PDC Final Project - The Tree House
A Suburban Permaculture Property Retrofit

June 2021

Contents

Project Overview

Context

This project is a permaculture retrofit of an existing suburban property located on the lower slopes of the Hemi Matenga hill reserve in the town of Waikanae on the Kapiti coast Bio region of New Zealand. Waikanae is a Bush to Sea setting as the town is located on a narrow strip of land bounded by the foothills of the Tararua Range on the East and the Tasman Sea on the West. The residents (owners) are in the process of 'downshifting' their lives to create a simpler and more resilient lifestyle. The site was selected due to its close proximity to public transport and amenities, a village centre for provisions and services, walking tracks, good walking and bicycling as local transport options, community, and a good climate for health and growing food in a backyard garden.

My Interpretation of Permaculture

A practice based on patterns, relationships and systems found in nature. Permaculture design is used to create diverse and functional systems that have regenerative (beyond sustainable) outcomes, where the various elements within the system interact in ways that improve the health and resiliency of that system over time.

The 12 permaculture principles used in combination provide a holistic framework for decision making during the design and refining processes of a system. The principles stem from, and interact to achieve, the three ethics of earth care, people care, and fair share that are at the core of permaculture. A successful system is one which is stable, and stability is achieved when these ethics are achieved.

Every element of the system or issue that is being worked through should consider each principle like a checklist. The principles are structured like 'spokes on a wheel' showing that each one provides a different perspective that restrains and balances with the others. Therefore a system based on one (or few) principle(s) alone may be detrimental to the system and the ethics at the centre of the 'wheel'. A successful system cannot be achieved if the 'wheel' is out of balance.

The principles guide the designer through a thinking process to observe, design and adjust the system so that it becomes integrated, sustainable and regenerative. These principles will be considered at all stages of the project from the initial site analysis through to the implementation of the design.

