A windbreak can be made up of trees that provide fodder or sugar pods for cows (willow, honey locust, tagasaste, taupata, carob); coppice for kindling or firewood (*Leucaena*); give nectar and pollen for bees (*Acacia fimbriata*); and provide for their own nitrogen requirements (leguminous trees). Acacias fulfil many functions: they provide seeds for poultry forage, foliage for larger stock, and fix nitrogen in the soil, while blossoms provide pollen for bees. They are also pioneer plants which prepare and protect the soil for slower-growing, more sensitive plants.

Selecting appropriate species requires a thorough knowledge of the animal or plant cultivar under consideration, its tolerances, its needs and its products. When considering plants, for example, we want to know: Is it deciduous or evergreen? Are its roots invasive? To what height does it grow? Is it fast-growing and short-lived, or slow-growing and long-lived? Does it have a dense or light canopy? Is it disease-resistant, or susceptible? Can it be browsed or cut, or will it die if over-pruned or coppiced?

To begin, start a species index, or keep notes on each plant (its characteristics, tolerances, and uses) on cards in a file system (see the annotated species lists in the Appendix). Some of the things to note are as follows:

1. **Form:** life style (annual, perennial, deciduous, evergreen) and shape (shrub, vine, tree), including heights.
2. **Tolerances:** climatic zone (arid, temperate, tropical, subtropical); shade or sun tolerance (preferring shade, partial shade, full sun); habitat (moist, dry, wet, high or low elevation); soil tolerance (sandy, clayey, rocky); and pH tolerance (acidic or alkaline soils).
3. Uses: edible (human food or seasoning); medicinal; animal forage (for specific animals, e.g. chickens, pigs, deer); soil improvement (nitrogen fixing, cover crop and green manure); site protection (erosion control, living fence, windbreak); coppicing (fuel, poles, stakes); building material (poles, timber, furniture); and other uses (fibre, fuel, insect control, ornamental, nectar and pollen for bees, rootstock, dye).

There are various factors that may limit species selection:

- Unsuitable for climate or soil.
- Locally rampant or noxious.
- Unavailable or rare (usually not traded outside the country of origin).
- Preference (vegetarians may not choose fodder species or animals used for meat).
- Area of land available (smaller species for small properties).
- Usefulness in relation to difficulty of growing, small yield, or time taken to reach maturity.

## 1.4
## EACH IMPORTANT FUNCTION IS SUPPORTED BY MANY ELEMENTS

Important basic needs such as water, food, energy, and fire protection should be served in two or more ways. A careful farm design, for example, will include both annual and perennial pasture *and* fodder trees (poplars, willows, honey locust, and tagasaste) which are either cut and fed to domestic stock, or the stock let in for short periods of time to eat the leaves, pods, or lopped branches.

In the same way, a house with a solar hot water system may also contain a back-up wood-burning stove with a water jacket to supply hot water when the sun is not shining. And for fire control, many elements (the pond, driveway, slow-burning windbreak trees, and swales) are incorporated in the homestead or village design to reduce damage should wildfire occur.

In other examples, water is caught in a variety of ways, from dams and tanks to swales and chisel ploughing (to replenish ground waters), and on sea coasts, winds are contained first by a strong, front-line windbreak of trees and shrubs, and closer in by semi-permeable fences or trellis systems.



## 1.5
## EFFICIENT ENERGY PLANNING

The key to efficient energy planning (which is, in fact, efficient economic planning) is the zone and sector placement of plants, animal ranges, and structures. The only modifiers are local factors of market, access, slope, local climatic quirks, areas of special interest (flood plains or rocky hillsides), and special soil conditions, such as hard laterites or swamp soils. The following sections cover zone, sector, and slope plans for an "ideal" site, say a gentle slope facing the sun side where few variables are encountered. "Real" landscape, however, will differ, so that your designs will be more complex than those illustrated.

### ZONE PLANNING

Zone planning means placing elements according to how much we use them or how often we need to service them. Areas that must be visited every day (e.g. the glasshouse, chicken pen, garden) are located nearby, while places visited less frequently (orchard, grazing areas, woodlot) are located further away (**Figure 1.2**). To place elements in zones, start from a centre of activity, usually the house, although this can also be a barn, a plant nursery business, or, on a larger scale, an entire village.

Zoning is decided by (1) the number of times you need to visit the element (plant, animal or structure) for harvest or yield; and (2) the number of times the element needs you to visit it.

