

Diploma in  
Permaculture  
Design 8

CREATING A  
TRADITIONAL  
ORCHARD.

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# OVERVIEW OF DESIGN TO CREATE A TRADITIONAL ORCHARD

## Design Aims and Objectives

To design and plant an orchard on large rootstock trees with both fruit and nut trees with the aim of producing:

- A high diversity habitat that might eventually gain priority habitat or county wildlife site status and some protection.
- A diverse crop of fruit, nuts, berries and other plants.
- Some heritage varieties.
- Some varieties known to be long lived, so creating veteran tree habitat.
- Produce that can be harvested over a very long season.
- Produce, suitable for as many uses as possible
- Sunny and dappled areas for camping and leisure that have a good view of lake and sense of place
- Fairly low requirements for management with the possibility of grazing as a management strategy.

## Project Outline

To design, plant and maintain approximately two acres of orchard and nuttery.

## Design Outline

- 1) Assess the site.
- 2) Learn more about fruit and nut trees.
- 3) Choose rootstocks suitable for the situation.
- 4) Choose species, cultivars and varieties
- 5) Design a rough layout for the trees to be planted.
- 6) Buy or graft chosen trees.
- 7) Plant trees
- 8) Care for the trees
- 9) Care for the grassland and soil.

## Accreditation and Complementary Criteria involved

**Demonstrating Design Skills.**

**Site Development**

### Holmgren Domain involved

**Land and Nature Stewardship**

### Permaculture Ethics and Principles involved

- **People Care, Earth care, Fair shares**
- **Observe and interact, Catch and store energy, Obtain a yield. Apply self-regulation and accept feedback. Use and value renewable resources and services, Produce no waste, Design from pattern to detail. Integrate rather than segregate. Use small and slow solutions, Use and value diversity, Use edges and value the marginal. Creatively use and respond to change.**

These are looked at in more detail in my [Assessment of how this design meets the ethics and principles of permaculture](#)

## Methods used

**Thinking tools:** Mind-maps, PNI (Positives-Negatives-Interesting)

**Design frameworks:** OBREDIMET (Observe-Boundaries-Resources-Evaluate-Design-Implement-Maintain-Evaluate-Tweak), **Incremental design**

**Survey techniques: Scale of Permanence, PFASTE (Plants-Fungi-Animals-Structures-Tools-Events), DAFORL (Dominant-Abundant-Frequent-Occasional-Rare-Local)**

**Evaluation: ALC (Design-Implement-Observe-Reflect - went well, challenging, goals, next steps?).**

### **Results Summary**

The design process involved a huge amount of research during the observation phase and as a result I have learnt a lot. The implementation of the design is creating a diverse orchard and nuttery for the future. It will be a few years before there is a worthwhile fruit and nut crop from this project but it is already giving great pleasure and the trees are growing well. I have also gained confidence as an orchardist.

### **Evaluation Summary**

The design process OBREDIMET along with Incremental design of details was perfect for this situation. The project, all the research and things I learnt from orchard enthusiasts highlighted the importance of the Observation phase. This is looked at in more detail in my [Assessment of this Design](#).

### **Reflection**

Old traditional ways of doing things often look simple to newcomers but when you start to investigate you come across the accumulated knowledge of generations. What can be found on the internet doesn't begin to cover what is known - and is often wrong. I know now to find enthusiasts who are actively involved for local knowledge and buy the books that enthusiasts who (have tried and tested the methods and done the research) write. This was a challenging project. Passing on the love and knowledge (**dissemination**) and paying back (**symmetry**) for all that people have shared with and taught me is another phase I try to do with voluntary work for a number of orchard groups.

### **Self-Assessment**

My assessment of how successful the design and my learning session were and how it fits with the assessment criteria is analysed in my [Assessment of this Design](#).

# INTRODUCTION

I had been looking for a piece of land for about 5 years before finding approximately 6 acres in Norfolk that I felt would make a good edible nature reserve and somewhere for camping. It is not ideal for fruit as it has a slight North facing slope and is in the bottom of a gentle valley. However, on the plus side there was some woodland, a stream and small lake on site. The soil is wonderfully peaty on a clay base, drainage appeared to be good and the site feels secluded being up a field track and well away from any busy roads. I fell in love on first sight, I looked at the wonderful soil the moles had heaped up, had a check on what plants were around and telephoned the estate agent with an offer of the asking price within an hour of seeing it. By that afternoon I had put down a deposit. So after 5 years of observing many sites it was time to follow my excitement and jump in.

Having already read quite a bit on orchards and biodiversity I wanted to create an orchard with Traditional Orchard features because of their high biodiversity and the shocking decline in their numbers. Traditional orchards were recognised as a UK Priority Habitat in 2007 and are one of a list of 65 habitats in urgent need of conservation action <http://jncc.defra.gov.uk/page-5706> . They also make an important cultural and visual contribution to the landscape as well as providing a crop and a wonderful place to be. I was keen to be a part of the movement to protect, restore and re-create traditional orchards and their associated wildlife features. I considered making a forest garden in this area but felt that a traditional orchard and nuttery with some understory of useful and beneficial plants would be better suited to the circumstances at the moment.

The aims of this project are to design and plant an orchard on large rootstock trees with both fruit and nut trees with the aim of producing:

- A high diversity habitat that might eventually gain priority habitat or county wildlife site status and some protection.
- A diverse crop of fruit, nuts, berries and other plants.
- Some heritage varieties.
- Some varieties known to be long lived, so creating veteran tree habitat.
- Produce that can be harvested over a very long season.
- Produce, suitable for as many uses as possible
- Sunny and dappled areas for camping and leisure that have a good view of lake and sense of place
- Fairly low requirements for management with the possibility of grazing as a management strategy

Figure 1 Plan of land showing position of orchard



Figure 2 Looking East from promontory in lake.



Figure 3 Looking West from promontory in lake.



# DESIGN

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## Observation

The observation aspect of this design has been a very major part of it. I had been reading about orchards and decided that if any land I found was suitable for top fruit growing I'd plant a traditional orchard. Having bought the land I started on some proper orchard research and discovered that the more I knew the more I realised I didn't know. There was so much to learn and remember. It was good to be able to observe the land over a full year's cycle before making decisions. The scale of permanence was analysed with the help of the [table](#) created by Steve Gabriel (1) which is based on Yeoman's Scale of Permanence updated by Dave Jacke and Eric Toensmeier. The order within the scale varies with site, the following list relates to the orchard site - 1) Climate 2) Landform 3) Water 4) Soil 5) Access and Circulation 6) Vegetation and Wildlife 7) Microclimate 8) Zones of Use 9) Aesthetics and Experience 10) Buildings and Infrastructure.

## Scale of permanence analysis of site

### 1) Climate

**Plant hardiness** - Zone 8.

**Frost period** - Mid November - late April

**Precipitation/distribution** - Much of Eastern England receives less than 700 mm per year and includes some of the driest areas in the country. There is a much more even distribution of rainfall throughout the year than in most other parts of the UK. Eastern England is one of the more sheltered parts of the UK

<https://www.metoffice.gov.uk/climate/uk/regional-climates/ee>

**Latitude** - 52.5 degrees

**Extreme weather potential** - This is no more likely than most of eastern England.

**Predicted climate changes** - May get more erratic and extreme. On average it is likely to be warmer.

**Dominant winds** - SW with N-NE cold winter winds.

### 2) Landform

**Elevation** - 30m (2)

**Slope** - very gentle with a few level areas

**Aspect** - North

**Position** - It is situated near the head of a very shallow valley close to a stream.

### 3) Water

**Existing sources** - Stream nearby, which is said to not quite dry out, and small lake.

**Potential sources** - Mains supply could be put on as it is about 300m from site.

**Infrastructure: culverts, wells, water lines, tanks** - There are drainage channels on three sides of the orchard area with a lake on the fourth. All these drain into a stream on the far side of the lake.

**Erosion areas** - None.

**Drainage** - The land is surrounded by good drainage ditches on three sides and the lake on the fourth. The area where the orchard would go is mostly raised above the rest of the land and sloping down to the lake.

### 4) Soil

**Soil type** - Peat, of varying depths, on clay

**Structure, pH, % OM, depth** - The soil has a high peat content over much of the land. This is on top of a layer of clay and the peat probably resulted from the land having originally been bog-land and also from dredgings removed to make the lake. Cores revealed the peat to be from about 15-30cm deep in most places. There was an area on the edge of the higher land where the peat was about 40cm deep. The pH varied with patches being as low as 6.1 and others as high as 6.8 and changing to a bit higher when soil was taken from the clay layer. The percentage of organic matter

changed from high to low as one went from the peat layer to the clay layer which was quite a defined transition even though this was often only 15 cm below the surface.

**Management history** - Talking to locals it had been very boggy and had then been dug out to make a motor-cross bike track. It was then dug out more and drainage put in to create a lake, drained field and woodland area in 1991. The orchard area since this time has been grassland cut once a year for hay.

**Toxicity** - There is drainage from arable farmland just uphill so this may introduce some agrochemical pollution. The field may have been sprayed with broadleaf herbicides as there are fewer broadleaf weeds than expected on site There is no known reason for other toxic materials to be on site.