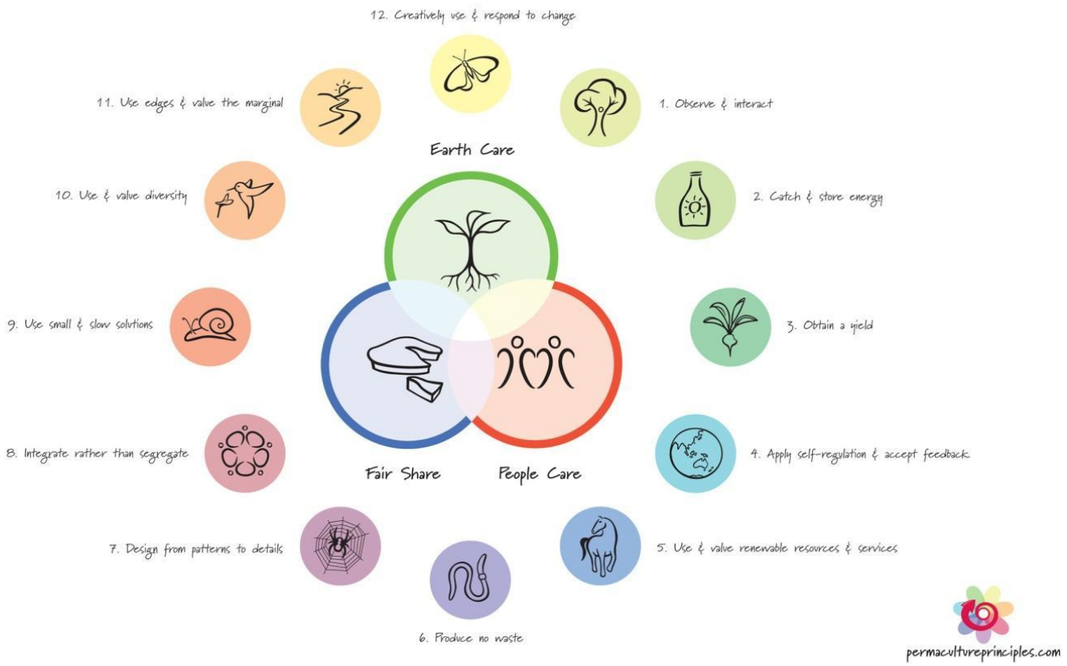


Figure 1: Permaculture Ethics and Principles

My Strengths and Personality as the Permaculture Designer

My interest in permaculture was sparked at a Transition Towns presentation over a decade ago. The ethics and lens through which to view the world, resonated with my own sense of 'appropriate living'. I have thoroughly enjoyed working through the Permaculture Design Certificate (PDC) modules and being challenged to learn and deepen my knowledge. I am particularly interested in how permaculture principles can be applied to all aspects of life and society, beyond the aspects of gardening and farming.

I trained in Interior Design gaining a Bachelor of Design degree leading onto a career in the construction industry on projects that span Interiors, Architectural Design, Commercial, and Residential.

My training and career path has allowed me to build extensive experience and skill in: working with people (clients, councils, contractors, other consultants and team members); brief taking; interpretation of brief into conceptual designs; working up the design through developed and detailed design stages; presentation and documentation skills. I have received fantastic feedback from employers and clients, and had repeat work with clients over the years.

In addition to the design degree I have completed a NZQA Certificate in Organic Horticulture which I undertook as an interest course because of my strong desire to grow and take more control of my food source. My practical gardening experience has been shaped by the time constraints of full time work, and the site conditions of my previous abodes.

My personal interests and hobbies revolve around gardening, tramping and other similar outdoors activities in natural environments. As an extension of this I am self aware of my actions to take care of our environment and have a desire to see native species incorporated into systems for both conservation, and species diversity.

Self Analysis

I am a likeable and pleasant person that people feel at ease with. I have a focused, steady and methodical personality with an eye for detail, and am a great organiser. I think deeply and strive to obtain the best outcomes. I am very hands on and learning new things is what gets me out of bed in the morning. I love plans and maps! I endeavour to live a low footprint life; live with integrity; have a desire to give back where I can; and share the journey with others.

These personality traits, skills and experiences assist me well in working through all stages of permaculture projects.

Needs of the End User

The residents are middle age professional couple, they are looking to down scale their working responsibilities and/or retire early to live a simpler life. They currently enjoy an active and healthy lifestyle, and need the property set up to enable them to manage and enjoy the property as they age.
Specific needs include

- System set up for a simpler, low impact and more resilient lifestyle
- Take more control of their food supply with productive annual and perennial gardens providing nourishing year round nutrient dense vegetables, herbs, and fruit
- Become part of a community, build links with like minded neighbours who can support each other
- During implementation they would like the project to be a catalyst for information sharing and building community networks
- Easy access around the property
- Systems and solutions that are restorative in nature being kind to the planet / environment
- A separate studio accommodation that has flexible use depending on needs at any one time. Possible uses include: studio office, guest accommodation for visiting friends, long or short term rental to provide an income stream, accommodation for Helpex/WOOFer or similar in return for help on the property, possible accommodation for intergenerational living
- The residents are very clear that they do not want to have domesticated animals in the system as they do not want the time investment or responsibility to look after animals. As well as this, they eat a whole food plant based diet so do not consume animal 'protein'

The residents are practical and able to undertake physical activities. They have knowledge and skill with building projects so are able to undertake practical tasks such as building raised garden beds, digging and planting, as well as some building refurbishment and maintenance work. They are keen to be actively involved in the implementation phase of the project.