For example, on a yearly basis, we might visit the poultry shed:

- for eggs, 350 times;
- for manure, 20 times;
- for culling, 5 times;
- other, 20 times.

For a total of 390 visits annually; whereas one

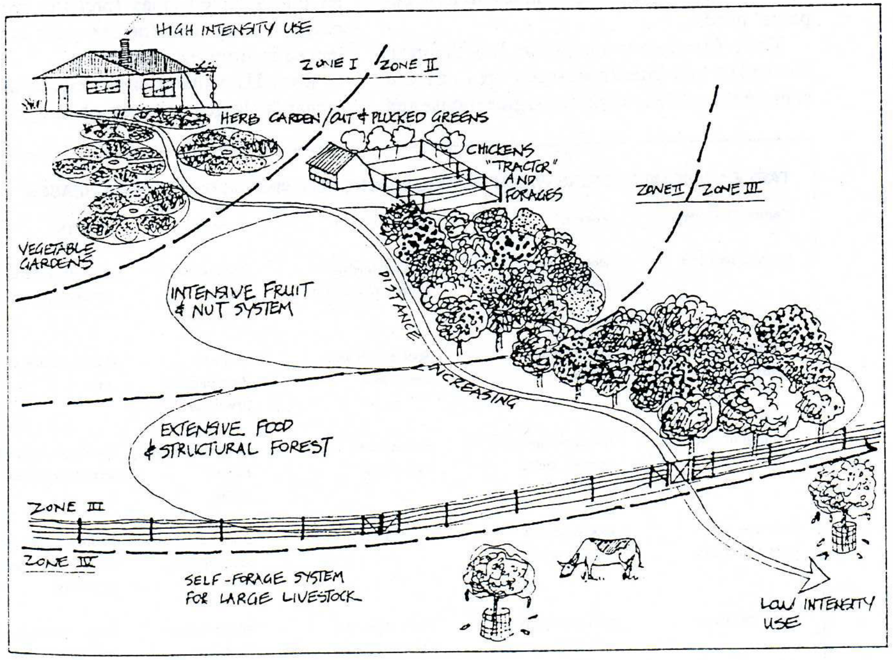


FIGURE 1.2 The relationship between distance and intensity of use. Frequently-visited areas are placed closest to the house.



from "Introduction to Permaculture" (Mollison) might visit an oak tree only twice a year, to collect acorns. The more visits needed, the closer the objects need to be. Those components needing very frequent observation, constant visits, work input, or complex management techniques must be placed very close by, or we waste a great deal of time, effort, and energy visiting them.

The golden rule is to develop the nearest area first, get it under control, and then expand the edges. Too often, the beginner chooses a garden far from the house, and neither harvests the plants efficiently, nor cares for them well enough. Any soil can be developed for a garden over time, so stay close to the home when placing the garden and orchard.

**Zone 0** is the centre of activity (house, barn, or village if the design is on a large scale). It is laid out to conserve energy and to suit its occupants' needs.

**Zone I** is close to the house. It is the most controlled and intensively-used area and can contain the garden, workshops, greenhouse and propagation frames, small animals (rabbits, guinea pigs), fuels for the house (gas, wood), compost, mulch, clothesline, and grain drying area. There are no large animals on range, and perhaps only a few large trees (depending on shade requirements). Any frequently-visited or essential small tree can be placed in this zone, e.g. a reliably-bearing lemon tree.

**Zone II** is still intensively-maintained, with dense plantings (larger shrubs, small fruit and mixed orchard, windbreaks). Structures include terraces, hedges, trellis, and ponds. There are a few large trees with a complex herb layer and understorey, especially small fruits. Plant and animal species that require care and observation are located in this zone, and water is fully reticulated (drip irrigation for trees). Poultry is let into selected areas (orchard, woodlot) to range, and an area for one milk cow can be fenced in from the next zone.

**Zone III** contains unpruned and unmulched orchards, larger pastures or ranges for meat animals or rearing flocks, and main crop. Water is available only to some plants, although there are watering areas for animals. Animals are cows, sheep, and semi-managed birds. Plants include windbreaks, thickets, woodlots, and large trees (such as nut and oak) for animal forage.

**Zone IV** is semi-managed, semi-wild, used for gathering, hardy foods, unpruned trees, and wildlife and forest management. Timber is a managed product, and other yields (plant and wildlife) are possible.

