Appendices

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Appendix I: Consultation Record

Consultee	Date contacted	Date response received	Consultee Comment	Forest District Response
Neighbours and members of public via posters & flyer-drop	1/11/18	No responses	N/A	N/A
Fife council archaeologist	29/10/18	No response	N/A	N/A
Fife council planning	29/10/18	No response	N/A	N/A
Scottish power energy networks	29/10/18	No response	N/A	N/A
Scottish Water	29/10/18	7/11/18	A review of our records indicates that there are Scottish Water assets in the area: Dean plantation: 125mm rising main, the rising main with air valve chambers runs up the side of the access track when on site you can clearly see the air valve manholes and chambers, you need to be aware of this if crossing into that section of woodland. Carnock forest: There's a 15" CI trunk main in very close proximity to the site. The location of the main will need to be confirmed on site to determine exactly how close it is to the area you will be working and design a suitable crossing point. The rest of the main should be fenced off to stop machines accidentally tracking over the main and a Risk Assessment Method Statement (RAMSs) will be required.	Issues noted

Reforesting Scotland	9/7/16	9/8/16	We support most of the proposals in the Carnock plan and its general direction of travel. The hutting development can be thought of as an opportunity as well as a constraint. Future hutters are likely to become interested in woodland management and may take on removing invasives, pruning & thinning young trees on a voluntary basis, in exchange for wood fuel. Reforesting Scotland will encourage this responsible management. We would welcome links from the core path to the north to link in with existing routes. If there is to be a move away from Scots pine, then we would like to see more productive hardwoods, both native and introduced. Has NVC or ESC analysis been carried out? This would be a good starting point. We would also like to see some restructuring in the birchwoods with small group felling and enrichment through planting productive hardwoods, protected against the roe deer. Replanting large areas with spruce wouldn't be the best solution due to possible drier and windier conditions in the future. Encouraging red squirrels is desirable but not by excluding large fruited trees such as oak.	Issues noted and where possible incorporated into plan.
Historic Environment Scotland	11/7/16	14/7/18	We note that there are no scheduled monuments, category A listed buildings or Inventory gardens and designed landscapes within the boundary of the proposed	N/A

			management plan and therefore have no comments to make regarding this consultation.	
RSPB	11/7/16	8/8/16	RSPB Scotland does not hold any records of species on both sites that would be affected by these plans and therefore do not have any concerns because we believe there would not be an impact on bird species populations or designated sites in the area. We support the management methods included in the plan to enhance native biodiversity at these sites and would advocate that further biodiversity enhancement methods are considered such as more creating open and wet habitats on the site in order to encourage a healthy ground flora.	Noted
SEPA	7/7/16	14/7/18	These consultations for both the Dean and the Carnock Woods are below the threshold where we would provide bespoke advice. Please therefore refer to Advice for the Forestry Commission Scotland and forest managers on how and when to consult SEPA including standing advice for small scale felling and planting applications and forest plans.	N/A
SNH	7/7/16	11/7/16	As the Plan does not impact on any SSSI, we have no comments to make	N/A

Appendix II: Tolerance Table

	Adjustment to felling period	Adjustment to felling coupe boundaries	Timing of restocking	Change to species	Windthrow response	Adjustment to road lines	Designed open ground
FC Approval not normally required (record and notify FC)	Fell date can be moved within 5 year period where separation or other constraints are met	<10% of coupe size.	Up to 5 planting seasons after felling (allowing fallow periods for hylobius).	Change within species group E.g. Scots pine to birch, Non-native conifers e.g. Sitka spruce to Douglas fir, Non-native to native species (allowing for changes to facilitate Ancient Woodland policy).	**Low sensitivity area** Where windthrow represents more than 60% of the crop the area, including standing trees may, be felled plus up to 5Ha beyond in order to seek a windfirm edge.	**Low sensitivity area** Creation of turning points/ loading bays. Deviation of <100m either side of the predicted centre line of the road/ track. **High sensitivity area** Deviation <75m in either direction from centre of road/track.	Location of temporary open ground e.g. deer glades if still within overall open ground design Increase by 0.5 ha or 5% of area - whichever is less
Approval by exchange of letters and map		10-15% of coupe size.	5 years +	Change of coupe objective that is likely to be consistent with current policy (e.g. from productive to open, open to native species).	**Low sensitivity area** As above to include 5-10 Ha of standing crop to seek a windfirm edge. Areas where windthrow represents <60%. **High sensitivity area** Areas where windthrow represents <60%.	**Low sensitivity area** Deviation of 100-150m in either direction from centre of road/track. **High sensitivity area** Deviation of 75-100m in either direction from centre of road/track.	Increase of 0.5 ha to 2ha or 10% - whichever is less Any reduction in open ground
Approval by formal plan amendment	Felling delayed into second or later 5 year period Advance felling into current or 2nd 5 year period	>15% of coupe size.		Major change of objective likely to be contrary to policy, E.g. native to non-native species, open to non-native,	**Low sensitivity area** As above. Windblown area + an area>10 Ha to find a windfirm edge. **High sensitivity area** Felling of standing trees beyond the area of windblow.	Deviations exceeding the above.	More than 2 ha or 10% Any reduction in open ground in sensitive areas Colonisation of open Areas agreed as critical

Forest Enterprise Scotland
Managing the National Forest Estate

Forestry Commission Scotland
Coimisean na Coilltearachd Alba

Appendix III: Management Plan Brief

Dean & Carnock

Land Management Plan Brief

Contents

1. Key Background Information

- Dean & Carnock Forests are two forest blocks situated in southwest Fife lying south and north respectively of the villages of Gowkhall and Carnock on the A907 Dunfermline to Alloa road. Dean covers an area of 79.5 Ha and Carnock covers an area of 48.9 Ha.
- This Land Management Plan will revise the previous Forest Design Plan which expired in June 2013. These blocks will be incorporated into the existing management plan covering Devilla and the surrounding forests due to their geographic proximity to each other and their similar characteristics.
- Soils in Carnock are largely acidic peaty gleys, with more fertile pockets in small areas. In Dean the nutrient levels are higher and there is a mixture of well drained and poorly drained soils giving much greater variety through the forest. Elevation ranges from approximately 116m - 172m above sea level (asl) at Carnock, which is generally moderately exposed (DAMS score of 11-15). Dean is more low-lying, at 64m – 113m asl, and is generally more sheltered (DAMS score of 9-14).
- The prevailing warm, moist climate is conducive to good tree growth of both broadleaves and conifers although the relatively poor soil in Carnock limits the choice of tree species suitable for commercial production, whereas the generally brown forest earths in Dean results in a greater range of species choice. Climate change predictions suggest that the climate will become generally warmer, with drier summers and wetter winters which will be considered when choosing future species.
- Currently approximately 88% of the total managed area is under forest cover with the remaining 12% consisting of disparate elements such as open ground, unplantable/bare ground and quarries. 62% of the forests are conifer and 38% broadleaves with 60% of the conifer comprised of Scots pine.
- Of the current forest cover across the sites the growth stages of the trees are split as follows approx. 8% establishment (0-10 years), 1% thicket (11-20 years), 22% pole stage (21-40 years), 28% mature (41-60 years) and 41% old forest (over 61 years).
- Both sites have areas of the forest which is designated as being Long Established of Plantation Origin (LEPO).
- Due to the relatively sheltered nature of their locations the previous plan implemented the initial stages of development of these sites for management by way of Low Impact Silvicultural Systems (LISS). There is an opportunity to develop this aspiration and be much clearer as to the objectives and methods to be employed.
- Both sites have operational access by single forest roads which link to the public road network, although extraction distances to these from the furthest parts of the blocks can be in the region of 700-900 metres. There is potential to upgrade a right of access into Dean

from the south west off Pitdinnie Road if deemed necessary.