Site Analysis

Locality

Township Latitude	-40.87352
Township Longitude	175.06395
Local council planning zone	Residential
Land area	906sqm
Bio Region	Kapiti Coast, Lower North Island

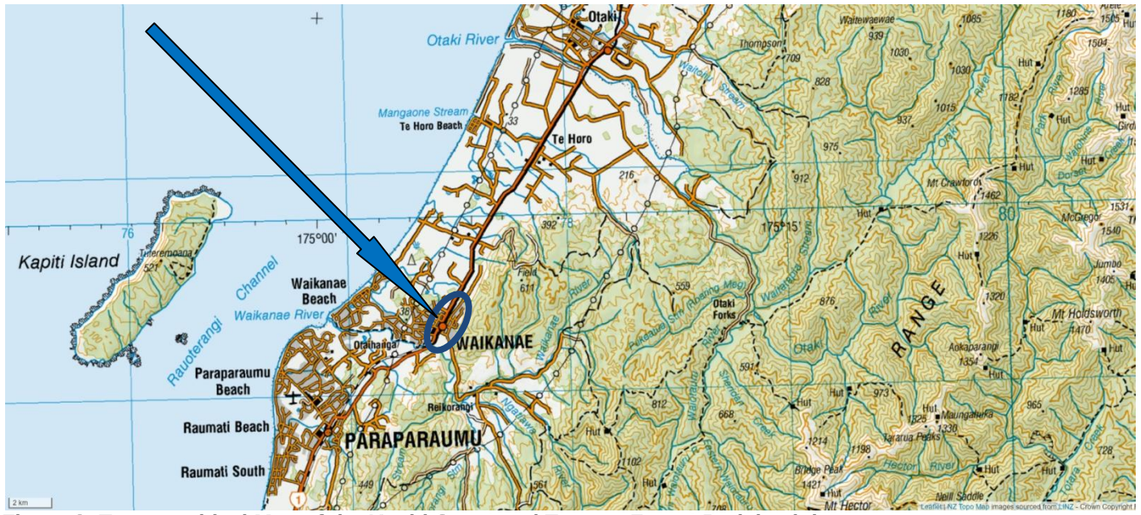


Figure 2: Topographical Map of the Kapiti Coast and Tararua Forest Park backdrop,

The 'Bush to Sea' setting is home to a wide diversity of habitat and species. This is supported and enhanced by a wild life corridor that extends from the Tararua Forest Park to Kapiti Island, a predator free reserve, connected via the Waikanae River and the Kapiti marine reserve.

The Hemi Matenga bush reserve encompassing the ridge above the site provides a number of benefits. It acts as a sponge holding and regulating water flow from the forested hillside, thus slowing water flow and minimising surface flooding or erosion. Water seeps down the hillside through the year providing *some* soil moisture even in the driest months. The dense bush in the reserve stabilises the land so the site should be largely protected from landslide. The hillside has the effect of blocking/ halting the prevailing weather and combined with transpiration from the trees creates a slightly damper microclimate compared to the coastal areas of the Kapiti Coast. Some of the small streams that come off the hill are home to native species such as tuna, koura and kokopu indicating a healthy waterway.

The site is approximately midway up the slope between the town centre 22m Above Sea Level (ASL), and the bush edge 120m ASL. Both are approximately 350m away in opposite directions. The hill rises up to the East (E) with increasing steepness to the ridge top at approximately 470m ASL. To the West (W) and North West (NW) the gradient flattens out extending to the sea approximately 3.2km away

The close proximity of the bush reserve, nearby streams, Waikanae River and Beach, benefit the site as the wider community area can be incorporated into its zone planning.

The coastal shoreline and wider area is largely protected by Kapiti Island which dominates the local western horizon and provides a buffer from onshore wind.

120,000-70,000 years ago the sea level was higher than today. The flat part of Waikanae was under water and the sea "cut a line of costal cliffs at the base of the foothills…" (*Reference Chris Maclean 'Waikanae 'Pg 145*). Then approximately 70,000 years ago a cold period accelerated the erosion of the hills, creating large shingle fans which an early geologist referred to as *'Matenga Fanglomerate'* which describes the varying size stones irregularly scattered through the soil in this area. (*reference Chris Maclean Waikanae Pg 145*) This explains the higher than expected sand content and quantity of stones in the soil (refer soil notes below).

