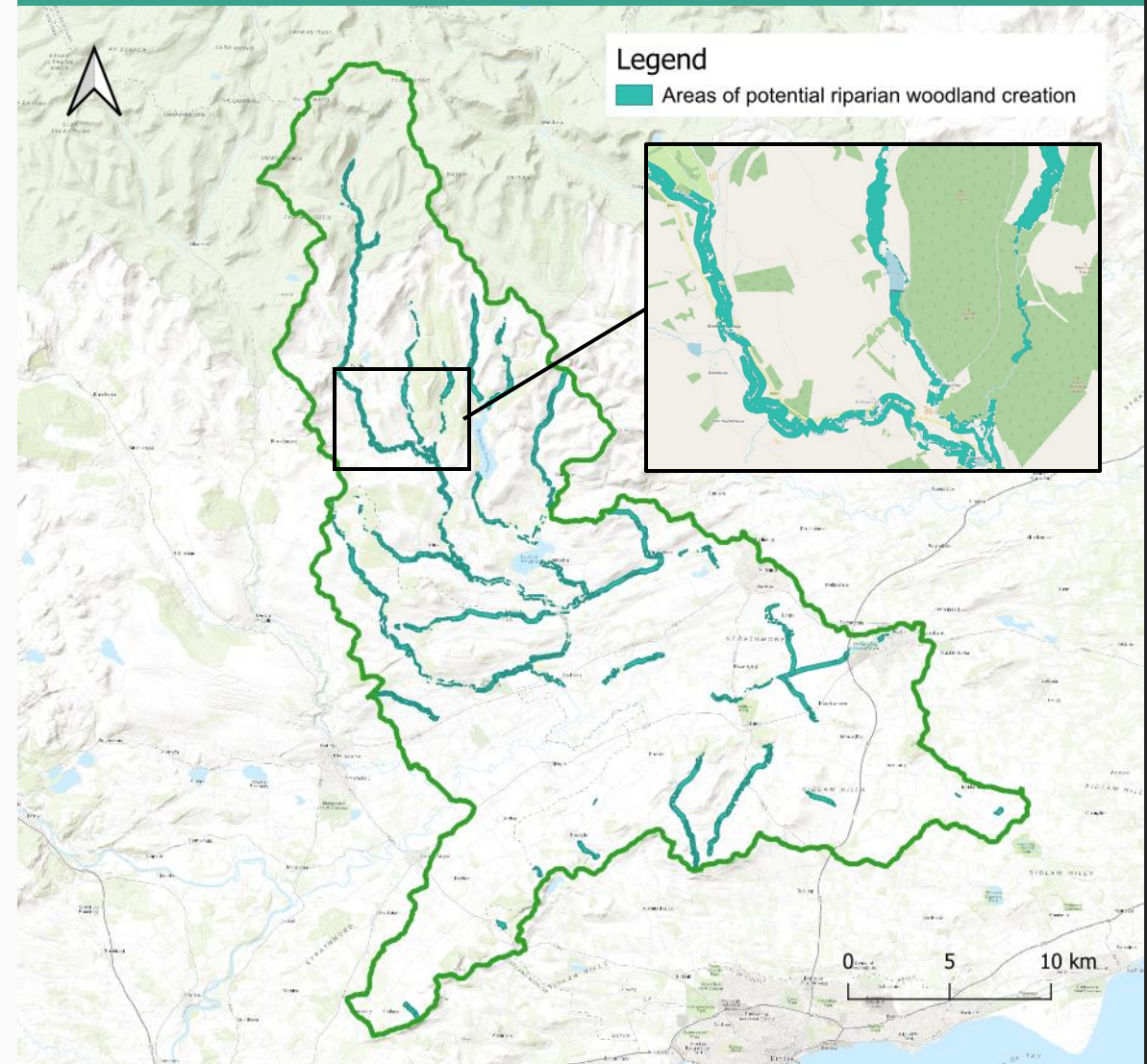
Overview of the nature restoration