

6 Forests in mountainous landscapes

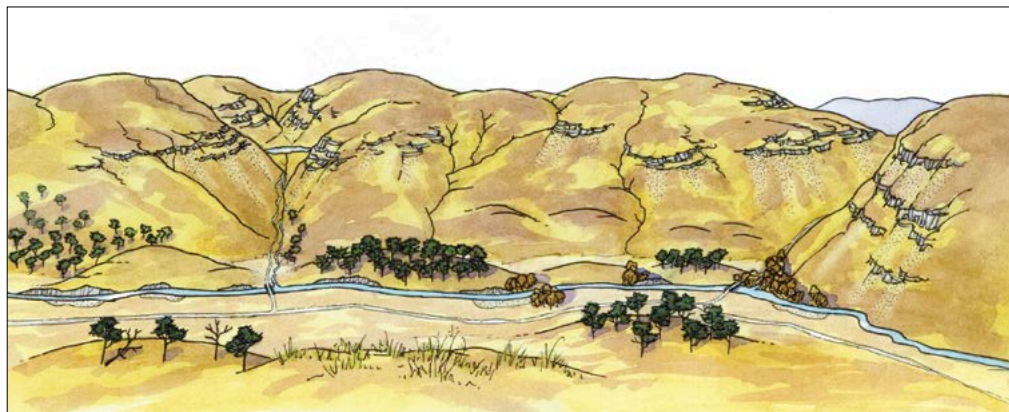
6.1 New native forest on a steep mountainside

This example is of a steep and rugged mountain of the type to be found in the Highlands of Scotland, where the slopes rise from a glaciated valley up to a rugged and rocky montane zone. This could be public land or a private estate. The objective includes growing timber using native conifers within a framework of non-productive native woodland which is concentrated in key areas. The montane land above the planting limit also has to be considered since the area has to be deer fenced. The landscape is highly sensitive, being in a National Scenic Area, and is popular for hiking and climbing as well as mountain biking. The views from high peaks over the area also increase its prominence. There are remnants of Caledonian pine stands which give some structure and also provide a seed source for natural regeneration. The design approach uses the National Vegetation Classification (NVC) to predict where different woodland types should be located and also recognises the presence of mires or deep peats which should be kept open.

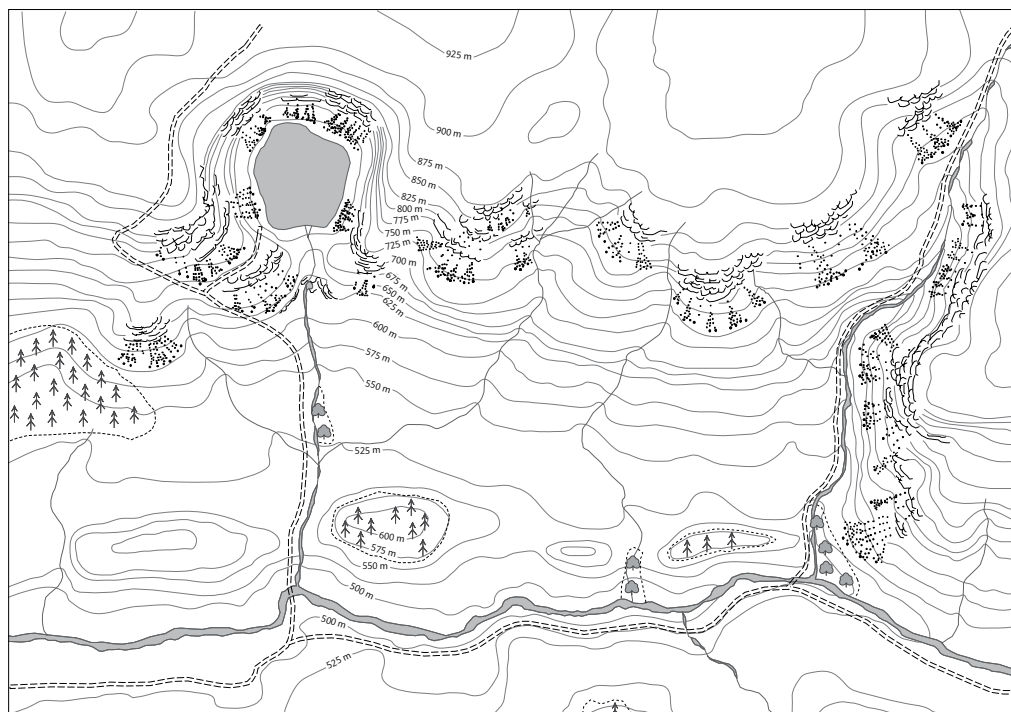
Objectives

Resource	Objective	Indicator of objective being met
Ecological restoration	To develop the full range of appropriate native woodland and other vegetation types across the landscape	The NVC-predicted woodland types to emerge over time
Timber	To produce as much timber as possible while also restoring the native forest	The forest, while developing into the appropriate native woodland types, will be managed so that good quality timber can be obtained from thinnings and regeneration fellings
Landscape	To reflect the character of the local landscape while allowing for the ecological aspects to be the main driver of the design	The ecological-driven design is modified to reflect the large-scale patterns visible in the landscape Scenic values to be maintained or enhanced
Biodiversity	To enhance the value of the forest for wildlife	A wide range of forest, mountain and other species of wildlife will flourish in the new forest
Historic environment	To protect sites of archaeological value	Known sites to be kept open and managed to prevent tree regeneration
Public access and recreation	To maintain the routes up and through the landscape	Right of way to be kept open and managed to enhance user experience
Water	To maintain or enhance water quality	Streams to be developed as riparian habitats in accordance with the NVC Wetlands and mires to be maintained with only a sparse tree cover

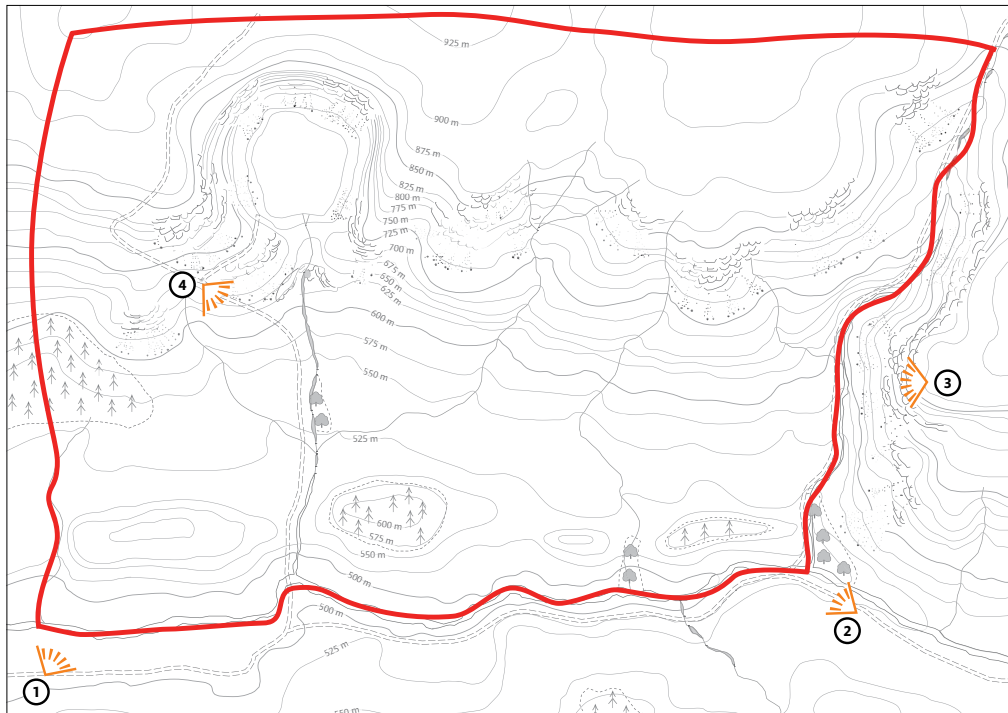
Base - perspective



Base - plan

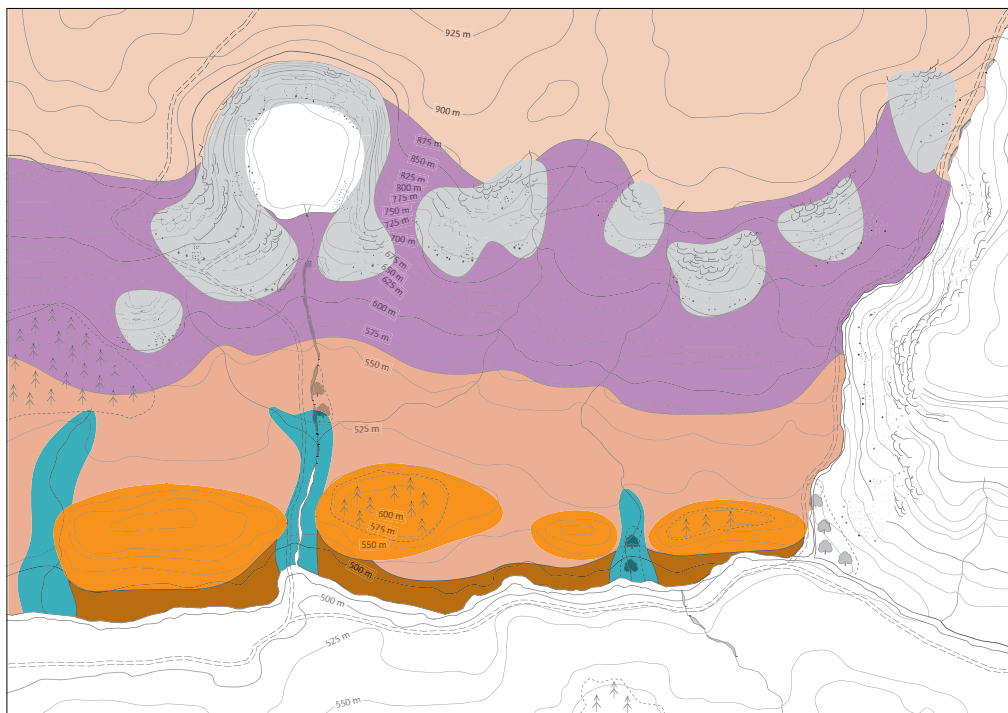


Location and viewpoints



- Boundary of proposed planting
- ① Agreed viewpoint
- Direction and angle of view