**Zone V** is unmanaged or barely managed natural "wild" systems. Up to this point, we design. In Zone V, we observe and learn; it is our essential place for meditation, where we are visitors, not managers.

**Table 1.1** shows the factors which change in zone planning as distance increases.

Zones are a convenient, abstract way to deal with distances; however, in practice, zone edges will blur into each other, or landform and site access may mean that sometimes the least-used area (Zone V) is next to the most intensely-used area (Zone I); for example a steep forested hill directly behind the house).

We can in fact bring wedges of Zone V right to our front door as a corridor for wildlife, birds,

**TABLE 1.1** SOME FACTORS WHICH CHANGE IN ZONE PLANNING AS DISTANCE INCREASES

| Factor or Strategy | Zone I | Zone II | Zone III | Zone IV |
|---|---|---|---|---|
| Main design for: | House climate Domestic sufficiency | Small domestic stock and orchard | Main crop, forage, stored food | Gathering, forage, forestry, pasture |
| Establishment of plants | Complete sheet mulch | Spot mulch and tree guards | Soil conditioning and green mulch | Soil conditioning only |
| Pruning of trees | Intensive cup or espalier, trellis | Pyramid and built trellis | Unpruned and natural trellis | Seedlings, thinned to selected varieties |
| Selection of trees and plants | selected dwarf or multi-graft | Grafted varieties | Selected seedlings for later grafts | Thinned to selected varieties, or managed by browse |
| Water provision | Rainwater tanks, well, bore, reticulation | Earth tank and fire control | Water storage in soils, dams | Dams, rivers, bores, and wind pumps |
| Structures | House/glasshouse, storage integration | Greenhouse and barns, poultry sheds | Feed store, Field shelter. | Field shelter grown as hedgerow and woodlot |