More recently native bush covered the hillside (including the project site) before being cleared for grazing around 1892/1905 for dairy, beef and sheep through to the 1940's at which time suburban development of the lower slopes started.

Project Site and Topography

Overview

The project site was developed for housing in the 1950's and is typical of the era '¼ acre' section (906sqm) on a quiet side road, it is rectangular in shape and orientated on a NW / SE axis largely parallel with the land contour. It is surrounded by other properties of similar size and age. It has good proximity to town centre amenities (10 minute walk or 5 minute by bicycle) and public transport so has good access to the wider area and Wellington city (45 minute drive or 55 minute train journey) if needed. It is a friendly neighbourhood.

The site is elevated at approx 54m ASL and has a NW aspect so benefits from good light, sun and a slight slope of 5°.

The slope means that any incoming water can run across it and gravity can be used to transport water and other elements around the site. There is no council storm-water system in the immediate area and excess water can enter the site from neighbouring properties. This effect is likely exaggerated by old storm-water soak-pits on respective properties having filled up with debris over time, and infill housing creating more hard surfaces for water run-off from instead of being absorbed by the soil. Incoming surface water can potentially be captured, stored and used as a resource rather than letting it run straight off eroding soil and removing nutrients from the site. **Refer Sector Plan**

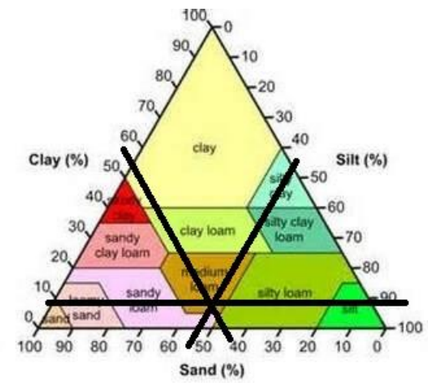
The NW aspect of the site receives virtually all day sun. There is a slight delay in the arrival of the morning sun because of the hill that on the E however temperatures warm up quickly once sun arrives and the site receives sun well into the evening. Refer **Existing Site Topographical Plan**

Soil

The soil classification is Q2a: Poorly sorted steep fan deposits
Per GNS Geological map

The soil on the site is:

- A medium loam comprised of 9%clay, 45%silt, 45%sand (Jar test May 2020)
- Compacted
- pH6 to pH6.5
- Interspersed with rounded rocks ranging in size and density.
    - Rock sizes typically vary from 10mm to 300mm, with most approximately 100mm x 50mm
    - There are areas of virtually no rocks and other areas where dense rocky layers occur around 300-400mm below the surface



The shapes of the rocks indicate that they have been weathered and come off the hillside, and the sand component is evidence of the shoreline having once been along the hills.

The past land management at the site has had a negative effect on the soil ecology. The removal of the native trees, shrubs, and ground cover of an established natural forest ecosystem also removed the diversity of plant, animal, bird, and soil species.

The conversion to grass land, typically a few species of grass (mono-crop) for grazing, likely disrupted the ecosystem causing it to shift to an earlier stage of succession that favored 'weed' species. And a soil ecology dominated by bacteria rather than the fungi dominated soil of the forest ecosystem. The farming of the land likely involved the addition of fertilisers to support grazing, with potential of further degradation.

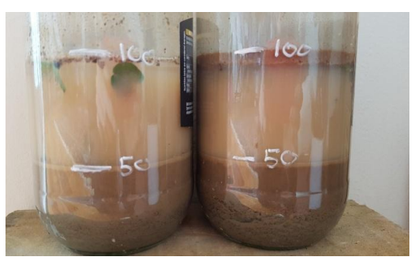


Figure 3: Soil Test Results - Front yard (left), Rear yard (right) Jars calibrated for volume

Running stock on the fragile soil, lack of tree cover to buffer effects of rain fall, and loss of ability for the soil to absorb water likely contributed to soil compaction and loss of topsoil through erosion. The later development of the land for present day housing involved removing/ turning over of any remaining top soil and other disturbances to the soil ecology as roads were formed, trenches dug for services and building sites carved out of the slope.