Soils

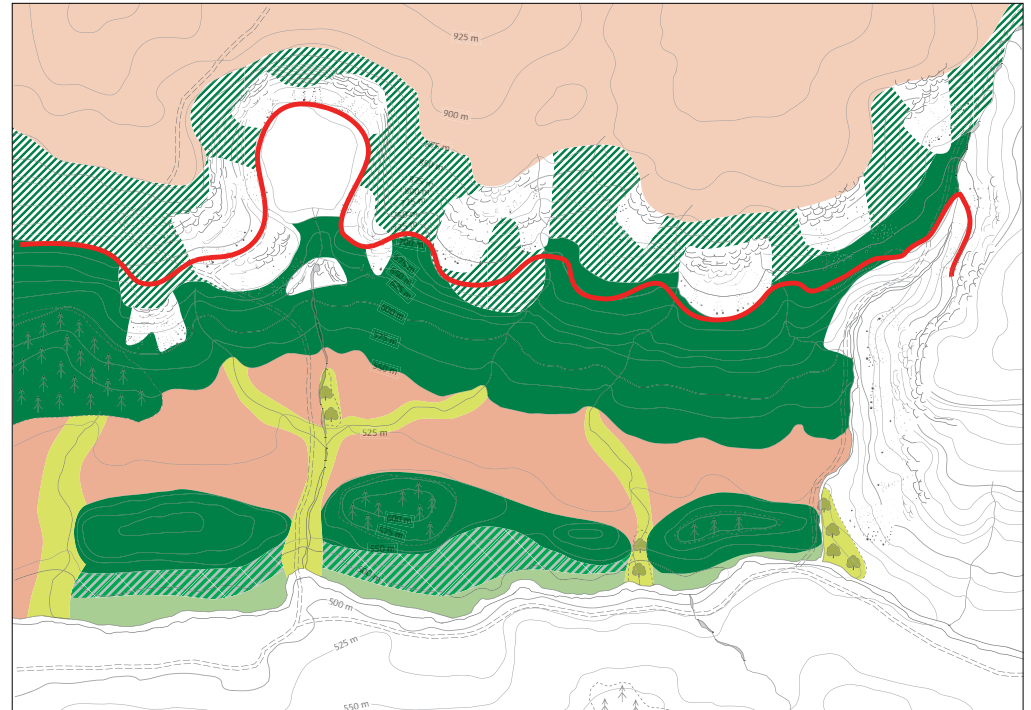


- Shallow and undifferentiated hill peat/wind-eroded hill peat
- Podetic rankers and skeletal soils, rock
- Flushed and unflushed peaty soils
- Open mire with areas of bog near watercourses
- Podzols and peaty podzols
- Brown earth forest soils, peaty podzols
- Surface water, gleys, peat

Geology is granite schists and quartzites, heavily eroded and overlaid by glacial moraine deposits and peat accumulation. Rocks outcrop on upper slopes and there are patches of scree.

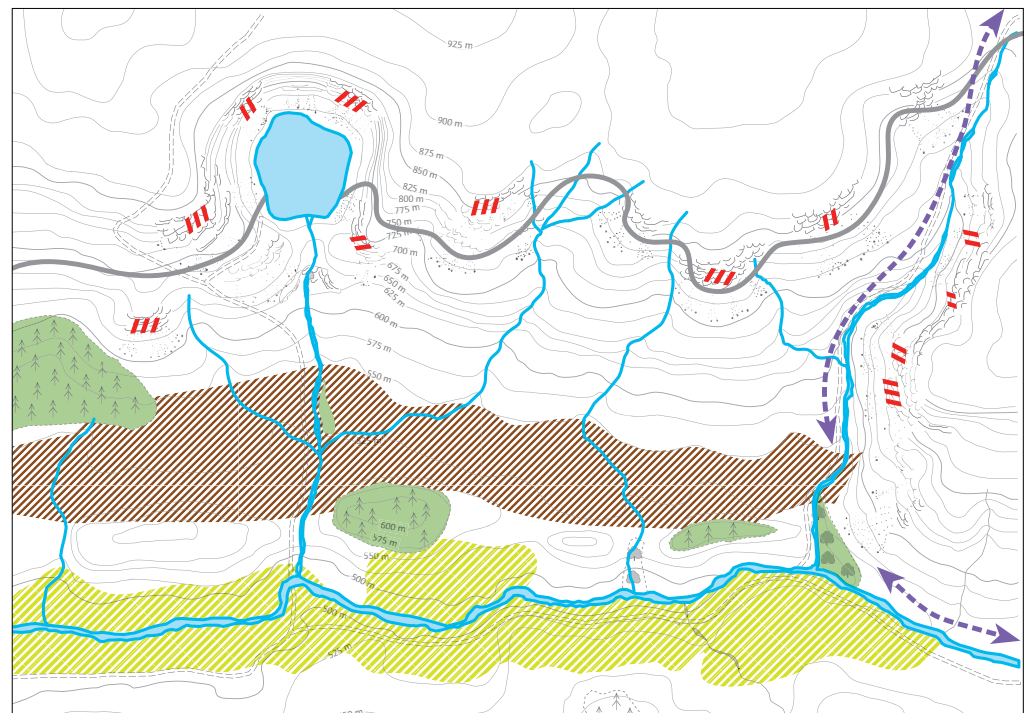
Ecological analysis

- Forest/montane zonal boundary
- No planting
- No planting on scree/rock
- W18 and 19 low density, fading out with elevation
- W18 Scots pine with birch (20%)
- Open mire with small pockets of Scots pine and birch
- W11/W18 mix
- W11
- W4/W7 (in wettest places)

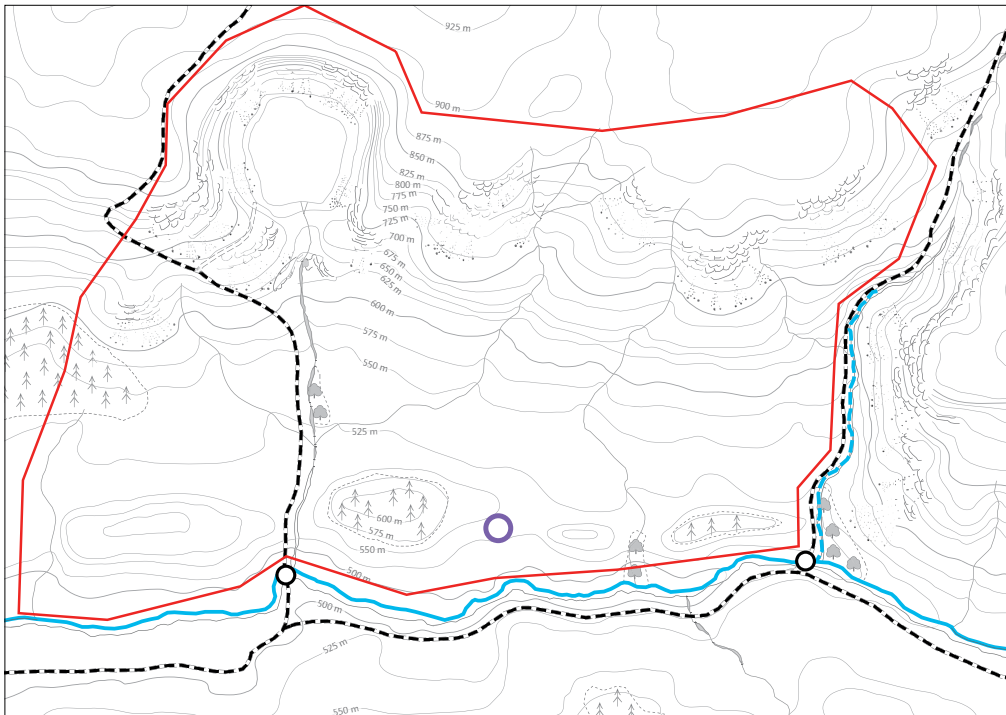


Hydrology and ecology

- Melt and rainwater-fed mountain tarn
- Remnant native woods, heavily grazed
- Mires, store and release water of low pH
- Deer overwintering areas, grazing problems from too many animals
- Stream/river watercourses
- Line above which snow lingers longest and feeds the streams
- > Main red deer movement
- /// Raptor nesting areas



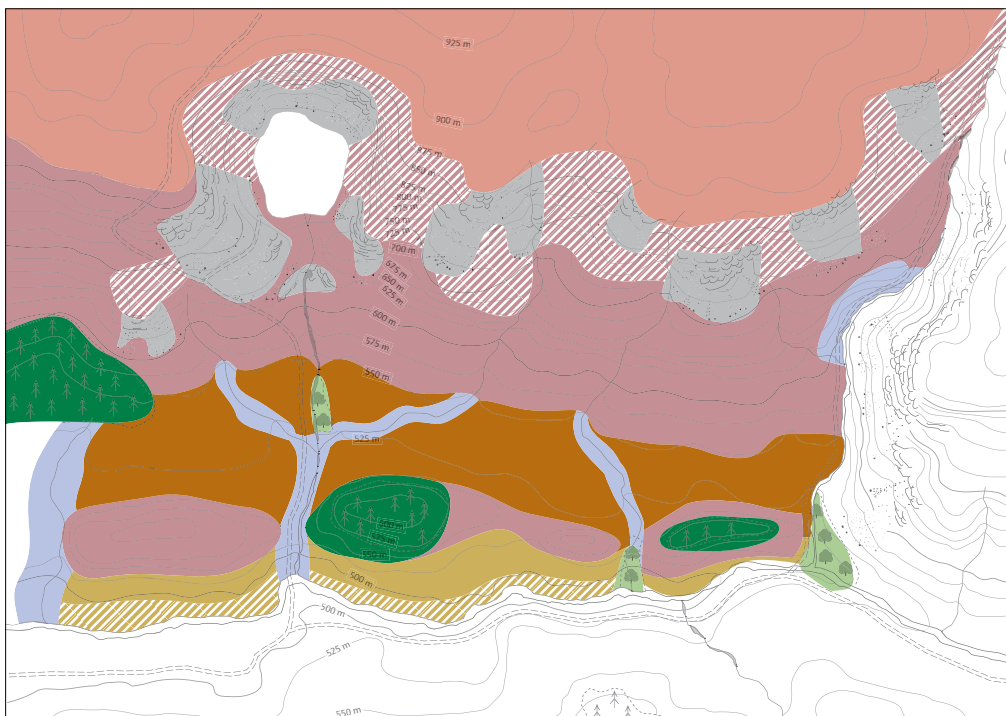
Access for recreation, sport and deer management