**Underground obstacles** - None known.

## 5) Access and Circulation

**Access points** - The main access to the land is to the SW of the site. This is wide enough for a small tractor or jeep with trailer of similar. There is footpath access in the SE corner. The woodland and stream area which is where the facilities are meets the orchard on its NW side and there is also access from the woodland on the NE corner of the orchard site.

**Materials storage & flows** - No materials are stored on the site..

**Vehicle/Cart/Foot access** - There is a public footpath along the south border of the site entering on the SW corner and exiting on the SE corner.

**Paths, roads, gates, etc.** - There is an open gate with no fencing around on the SW corner and a small bridge and gate for pedestrians on the SE corner.

**Desire lines** - As no one is living on site this is not such an issue but importantly access to the grassland/orchard area from the main access point in the SW corner and to the facilities in the NW corner will be needed for management and harvesting. If there is camping, as intended, in the central and eastern areas then there will be a pathway from these to the NW corner where all the facilities are. Access through the orchard to the woodland where the facilities are is the most used desire line and will probably remain so.

## 6) Vegetation and Wildlife

**Ecosystem types** - The site is basically a grassed field with a mixed hedge and some taller trees on the South side, a group of Ash trees on the SE corner with *Phragmites australis* running along the drainage ditch on the Eastern side, the lake and a pond with woodland behind on the North side and open land on the Western side

**Habitats** - Grassland, hedges, trees, drainage ditches, shrubs, lake, pond, reeds.

**Problem Species** - Ragwort (*Senecio jacobaea*), poison hemlock (*Conium maculatum*) and creeping thistle (*Cirsium arvense*)

**Old trees and rare plants** - On the neighbours land on the S border there is a partially dead ash tree which looks to be very old. The group of ash trees in the SE corner are large specimens and, as the land is in the centre of a highly infected area, may have a problem with Ash dieback caused by the fungus *Hymenoscyphus fraxineus*.

**Organisms:** A survey of the grassland showed that there are no protected or rare species, in fact it contained very few broadleaved plants and grass varieties. It looked as if the land had been sprayed to get rid of “weeds”. As a result it may have a damaged soil ecosystem due to spraying along with the removal of an annual crop of hay. It may be lacking in a good fungal community because of this, however there are plenty of mole hills indicating that the soil is probably healthy.

Table 1 PFASTE and DAFORL analysis of orchard site.

<b>ON ORCHARD SITE</b>	
<b>Plants</b>	<b>Dominant plants</b> = Grass species - <b>Occasional plants</b> ( not including those on the lake perimeter) = Broad leaved Dock ( <i>Rumex obtusifolius</i> ), Redshank ( <i>Polygonum persicaria</i> ), Cow parsley( <i>Anthriscus sylvestris</i> ), Hogweed ( <i>Heracleum mantegazzianum</i> ), Creeping thistle ( <i>Cirsium arvense</i> ), Ragwort ( <i>Senecio jacobaea</i> ), Stinging nettle ( <i>Urtica dioica</i> ), Dandelion

	( <i>Taraxacum officinale</i> ), Yarrow ( <i>Achillea millefolium</i> ), Broad leaved plantain ( <i>Plantago major</i> ). <b>Rare plants</b> = Hemlock ( <i>Conium maculatum</i> ).
<b>Fungi</b>	None found
<b>Animals</b>	Moles, nesting birds were not found but would most likely include pheasants, partridge. Hedge nesting birds are present around the site particularly wrens. There are a lot of insects around and the soil contains a good number of invertebrates. Using the Permaculture research soil test handbook worms were found at a mean of 3.4 per 20X20X10 cm sample (5 samples) (3).
<b>Structures</b>	Gate at SW corner and small bridge and stile at SE corner
<b>Tools</b>	None
<b>Events</b>	None.

Around the grassland the area is diverse with a lot of good wildlife habitat. Roe and Muntjac deer are frequently seen on site as well as the occasional hare. There is a fox den on the NW corner and there are no signs of rabbits.

## 7) Microclimates

**Wind (directional and combinational sectors)** - The grassland area is protected from the winds in all directions with tall hedging with trees on the South, East and West and woodland to the North. There is a gap in the SW corner where wind may funnel in but the neighbour has planted mixed native woodland which will shelter this gap in the future.

**Sun/shade patterns (directional and combinational sectors)** - The hedging to the South may cause some shade for trees if planted very close but there is a footpath running down this side of the land which means that trees cannot be planted too close. Taller trees should be better in this area than shorter ones. The neighbours' woodland planting to the west may shade the western edge of the land in the afternoon in the future so needs considering. In general the land is sheltered.. Rain shadows should not be a problem.

**Frost pockets (combinational sector)**- The most problematical issue may be that the land may be in a frost pocket. It is in the bottom of a wide gently sloping valley and this may cause problems. The presence of the lake may buffer temperature extremes.

**Slope/aspect and affects (topographical sector)** - The land slopes gently to the North over most of the area with a few level areas. This means the soil will stay cooler for longer after winter and may not heat up as much during the summer but as the slope is very slight the affects will be small.

## 8) Social and Economic Factors

**Ownership & tenure** - The land is owned by myself.

**Property easements/right of way**- The only right of way is the public footpath along the S boundary. The neighbouring farmer on the S side has access rights to clear the drainage ditch.

**Available capital** - There is enough for the project if it is carried out over several years in person

**Municipal zoning & laws** . The land is amenity land so is unlikely to be granted planning permission for a dwelling.

**Neighbours** - There are three different neighbours. Two are farms with fields adjoining on the S and E boundaries. A house with a long (250m) area of field and newly planted woodland forms the W boundary.

**Local markets** - There are none very close by. There is a juice presser and cider maker approximately five miles away.

**Time** - This is available at the current time.

## 9) Zones of Use

**Property lines** - The boundaries are delineated with drainage ditches. The ones on the Western and Eastern boundaries belong with the land and are my responsibility to maintain. The southern boundary ditch belongs to the neighbouring farmer.

**Activity centres** - Currently, there are no activity centres. Other than the public footpath the edge of the lake tends to be the most used site

**Zones 1-5** - Currently the orchard site is zone 3 on the land as a whole with the hut zone 1 and the outside cooking and other facilities being zone 2. Within the site each tree could be regarded as zone 1 as they are what require most attention.

## **10) Aesthetics and Experience**

**Arrival experience** - The site feels secluded and natural rather than like a field. The lake with the woodland behind enhances the feel dramatically. The fact there are no roads adjoining the land and that the nearest road is very quiet helps create this atmosphere .

**View lines and corridors** - Views to the East and West can see neighbouring farms and it would be nice to screen these. Views to the North over the lake and woodland are lovely. In the SE corner there are some large Ash trees and the edge of the drainage ditch has an uneven growth of mixed shrubs which help to round off the straight line of the Southern border. As the site is in the centre of an area of high ash dieback planting this area should take that into consideration.

**Public/private continuum** - Although there is a public footpath along the Southern border this is rarely used and it does not come near the area where the facilities are, These cannot be seen from the footpath. Although people are meant to stick to the footpath they often go through the site to have a look at the lake.

**Ease of navigation** - The land is difficult to reach by car as the access strip to it gets boggy but once on the site vehicles can go wherever they like. There are no defined paths and access to everywhere is easy if the land is mown twice a year.

## **11) Buildings and Infrastructure.**

**Fences & gates** - These are the only infrastructure other than the drainage ditches. There is a pedestrian gate in the SE corner with a small bridge going over the drainage ditch to access it. A gate with no fencing around it is in the SW corner and drainage ditches are on the S, E and W sides.

## **Collecting and summarising information**

It was important to first work out exactly what was wanted from the orchard but this required more knowledge about orchards and land management to adequately identify the desired goal. This involved a lot of reading and the attending of workshops, talks etc. Part of this process involved doing the Permaculture Design Certificate course, joining orchard groups, volunteering and meeting those incredible orchard enthusiasts who are eager to share all they know. This period was a steep learning curve and to keep some hold on all the information that needed to be considered mind-maps were made. This mind-map making was not just for the one orchard site, while doing the research it made sense to make multiple gains by making the mind-maps applicable to other types of orchard as well and put it on my web site, particularly for those starting community orchards. It will not be 100% complete but it acts as a good thinking aid and reminder of things to consider when designing an orchard. It covers nine areas requiring consideration: **The Site, Planning for Purpose, The Trees, Roots and Rootstocks, Varieties and Cultivars, Pollination, Other Plants, Other Features and Issues, Management.**

## **Goal clarification**

During this long observation process decisions on what was wanted from the project were clarified, These were:

- A high biodiversity habitat that might eventually gain priority habitat or county wildlife site status and some protection.
- Fruit, nuts, berries and other foraging, maintenance and wildlife plants.
- Some local heritage varieties.
- A long season of produce to pick
- Produce that keeps over a long period.
- Produce, suitable for as many uses as possible
- Sunny and dappled areas for camping and leisure with a good view of lake and sense of place
- Low requirements for management with the possibility of grazing as a future strategy.