Plants as indicators of soil conditions
It is useful to observe dominant plant species to understand soil conditions and the current succession phase.

Front and Rear yards: The different plant species create a scatter pattern with clusters of dominant plants in certain areas. The factors that have created this scatter pattern are: soil structure, moisture, pH, and nutrient profile.

Front yard: mixed grasses (including Kikuku), Dandelion, Creeping Buttercup, Bird's Foot Trefoil, Clover, occasional Plantain.

Rear yard: mixed grasses, Dandelion, Creeping Buttercup, Yarrow, Clover, occasional Plantain. There are also patches of Bindweed, Artillery plant and Tradescantia around boundary corner areas.

The presence of these plants is indicative of soil and conditions helping them thrive. Several are considered 'weeds' however these plant species are actually the ones the soil needs at an early stage of natural succession and help move towards a later stage permenant stable system. Refer Figure 4. They have a useful purpose – as indicators of the current soil conditions, and to protect and improve the soil.

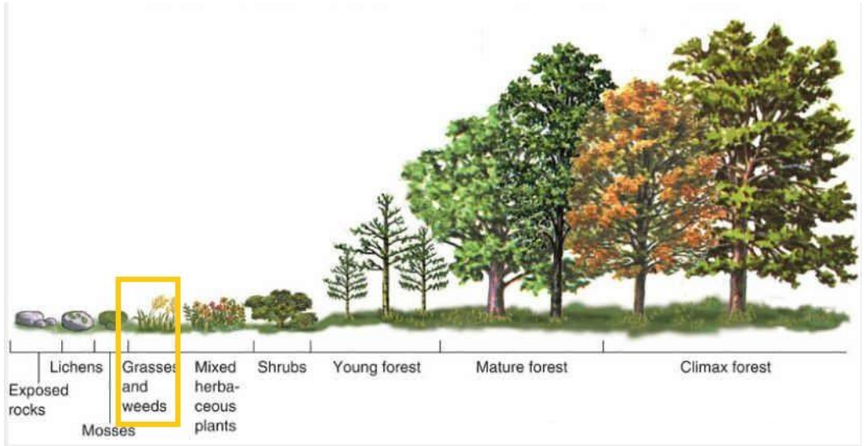


Figure 4 Ecological succession - Changes in soil structure, chemistry and pH alters soil biology, which leads to plant succession. The current succession stage of the site is shown within the yellow box

No single plant will give a complete picture of soil conditions, however the community of plants in a given area can reveal information. For example plants with deep strong roots indicate that the soil is compacted (plants with finer and less strong roots are not able to take hold). Taproots work to break up the soils, transport nutrient up from the deep layers, and when they decompose provide organic material and create pathways for water, nutrients, and weaker roots systems.

Plant	Characteristic	Indicates	Benefit
Dandelion	Broadleaf perennial, likes sun or shade, has a strong taproot	Compacted soil low in fertility	Mines calcium, rich hummus when it decomposes
Creeping buttercup	Low growing perennial, roots at nodes, forming a ground cover that out competes other plants	Likely heavy, poorly drained soils	Ground cover / covers bare soil
Bird's foot trefoil	Clover/legume family Deep branched root system. Invasive	Acidic soil low in nitrogen, well drained	Branched roots hold soil together, fixes nitrogen, breaks up compacted soil, mines nutrients
Broadleaf Plantain	Broadleaf perennial with a large number of 'adventitious' roots spreading downward from a crown rather than a single tap-root.	Compacted, acidic soil with low fertility	Breaks up soil
Yarrow (predominantly close to established trees)	Perennial with a deep rhizome system, tolerates dry, does not like waterlogged soil	Loam	Rich in nutrients (magnesium, calcium, phosphate), flowers attracts beneficial insects
Bindweed	Persistent creeping vines that spread over other plants, tap root with numerous brittle lateral roots usually in top 600mm of soil	Excessively low or high pH, incomplete decomposition of organic material, low in humus	
Artillery plant	Invasive, creeping plant that carpets the ground and prevents other plants from establishing	Shady cooler location with well drained moist soil	Ground cover / covers bare soil
Tradescantia	Invasive, creeping plant that carpets the ground and prevents other plants from establishing	Damp, humid and shaded location	