- Fording points
- Site of sheiling
- Estate tracks also used by the public for access to the glen and mountains
- Salmon and trout fishing
- - - Trout fishing
- Potential deer fence

Deer are stalked all over the area

National Vegetation Classification



- U7/U5 *Nardus stricta montane* grassland
- ▨ H18, blaeberry/*deschampsia* heath
- Rock, scree, H18
- H12 heather/blaeberry heath
- M18 raised and blanket mire/M19 blanket mire
- M6 *Carex*//*sphagnum* mire
- W18 Scots pine on *Calluna vulgaris*
- U4 *Festuca*/*Agrostis*/*Galium* grassland -H12 mosaic
- ▨ U4

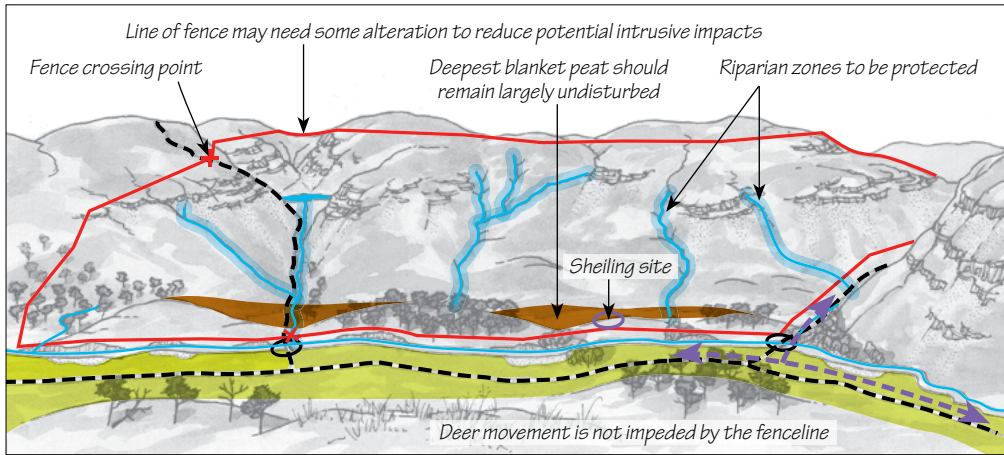
The survey in this project focuses on the soils and vegetation as these are the drivers of the ecological analysis and through this the design, which is constrained and modified to some extent by other factors. The special ecological analysis therefore has a role here which is much more significant than in any of the other examples. The constraints and opportunities analysis focuses on aspects such as the deer fence, deer movement outside it, water issues and access to the mountains.

Constraints and opportunities analysis

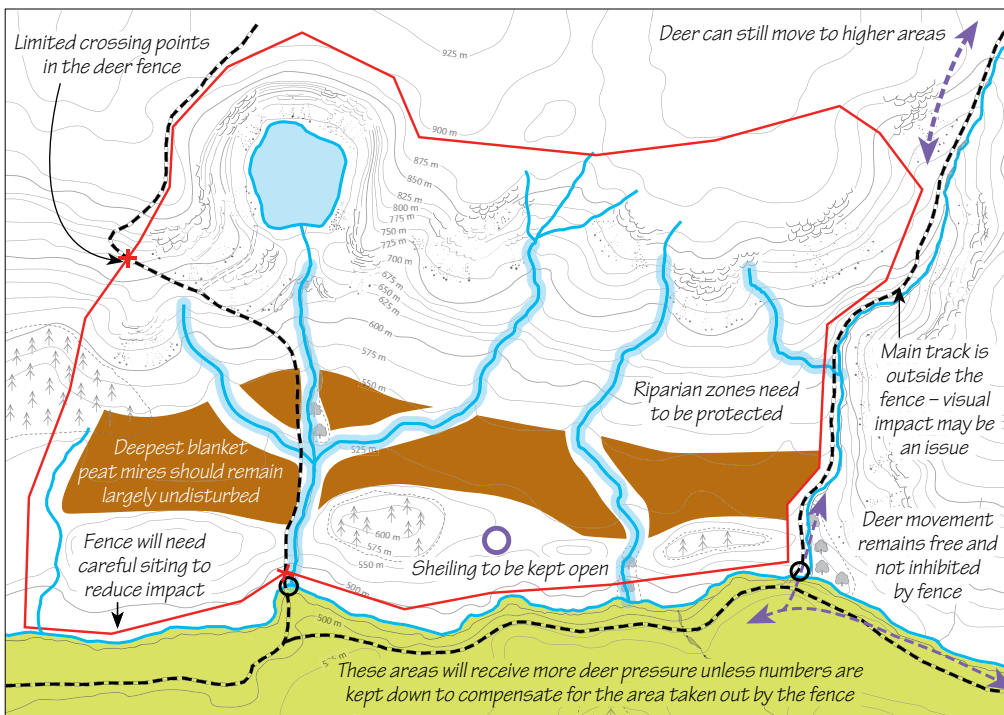
Factor	Constraint	Opportunity
Deer	It is necessary to maintain a fence in an expansive landscape where deer are wide ranging	To control numbers outside the fence to reduce overall pressure To site the fence so that it will neither disturb deer movement patterns nor look inappropriate in the landscape
Scenic quality	The scenic values are very high and some people may react negatively to open rugged landscapes being covered in forest	To present and celebrate the Caledonian forest as an integral part of the landscape since prehistory To communicate the forest's contribution to local landscape character
Accessibility	Access routes pass through the area and have to cross the deer fence	To align the fence to minimise crossing points To enhance the experience of using the routes when passing through the forest up to the mountains
Water	Watercourses throughout the site area are sensitive to land management change Salmonids need to be protected as part of the overall plan	To develop rich riparian habitats along the watercourses through the forest To ensure that all forest management operations do not affect water quality and associated habitats

There is no separate zoning strategy in this project because of the strongly ecologically driven approach. This determines the concept, which is based largely on the predicted NVC woodland types. The design follows and develops these patterns while ensuring that all the other factors are also taken into account. The visualisations are used to show the anticipated appearance of the new forest in the landscape. Owing to the presence of blanket peat on the lower slopes/flat valley floor there is a section of open ground between the forest on the moraines and the forest on the upper slopes. This could potentially present a layered effect but in practice, because of the screening effect of the moraines, this area is not seen from the main viewpoints.

Constraints and opportunities – perspective

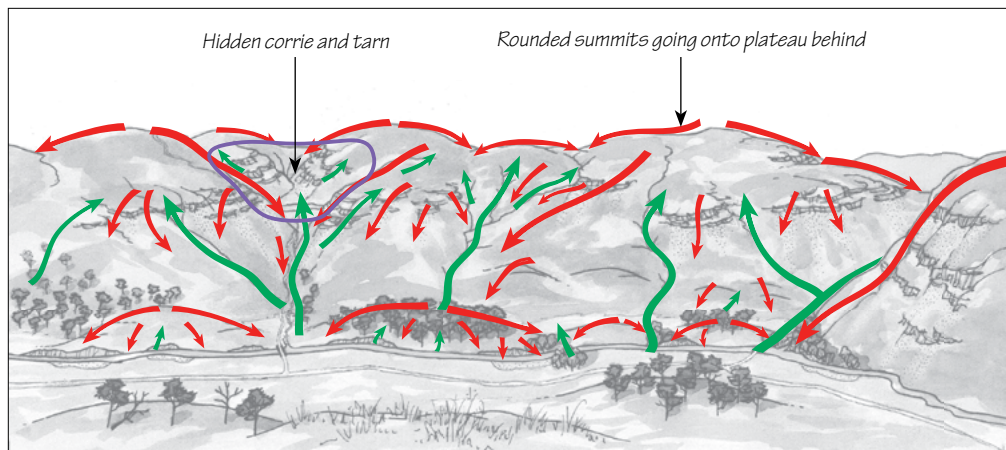


Constraints and opportunities – plan



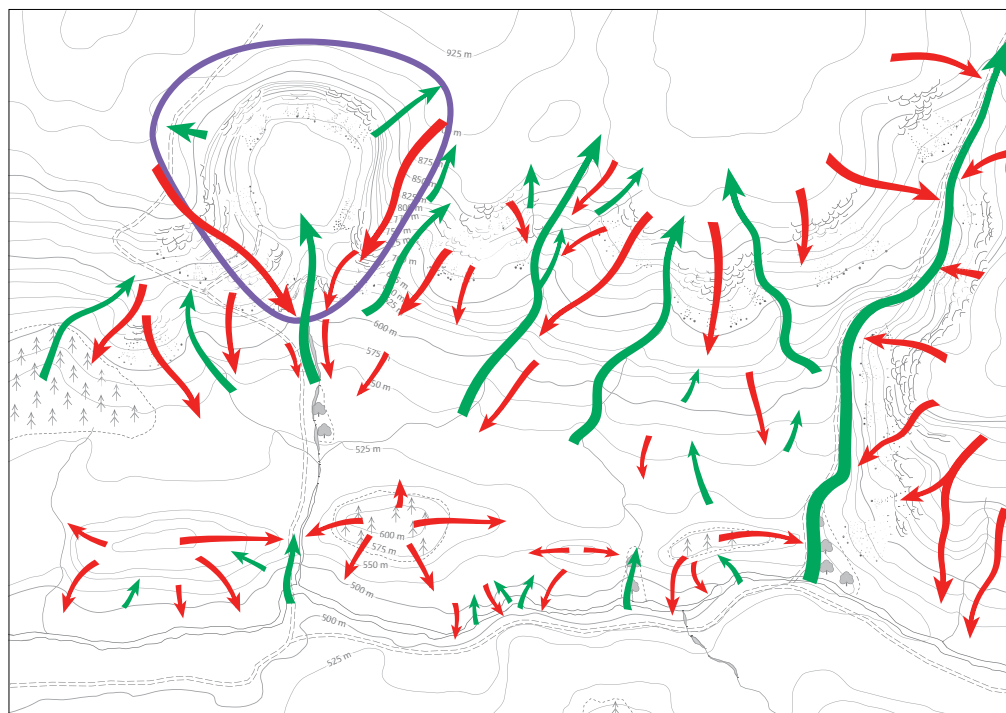
Landscape character analysis - perspective