- An overhead powerline crosses Carnock roughly NE to SW with an underground line following the same course whilst in Dean there are two overhead powerlines affecting the site, one along a section of the north western edge, and a second which runs along Lundin Road by the forest entrance with a spur cutting into the site to feed the house just north of the main access. An underground power line and a gas pipeline also bisect Dean from north to south.
- Carnock generally drains to the west however the north west of the site drains into the Grange Burn which eventually feeds the Forth. A central drain generally diverts water north at Dean however to the east the Pitfirrane Dean burn has carved out a gully which cuts through the site from north to south and feeds the Crossford Burn and eventually also the Forth.
- Recreational use of these sites is mainly by local walkers, dog walkers and horse riders although there is some abuse by motor bikes. Many of the older crops are open enough for easy walking through the trees and the existing ride network is well used by walkers; both sites have a Core Path running through the northern (Carnock) and southern (Dean) edges respectively.
- Carnock falls within the Cleish Hills Area of Great Landscape Value (AGLV), and landscape considerations are most significant at the small to medium scale. The more visible edges of Carnock to the south are already quite varied in colour and texture with both broadleaves and a variety of conifers including larch, Scots pine and Norway spruce. Dean sits within its surroundings fairly well with a variety of colours and textures from various species, although the northern edge forms a relatively stark line in the landscape.
- There are no designated archaeological features within the forests; however there are various remnant features such as earthen banks, ditches and walls which have been recorded in the heritage layer.
- The majority of Dean forest is classed as LEPO, as are some areas within Carnock. In addition there are important habitats such as upland birch native woodland as well as the useful habitats of the pond and old quarries in Carnock.
- Roe deer are present at both sites, and the annual cull has increased steadily in recent years, in part due to the increase in palatable young crops as restructuring has got under way.

2. Strategic Priorities

The work of FES is guided by the Scottish Forestry Strategy 2006, which set out seven Key Themes:

- *Climate Change*
- *Timber*
- *Business Development*
- *Community Development*
- *Access & Health*
- *Environmental Quality*
- *Biodiversity*

Since 2006 the purpose of the estate has evolved slightly and has been re-characterised in: The Role of Scotland's National Forest Estate and Strategic Directions 2013 – 2016, which sets out six aspirations that the National Forest Estate is:

- ***Healthy*** - achieving good environmental and silvicultural condition in a changing climate
- ***Productive*** - providing sustainable economic benefits from the land
- ***Treasured***- as a multi-purpose resource that sustains livelihoods, improves quality of life, and offers involvement and enjoyment
- ***Accessible*** - local woodlands and national treasures that are well promoted, welcoming and open for all
- ***Cared for*** - working with nature and respecting landscapes, natural and cultural heritage
- ***Good value*** - exemplary, effective and efficient delivery of public benefits

In light of the new national strategic directions, Scottish Lowlands Forest District revised the District Strategic Plan, producing the Scottish Lowlands Forest District Strategic Plan (2014-2017), which draws on the six aspirations and sets out the key national commitments and what district specific actions are to be taken to achieve them.

In preparing the Brief and Objectives for this Land Management Plan (LMP), issues were considered against these revised 'Key Commitments' and assessed for their importance. Those most relevant to the Clydesdale Forests are set out below.

3. Key Drivers & Draft Management Objectives

On the basis of the background information, and given the considerations outlined above, a series of drivers have been identified in order to produce the management objectives proposed for Dean & Carnock Forests.

Key Aspiration – Healthy

The potential impacts of climate change and the potential threat from current and/or future pests and disease such as *Phytophthora ramorum* and Dothistroma Needle Blight means uncertainty to the future make-up of the forest. Changes in storm frequency and intensity may increase the risk of windblow, while drier and warmer summers might increase the risk of drought. Increasing trade importation from across the world, facilitating pest and disease movement, is likely to lead to more risk of new threats arriving on our shores. The current narrow range of tree species is generally site suited which should reduce tree stress and the chances of infection or infestation however some alterations in future restock species choice to more site suited species would improve this situation further.

The forests are being managed using a Low Impact Silvilcultural System (LISS) approach in order to encourage natural regeneration of a successor crop. However in some areas this may not be an appropriate strategy e.g. where stands have had too few previous thinning interventions and may be susceptible to future windthrow; and/or where the species is not ideally suited to the site conditions.

Management Objectives:

- *Manage the mature conifers in Carnock, using LISS where appropriate, to alter the species make up for more site appropriate species.*
- *Manage the conifers in Dean appropriate to their area and previous management, using LISS mini-coupes and thinning where possible but if necessary as clearfell.*
- *Where appropriate when restocking diversify the planted species to enhance the resilience of the woodlands to the impacts of predicted climate change and the threat from pests and diseases.*

Key Aspiration – Productive

The favourable climatic conditions and generally lowland nature of the woodlands offers the potential to grow a number of productive species, albeit with a wider range at Dean due to the better quality soils. Where feasible the focus should be on productive broadleaves and/or

alternative conifer species to maximise the economic return available by growing high quality timber crops.

In order to establish successor crops (whether through natural regeneration or via planting) in the relatively small areas favoured by LISS management over clearfelling, it will be necessary to actively manage deer numbers in order to minimise damage to young stands.

Management Objectives:

- *Maintain sustainable volumes of softwood and hardwood timber for local and national markets determined by appropriate coupe management in conjunction with district-wide felling programme requirements.*
- *Use appropriate methods of herbivore protection to minimise leader browsing on establishing or regenerating trees.*

Key Aspirations – Treasured and Accessible

Although there is a relatively small resident population in the immediate vicinity of the woods, there are a number of population centres locally and the woods are generally well used by the local population.

Management Objectives:

- *Preserve the current informal path networks to maintain the visitor experience in the woodlands.*
- *Where appropriate enhance views out from and to the sites by judicious use of thinnings, enhanced spatial transition along informal paths by way of various methods e.g. crown lifting, pruning, thinning etc.*

Key Aspiration – Cared for

The majority of Dean, and a substantial proportion of Carnock, are designated as LEPO (Long Established of Plantation Origin) woodland, and have a high biodiversity value due to the veteran trees and good quality ground vegetation present.