## Evaluate

### Positives:

The site is likely to be good for a traditional type of orchard with fruit and nut trees. It is reasonably sheltered, it is in good orchard country, the soil is good and the pH is correct. The land appears to be well drained.

The surrounding features of the site make it a place that is a pleasure to work and stay in.

The natural water sources for watering young trees is present all year round.

### Negatives:

Frosts are my major concern, however, as the trees are on large rootstocks and generally on higher ground they may miss some of the frosts. I am not aiming for it to be a serious commercial orchard.

I am a little concerned about the soil not being solid enough to hold the trees up but I have asked an experienced orchardist and he thinks that with good sized rootstocks and strong staking for the first years, until the roots get down, this shouldn't be a problem.

The soil appears to be very fertile, judging by grass growth and this may make it more difficult to get a nice diverse sward under the trees. Ragwort, Nettles, Broad leaved dock and creeping thistle are likely to be a problem in the grassed area. Ragwort and Hemlock (both toxic) and creeping thistle, by law, need to be controlled to prevent them spreading to agricultural land and particularly grazing land - as surrounds my land. In the field adjoining to the East there are Suffolk Punch horses which are rare, expensive and much loved and so injurious weed control will be a high priority on my management regime. The spread of broad leaved dock also needs to be stopped from spreading to adjoining land.

I live 50 miles from the land.

The access strip to the land can only be driven down in my van in summer when the ground is hard.

### Interesting:

Some of the local people think I'm a bit crazy buying land to manage as a nature reserve. People assumed I bought it for fishing - and still believed I was crazy as otters have been seen in the lake.

Living 50 miles from the land is enough to make it feel far away from home and it makes me plan for being there for many days at a time. If it had been closer I might be back and forth which I don't think would make it feel so much like the place to go to escape from the modern world.

## Design

Designing what to have and where to have it has been an incremental process. Every year more knowledge and opportunities for certain trees affect decisions. The need to design from pattern to detail has been conspicuous, deciding what species to include on what rootstocks going down to their, positioning, varieties, vigour, pollination requirements, compatibility, uses, season of harvest, tastiness, use and more. This is without integrating a surrounding pest predator and pollinator friendly environment, habitat boosters for wildlife or the growing of plants for various uses such as pest control, dynamic accumulators, mulch etc. Some spaces have been left for additional trees to be planted when the current ones are mature to allow for some diversity of age in the future.

The trees were not planted in lines as a more natural look integrated better into the environment, even though this makes mowing more complicated. Having decided on the basic outline it was better to decide final tree positions (and mark with a cane) while on the land rather than mapping on a plan. With small but important features such as flat patches for tents, small dips in the land and depth of peat at a planting position it was better that tree placement be led by the site than by a flat piece of paper. A very accurate GPS system, from Cambridge University, was used to map the final tree positions. The dark patch on the NW side of the orchard is a pond.

Figure 5 GPS mapping of site and tree positions

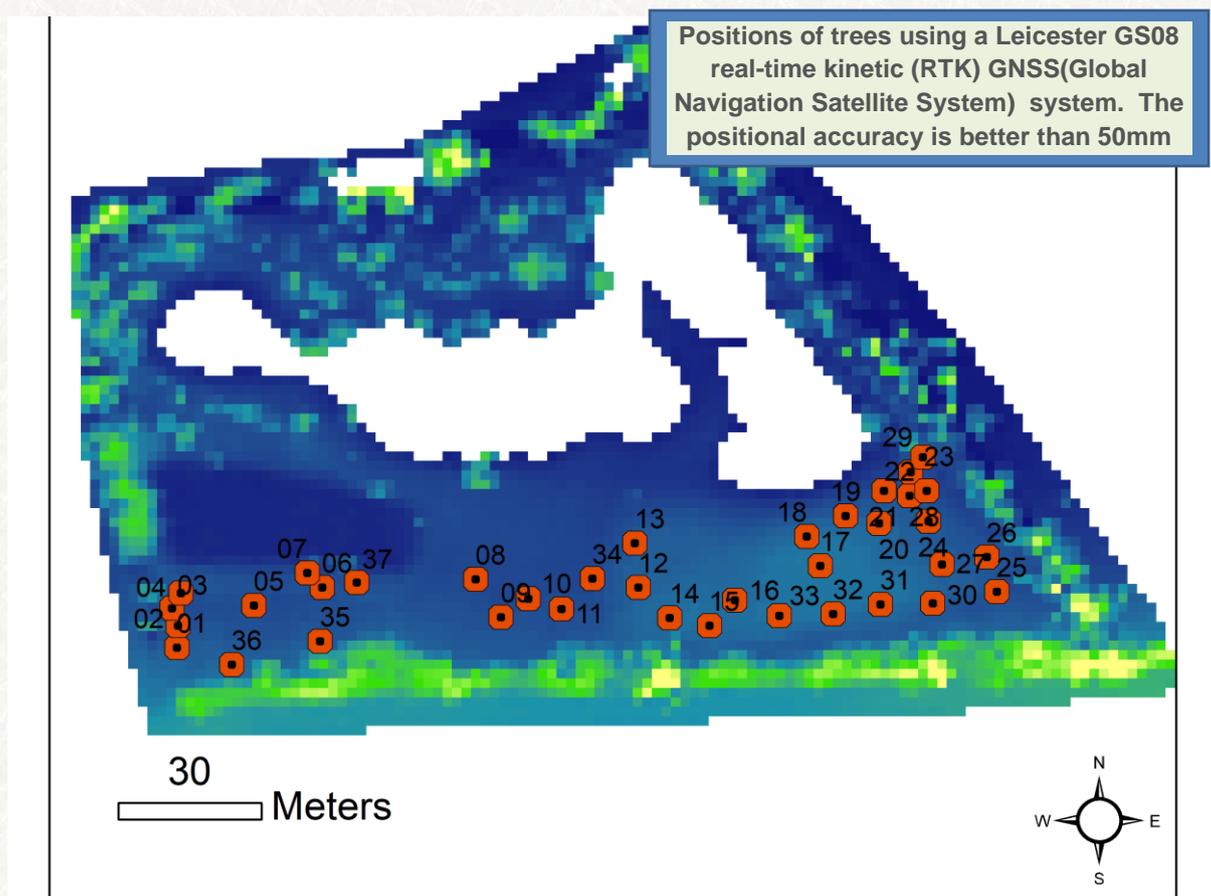


Table 2 Key to numbers on GPS map.

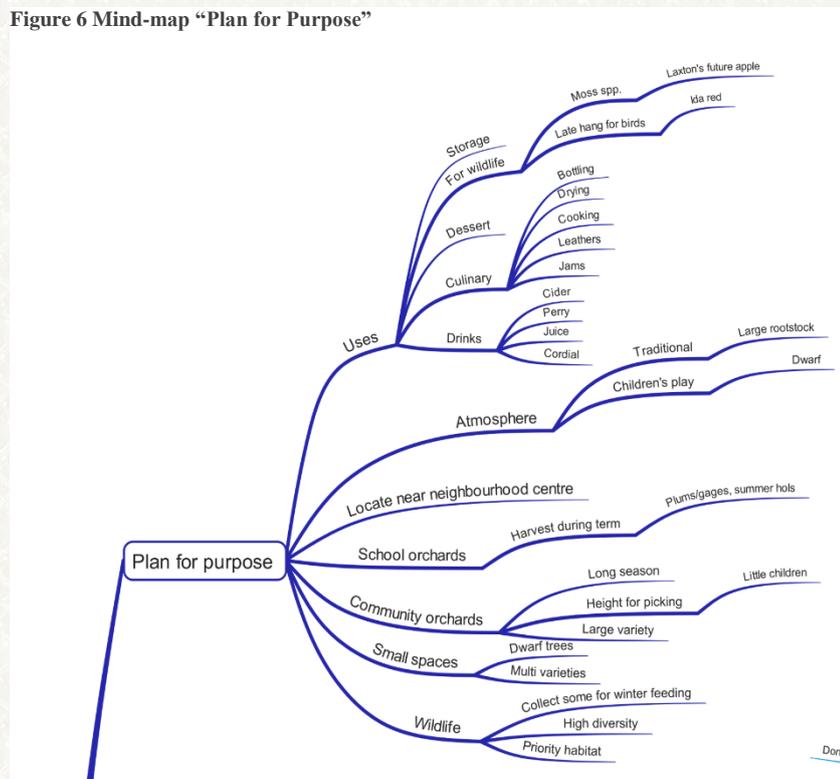
No on map	Tree	Rootstock
1	Hazel Webbs Prize Cob	
2	Hazel Corabel Cob	
3	Hazel Cosford Cob	
4	Hazel Kent Cob	
5	Walnut (red) "Rubis" ("Noyer Rouge")	<i>Juglans regia</i>
6	Almond "Ingrid"	St Julien A
7	Spindle	
8	Walnut "Broadview"	<i>Juglans regia</i>
9	Dead apple replaced with Trazel in large gap to west 2017-18	
10	Apple "?"	M25
11	Apple "?"	M25
12	Apple "Crimson Bramley"	M25
13	Apple "Late Gold" cider	M25 with inter-stem
14	Apple "Lady Henniker"	M25
15	Apple "Norfolk Royal Russet"	M25
16	Apple "Summer Broadend"	M25
17	Apple "Howgate Wonder"	M25
18	Apple "Howgate Wonder"	M25
19	Pear "Robin"	<i>P. communis</i>
20	Pear "Emile D Heist	<i>P. communis</i>
21	Pear "Winter Orange	<i>P. communis</i>
22	Pear "Black Worcester"	Pyrodwarf