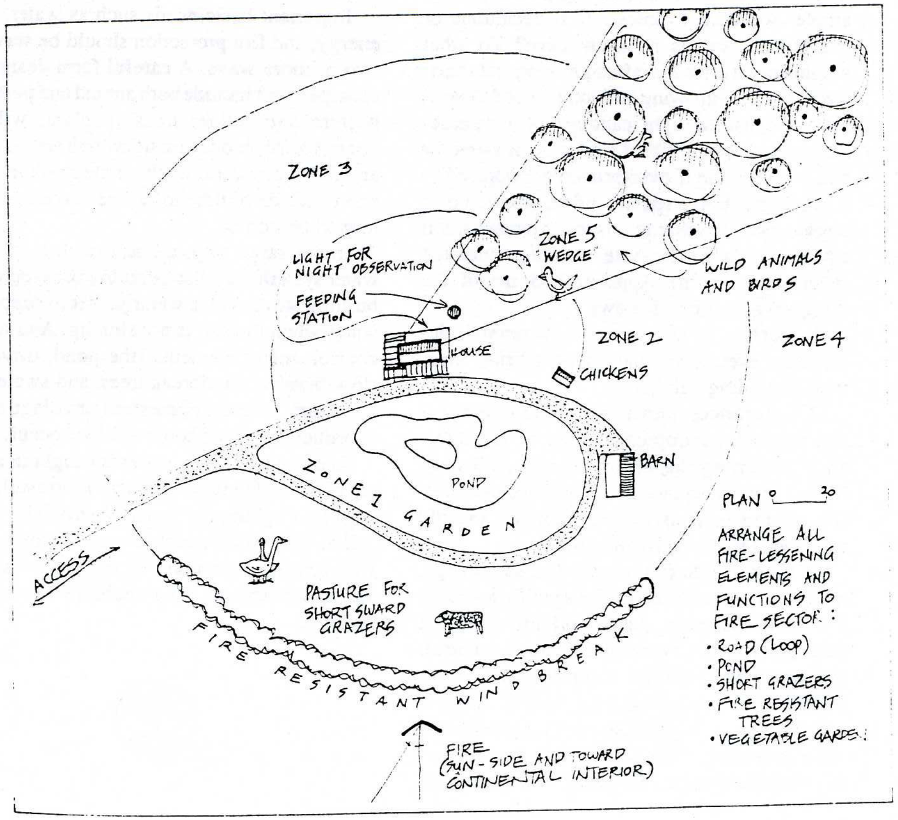


**FIGURE 1.3** Fenced wildlife corridor (Zone V) extending into Zone 0.

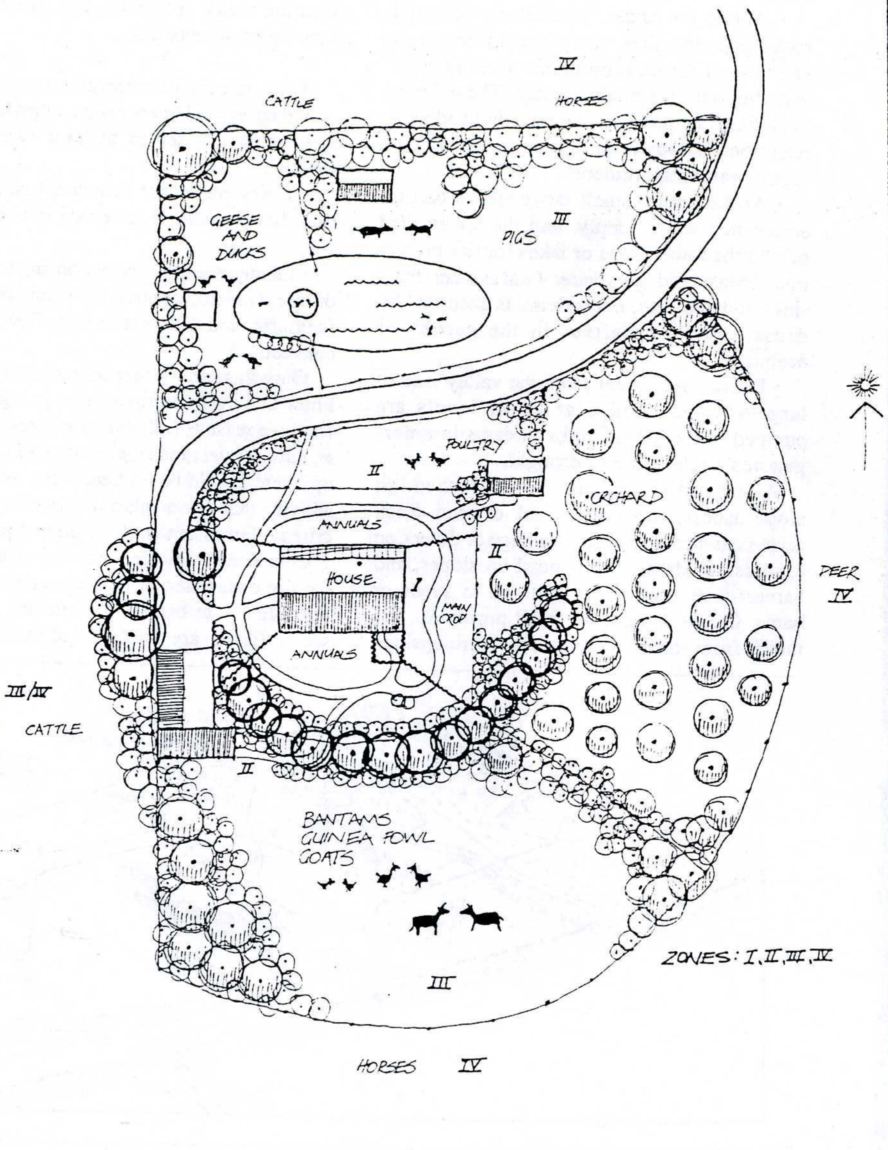


FIGURE 1.4 Sample groundplan for a small mixed farm design.



and nature. Or we can extend Zone I along a frequently-used path (a loop path which takes us from the house, to the barn, past the chicken shed, into the garden, near the woodpile, and back to the house). **Figures 1.3** and **1.4** show sample zone plans for a small farm.

Zonation patterns may change when we are working with two or more centres of activity, say between the house and a guest cottage, or the house and barn, or, on a larger scale, between the buildings in a village. In this case we must carefully work out linkages between these centres, consisting mostly of access, water and energy supply, sewage, and fencing connections. This is what David Holmgren calls "network analysis", which plans for more complex sites making connections between roads, pipes, windbreaks and so on to service more than one centre.