Management Objectives:

- *Improve red squirrel habitat through appropriate choice of tree species and continued implementation of LISS*
- *Continue ongoing management of invasive species at Carnock.*

- *Maintain high deadwood potential through retention of veteran trees and extension of rotation lengths where feasible.*
- *Protect LEPO features, particularly veteran trees and ground flora, in accordance with UKFS guidelines on Forests and Historic environment.*

Appendix IV: Objective Appraisal, Monitoring & Evaluation

Key Aspiration	**Objective**	**Assessable Criteria**	**Appraisal Method**	**Monitoring Method**	**Monitor Where**	**Monitor When**	**Monitor Who**	**Record Monitoring Where**	**Evaluation.** *How does the Appraisal and Monitoring method inform current & future proposals? If you cannot answer this question then the methods may not be appropriate.*
Healthy	*Manage the mature conifers in Carnock, using LISS where appropriate, to alter the species make up for more site appropriate species.*	Species composition	Species composition, diversity and distribution	Surveys (Attribute, IN45, Production)	On site SCDB	IN45 – every 5 years Attribute – when required Production – Prior to operations	Planning forester	Surveys/CCF folder Against the LMP	Monitoring the output from the surveys identified will inform the change in species composition and help instruct future management interventions
Healthy	*Manage the conifers in Dean appropriate to their area and previous management, using LISS mini-coupes where possible but if necessary as clearfell.*	Silvicultural system used during operations Diameter distribution	Liason with Operations team (3/4 work plan meetings etc.) Analysis of IN45 survey	Site meetings IN45 survey	On site	Site meetings – during operations In45 – every 5 years	Planning forester	Surveys/CCF folder Against the LMP	Site meetings and ensuring operations adhere to the prescribed silvicultural system. The diameter-distribution information from the IN45 survey will indicate changes in stand structure and the silvicultural system employed. The same data can help inform future thinning operations.
Healthy	*Where appropriate when restocking diversify the planted species to enhance the resilience of the woodlands to the impacts of predicted climate change and the threat from pests and diseases.*	Species composition	Analysis of survey information	Stocking density assessments (SDAs) IN45 survey	On site SCDB	IN45 – every 5 years SDAs – One, three and five years after planting	Planning forester	Surveys folder SCDB	Survey data can be analysed to inform future restock operations.

Productive	*Maintain sustainable volumes of softwood and hardwood timber for local and national markets determined by appropriate coupe management in conjunction with district-wide felling programme requirements.*	Volume out-turns	Analysis of survey and production forecast outputs Volume data from Operations team	Production survey Forester Production forecast module Harvester head volume data	On site SCDB	Prior to operations Annually for Production forecast	Programme manager Harvesting forester	Against the LMP Surveys and Ops folders	A combination of on-site data collection and modelling will allow a sustainable yield to be identified that fits in with the District-wide felling programme.
Productive	*Use appropriate methods of herbivore protection to minimise leader browsing on establishing or regenerating trees.*	Browsing damage to leader Deer population	Analysis of survey data	SDA Nearest-neighbour surveys IN45 survey Infra-red population survey	On site	Nearest-neighbour and IN45 surveys occur annually. IN45 survey every 5 years. IR population surveys periodically	Programme manager Wildlife manager	Deer management and surveys folders	Analysis of deer population figures will enable the annual cull to be adjusted, whereas data from browsing damage surveys will inform whether fencing, tree shelters etc. are required.
Treasured & Accessible	*Preserve the current informal path networks to maintain the visitor experience in the woodlands*	Public opinion	Survey users of woodland	Visitor surveys	On site Online	Mid-term and 10 year review Continual assessment on site	Recreation manager	CRT2 folder within Management unit folders	Visitor feedback will inform where further improvements can be made and if necessary factored in to future business plans.
Treasured & Accessible	*Where appropriate enhance views out from and to the sites by judicious use of thinnings, enhanced spatial transition along informal paths by way of various methods e.g. crown lifting, pruning, thinning etc.*	Quality of views	Survey users of woodland	Visitor surveys	On site Online	Mid-term and 10 year review Continual assessment on site	Recreation manager	CRT2 folder within Management unit folders	Visitor feedback back on the aesthetic value of the views will help inform whether the choice of species and silviculture is having a positive impact on the views to/from the management areas.

Cared for	*Improve red squirrel habitat through appropriate choice of tree species and continued implementation of lower impact silvicultural systems*	Diameter distribution Species composition	Analysis of survey information	IN45, attribute, production and SDA surveys	On site	IN45 – every five years Production – prior to operations Attribute – when required SDA – One, three & five years after restock	Planning forester	Surveys folder (CCF, SDA, Production survey, Attribute survey) Against the LMP	Diameter-distributions derived from IN45 survey data will provide information on stand structure. Species composition can be analysed to investigate the potential food sources for squirrels from small seeded conifers and broadleaves.
Cared for	*Continue ongoing management of invasive species at Carnock.*	Presence/absence of invasive species	Species, quantity and location of invasive species	Site survey	On site	As indicated on Forester tactical planner At mid-term and 10 year review	Environment & Heritage manager	Forester Conservation module	Survey data will be used inform programme of work, which will be put into the Forester tactical planner.
Cared for	*Maintain high deadwood potential through retention of veteran trees and extension of rotation lengths where feasible.*	Deadwood volume	Analysis of surveys data	Deadwood surveys Production surveys	On site	Production surveys prior to operations Deadwood surveys periodically	Environment & Heritage manager Programme manager	Deadwood and veterans folder within the Biodiversity folder. Against the LMP	Survey data can be used to check volumes fall exceed the UKWAS target of an average of 20 m^3/ha. Operations can be adapted to ensure sufficient deadwood volume is left on site.
Cared for	*Protect LEPO features, particularly veteran trees and ground flora, in accordance with UKFS guidelines on Forests and Historic environment.*	The quantity and spatial distribution of Veteran trees and ground flora	Analysis of survey data Checking Forester Conservation Module	Site survey Forester Conservation Module Query	On site Forester Conservation Module	At mid-term and 10 year review	Planning Forester	Forester Conservation module	Survey data will ensure that the location of LEPO features is known and that operations can avoid these locations, or their effects mitigated where feasible.

Appendix V: Maps

The table below lists the maps which support and form part of this Land Management Plan:

- 1.1 Dean & Carnock location map
- 2.1 – Dean & Carnock context map
- 3.1.1
  - Carnock Soils map
  - Dean Soils map
- 3.1.2
  - Carnock climatic zones
  - Dean climatic zone
- 3.1.3
  - Carnock Hydrology
  - Dean Hydrology
- 3.2.1
  - Carnock existing woodland
  - Dean exisiting woodland
- 3.2.2
  - Carnock access
  - Dean access
- 3.6
  - Carnock entrance locations
  - Dean entrance locations
- 4a
  - Carnock opportunities & constraints
  - Dean opportunities & constraints
- 4b
  - Carnock concept map
  - Dean concept map
- 5.1
  - Carnock management
  - Dean management
- 5.2
  - Carnock future species & restock
  - Dean future species & restock

Appendix VI:Carnock LISS Plan

Contents

1.0 Introduction

All 48.9 ha of Carnock are suitable for LISS. The eastern two-thirds are mainly Scots pine whilst the western third is dominated by birch.

See **Map 5.1 Carnock silvicultural systems**

2.0 Current Situation

2.1 Ground Conditions

2.1.1 Soil Types

Soils are largely acidic peaty gleys, with more fertile pockets in small areas.