- ➔ Visual forces running down ridges and spurs
- ➔ Visual forces running up valleys and gullies
- Area with very strong genius loci



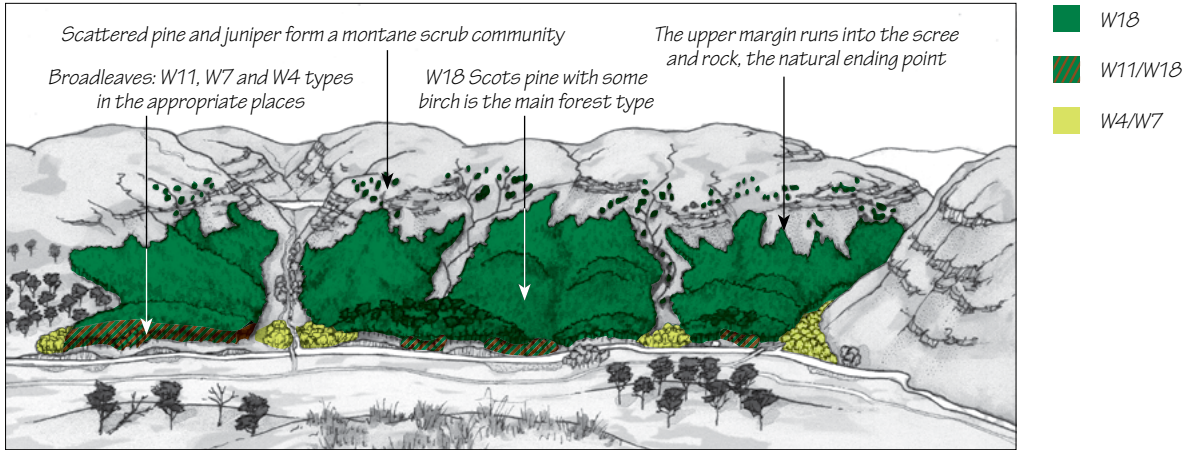
A large-scale, rugged, remote and wild landscape with few human-made elements apart from the access tracks. The dark, sombre colours, the scatter of pine trees and the rocks give the area a brooding quality. The corrie perched high above the glen is hidden and waiting to be discovered; it gives the area a particularly strong genius loci. It also provides a focal point, as does the valley leading up to it. There is significant foreshortening, as the extensive deep peat area is hidden from view behind the foreground moraines.

Landscape character analysis - plan



In the regional landscape character assessment this area is described as high mountain plateaux and valleys of the Highlands and Islands. It is characterised by high, rugged, glaciated mountains with deep, steep-sided valleys containing remnants of native Caledonian pine forest, swift rivers and wide open vistas.

Planting – perspective



The design follows the ecological analysis to place the woodland types in the correct places. Above the forest zone the sub-alpine zone is included in the design, with scattered patches. The large mire expanse, kept open, is almost invisible from this viewpoint, hidden behind the foreground knolls. The focal point of the perched corrie remains strong and mysterious.

Planting – plan



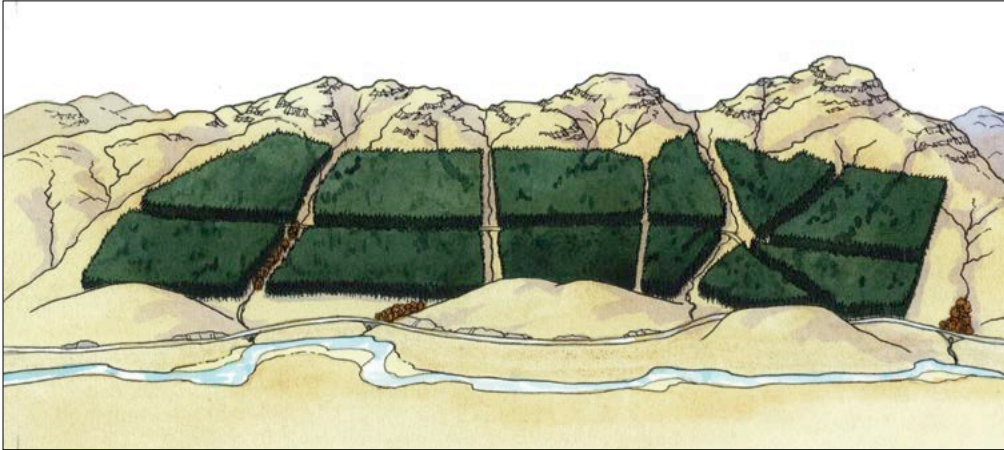
6.2 Felling and replanting of a conifer forest in a mountainous landscape

This landscape could be found in parts of Scotland, Wales, the Lake District or Northern Ireland. Non-native conifers planted from the 1960s in several phases with rather geometric shapes stand out in the landscape as seen from many lower and higher elevation viewpoints. Steep torrents run through the forest, which rises to rugged heights, and there are a few small patches of remnant native woodlands here and there. The landscape outside the plantation is full of diversity due to the colours of the vegetation and the presence of rock outcrops. Soils include mineral and peaty variants with different potential for species diversity after felling. There are very limited opportunities for low-impact silvicultural systems (LISS), in part because of the unsuitability of the established Sitka spruce to be managed this way. Several popular routes up to the mountains pass through the forest. Access for harvesting is a challenge because of the steep terrain.

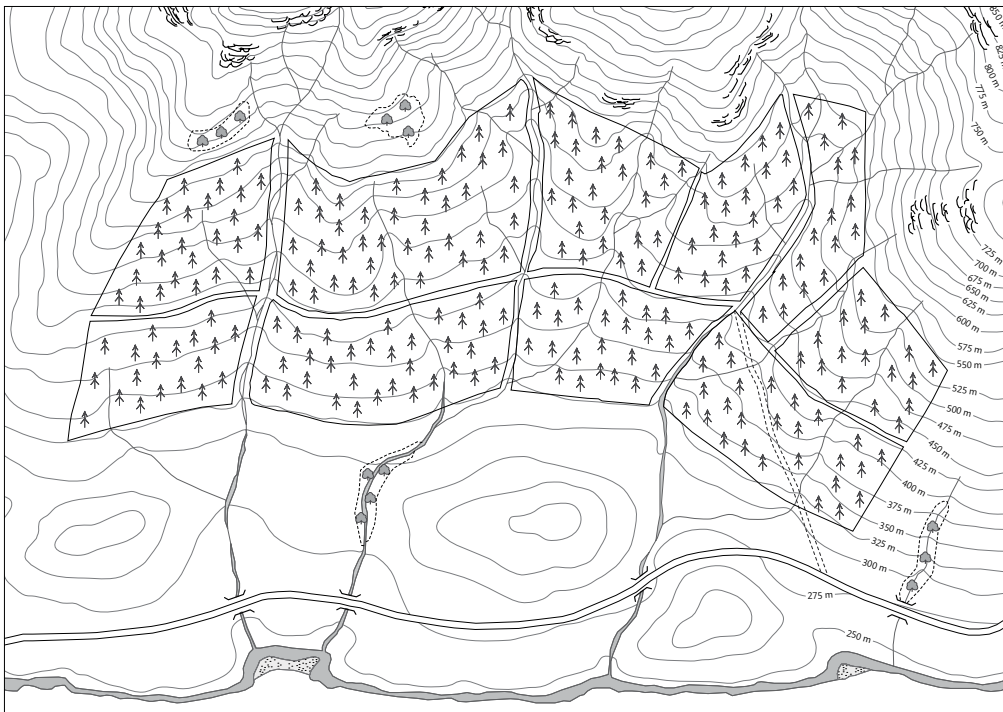
Objectives

Resource	Objective	Indicator of objective being met
Timber	To produce as much timber as possible economically while diversifying the species range to the local landscape character	Most productive species will occupy economically productive ground
Financial	To maximise net present value (NVP)	Forest is felled as close to max. NPV as possible
Landscape	To improve the landscape during felling, especially the external margins and the stand and species diversity	External margins are reshaped to follow landform Internal geometric rides are removed Age class diversity is introduced Species diversity (colours and textures) fits that of the surrounding landscape
Biodiversity	To enhance the biodiversity value of the forest by increasing the internal habitat diversity and also connecting the forest into the wider landscape	Open ground to be increased and connected to unplanted areas outside the forest Broadleaves to be planted, including riparian zones to watercourses
Public access and recreation	To maintain the right of way	Right of way to be kept open and managed to enhance user experience
Water	To maintain or enhance water quality	Streams to be opened up Wetlands to be restored