23	Cherry Plum "Golden Sphere"	WA-VIT
24	Plum "Golden Globe"	Brompton
25	Plum "The Drooper"	Brompton
26	Bullace seedling from Landermere	
27	Gage "Old Green Gage"	Brompton
28	Pear "Gorham"	Pyrodwarf
29	Plum from Landermere	
30	Amber Heart (Kent Bigarreau)	F12/1
31	Apple "Genet Moyle" cider	M25
32	Apple "?"	M25
33	Apple "Chivers Delight"	M111
34	Mulberry "King James 1st"	
35	Plum "Belle de Louvain"	St Julien A
36	Cherry plum "Mirabelle de Nancy"	Wavit
37	Almond "Feragnes"	Myran
	Along the Eastern hedge line Cornus mas x 1 and Bladdernut x 2 planted 2017-18	

## Planning for purpose of orchard

The applicable points on this mind-map were considered, Having a long season of production, a wide variety of uses were of high priority.

Figure 6 Mind-map "Plan for Purpose"



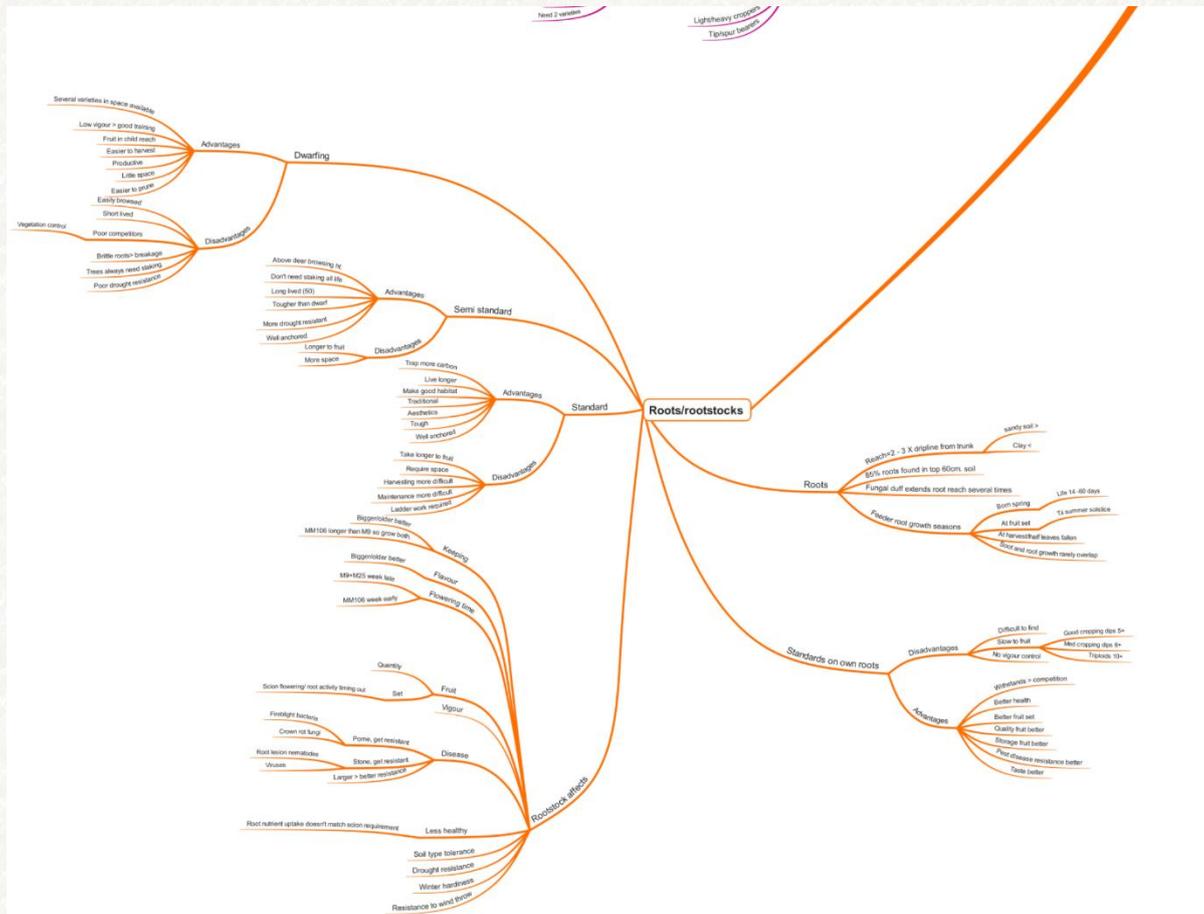
Planting an orchard is a long term investment but it is possible to make longer-lived orchards if the right rootstock and variety or cultivar is chosen. Thinking 7<sup>th</sup> generation, for this design many varieties were chosen because they are vigorous and long-lived by nature and will grow into large veteran trees of 200 years, given the chance. Some of the trees are shorter lived to give diversity over time. The overall design for this piece of land of which the orchard is a part promotes diversity. Apple trees in particular are good wildlife habitat and develop the beneficial characteristics of ancient trees relatively quickly. They break, form hollows and holes and carry dead wood, depending on variety



# Roots and rootstocks

The advantages and disadvantages of different rootstocks or own root trees were researched and summarised in the mind-map below.

Figure 8 Mind-map roots and rootstocks



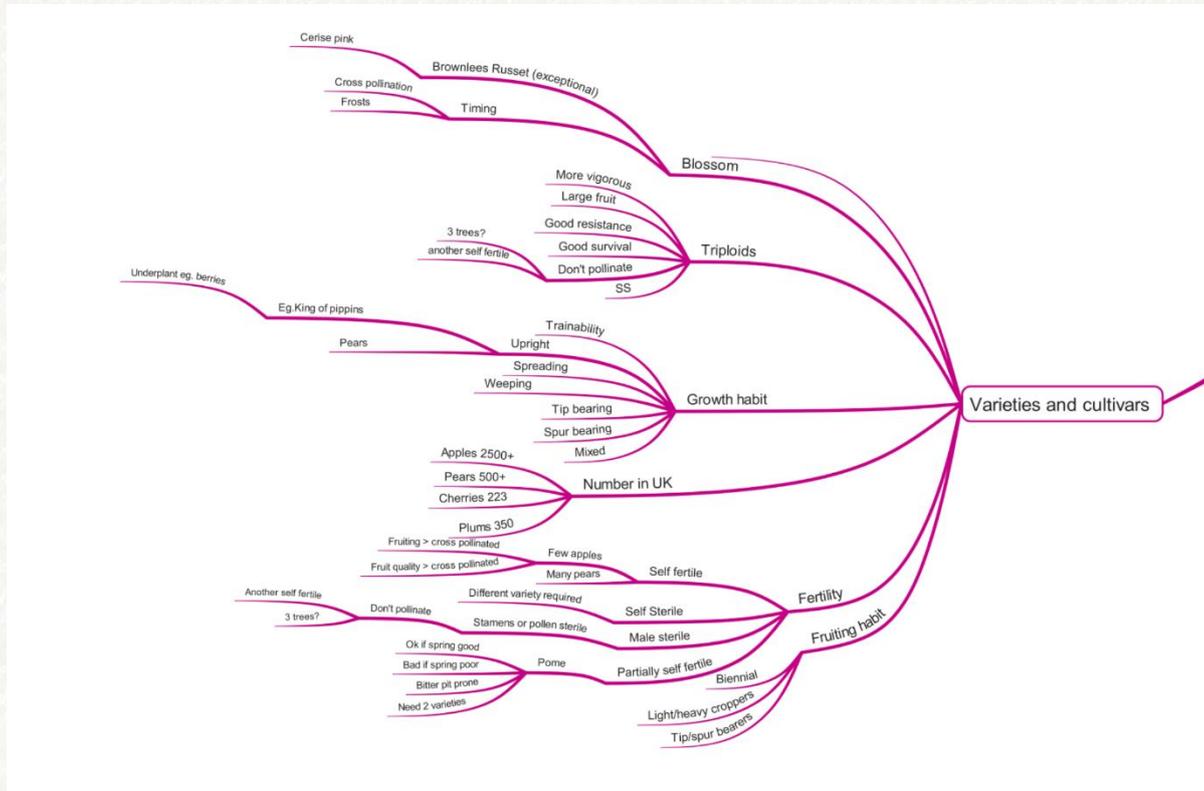
For this orchard large rootstocks were chosen for the majority of trees. These will be slow to come into fruit but fruit trees on half standard rootstocks were planted along the access strip to the land and these are already cropping so it is no real hardship to wait.