2.1.2 Aspect

The majority of Carnock has a south-westerly aspect, which should be beneficial in terms of light and warmth for potential natural regeneration.

2.1.3 Slope

There are no slopes that would prevent use of a harvester-forwarder on site other than the natural reserve area on the knoll to the south-east of the management area.

2.1.4 Ecological Site Classification (ESC)

The Soil Nutrient Regime (SNR) is three (Medium) and the Soil Moisture Regime (SMR) is three (moist), making the site eminently suitable for a wide range of tree species.

2.1.5 Vegetation

Ground vegetation is not a limiting factor in Carnock, though there are some areas of bracken around the proposed hutting project area that would impede the establishment of natural regeneration.

2.2 Wind Risk

DAMS scores across Carnock range from sheltered to moderately exposed (10.9-15.2). The general absence of windblow across the wider site suggests that the area is sufficiently sheltered for thinning throughout. The only cautionary note is that Scots pine, being a tap rooting species is windfirm relative to flat rooting species like spruce.

2.3 Stand Details

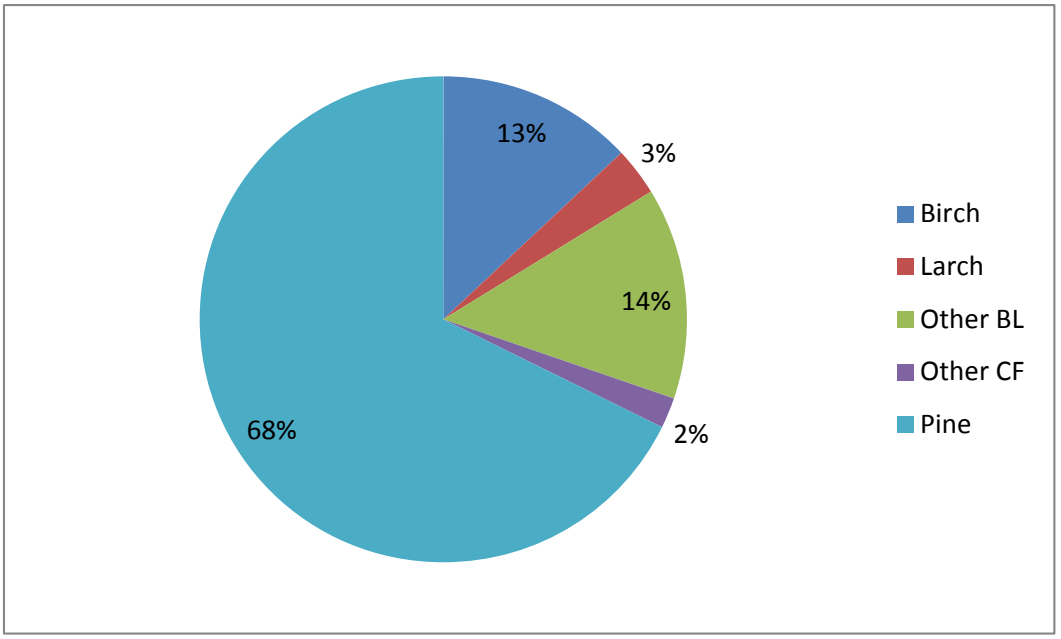
2.3.1 Species Composition

Conifers, the majority of which are Scots pine, comprise roughly 2/3rds of the area, with birch forming the main broadleaf element. Both the pine and birch are of poor quality.

Table 1 – Species Composition

Species	Area (ha)
Alder	0.2
Beech	0.6
Birch	5.6
Elm	0.5
European larch	0.9
Hybrid larch	0.1
Japanese larch	0.5
Lawson cypress	0.2
Mixed broadleaf	4.5
Mixed conifer	0.6
Ponderosa pine	0.1
Scots pine	28.8
Willow	0.2
Total	**42.7**

Figure 1 – Species Composition



2.3.2 Age Class Structure

The area is currently comprised primarily of mature trees, as the transformation to Continuous Cover Forestry (CCF) was only recently started.

Figure 2 - Age class by area for Carnock

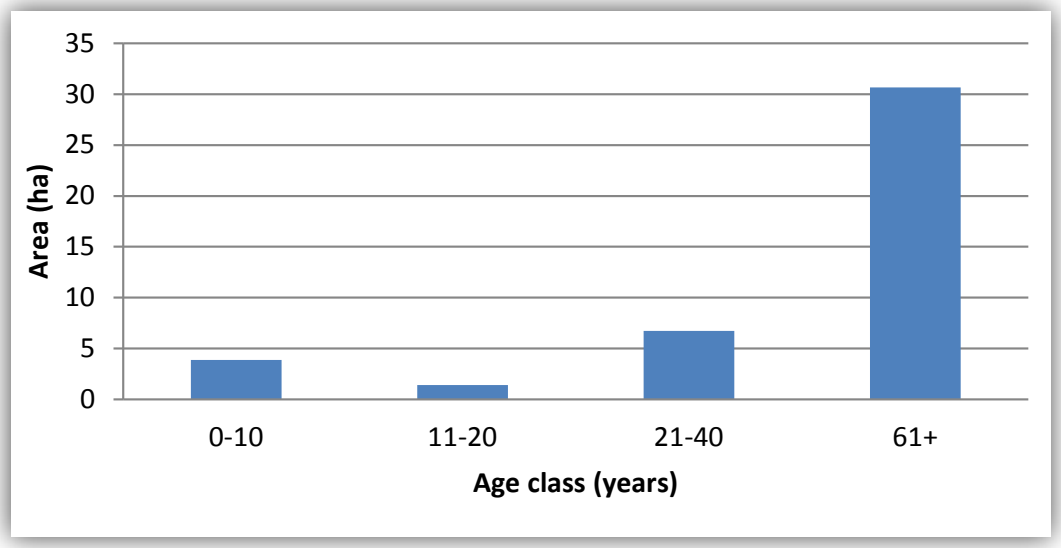


Figure 3. The ideal versus actual diameter-frequency distribution for the conifer areas of Carnock