Base – perspective

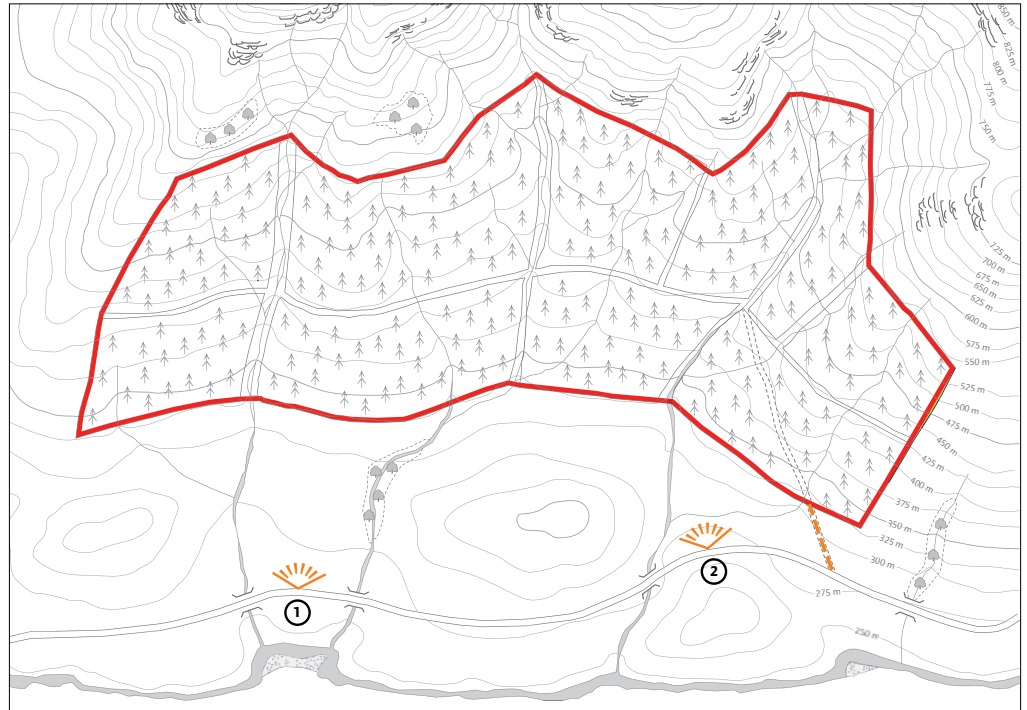


Base – plan



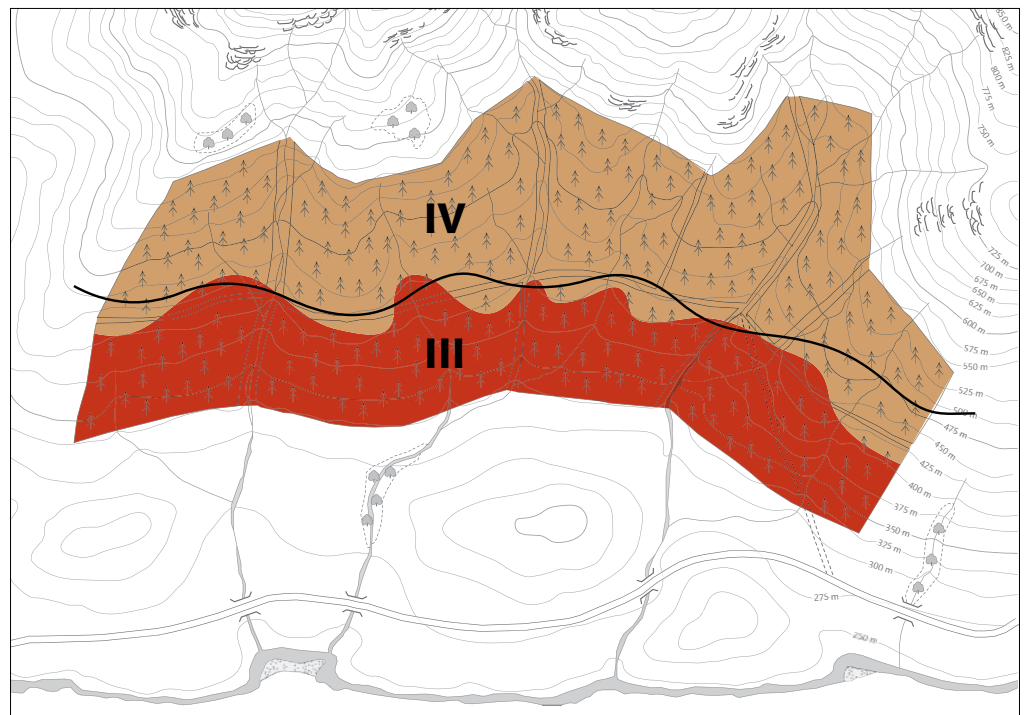
Location and landscape context

- Ownership boundary
- - - Legal access
- ① Agreed viewpoint
- Direction and angle of view



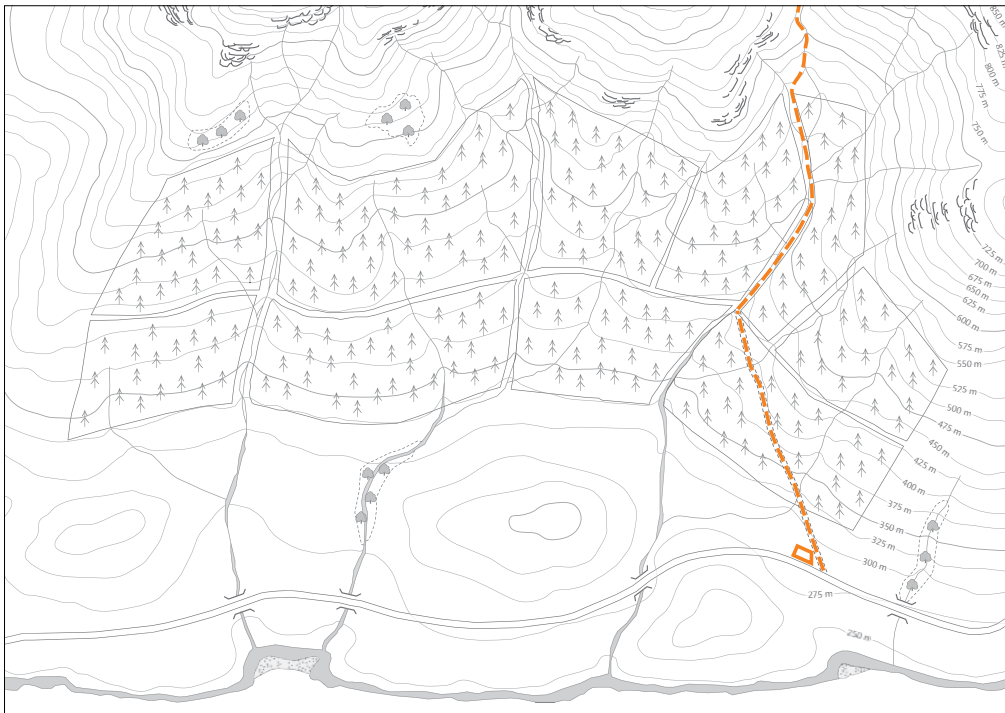
Soils

- Upland brown earth
- Peaty podzol
- IV** Windthrow hazard class



Geology is sedimentary rock, low pH, with glacial moraines along the valley floor. Slopes have superficial deposits, rocks only outcrop at higher elevations.

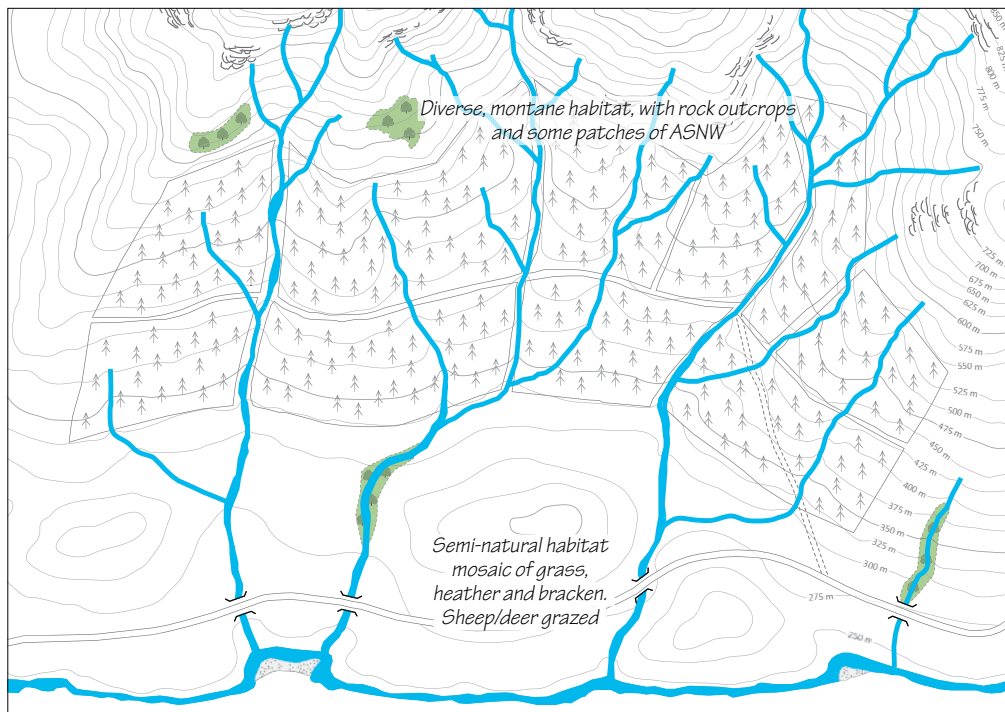
Access and historic environment



- Informal parking by hillwalkers
- - - Route into peaks using access track and forest ride

Historically, this area has been part of the estate and grazed by sheep. There are remains of a cleared farm town further up the glen but no evidence of previous habitation has been found in the forest.