It was difficult to find many of the tree varieties on large rootstocks but by integrating contacts it was possible to create a win-win-win-win-win process. I help prune the [East of England Apple and Orchards](#) fruit library and I can have scion wood for all the East Anglian varieties. I have grafted some of my trees myself but a friend runs grafting classes to raise money for a local community orchard and has space to look after them at home. I can give her a lot of local varieties to offer the participants. She grafts my trees during the demonstration. I buy them back after a year for £10 (which goes to the community orchard) and pop them in my land.

## Varieties and cultivars

When choosing a variety or cultivar there are a lot of considerations apart from flavour, uses, keeping ability, pollination and time of fruiting. The mind-map below summarises these.

Figure 9 Mind-map "Varieties and cultivars"

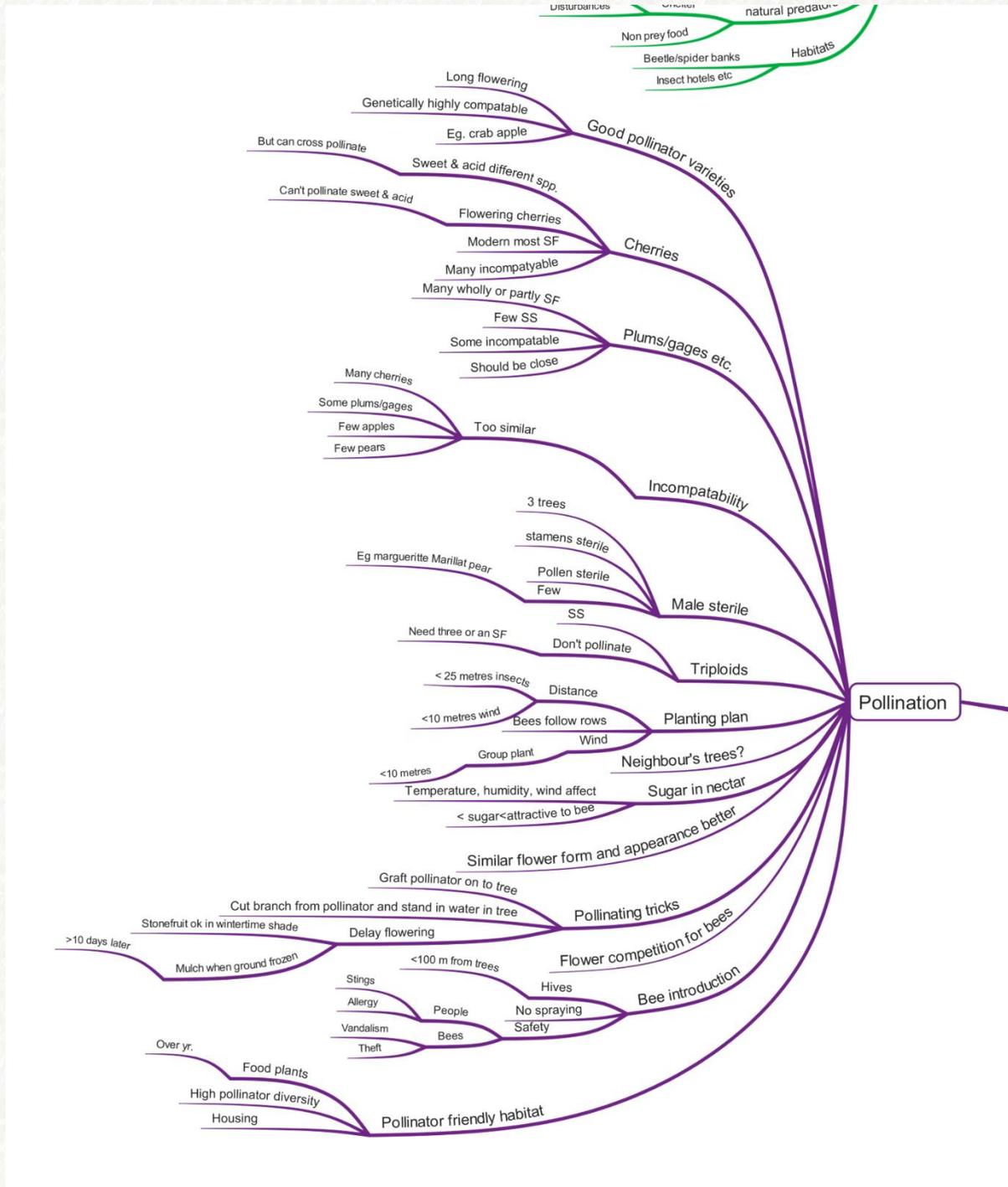


Variety affects the size and nature of a tree as well as its rootstock and the planting of trees with different vigour affects planting position and distance. Some very vigorous varieties that make good veteran trees were wanted as were a variety of shapes of tree to give more interest and increase diversity. A Crimson Bramley was planted on higher land in full view as one enters the orchard as it should make an exceptionally vigorous tree and be very beautiful when in flower and fruit. The walnut trees were kept apart from the fruit trees and a good distance from other trees due to their negative allelopathic properties and also because it may be possible to squirrel proof them by putting guards on their trunks - as long as they cannot be reached via tree crowns.

# Pollination

Pollination problems arise when varieties flower at different periods, are incompatible and can't germinate each other, are male sterile or are triploid with an unusual make up of chromosomes. Although many factors have to be considered when choosing trees to pollinate each other, when there are going to be a good mix of varieties nearby it gets easier to choose a new tree. With such a diverse range of varieties wanted pollination issues would not be such a problem when planning. The factors in the mind-map below were considered before choosing varieties and cultivars.

Figure 10 Mind-map "Pollination"

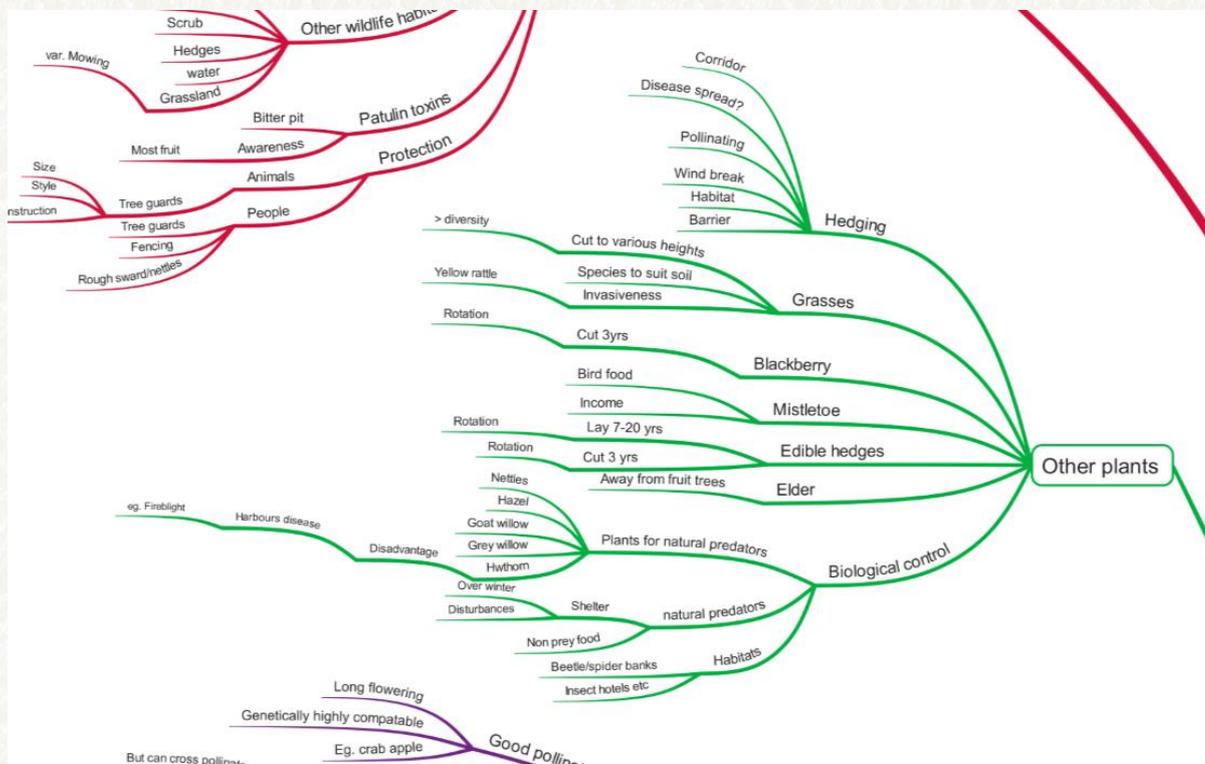


One requirement was to make sure that overall the trees flowered over a long period to increase the chances of some missing a frost and to please the pollinators too. This has not been as easy as it might appear as the vast majority of varieties actually flower in the same period.

## Other plants

Creating a diverse and stable environment around the orchard can improve its health and reduce pest and disease problems if considered carefully. The mind-map below considers some types of plants but is not complete. The addition of other plants to the orchard trees is an area that requires more research. The trees are well spaced allowing for the addition of additional beneficial plants.