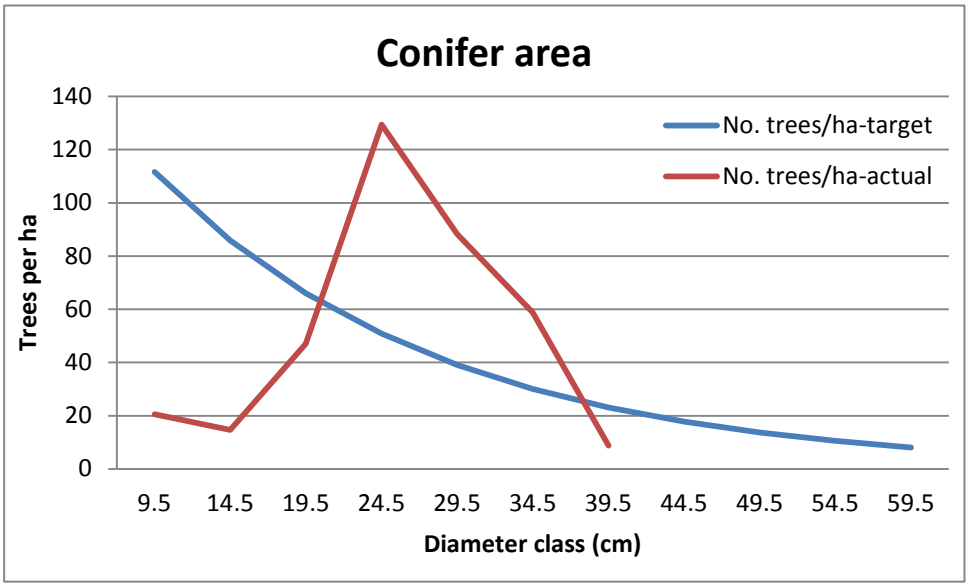
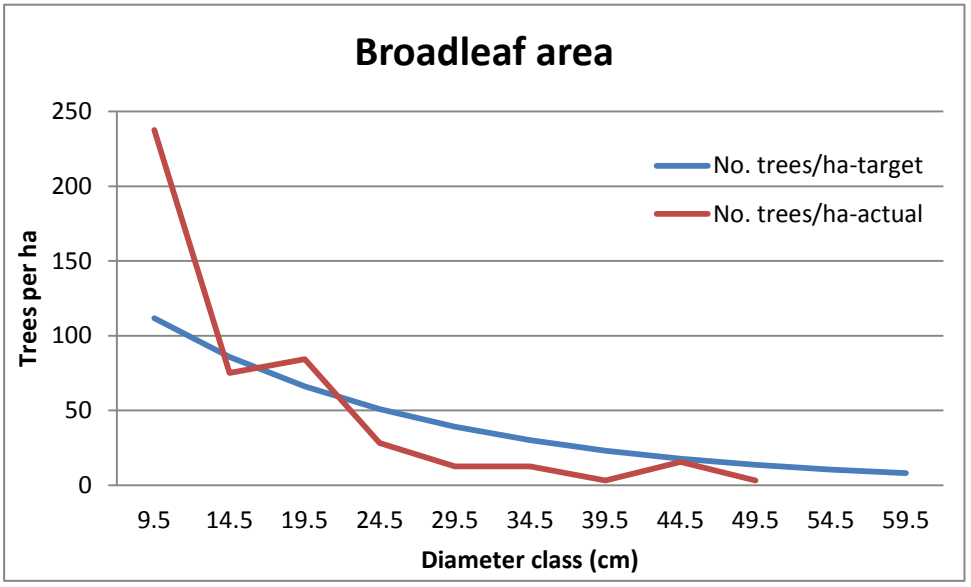


Figure 4. The ideal versus actual diameter-frequency distribution for the broadleaf areas of Carnock



A simple way of assessing stand structure is to examine a diameter-frequency distribution for the area you are managing (see figures 3 & 4). Stands managed

under CCF/LISS will typically show a negative exponential or “reverse-J” shaped curve with many small trees and very few large trees. Carnock underwent an IN45 survey in 2016 where the broadleaf and conifer areas were assessed separately. The red lines in figures 3 and 4 show the actual diameter-frequency distribution for Carnock in 2016. The conifer diameter-distribution shows a peak between the 24.5 and 29.5 cm diameter classes. This, normal distribution, is typical of even aged stands where the majority of the crop was planted at the same time. The broadleaf diameter-distribution is much closer to an exponential curve as would be expected in CCF.

Another useful tool is an ideal dimeter-frequency distribution with which can be compared to the actual stand structure. The blue lines in figures 3 & 4 show the ideal line which is generated by choosing three stand parameters associated with CCF/LISS management; the target diameter at harvesting, target basal area and q (the ratio of trees in one diameter class divided by those in the next, larger class, which is typically 1.3 for UK conditions).

By comparing the ideal and actual lines, it can be seen where there are too few/many trees which can in turn inform management. In the conifer area, there are too few small trees, too many medium sized trees and too few large trees. The broadleaf diameter-distribution is more akin to a reverse-J but has too many trees in the smallest diameter class and then too few trees in diameter classes above 19.5cm.

2.3.3 Thinning History

Since 2003, Carnock has undergone two thinning interventions, both of which were intermediate. The first was in 2006 and also involved clearfelling several small areas totalling 7 hectares. The second thinning intervention was in 2014.

2.3.4 Regeneration Potential

Carnock shows considerable potential for birch regeneration. The IN45 surveys that took place in 2016 split the management area in two: conifer and broadleaf. In both areas, regeneration was assessed in terms of seedlings (<1.3m high) and saplings (>1.3m and <7cm DBH). The main regenerating species was birch, with densities similar in both areas:

Conifer area		Broadleaf area	
Seedling(No per ha)	Sapling(No per ha)	Seedling(No per ha)	Sapling (No per ha)
1971	2259	1234	3003

Despite good levels of regeneration in birch, there is very little Scots pine regeneration despite the overstorey being of seed producing age and the basal area being low (21 m^2 ha^{-1}). This is likely a result of a poor substrate for Scots pine regeneration to establish. Furthermore, despite being of a seed-producing age, the crowns are thin and of a reduced size due to DNB.

2.4 Current Access

Access is generally good. The forest road accesses the management area from the west and runs approximately half way along the north side. This road then carries on, as an unclassified road, to the south. Throughout the conifer areas there are several existing forwarder routes created during previous thinning operations.

3.0 Management Proposals

3.1 Long Term Vision

Move away from Scots pine due to DNB

The long-term vision for Carnock is to ultimately move away from Scots pine as the dominant species and replace it with a range of medium-high shade tolerant species.

The main reason for the move from Scots pine is that it is infected with DNB and in addition, is not regenerating well on site. Furthermore, Scots pine is not an ideal species choice for CCF due to its light demanding nature (thereby limiting it to group selection or seed tree systems).

Macedonian pine will be planted on the rocky knolls surrounding the quarry areas. Macedonian pine is of intermediate shade tolerance and has also exhibited resistance to several pests and diseases such as pine beauty moth, red band needle blight and white pine blister rust. Its use should retain some of the existing pine character that the management area is known for.

Introduction of shade tolerant species following birch clearance.

At present the majority of the conifer area is mature Scots pine with natural regenerating birch in the understorey. The Scots pine has very small crowns (infected with DNB) but appears stable with little or no windblow. The current basal area is 21.2 m^2 ha^{-1} (as of 2016) and it is not anticipated to increase significantly due to slow growth.

Beneath the canopy birch is regenerating well across most of the site and is well established in some areas (1-4m top height). Rather than clearing this birch and

immediately planting shade tolerant conifer species, the birch should be left for approximately 30 years (though respacing may need carried out in small areas) with the aim to produce a firewood crop that supresses ground vegetation. Then, following its removal, there should be a good substrate on which to underplant. Harvesting of the firewood Birch crop should be timed to ensure that planting can occur immediately following the operation. The ground disturbance associated with the felling should also facilitate further BI regeneration. When the Birch firewood crop is harvested, it may be wise to thin the overstorey at the same time depending on basal area (and possibly fell some areas depending on crop stability and choice of successor species).