Hydrology and ecology



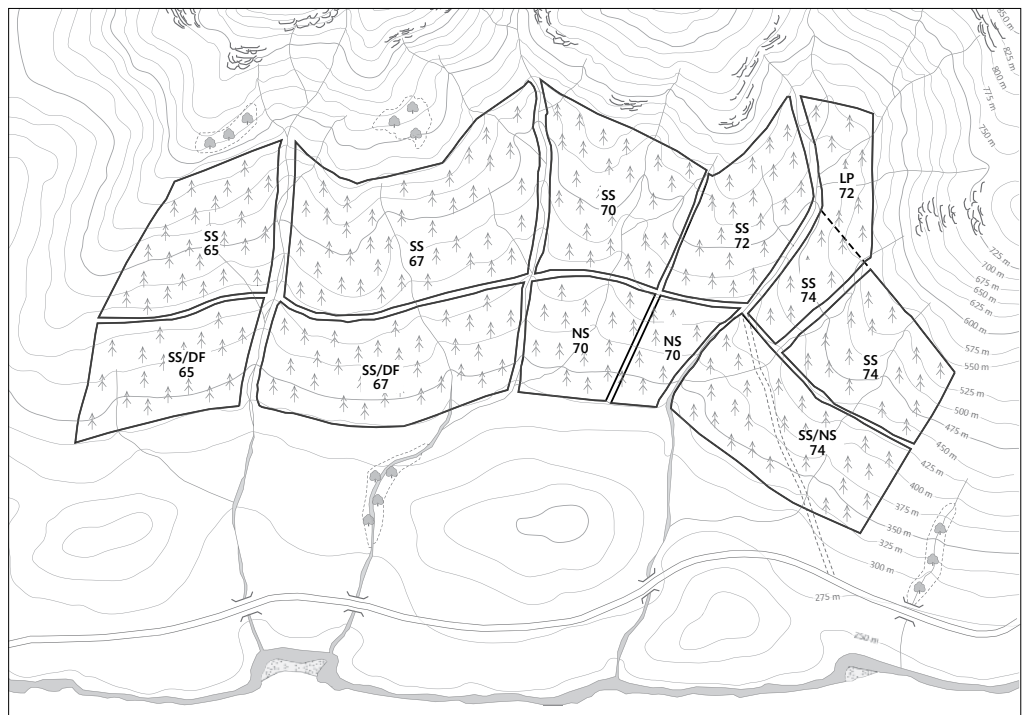
- Remnant ancient and semi-natural woodland patches, unrelated and outside the forest
- Streams, many of which have been planted over

Economic harvesting

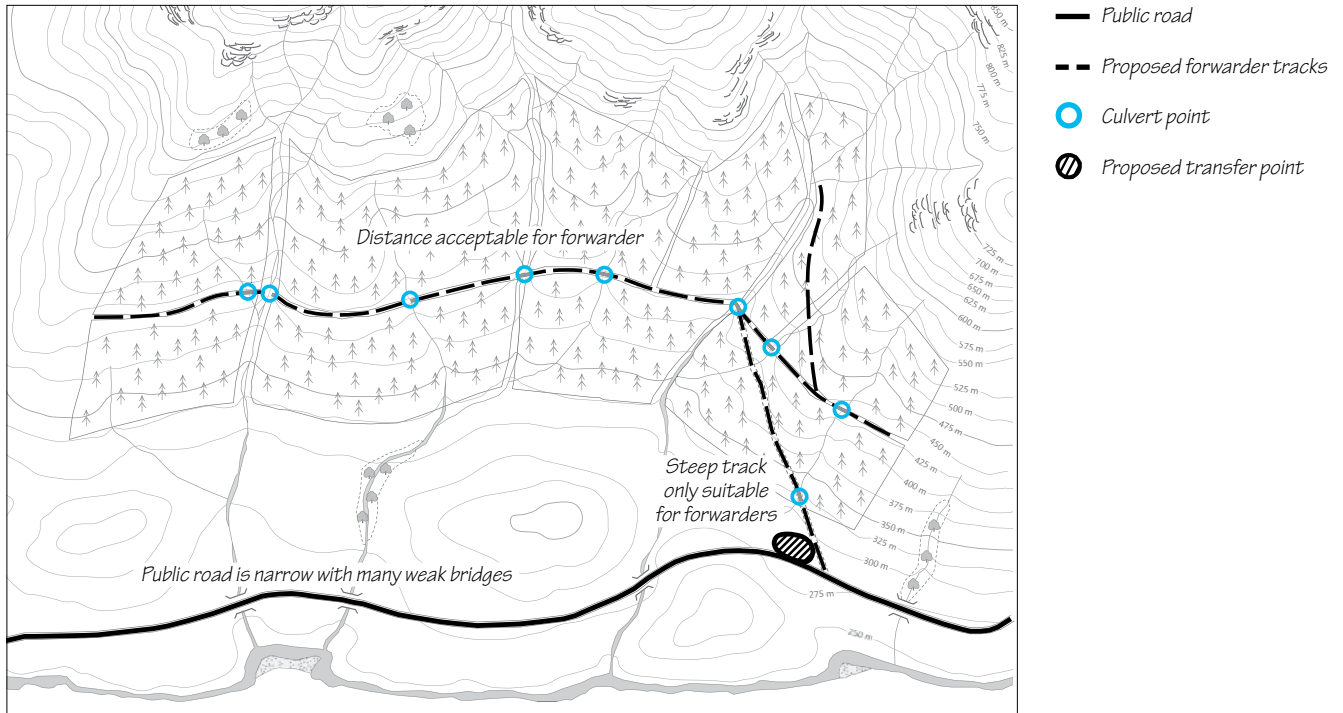
- 2014
- 2018
- 2021
- 2026
- 2031



Growing stock



Roads and harvesting



Forest access is not easy. The public road is narrow and with weak bridges and there are no places for transfer points within the forest.

The survey focuses on many practical aspects associated with the felling and restocking; windthrow risk, economic felling ages and harvest accessibility. The constraints and opportunities analysis also focuses on these as they are the most important in determining the direction of the design concept.

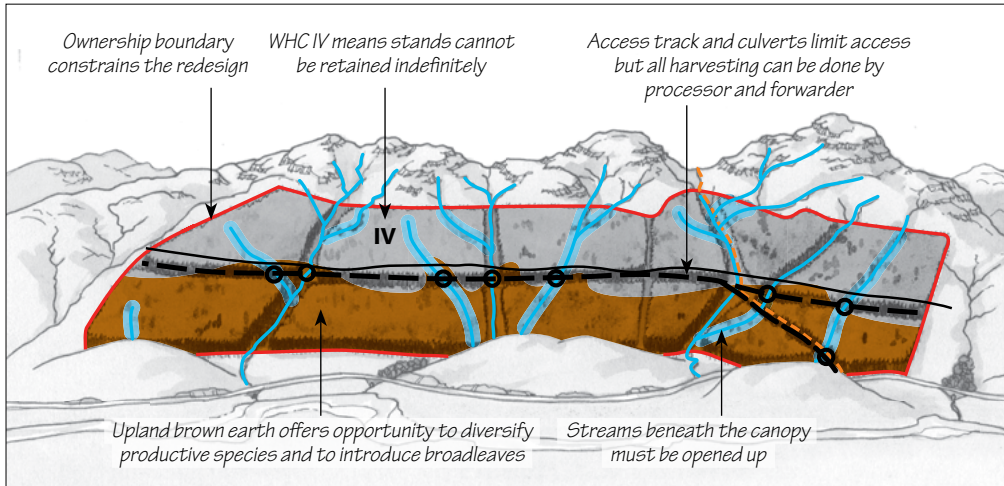
Constraints and opportunities analysis

Factor	Constraint	Opportunity
Windthrow risk	The upper half of the forest is in a zone where windthrow risk is a serious concern There are few green edges suitable for use as felling coupe boundaries	Some areas are younger and of lower yield class so that they can be felled later
Age class	The forest has some age variety but this is not mixed across the area; it is concentrated in larger blocks due to the planting phasing	To increase age variation at felling by stretching the felling phases as much as possible
Harvesting access	There are limits on the places that a main forest road can be located due to the difficult terrain There are many stream crossings required which pose problems for water protection during harvesting	The whole area is accessible by ground machinery A large-scale and simple pattern of coupes meeting the roads or requiring only short forwarder tracks is possible
Species	Very little species diversity	To introduce broadleaves and larch where sites and soils suit them
Water	The whole area is covered in a network of gullied streams which converge along the lower slopes	To use the streams as the framework for the restocking design and break up the forest into units which are more windfirm in the future
Habitats	Very limited habitats of value in the forest	To create new open habitat and to introduce a lot more broadleaves in association with the network of streams

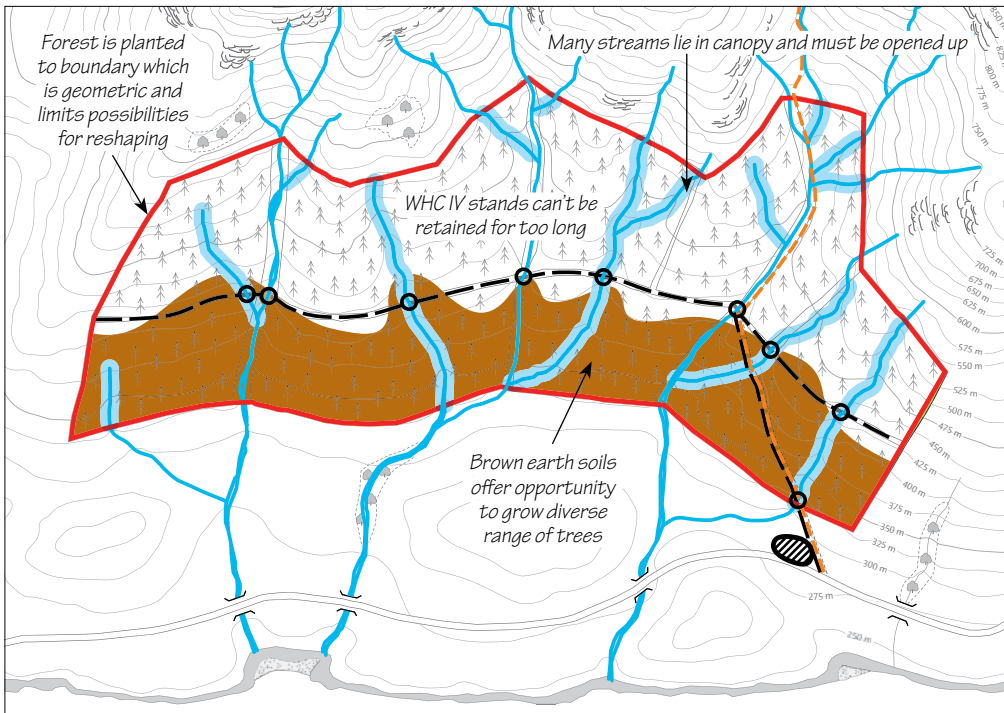
Landscape character is an important aspect in this design, especially as the existing forest is so poorly designed. Landform is a very strong factor in the redesign, while the colour diversity is something to be used sparingly as bracken, for example, is not such a dominating feature of this area.