Figure 11 Mind-map "Other plants"



**Grassland.** In terms of the grassland sowing some yellow rattle might reduce its vigour but having a vigorous grass that is cut and left to lie might be advantageous especially when the trees are a bit older and grazing might be a better land management strategy in the future. More research is required on this.

**Nutrients.** Boeking 14 Comfrey will probably be planted around the trees no closer than two to three meters apart and in patches around what will be the final drip line of the fully grown tree and perhaps further out as the roots and fungal hyphae extend beyond the drip line. There are issues with comfrey, in excess, possibly being toxic to livestock so levels of planting will be kept low(4).

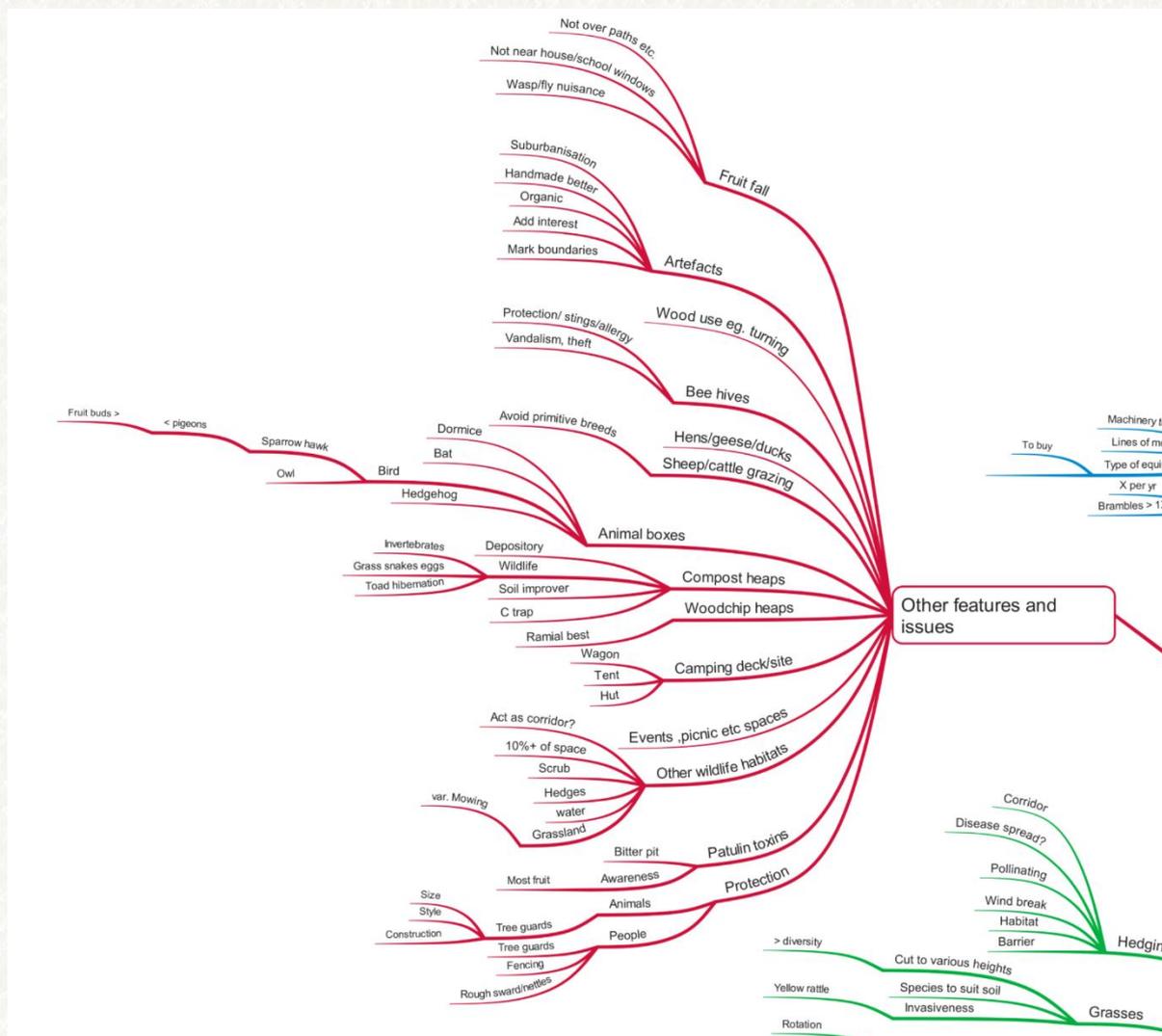
**Nitrogen fixers.** Clovers, vetches etc. will be sown and other nitrogen fixers will be planted, these include our native bog myrtle (*Myrica gale*) and a some varieties of Eleagnus species. The aim is to create a loose line of shrubs between the orchard trees and the footpath to make it clear where the footpath is. Some nitrogen fixing shrubs and others will also be positioned to add more structure to the environment for wildlife diversity and to create more of a sense of place where the flat areas suitable for camping are. The successful growth of the nitrogen fixing shrubs will be monitored before planting a lot.

**Natural pest predators, parasitoids and pollinators.** Plants beneficial to these will be grown throughout the land and habitat boosters to accommodate them for their whole lifecycle and over the year will be created.

## Other features and issues

There are many additional features that could be incorporated into the orchard over time and many of those found in the mind-map below have been considered.

Figure 12 Mind-map "Other features and issues"



Permanent sheep/deer proof tree guards will need to be made. The current guards will do a few years but are not resilient. The standard treated wood posts do not last very long term (and contain poisonous chemicals), untreated wood lasts even less time. This requires more research. When the trees are larger they may well be able to just have their trunks protected rather than a pen around them.

## Implement

Figure 13 Photograph of some of the trees in the orchard



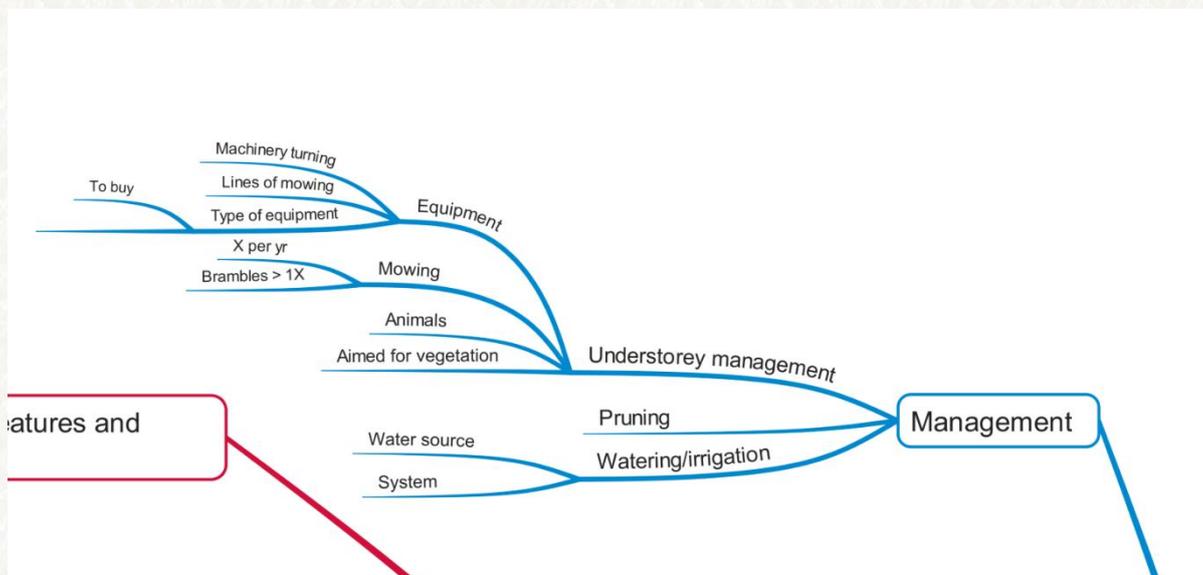
Most of the trees have been planted and are doing well, only one tree has died. The hazel are suffering from being eaten by weevils.

The *Cornus mas*, Bladder nut (*Staphylea pinnata*) and cherry plum “Golden Sphere” have gone in this winter (2017-18). There is one more apple tree planned for but this will need to be grafted/budded. It is an extremely late (Dec-Jan) hanging apple of good flavour (but not fully identified) from an orchard expert. A couple of Holm oak “Ballotta” (*Quercus ilex*) which have acorns that are low in tannins that can be eaten without serious soaking are growing elsewhere until large enough to plant out in 2019-2020.

## Maintain

Orchards do need maintaining and looking after but if they are non-commercial and are there as much for the environment as the produce this is less exacting, as long as one works with nature and uses biological methods.

Figure 14 Mind-map "Management"



**Grassland** is to be mown twice a year with the hay currently being left to rot and so increase the fungal content of the soil. Fruit trees are natural woodland edge plants where debris falls annually increasing the fungal content so this regime would to some extent mirror this. The first cut would be mid-July to miss the ground breeding birds nesting season and to catch the creeping thistle at its most vulnerable. A further cut would be in September or October when the fruit are ripe. Small areas of problem weeds are strimmed as needed. The ragwort and hemlock have been almost eradicated with hand pulling, this will continue as necessary. Whether or not it is sensible to use sheep to graze the grassland needs further research. Most of the neighbours have sheep and it may make sense for the lambing season and after fruit fall.