In summary the soil on the site is slightly acidic, poorly drained and compacted. There are notable areas of rear yard around established fruit trees with better soil conditions (indicated by the presence of Yarrow) . Neglected shady corners under dense tree cover and where previous occupiers discarded prunings are suffering from invasive species indicating poor and incompete decomposition of prunings.

(References: http://www.massey.ac.nz/massey/learning/colleges/college-of-sciences/clinics-and-services/weeds-database/weeds-database_home.cfm ; https://www.permaculturenews.org/2017/04/14/using-weeds-read-soil-basic-concepts-get-started/ ;https://www.almanac.com/weeds-indicator-plants ;https://underwoodgardens.com/; https://www.cabi.org/ ; "Weeds and What They Tell Us" by Ehrenfried E. Pfeiffer)

Soil critters (biology) as indicators of soil conditions
The presence and quantity of soil macro-invertebrates, and knowing their prefered habitat give an indication of soil health.

These species (including earthworms, nematodes, soil-dwelling insects, mites, spiders, slaters, isopods and springtails) modify soil habitat, redistribute resources, transport plant litter, predate on each other and accelerate the incorporation of plant and animal organic matter into the soil.

A Soil Critter Count Survey (April 2020) found a population of 111 native earthworms in a 0.25m^2 area. Refer **Ecosystems Soil Critter Count** (Appendix). This translates to approx 22 worms per 200mm cube (autumn); the ideal range is 30-35 per 200mm cube (late winter to early spring). Worm numbers and activity vary throughout the year and are at their peak and more active in July and August when conditions are cooler and wetter. July – August is considered the best time to conduct counts.

Considering the survey was done during the time of year when soil is typically drier and warmer, and worm numbers are expected to be lower the results show a healthy worm population.

Despite only worms being observed at the time of the survey, other species including Woodlouse, Springtails, Millipedes and Ground Beetles have been observed at other times when disturbing the soil for preparing garden beds. Like worms the activity of these other species vary throughout the year so a follow up survey late winter to early spring is recommended to establish a better picture of soil critter numbers.

The presence and population numbers of worms indicates that organic matter is present in the soil of the survey area. Further improvement of the soil will assist the population to increase and spread throughout the site.

(Reference: https://www.stuff.co.nz/business/farming/101241913/earthworms-play-a-vital-role-in-improving-new-zealand-soils)

Climate
The Waikanae climate is temperate with a NW prevailing wind; S is the second most common wind. Both are most frequent and strongest in spring. The area is known to be generally frost free. *(Reference Wikipedia)*

Influences

The Central New Zealand / Cook Straight region produces strong winds and storms. However the Tararua Range provides shelter for the Kapiti Coast, in particular Waikanae, from the S and E, and Kapiti Island provides shelter from the W. Because of this the area is largely protected from Cook straight climate extremes.