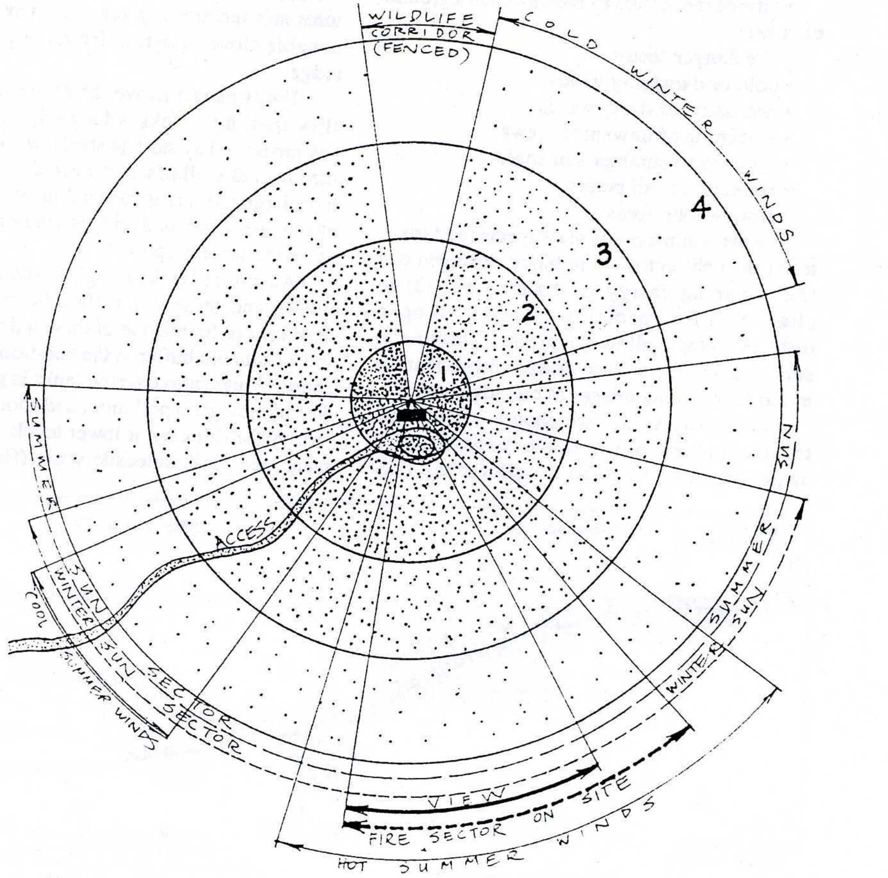


FIGURE 1.5 Understanding the direction from which sun, wind, fire and flood come helps in the placement of structures and vegetation.

## SECTOR PLANNING

Sectors deal with the wild energies, the elements of sun, light, wind, rain, wildfire, and water flow (including flood). These all come from *outside* our system and pass through it. For these, we arrange a **sector diagram** based on the real site, usually a wedge-shaped area that radiates from a centre of activity (commonly the house but it can be any other structure). **Figure 1.5.**

Some of the factors to sketch out on a ground plan are:

- fire danger sector
- cold or damaging winds
- hot, salty, or dusty winds
- screening of unwanted views
- winter and summer sun angles
- reflection from ponds
- flood-prone areas

We place appropriate plant species and structures in each sector (1) to block or screen out the incoming energy or distant view, (2) to channel it for special uses, or (3) to open out the sector to allow, for example, maximum sunlight. Thus, we place design components to *manage incoming energy* to our advantage.

For the fire sector, we choose components that do not burn, or that create firebreaks, such as ponds, stone walls, roads, clear areas, fire-suppressing vegetation, or grazing animals to keep the vegetation short.

## SLOPE

Finally, we look at the site *in profile*, noting relative elevations to decide on the placements of dams, water header tanks, or wells (above the house; water falls); to plan access roads, drains, flood or flow diversions; and to place wastewater or biogas units and so on. **Figures 1.6** and **1.7** illustrate some ideal relationships of structures and functions, given that there is a reasonable slope. Starting from the plateau or ridge:

- Dams placed above the house take overflow from high tanks, which rely on the roof catchment of hay storage sheds, workshops, or meeting halls, all of which need little water but have large roof areas for catchment. Diversion channels around high ridges leading to dams serve the same purpose.
- All covered tanks at high elevation are very useful, and these can in fact be built as the basement or foundation of the buildings, forming a heat/cold buffer in the sub-floor of workshops. Water from covered tanks is guaranteed free of biological pollution, and should be kept strictly for drinking at lower levels, the settlement area. Bulk domestic water (for showers, toilets, gardens) are supplied from the high dams.
- Above the house, particularly on rough, rocky and dry sites, there should be careful selection of dry-country plants needing "spot" watering only for establishment. These forests or orchards help with erosion control and water retention. On lower sites choose plants with higher water requirements.
- At the house, small tanks are needed for emergency water supply, and the house sited behind the lower dams or lakes for fire protection. Household greywater (wastewater from sinks and showers, not toilets), is absorbed by dense vegetation either in the garden or orchard.
- Downslope, water from the valley lake or large-volume storage at lower levels are pumped to the higher tanks or dams in emergencies such as fire or drought.