The forest is currently a single large and homogeneous unit. The concept is to divide it up into a pattern of practical coupes organised to work in the landscape. The redesign will then concentrate on using the watercourses as major elements of diversity together with some conifer diversity. The full time series shows the progressive development of the forest over time.




Constraints and opportunities – perspective

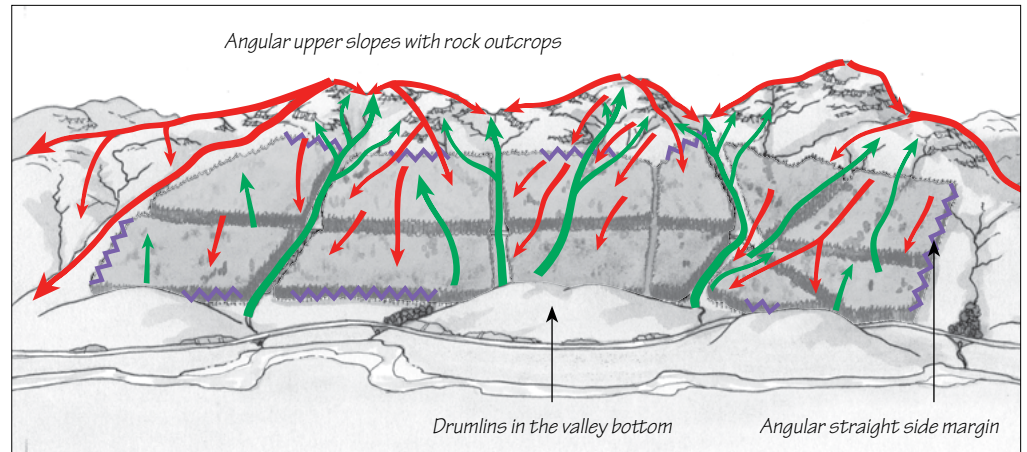


Constraints and opportunities – plan



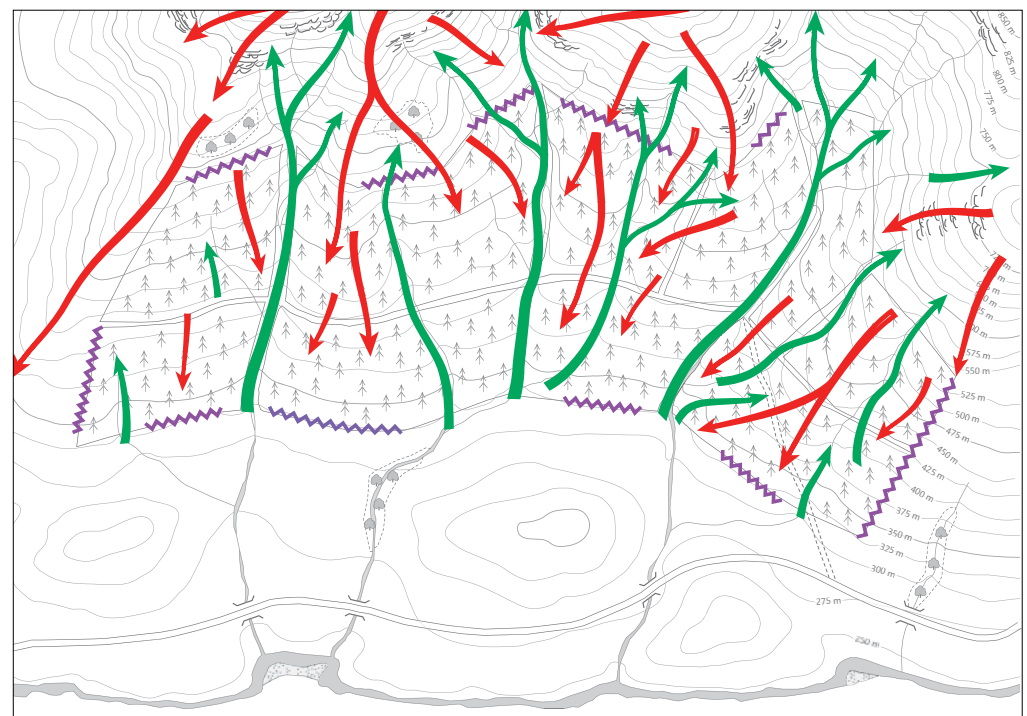
Landscape character assessment – perspective

-  Visual forces running down ridges and spurs
-  Visual forces running up valleys and gullies
-  Geometric forest edges conflicting with the underlying landform



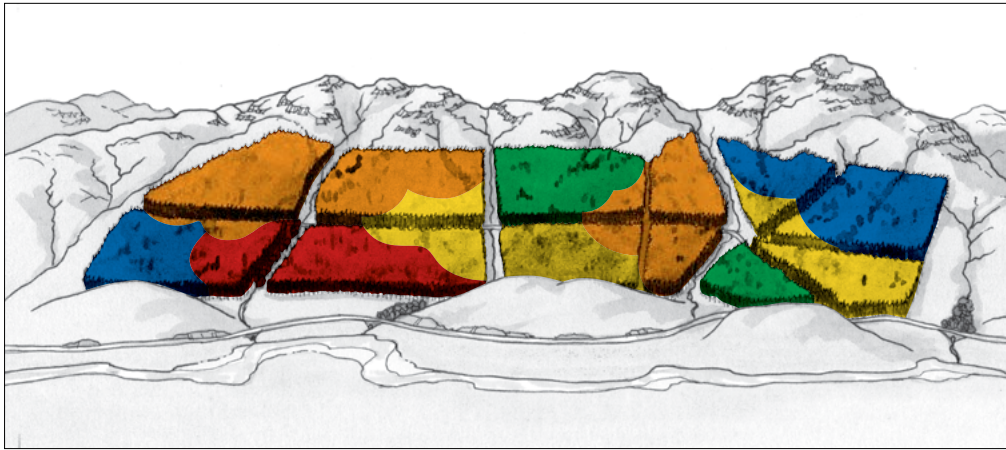
A large-scale landscape of angular, rugged forms on the upper slopes, typical of glaciated topography, with simpler slopes incised by streams and a flatter valley floor containing drumlins and a meandering river. The landscape is generally simple with a subtle mosaic of semi-natural vegetation. The forest is even-aged, all evergreen conifer and arranged in angular compartments. It is reasonably in scale but needs major redesign in order to be unified with and respect the character.

Landscape character assessment – plan



The landscape character assessment classifies this area as 'Steep, high mountains of the Highlands and Islands'. It notes the coarse textures and subtle colour mosaic providing visual diversity. The presence of intrusive afforestation is also noted, with suggestions to improve this to enhance character.