opportunities in Ericht sub-catchment
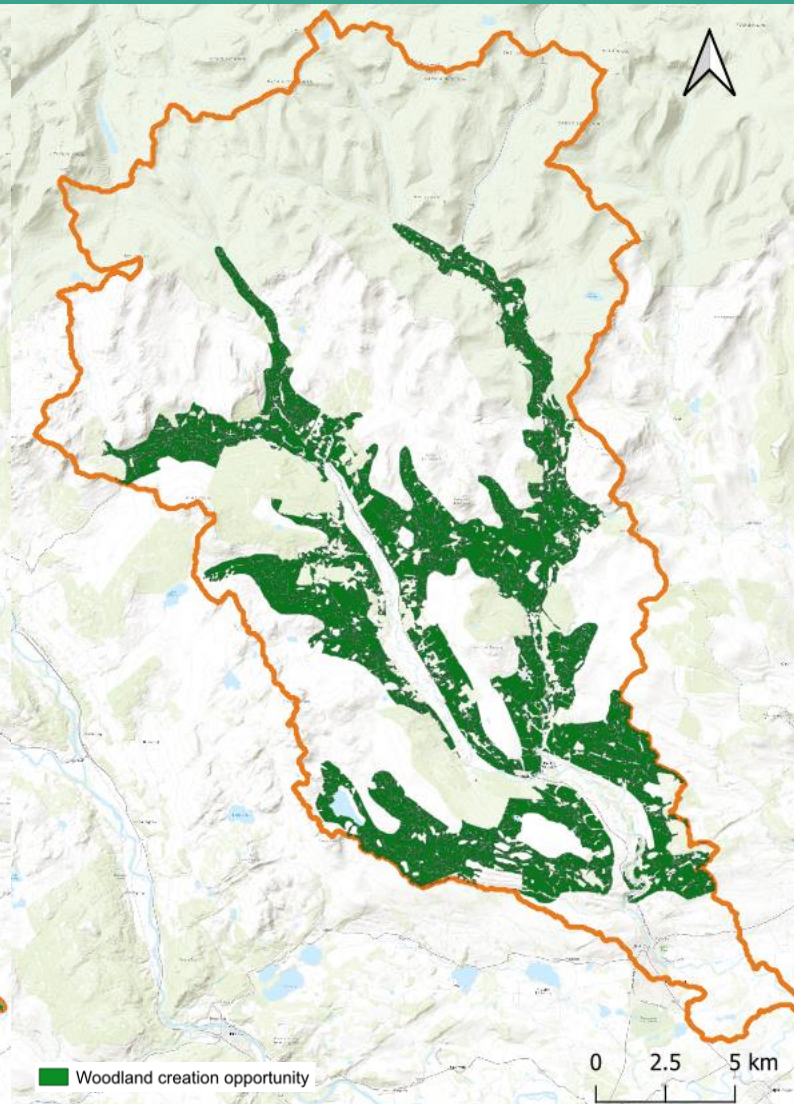
05