A factor often left unplanned is the high slope access, either as a track or road. Such access can provide water drainage or diversion to midslope dams, fire control on slopes, and harvest-time access to forest and to sheds or barns. Often enough, on small properties, the mulch from forests and manures from upslope barns can be easily moved downhill to establish a barn-to-house garden. Slatted floors in upslope shearing sheds, goatsheds, and stables enables easy access to manures.

To re-state the basic energy-conserving rules:

- Place each element (plant, animal, or structure) so that it serves at least two or more functions.
- Every important function (water collection, fire protection) is served in two or more ways.
- Elements are placed according to intensity of use (zones), control of external energies (sectors), and efficient energy flow (slope or convection).

Once this commonsense analysis is done, we know that every component is in a good place for three reasons (relative to *site resources*, *external energies*, and *slope or elevation*). To sum up, there should be no tree, plant, structure, or activity that is not placed according to these criteria. For instance, if we plant a pine tree, it goes in Zone IV (infrequent visits), *away* from the fire danger sector (it accumulates fuel and burns like a tar barrel), *towards* the cold wind sector (pines are hardy windbreaks), and it

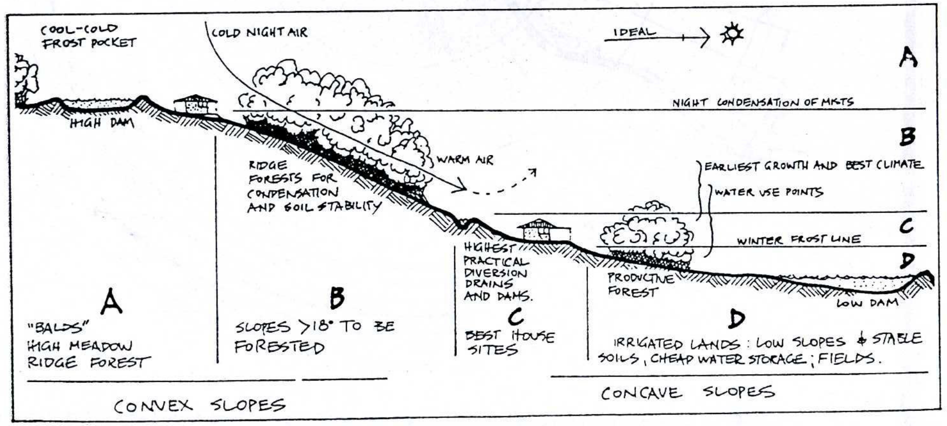


**FIGURE 1.6** Slope analysis and site planning in relation to slope aspect largely decides the placement of access, water supply, forests, and cropland (for the humid landscape).

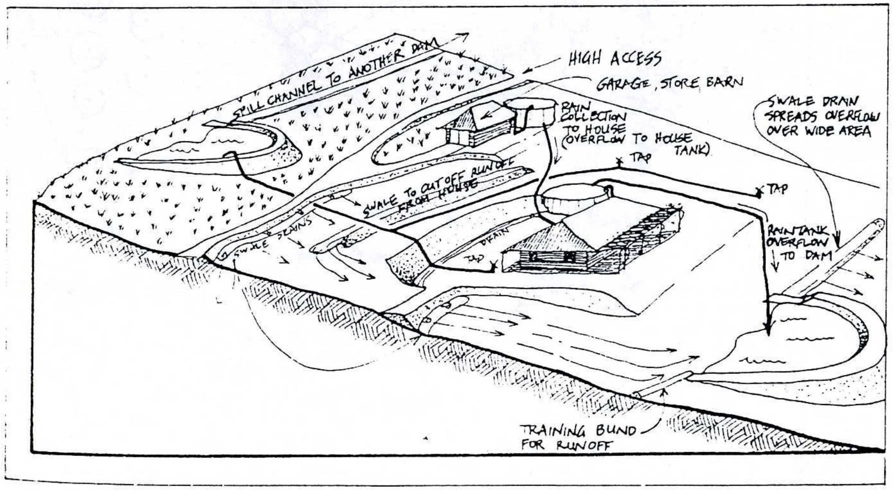


**FIGURE 1.7** Idealised layout of water, buildings, and access (vegetation not drawn to better show water movements). Swales distribute water over a wide grassed slope to prevent gully erosion during wet seasons.