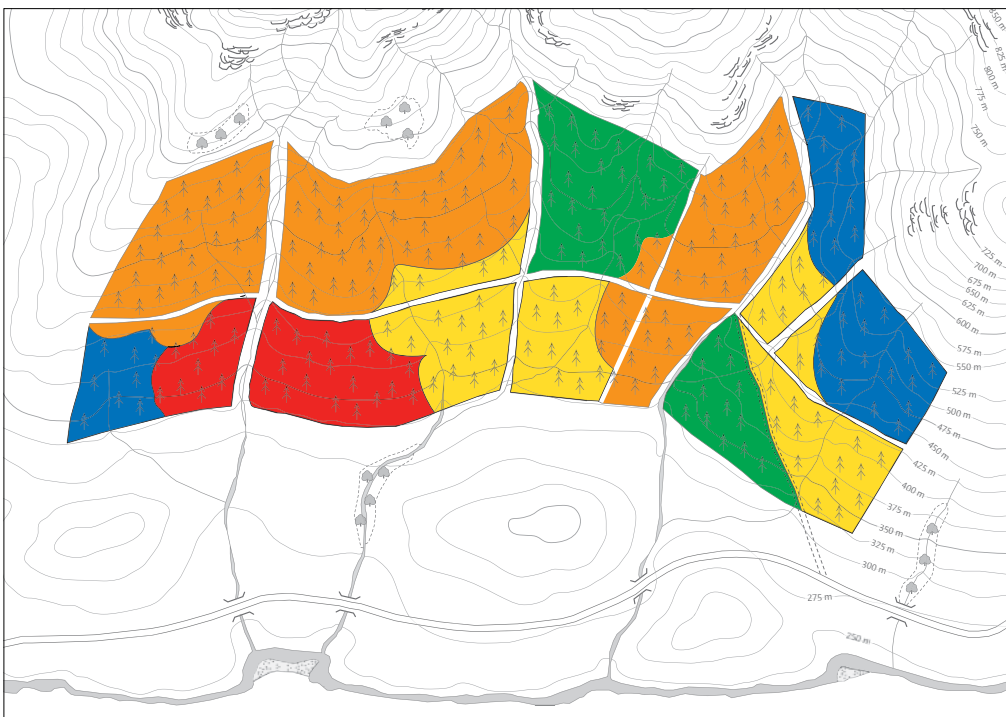
Felling design – perspective



- 2014
- 2018
- 2023
- 2028
- 2033

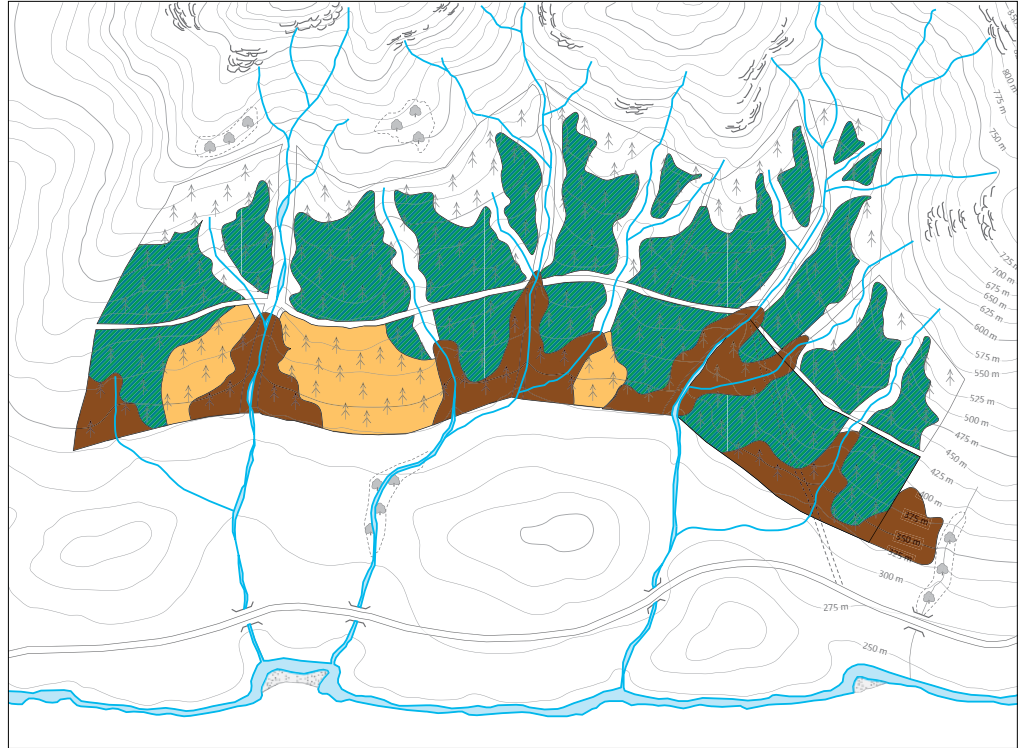
The felling design is kept fairly simple, using green edges where possible to reduce the risk of wind damage. Phasing is kept as close to the optimum as possible.

Felling design – plan

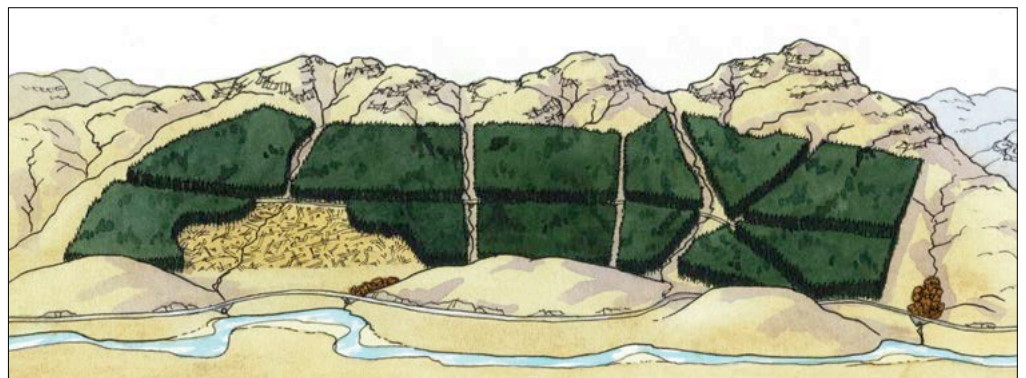


Restocking plan

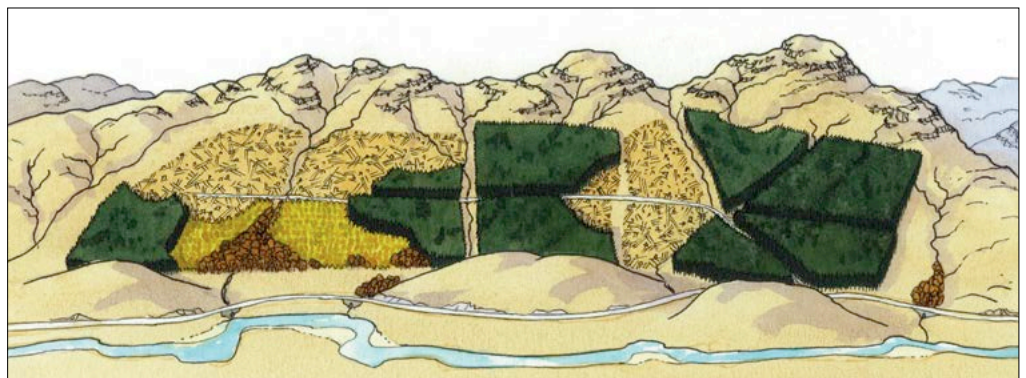
- Evergreen conifer
- Larch
- Mixed native broadleaves



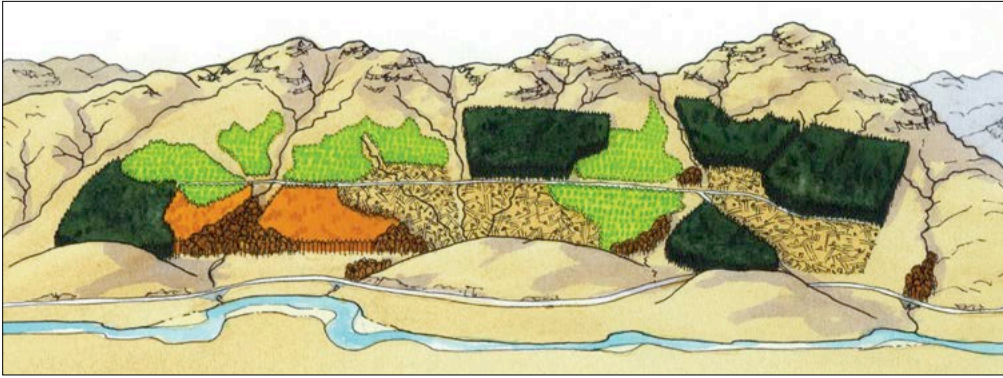
Sketch design – projection (Phase 1)



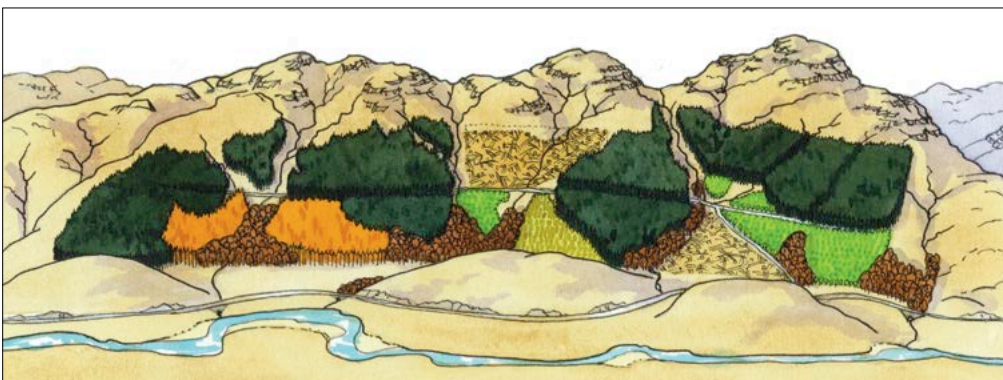
Sketch design – projection (Phase 2)



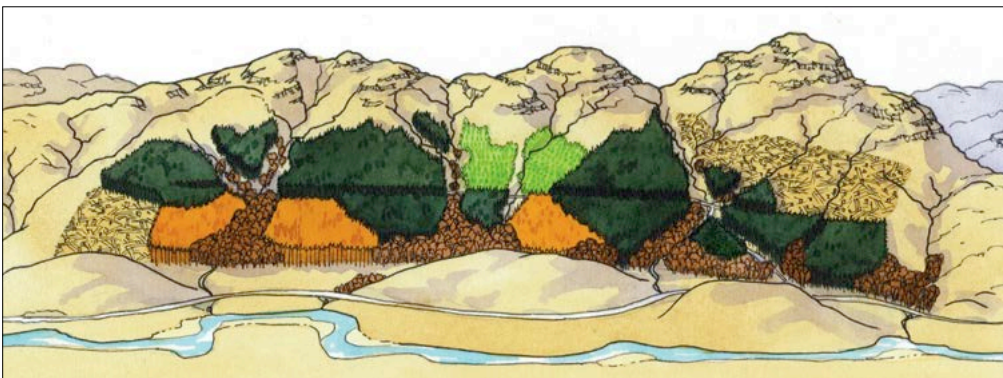
Sketch design – projection (Phase 3)



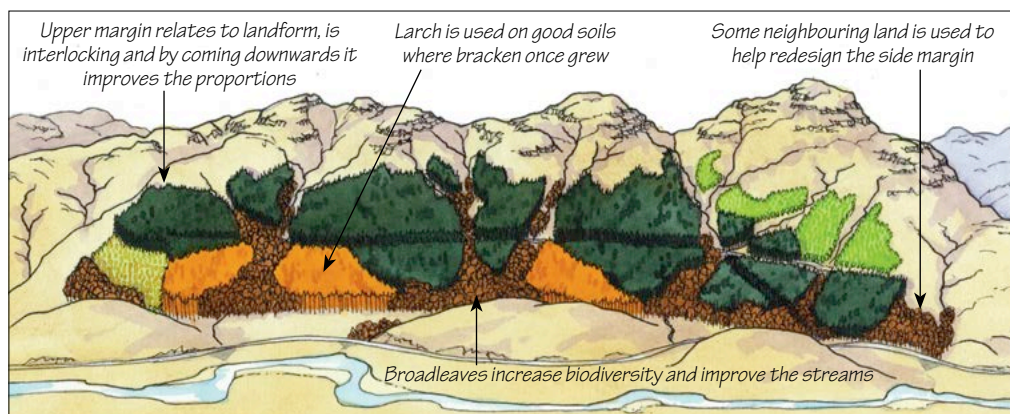
Sketch design – projection (Phase 4)



Sketch design – projection (Phase 5)



Sketch design – projection (10 years after the final coupe has been felled)



At this phase the full effect of the redesign is clear