Ericht sub-catchment: There is a total of over 17k hectares of nature restoration.

There are approximately 9,900ha of woodland creation potential and 7,200 hectares of deep peat with the potential to be restored. See this link.
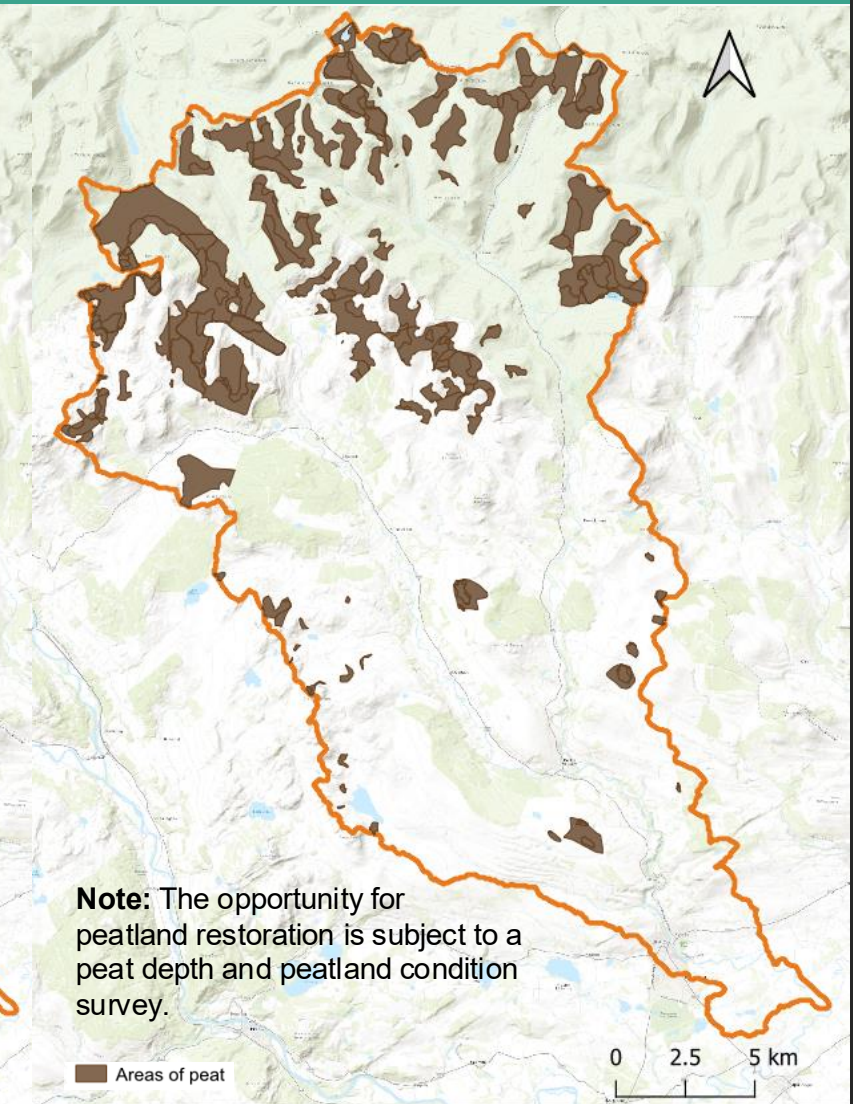
Bioregioning Tayside

Baseline: Current habitats

Legend:
- Saltmarsh and dunes
- Water
- Raised and blanket bogs
- Fens and mires
- Grasslands
- Scrub and forbs
- Heathland
- Broadleaved woodland
- Coniferous woodland
- Mixed woodland
- Scree, rock pavements and outcrops
- Arable land and market gardens
- Built-up
- Bare field

0   2.5   5 km

Woodland creation opportunity

Woodland creation opportunity

0   2.5   5 km

Presence of deep peat

Note: The opportunity for peatland restoration is subject to a peat depth and peatland condition survey.

Areas of peat

0   2.5   5 km

Summary of nature restoration opportunities

06

Summary: Woodland creation and peatland restoration are the main opportunities for nature restoration across the studied areas

|	Total area	Woodland creation	Potential peatland restoration*	Water quality	Natural Flood Management	Biodiversity uplift via the creation of riparian corridors
Dochart and Lyon	118,196 ha	23,515 ha Equ. to 20% of the area	26,992 ha Equ. to 23% of the area	16% of waterbodies require enhancement	4,597 ha Equ. to 4% of the area	2,160 ha Equ. to 2% of the area
Earn	97,520 ha	36,060 ha Equ. to 37% of the area	11,036 ha Equ. to 11% of the area	3% of waterbodies require enhancement	1,233 ha Equ. to 1% of the area	2,380 ha Equ. to 1% of the area
Isla	67,802 ha	25,585 ha Equ. to 38% of the area	3,162 ha Equ. to 5% of the area	4% of waterbodies require enhancement	3,582 ha Equ. to 5% of the area	2,200 ha Equ. to 3% of the area
Ericht	49,612 ha	9,913 ha Equ. to 20% of the area	8,238 ha Equ. to 17% of the area	5% of waterbodies require enhancement	Not mapped	Not mapped

- **Woodland creation**: Present the greatest potential for land use change, with 20% to 38% of the area available for reforestation across the three sub-catchments.