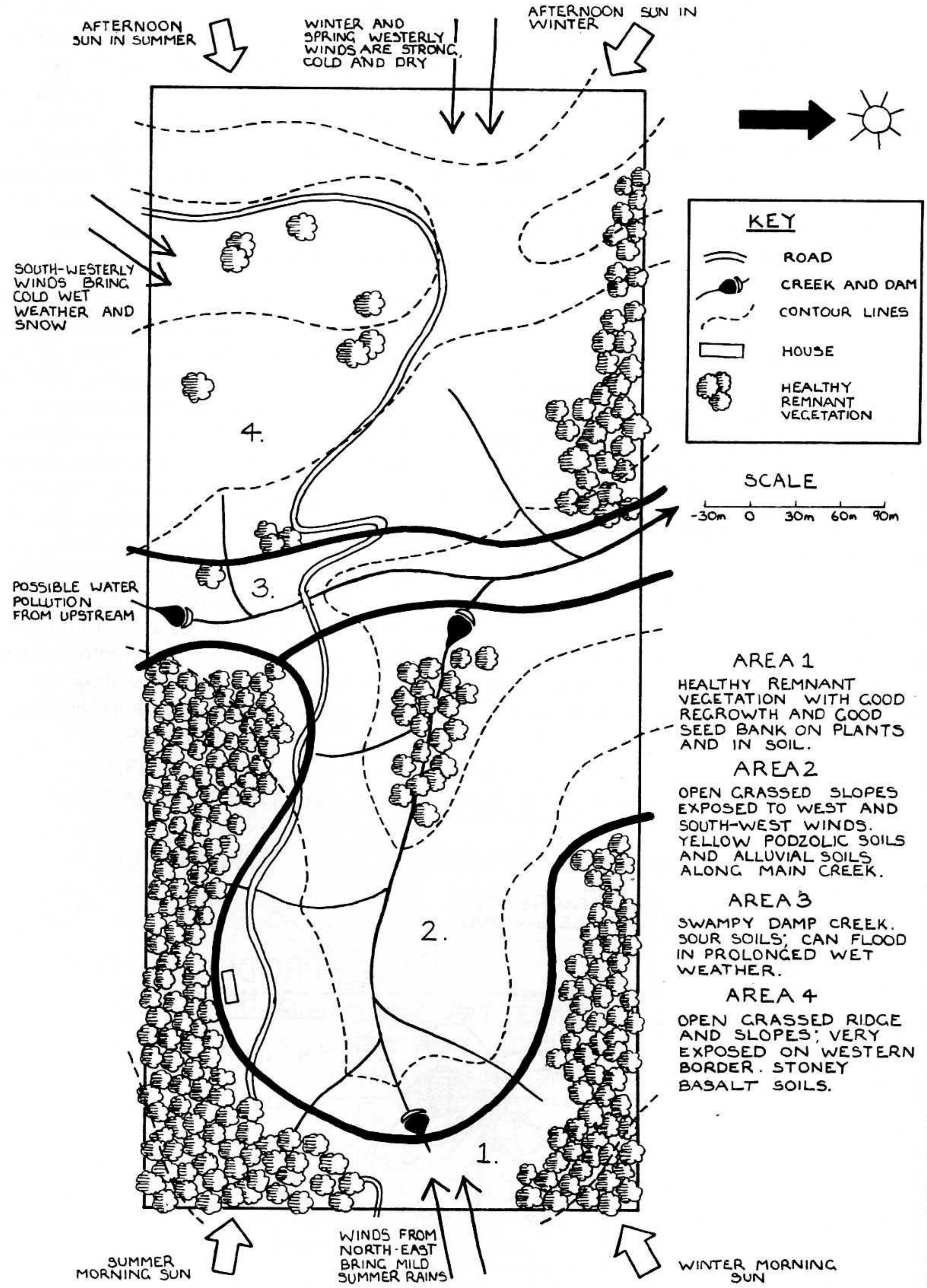


Fig. 10.3 Site analysis and sector analysis of Rosie's Farm