**Trees** have been grafted and bought in groups of about 10-15 over each year. This means they can be watered, maintained and pruned adequately and it is possible to work out from well managed areas.

**Planting** trees bare-root with a bought mycorrhizal fungi inoculum and spade full of the woodlands soil aims to work with nature hopefully ensuring that fungi are present to support the damaged roots and create a symbiotic relationship for the future. Watering-in with an isotonic solution of sugar (1 cup per gallon bucket of water) helps reduce transplant shock (perhaps by setting the mycorrhizal fungi off to a good start?) The trees need staking for the first few years and 1.2m high deer protection. Old bicycle tyre inner tubes are recycled as tree ties and apart from reducing consumption are ideal as they stretch and break after a few years, stopping the tie from strangling the tree as often happens.

**Mulching** of trees for the first five years is important and whenever possible thereafter. After each hay cut this can be done relatively easily raking it in from around each tree to form a deep mulch under it. Do not mulch when the soil is cold in winter. If any other mulch materials can be found these can be added to improve the mulching.

**Watering** is done as and when necessary

**Pruning** is an annual job for years to come but will be most important during the first five years.

All the trees are pruned for tall trunks of about five feet so grazing below is an option in the future and deer damage is kept to a minimum.

The apple trees will generally be pruned in winter in the traditional way for East Anglia as open bowls but the cider varieties will be central leader trees and left alone as much as possible as pruning stiffens branches and makes it less easy to shake the fruit off.

The pear trees will generally be winter pruned; those on Pyrodwarf rootstock will be pruned as open bowl. The pear trees on the large *Pyrus communis* rootstock will be left to their own devices. Other than pruning where there are issues which will cause problems for the tree in the future.

The plum and gage trees will be summer pruned as open bowls initially and then left to their own devices to a great extent with just removal of seriously crossing branches and diseased wood. Dead wood should be left for wildlife as long as it will not be too detrimental to the tree.

Cherry trees will be summer pruned as central leader trees initially and then left to their own devices to a great extent..

The mulberry trees will only be pruned where badly placed branches may create future problems.

**Labelling** the trees with permanent labels is of high priority. There is a plan of tree positions but things can go astray. Some apple tree labels were lost early on and will have to wait to be labelled until they fruit and can be identified. It is also nice for people to be able to read the variety when picking the fruit..

**Future management objectives:** will include creating a better soil, a more diverse environment that supports tree health and better habitat for orchard pest predators and pollinators. It will also involve Dr Alex Shigo's "7 pleas for trees":

**Prepare:** Learn about trees and their care.

**Plan:** Select planting location carefully and allow for tree growth.

**Protect:** Protect from wounding

Figure 15 mulching young trees with hay cut.



**Prevent:** Prevent development of decay if damage occurs.

**Prune:** Prune as necessary, and prune properly. Remove dead branches and suppressed sprouts.

**Provide:** Provide adequate water, sunlight and care for healthy growth.

**Professionals:** Utilize qualified assistance when needed.

## Evaluate

### What went well?

Sourcing the trees and planting them has gone well. The survival rate has been nearly 100%. In general large spaces have been left between the trees and some areas kept entirely free for camping and to maintain a sunny site. Mowing twice a year plus occasional strimming of patches seems to be dealing with the dock, nettle and creeping thistle. The ragwort and hemlock appear to have gone from the orchard although there is the occasional plant in other areas of the land. I feel comfortable with the management regime at the moment which is not too time consuming or expensive to mow. So far I am very happy with the orchard progress and I am really glad I didn't rush in and plant lots of trees at once. I am certain there will be varieties I find that I wish I had planted instead.

### What was challenging?

It has been challenging looking after the tree guards, their supports have rotted away several times. I will put in much stronger posts in the future. Labelling the trees has also been an issue and I am going to have to make some engraved metal ones for the future. I have a good map of most of the trees but there are a few which I lost labels to before mapping them. A lesson to learn.

### Long term goals and next steps

In the long term it would be good to scythe the grass and let it lie rather than mow it. Using the neighbours' sheep has been considered but with such young trees this would require serious tree protection and would remove some organic matter and nutrients from the land so the advantages of this need to be assessed. There are a number of considerations in the mind-map on "[Other features and issues](#)" which need to be addressed. The next project is to introduction of other plants around the tree canopies such as Russian comfrey (*Symphytum x uplandicum* "Bocking 14"). This has been planted in other areas so there is now a source of roots to cut for new plants. Plants and habitat for orchard pest predators and pollinators has started and the next large undertaking is to make a semi-natural bee hive from. or a large hollow log.

In the future when the trees really start to produce it is hoped that more people come and pick fruit and process it on site. In the short term the labels on the trees need to be made and sturdier posts are needed for some of the tree guards.

## Tweak

The design has been tweaked a little by moving the pears that are on large rootstocks further apart. This is because it was decided that, given that they are going to be very large, leaving them to grow more naturally after their early pruning would be more sensible and so they will ultimately need more space.

Figure 16 Late Gold cider apple is flourishing.



## References

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(1) <https://smallfarms.cornell.edu/2016/04/scale-of-permanence/>

(2) <https://elevationmap.net/>

(3)

[https://www.permaculture.org.uk/sites/default/files/page/document/permaculture\\_research\\_soil\\_test\\_hb\\_v.2.1\\_0.pdf](https://www.permaculture.org.uk/sites/default/files/page/document/permaculture_research_soil_test_hb_v.2.1_0.pdf)

(4) <https://www.permaculture.co.uk/articles/comfrey-its-history-uses-benefits>

<https://shigoandtrees.com>

<http://conservancy.umn.edu/handle/11299/141442>

# APPENDIX

## Supporting documentation

The Scale of Permanence Table (1) below was used as an outline guide during the surveying stage.

Table 3 Template for Scale of Permanence survey

Category	Checklist	Notes
<b>Climate</b>	<ul style="list-style-type: none"> <li>Plant hardiness zone</li> <li>Frost Free days</li> <li>Precipitation/distribution</li> <li>Latitude</li> <li>Extreme weather potential</li> <li>Predicted climate changes</li> </ul>	<p><i>Weather Data:</i>  <i>Hardiness Zone maps:</i>  <b>Note</b> that extremes are more important than averages for weather data.</p>
<b>Landform</b>	<ul style="list-style-type: none"> <li>Elevation</li> <li>Slope</li> <li>Aspect</li> <li>Position</li> <li>Geology</li> </ul>	<p><b>Note</b> Pay particular attention to aspect (direction a slope faces) on your land.</p>
<b>Water</b>	<ul style="list-style-type: none"> <li>Existing sources</li> <li>Potential sources</li> <li>Infrastructure: culverts, wells, water lines, tanks</li> <li>Erosion areas</li> </ul>	<p><b>Note</b> This is a helpful category to map while taking a walk on your property. See the example for hints. You are looking to discover micro-watersheds, flow directions, and areas of pooling</p>
<b>Social &amp; Economic Factors</b>	<ul style="list-style-type: none"> <li>Ownership &amp; tenure</li> <li>Property easements/right of way</li> <li>Available capital</li> <li>Municipal zoning &amp; laws</li> <li>Neighbours</li> <li>Local markets</li> </ul>	<p><b>Note</b> Consider the local ordinances and laws that might affect your choices. Consider what social connections and networks will be critical to success.</p>
<b>Access &amp; Circulation</b>	<ul style="list-style-type: none"> <li>Access points</li> <li>Materials storage &amp; flows</li> <li>Vehicle/Cart/Foot access</li> <li>Paths, roads, gates, etc.</li> </ul>	<p><b>Note</b> Another good category to make a map of. If you have been using the land, try and track your daily patterns on a map. Note where your efforts are inefficient.</p>
<b>Vegetation &amp; Wildlife</b>	<ul style="list-style-type: none"> <li>Ecosystem types</li> <li>Habitats</li> <li>Problem Species</li> <li>Old trees and rare pants</li> </ul>	

<b>Microclimate</b>	Wind Sun/shade patterns Frost pockets Slope/aspect and affects	<b>Note</b> Make a “bubble map” to delineate areas of the land that would have different microclimate. A combination of effects in the list creates these conditions.
<b>Buildings &amp; Infrastructure</b>	Building conditions & use Fences & gates Paved surfaces Power & Electric lines Other utilities Snow piles	<b>Note</b> Depending on your context, this might be assessing the current condition and location of these elements, or it might involve careful planning of where future items will go. This is some of the mostly costly stuff in startup farms
<b>Zones of Use</b>	Property lines Activity centres Zones 1 – 5	<b>Note</b> Make a map of existing and/or future zones based on your planned intensity of use.
<b>Soil</b>	Soil type Structure, pH, % OM Management history Toxicity	
<b>Aesthetics &amp; Experience</b>	Arrival experience View lines and corridors Public/private continuum Ease of navigation	<b>Note</b> This might be just an overall description with some notes, or a mapping activity. This is a very subjective category, beauty is in the eye of the beholder.