The proposed successor species would be either shade or medium-shade tolerant. There are a wide number of species classed as either “suitable” or “very suitable” in ESC. These include Norway spruce, Sitka spruce, Douglas-fir, Lawson cypress, western red cedar, western hemlock, European silver fir, Pacific silver fir, grand fir and Noble fir. The proposed method of establishment is via underplanting. The seedlings should be of as large a size as possible and hand screefing or direct planting would be favoured over mounding. The main problem with many of these species is they are palatable to deer, and in the case of European silver fir and Pacific silver fir both are initially slow growers, meaning careful management of deer numbers would be essential to successful establishment. In problematic areas, mainly those with intense weed competition, alternative establishment methods could be explored.

Group selection of Birch

The birch growing on the west of the management area will act in contrast to the shade-tolerant conifer species when they become established in the east. The quality of this birch is very poor with firewood envisaged as the end product. As a result, management input should be kept to a minimum. Birch is regenerating well beneath its own canopy so the only management necessary will be the occasional removal of groups from the overstorey to allow regeneration to develop. This could

perhaps be managed in conjunction with the hutting scheme, providing a local source of firewood.

The natural regeneration should be accepted though if insufficient in terms of stocking, consideration should be given to supplementary planting with planting stock from two degrees latitude south. This has shown to grow better than local planting stock and will be better suited under future climate change scenarios.

3.2 Prescriptions

3.2.1 Access

Current access should be sufficient for future felling operations.

See **Maps 3.2.2 (access) and 3.6 (entrance locations)**

3.2.2 Felling

No felling is planned during the 10 year period the LMP covers.

Phase	Proposed Felling	Area (ha)
Future felling	Felling will only be carried reactively following windblow. As the majority of the mature crop is Scots pine, which is a wind-firm, the need for clear-felling is expected to be low.	

3.2.3 Thinning

The Scots pine overstorey generally has very small crowns which is likely a combination of genetic factors and DNB. It appears wind firm and it is unlikely the basal area will increase much over the 10 years of the LMP. As a result, no thinning is proposed during the period the LMP covers.

Phase	Proposed thinning approach
Future thinning	When the birch understorey reaches a harvestable size (2030s), it will be harvested along with a final thin of the Scots pine over-storey to create a light environment suitable for under-planting.

3.2.4 Restocking/Regeneration

All restocking is planned through natural regeneration up until planting of the shade tolerant conifers in the later 2030s.

Phase	Proposed approach	Net Area (ha)
Future restock	Shade tolerant conifers to be under-planted beneath Scots pine canopy. The main species to be planted will be Norway spruce, European silver fir, Pacific silver fir and Douglas-fir.	

See **Map 5.2 Future Species & Restock**

3.3 Monitoring

Where successor crops are sought via natural regeneration, it is essential to track the development of the stand over time, in order to allow an objective assessment of the success (or failure) of regeneration, and to determine whether planting interventions may be required. Monitoring in Carnock, via a IN45 assessment, will likely be on a 10 year cycle, until shade tolerant species are introduced, due to the slow growth of the overstorey.

The following information should be gathered during the next design plan period:

	2026	2036	2046	2051
Overstorey species				
Overstorey N [trees/ha]				
Overstorey BA [m2/ha]				
Overstorey C° [%]				
Saplings species				
Saplings N [trees/ha]				
Saplings N damaged				
Seedlings species				
Seedlings N [trees/ha]				
Seedlings N damaged				
other vegetation: type				
other vegetation: cover [%]				

Appendix VII: Dean LISS Plan

1. Contents

1.0 Introduction

All 79.5 ha of Dean are well suited to LISS. The specific silvicultural system employed is likely to vary between the amenity/riparian areas and productive areas. The management area already has a high diversity of species and age classes.

See **Map 5.1 Dean silvicultural systems**

2.0 Current Situation

2.1 Ground Conditions

2.1.1 Soil Types

The majority of the site comprises of surface-water gleys and typical brown earths, often with a gleyed phase. There is a small area of typical podzol, some of which is gleyed in the centre of the management area and on the northern edge there is an area of *Juncus articulatus* bog.

2.1.2 Aspect

The majority of Dean has a southerly aspect, which should be generally beneficial in terms of light and warmth for potential natural regeneration.

2.1.3 Slope

The majority of the site has no slopes that would prevent use of a harvester-forwarder. However, there is a steep sided valley running north to south through which the Pitfirrane Dean burn runs. Some of this is currently forested with Norway spruce though this will removed and the steep, valley area will be left as a mix of long term retention and riparian.

2.1.4 Ecological Site Classification (ESC)

Soil Nutrient Regime (SNR) is three (Medium) and the Soil Moisture Regime (SMR) is three (moist), making the site suitable for a wide range of tree species.

2.1.5 Vegetation

Due to the fertility of the soils, ground vegetation is very competitive, frequently acting as a barrier to the establishment of natural regeneration. As a result, careful management of the overstorey is essential.

2.2 Wind Risk

DAMS scores across Dean range from sheltered to moderately exposed (9-14.2). The general absence of windblow across the site suggests the area is sufficiently sheltered for thinning. Where windblow has occurred it has tended to be in the flat rooting spruce species (both Norway and Sitka spruce).

2.3 Stand Details

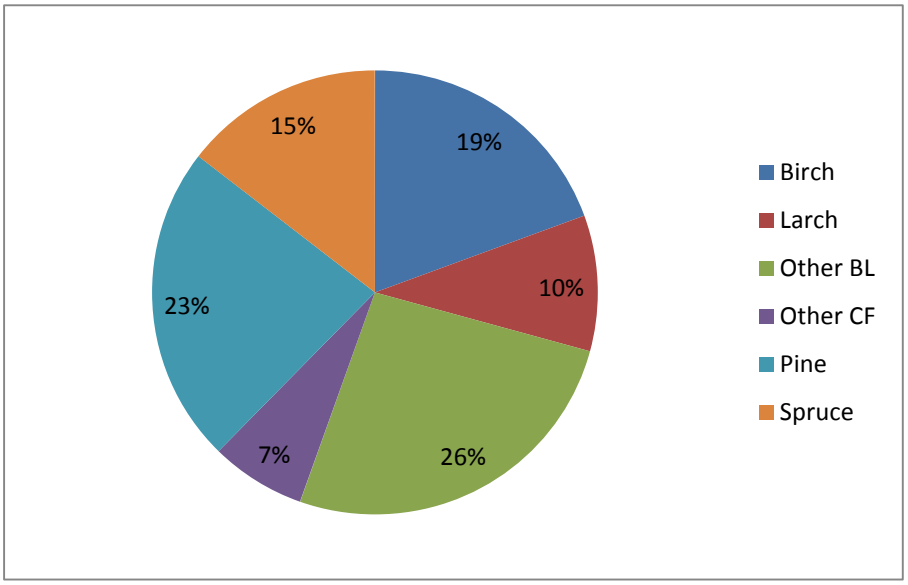
2.3.1 Species Composition

There is a fairly even split between conifers and broadleaves in Dean, with a high diversity of species represented.