- **Peatland restoration**: The two western sub-catchments (Dochart & Lyon and Earn) present the best opportunity for peatland restoration.

- **Water quality:** A small number of rivers and canals in the three studied areas are classified as being in poor or bad condition. The main reason for this low classification is related to their hydrological and ecological status, which in some cases can be improved via woodland creation and peatland restoration interventions.

- **Natural Flood Management**: Flood issues affect between 1% and 5% of the three sub-catchments and can be mitigated by the expansion of woodland and the restoration of drained peatland.

- **Biodiversity:** The three sub-catchments hold a good potential to increase the biodiversity levels via land use change which will create ecological corridors and benefit adjacent sites such as those designated for their environmental features (SSSI and SAC) .

* The estimated area covers the potential area of deep peat. To know the extent of peatland restoration potential, on-site peat depth and peat condition surveys are required

Summary: The full restoration potential of the four sub-catchments presents an opportunity to restore 20% of the Tay Bioregion.

- A total of 95,073 hectares have been identified as eligible for **woodland creation** across the four sub-catchments.

- There is also a total area of **49,428 hectares of potential deep peat** identified, which, if degraded, can present an opportunity for restoration.

- A peat depth and condition survey will need to be conducted across each of the sub-areas to assess the full potential for peatland restoration.

- Together, the maximum area for woodland creation and peatland restoration across the four studied areas cover **144,500 hectares**, equivalent to 20% of the entire Tay Bioregion.

Map of the woodland creation opportunities and peatland location.