Figure 17 Crimson Bramley positioned where it will be in good view when using the access route



# ASSESSMENT OF THIS DESIGN

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## Evaluation

The thinking tools of mind maps and PNI have been really useful but the mind-map software used was expensive and stopped working soon after finishing the project which means it is not possible to update the mind-maps as more is learnt. The thinking tools, surveying techniques and design framework were appropriate and worked well ensuring I really focused on things. There always seems to be some incremental design in my projects but I am happy with this as it means I am thinking, being flexible and learning along the way. The approach strategies of working out from well managed areas, diversity creates stability, work within nature, think 7<sup>th</sup> generation, use guilds, think about patterns, create win-win situations, use top down thinking and bottom up action along with others have all been useful in influencing how I have approached the design. The ALC evaluation process does make me think a bit more analytically and focus on the future rather than thinking the jobs done. I have learnt a lot about orchards and about the importance of observation and interaction especially with enthusiasts for the subject. Doing this now I would have made the tree guards and stakes tougher and got a good labelling system ready before planting. However, I am generally happy with the design and implementation of this project and it is going to be interesting to see how it develops over the years. On a scale of 1-10 I feel this project deserves a 7.

## How this design meets the Principles and Ethics of Permaculture.

Planting a traditional orchard naturally fits with the core ethics **Earth Care, People Care and Fair Shares**.

It is also easy to apply all of the permaculture principles when the design is for a traditional orchard.

**Observe and Interact:** This was a huge part of this project, lots of land observation, orchard research, workshops, voluntary work and chatting with orchardists and enthusiasts.

**Catch and store energy:** I have caught and stored the energy from all the people who have shared their knowledge. All the energy I have put in to planting the trees will be stored in their future existence. The trees will catch and store carbon, produce a crop, and improve the soil.

**Obtain a yield:** Fruit, nuts, berries, nature and a beautiful place to be should all be obtained.

**Apply self-regulation and accept feedback:** This has been going on throughout the design and implementation of this project as I observed and interacted. It will continue to go on as I maintain the space as both land management and tree care are all about paying attention to the feedback from nature and regulating what you do to do what works best for them.

**Use and value renewable resources and services:** The trees will supply a renewable resource. Not many resources were used in this project, however many were bought new. Many of the stakes were taken from the woodland but the mesh and bamboos were all new. Only the tree ties were recycled bike tire inner tubes. The grassland is mown with a petrol mower, however the hay is kept on the land to renew the soil.

**Produce no waste:** Little waste is produced. The tree guard mesh will eventually need to be discarded.

**Design from pattern to detail:** The need to design from pattern to detail is conspicuous, deciding basic outline of areas trees will be planted in, down to what species to include on what rootstocks. going down to their, relative positioning, varieties, vigour, pollination requirements, compatibility, uses, season of harvest, tastiness, use and more.

**Integrate rather than segregate:** This project has encouraged me to integrate with people I might otherwise never have met. The orchard aims to integrate nature with crop production and people's space for relaxation. Many species and varieties of plant are integrated within the system and over time more of the surroundings will become better integrated.

**Use small and slow solutions:** On a world-wide scale this is a small slow part of the solution to the problems the world faces.

**Use and value diversity:** This is evident in the variety of trees chosen. It is also evident in the design aim to create a high biodiversity habitat.

**Use edges and value the marginal:** Many of the apple varieties are heritage varieties which have been marginalised by commercial concerns. Nature has also been marginalised and it is at the centre of this design.

**Creatively use and respond to change:** This project is a response to the changes which threaten our planet. It is also a response to having fewer responsibilities and being able to use my energy where it can effect at least some positive change.

## Assessment of Individual Design for Feedback Table

**DIPLOMA in APPLIED PERMACULTURE DESIGN System 5.2**

**ASSESSMENT of INDIVIDUAL DESIGN for FEEDBACK**

Effective from Oct 1<sup>st</sup> 2013

<b>Diploma Apprentice's name:</b>	<b>Charlotte Synge</b>
<b>Date first registered for Diploma:</b>	<b>26<sup>th</sup> January 2015</b>
<b>Date of this feedback:</b>	
<b>Name of Personal Tutor:</b>	
<b>Name of Assessment Tutor:</b>	<b>Aranya Austin</b>
<b>Project Title:</b>	<b>Design to Create a Traditional Orchard</b>
<b>Date Started:</b>	<b>2013</b>
<b>Date Completed:</b>	<b>Tree planting is almost complete but other additions are ongoing.</b>
<b>Implemented:</b>	<b>Yes</b>
<b>Design Number</b>	<b>8 of 10</b>

**ACCREDITATION CRITERION: 1. Demonstrating design skills**

**(Section C3 in the Guide to Accreditation Criteria)**

	<b>What's gone well?</b>	<b>What could have been done differently?</b>
Accurate and appropriate use of an intentional design process.	Yes. The thinking tools (Mind-maps, PNI), Design framework (OBREDIMET and Incremental design), Surveying techniques (Scale of Permanence, PFASTE, DAFORL) and Evaluation (ALC) were appropriate. The Mind-maps were used as memory joggers. The approach strategies of working out from well managed areas, diversity creates stability, work within nature, think 7 <sup>th</sup> generation, use guilds, think about patterns, create win-win situations, use top down thinking and bottom up action along with others have all been useful in influencing how I have approached the design.	Other design frameworks and thinking tools could have been used to equal effect.
Use of permaculture ethics, principles and theory is appropriate to the situation.	Yes. How the design fits with permaculture principles and ethics can be seen <a href="#">here</a> .	Not sure.
Use of a variety of tools which suit the needs of the client and the situation.	Yes	Not sure.
Design is intelligible, coherent and effective (i.e. it met the needs of the client).	Yes	The GPS map isn't clear in the numbering of the trees but when you can see the trees on site it makes sense.
Documentation for and presentation of the design is appropriate for clients & third parties.	This was not required as it was for myself but the presentation is clear and appropriate. For the presentation of this project to third parties a clearer map would be better.	The GPS map isn't clear in the numbering of the trees but when on site it makes sense.

**Fill in 2a or 2b**

**ACCREDITATION CRITERION: 2a. Applying permaculture in your own life**

**(Section C4 in the Guide to Accreditation Criteria)**

	<b>What's gone well?</b>	<b>What could have been done differently?</b>
Explanation of changes made to enhance personal and / or household sustainability (e.g. needs and challenges).		
Clear explanation of how the solution was developed using design process and Permaculture theory.		

**ACCREDITATION CRITERION: 2b. Applying permaculture to your work and projects**

**(Section C2 in the Guide to Accreditation Criteria)**

	<b>What's gone well?</b>	<b>What could have been done differently?</b>
Identify which of the 15 categories of application the design applies to from the checklist in the Guide to Accreditation Criteria, and provide feedback on each.	<p><b>Demonstrating Design Skills.</b> The design shows a structured approach to tackling the design with consideration of site features, organisms, soil, climate, sectors, zones, desire lines. and personal (time and money available). No real mapping was required as an outline of the area was already available in the deeds for the land and the use of an accurate GPS system made things simple and very accurate.</p> <p><b>Site Development</b> The first phase of developing the site has been virtually completed. Almost all the trees have been planted and are growing well. Maintenance is now the main job. Around the site there is more designing and work to do improving the plant diversity and its usefulness for</p>	Not sure

	the orchard itself, wildlife and people.	
Clear explanation of how the solution was developed using design process and Permaculture theory.	Yes.  Yes. How the design fits with permaculture principles and ethics can be seen <a href="#">here</a> .	Not sure
The solutions are relevant and appropriate to the activity and content areas.	Yes.	

**ACCREDITATION CRITERION: 3. Learning from and developing your permaculture practice**

**(Section C5 in the Guide to Accreditation Criteria)**

	<b>What's gone well?</b>	<b>What could have been done differently?</b>
Evaluation of the effectiveness of your design work on this project.	The tree choice and positioning is generally well thought through and I am fairly happy with my work.	I do have qualms over the positioning of the large pears which aim to allow to get very tall as a group of three. Now is the time when I am looking out for any mistakes (evaluating) so I can remedy things while the trees are still young.
Reflection on use of design tools and processes, and use of Permaculture theory and practice.	I am very happy with the use of the design tool OBREDIMET. I bought the land and immediately took my PDC in order to learn more about design and permaculture theory - specifically for the projects on this land. Using it was a learning process that I feel kept me on the right track.  I found the scale of permanence difficult to assess and am not sure I got it exactly right. However, it was good to use it and think in a different way.	Not sure.

<p>How the design shows that your competence and skills in practice and learning is progressing.</p>	<p>The design shows how much I appreciate the importance of the “observe and reflect” principle as I have put so much effort into learning about orchards. It also shows how I think in permaculture terms for this project and my life. It has been a great project because I have been able to relate all I learn to my own land on a long term project which will hopefully last a lot longer than me. Trying new techniques like “the scale of permanence” improves my learning experiences.</p>	<p>Not sure.</p>
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**Comments about project format, general or specific issues**

Any other comments?

**Conclusions**

How ready is this design for presentation?

What are the apprentice’s next steps?

The highlight of this design for me was....