Table 1 – Species Composition

Species	Area (ha)
Ash	3.8
Alder	0.2
Birch	13.7
Douglas-fir	2.6
European larch	0.2
Hawthorn	0.5
Hybrid larch	4.7
Japanese larch	2.1
Lodgepole pine	2.7
Mixed broadleaf	3.6
Norway spruce	6.7
Oak	0.4
Scots pine	13.7
Siberian spruce	1.2
Sitka spruce	2.4
Sycamore	6.7
Western hemlock	2.3
Willow	3.2
Total (ha)	**70.7**

Figure 1. Species Composition

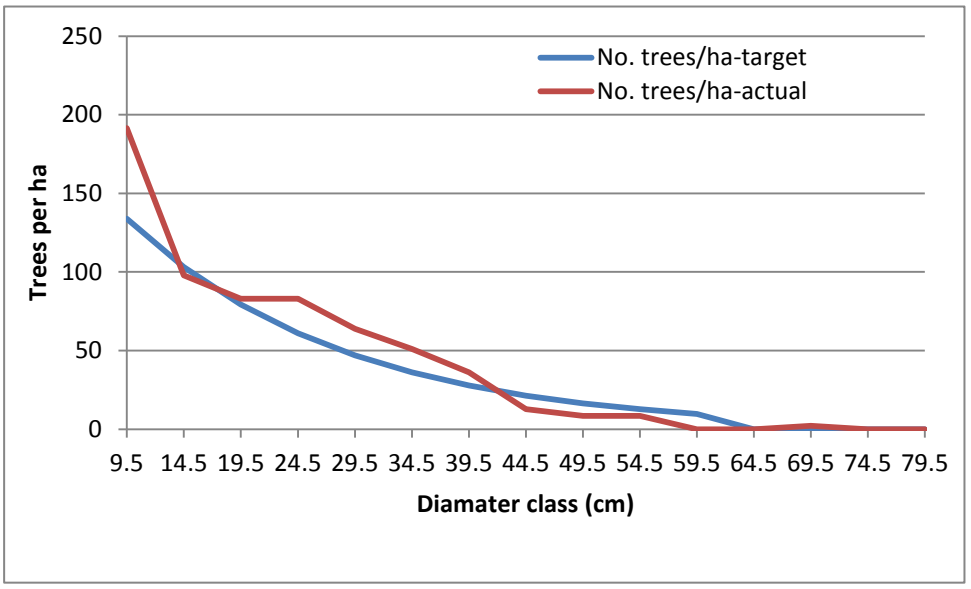


2.3.2 Age Class Structure

The area currently has a spike in the 41-60 years age class. This is a result of plantings being of a similar age and the move towards LISS being relatively recent. Additionally, much of the regeneration occurring beneath a mature canopy is not currently captured in the SCDB.

Figure 2. Age class by area of Dean

Figure 3. An ideal versus actual diameter-frequency distribution



A simple way of assessing stand structure is to look at a diameter-frequency distribution for the area you are managing (fig 3). Stands managed under CCF/LISS typically show a negative exponential or “reverse-J” shape with many small trees and very few large trees. The whole of Dean was assessed as part of an IN45

survey in 2016. The red line in figure 3 shows the actual diameter-frequency distribution for Dean which shows a roughly negative exponential shape.

Another useful tool is an ideal diameter-frequency distribution which can be compared to actual stand structure. The blue line in figure 3 shows the ideal line which is generated by choosing three stand parameters associated with CCF management; the target diameter at felling, target basal area and q (the ratio of trees in one diameter class divided by those in the next, larger class, which is typically 1.3 for UK conditions).

By comparing the two lines, you can establish where there are too few/many trees which in turn informs management. In the case of Dean, there are too many trees being recruited from the sapling class into the smallest diameter class, too many trees in the 19.5 – 39.5 cm diameter classes and then two few trees in the larger diameter classes.

2.3.3 Thinning History

Since 2003, Dean has been thinned on two occasions. Firstly in 2008 by a standing sale via Scottish Woodlands which involved a general, intermediate thin, windblow clearance and the removal of some Western hemlock areas. The Western hemlock was targeted due to its prolific natural regeneration which was viewed as undesirable at this site.

The next thinning, done by a DP contractor, occurred in 2013 and also involved some minor windblow removal.

2.3.4 Regeneration Potential

The IN45 survey that took place in 2016 also assessed regeneration in terms of seedlings (<1.3m high) and saplings (>1.3m and <7cm DBH). The main species of seedling were birch (255 ha^{-1}), Sitka spruce (177 ha^{-1}), ash (449 ha^{-1}), holly (196 ha^{-1}) and willow (136 ha^{-1}). The average number of seedlings per hectare was 981 ha^{-1}.

The main sapling species were birch (530 ha^{-1}) and willow (194 ha^{-1}) with an average saplings per ha of 1523 ha^{-1}.

The basal area of the stand is 33 m^2 ha^{-1} which is slightly too high for light demanding species and those of intermediate shade tolerance. In addition to this, the good soils at Dean mean that there is considerable competition from other ground flora species.

2.4 Current Access

A forest road (category A & B) runs from the eastern edge, extending about two-thirds of the length of the management area. As a result, there are some areas greater than 500m (the economical forwarding distance) from the forest road in the south and west. This has implications for future stand management.

3.0 Management Proposals

3.1 Long Term Vision

Consolidating areas

Dean has a very mixed set of species, often with the mixture being intimate, or blocky at a very small scale (10-20m). This presents a number of challenges to management due to differing site requirements and inter-species competition. Future management should try to ensure a similar level of species diversity is maintained but with species grouped into manageable areas to simplify interventions. This will be achieved through thinning out species that are currently in intimate mixture and ensuring future planting of a particular species is done in discrete blocks rather than intimate mixtures.

The use of CCF

The approach to long-term management will utilise CCF, and specifically employ silvicultural systems including uniform shelterwood and group selection systems. In the short-term (next 5 years) a number of small clearfell operations will be carried out. These will focus on windblown/unstable Norway spruce and western hemlock which is regenerating profusely within the riparian area.

As previously outlined, there is a high diversity of species within the management area. However, many of these species are light demanders (Scots pine, Lodgepole pine, hybrid larch and Japanese larch) which presents challenges in achieving successful regeneration beneath an existing canopy. Furthermore, the pine species are infected with DNB and there is the threat of infection from *Phytophthora ramorum* in larch. As a result, the introduction of shade tolerant species would aid the transformation to CCF. Possible suggestions are similar to those at Carnock and include Lawson/Leyland cypress (LC), western red cedar (RC), European silver fir

(ESF), Pacific silver fir (PSF), Grand fir (GF), Douglas-fir (DF), Grand fir (GF), Noble fir (NF), Norway spruce (NS) and Coast redwood (RSQ). However, most of these species are palatable to deer and PSF and ESF are both initially slow growing, further compounding the problem of potential browsing.

The move from light-demanders to shade tolerant species will be introduced through phased under-planting of the SP and larch. The basal area of Dean (as of 2016, IN45 survey) is approximately 33m^2 ha^{-1} so depending on the timing of operations and species choice, thinning of the overstorey will be required prior to underplanting. Of the existing regeneration, birch is not ideally suited to CCF management and ash is affected by *Chalara* which leaves Sitka spruce and holly. This natural regeneration should be utilised where possible but the densities are such that supplementary underplanting will be required.