Ericht

Isla

Dochart and Lyon

Earn

0   10   20 km

Woodland creation opportunity
Areas of peat
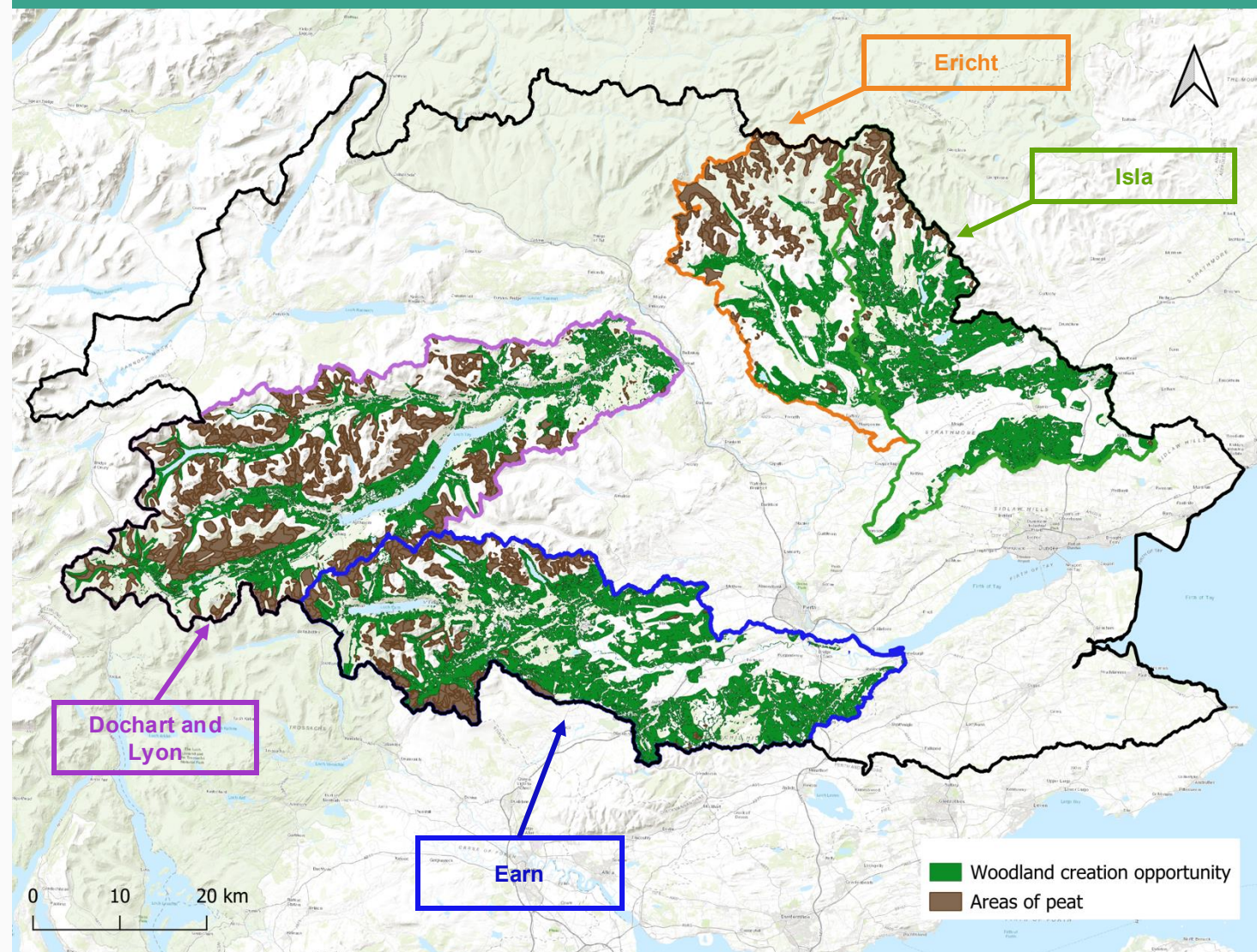
Addendum

- **Woodland creation:** Whilst constraint is set at 450m, montane woodland and scrub could probably recover to almost any elevation in Scotland. Further investigation of this in the Bioregion could reveal more elevated land that could offer restoration potential.
- **Species Rich Grassland:** In order to recover and restore this important habitat and ensure it is not converted to forestry/farm woodland, more work needs to be done on collating SRG data.
- The impact of **historic hydromorphological modifications** that are contributing to poor water quality in some area of the Bioregion are not simple issues to resolve.
- It is important to note that ground-truthed **peatland opportunities** are generally significantly less than available datasets of mapped deep peat. We suggest being reserved about the peatland opportunity until surveying can reveal peat depth and quality
- **Natural Flood Management:** Further investigation is needed on distinguishing between wetland creation potential and areas which could benefit from flow moderation
- **Existing broadleaved/mixed woodland:** Further investigation is required to distinguish between Native Woodland Survey of Scotland (NWSS – open data set) and 'other'.
- Condition of existing woodland: P&KCT 2022 report states: *"It is obvious that six main woodland types (four of which are 'upland' types if you include native Pine) account for 82.9% of 29,109.87 hectares of native woodland, and that … grazing pressure seriously impacts 50.7% of these six key woodland types and moderately impacts 90.6% of them."* See Perthshire Nature Connections Partnership (page 12).
- **Condition of SSSIs**: It is worth noting that condition issues affect approximatley 50% of SSSIs
- **Biodiversity uplift opportunities:** Our intention is to develop this data set to reflect data that is emerging from Unitary Authorities' 30x30 Nature Networks research and Buglife's B-Lines work.
- **Riparian Corridor Improvement:** This includes all the following habitats: woodland, wetland, scrubland, ponds and meadow.