In the broadleaf areas, oak is the favoured species due to the good soil conditions. Managing oak, a light demanding species, will require the use of a group selection system. Within these groups oak will be planted at high density (>5000 ha^{-1}) or in "nests". The latter option is favoured as it will provide the benefits of high-density planting but with far fewer trees. Oak "nests" are small, high density (1-2m spacing) groups of 21 trees. Surrounding these groups a ring of other broadleaves such as hornbeam or small-leaved lime is planted (16 trees). The hornbeam and small-leaved lime should attract the majority of browsers, thereby minimising browsing damage to the oak. The long-term aim is to produce one final-crop oak tree per group. Between the groups the ground can be left to naturally regenerate or planted with species of a shorter rotation such as wild cherry, which can be planted at a much lower density due to its apical dominance.

Enhance the riparian corridor

The other main management area is the riparian corridor following the Crossford burn. The burn flows through a deep gully that restricts future management interventions. As a result, an area outside of the riparian zone will be maintained as

amenity/minimum intervention woodland. It will be wet woodland utilising common alder, downy birch and willow (W7).

In addition to this, an area to the south of the management area (>500m from the forest road) will also be left as minimum intervention, with the conifer species selectively removed to leave native broadleaves such as oak, birch, rowan and hazel (W11).

3.2 Prescriptions

3.2.1 Access

Current access is poor to the south and western end of the management area. However, there is potential to develop access via the Pitdinnie road that passes its western edge.

See **Maps 3.2.2 (access) and 3.6 (entrance locations)**

3.2.2 Felling

There are several small areas scheduled for clear-felling over the next few years. These include the WH areas and the unstable and windblown NS which will be felled at the time of next thinning (2018/2019).

See **5.1 Dean management map**

Phase	Proposed Felling	Area (ha)
1 (2018-2022)	Approximately 1386 m^3 obs from Western hemlock mini-coupes (with minor amounts of birch and Norway spruce).	2.2ha
1 (2018-2022)	Norway spruce windblow and unstable NS to the north yielding approximately 665 m^3 obs	1.29 ha
Future Felling	Felling will only be carried reactively following windblow.	

3.2.3 Thinning

Most larch and pine throughout the management area will be thinned with an aim to underplant with shade tolerant conifer species. In the broadleaf areas thinning will occur to facilitate the establishment of regeneration. However, where species like oak are to be favoured, a group selection system will be employed.

Phase	Proposed thinning approach
1 (2018-2022)	31.8 ha of the easier accessed areas in the east and centre of the management area, yielding approximately 1228 m^3 obs. The approach will be a standard intermediate thinning at this stage, with the aim of improving the below-canopy light environment to aid natural regeneration.
Future Thinning	Thinning will take place periodically at Dean on a 5-10 year cycle depending on the growth of the overstorey. Target basal areas will be chosen to promote natural regeneration and to ensure under-planting is successful. In broadleaf areas group selection shall be employed, with the group width typically being at least twice the height of the canopy.

See **5.1 Dean management map**

3.2.4 Restocking/Regeneration

Soils are better than at Carnock and therefore there is higher competition from ground flora. As a result scarification or hand screefing may be needed and species choice, despite being larger than Carnock, may be limited to faster growing species (potentially excluding most fir species). In the conifer areas underplanting will be essential to change from a light demanding – shade tolerant set of species. In the broadleaf areas, regeneration should be utilised where it occurs but supplementary planting will be required. In both cases, direct planting is favoured, though if competition from ground flora proves unmanageable, ground preparation such as hinge mounding using a small machine may be employed.

Phase	Proposed approach	Net Area (ha)
1 (2018-2022)	Western hemlock area (net planting area 85% of gross clearfelled area)	1.87 ha
1 (2018-2022)	Norway spruce area (net planting area 85% of gross clearfelled area)	1.1 ha

Future restock	Underplanted species will have medium-high shade tolerance and include Norway spruce, Douglas-fir, European silver fir and Pacific silver fir. These will be planted following thinning operations to ensure the light environment is suitable.	

3.3 Monitoring

Where successor crops are sought via natural regeneration, it is essential to track the development of the stand over time, in order to allow an objective assessment of the success (or failure) of regeneration, and to determine whether planting interventions may be required. Monitoring, using the IN45 methodology, will likely be on a 10 year cycle, until shade tolerant species are introduced and/or greater amounts of natural regeneration establish. This is due to minimal change in the overstorey diameter distribution due to slow growth.

The following information will be derived from the more detailed IN45 monitoring which is due to take place in 2026.

	2026	2036	2046	2051
Overstorey species				
Overstorey N [trees/ha]				
Overstorey BA [m2/ha]				
Overstorey C° [%]				
Saplings species				
Saplings N [trees/ha]				
Saplings N damaged				
Seedlings species				
Seedlings N [trees/ha]				
Seedlings N damaged				
other vegetation: type				
other vegetation: cover [%]				

Appendix VIII: Relevant Reference Documents

In addition to those already referenced within the main text the following key policy or guidance documents which have influenced this plan are listed here:

- UK Forestry Standard (4th Edition)
- UK Woodland Assurance Standard 3.1
- Scottish Forestry Strategy 2017
- Scottish Lowlands Forest District Strategic Plan 2014 – 2017
- SNH Landscape Character Assessments for Fife 1999
- Landscape Character Assessment and Landscape Designations: Supplementary Guidance SG09 – July 2015
- FC Bulletin 62 – Silviculture of Broadleaved Woodland
- FC Bulletin 115 – Alternative silvicultural systems to clear cutting in Britain: A review
- FC Bulletin 112 – Creating New Native Woodlands
- Kerr, G and Haufe, J (2016) Successful Underplanting
- Kerr, G and Haufe, J (2010) Thinning practice: A silvicultural guide
- Ecological Site classification: A PC-based Decision Support System for British Forests 2001
- FC Practice Guide 3 – The management of semi-natural woodlands: 3. lowland mixed broadleaved woods
- FC Practice guide 6 - The management of semi-natural woodlands: 6. upland birchwoods
- FC Practice Guide– Forest Design Planning: A guide to good practice 1998
- FC Practice Guide 17 – Managing and controlling invasive rhododendron
- FC Practice Guide 20 – Managing deadwood in forests and woodlands
- FC Research Note 30 - Choice of silver birch planting stock for productive woodlands
- FC Information Note 45 - Monitoring the Transformation of Even-aged Stands to Continuous Cover Management
- Scottish Lowlands Forest District Deadwood Policy 2012
- Scottish Lowlands Forest District Deer Management Strategy
- Forestry Commission Scotland - Rhododendron control strategy for the national forest estate in Scotland 2011
- FC Practice Note – Managing Forests as red squirrel strongholds
- Dean Plantation and Balgownie Wood, Fife. Archaeological Survey. 2007
- Lee, S. (2017) Choice of silver birch planting stock for productive woodlands. FR Practice note

**Most of the documents listed are available online through their respective sources but are also available on request from SLFD.*