The shallow channel between Kapiti Island and the mainland (Waikanae Beach) produces a higher water temperature than the steeper coastlines closer to Wellington Harbour further S. The prevailing wind in this region is from the NW, which drives rain-clouds inland to the ranges and results in high rainfalls during the winter and spring. *(Reference https://en.wikipedia.org/wiki/Waikanae)*

The nearest NIWA weather station is located 8km away at Paraparaumu Airport. From observation the Waikanae climate is somewhat different; more rain, less wind, lighter frosts. The NIWA climate data information from Paraparaumu Airport is incomplete, so for the purposes of this project, data has been sourced from the “National Center for Environmental Information - National Oceanic and Atmosphere Administration” (NOAA) USA, and Climate-data.org (date ranges of data collection and exact weather station locations are not provided).

The data is generally consistent from both sources for average temperatures however average rainfall differs in quantity and time of year. This may be attributed to data being collected over different time periods and may indicate a general change, or annual variance in rainfall patterns.

	Climate-data	NOAA
Warmest months	Jan, Feb	Jan, Feb
Coldest months	Jun, July, Aug	Jun, July, Aug
Driest months	Feb	Jan, Feb, Mar
Wettest months	May, Jun, July	Oct (then Jun, May & Aug)

The data from both sources however gives an overview and provides guidance on climatic trends of the area. Regular daily observations can then be measured and recorded as an ongoing process to build up site specific microclimate data and trends over time.

Climate challenges on this site are hot and dry summer conditions and excess wet in winter.

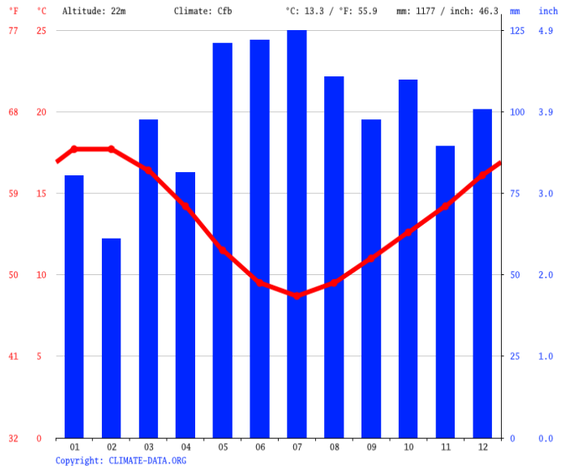


Figure 5: Bar chart showing rainfall with line chart overlay showing temperature (climate-data.org)

Figure 6: Temperature line chart, Rainfall bar chart, and Daylight hour’s bar chart (NOAA)

Rain Harvesting Potential and Irrigation Requirements
The residents are experimenting with harvesting rainwater, starting with the shed roof collecting into recycled 200L food grade barrels, and gravity irrigating a vegetable patch during summer dry spells.

Waikanae Rain Month by Month. Chart created from data sourced from Climate-data.org:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Rain (mm)	79	60	96	80	119	120	123	109	96	108	88	99	1177
No. rain days	9	8	9	10	11	11	11	12	12	12	10	11	

Based on the house roof area of 90m^2, the annual rain harvesting capability is approximately 106,000 L. The 12.5m^2 shed roof can provide an additional 1,400 L annually.

January and February are on average the warmest, driest months and is when irrigation for the garden is required. The residents calculate, needing approximately 2000 L per week, during January and February to irrigate an establishing garden (based on current water use). On average there are only 8 to 9 rain days each of these months, so assuming a dry spell of 3 weeks is likely and a dry spell of 4 weeks is possible (and should be planned for as a worst case scenario) then between 6,000 L and 8,000 L water needs to be collected and stored before the start of January.

Average rainfall in December and collection from the house roof would provide sufficient (8,910 L) to meet this requirement however it would be prudent to begin ‘banking’ water prior, in case of a dry December (16,830 L potential from an average November and December).

Additional usage data can be obtained from water rates bills to calculate harvesting and storage needs for household use if this is required in the future.

Microclimate
A microclimate is the climate of a small area that differs from the general climate of the surrounding area. Microclimate is affected by aspect, slope, light and shade, temperature, shelter, drainage, and soil.

Beyond the site boundaries the local microclimate is influenced by the hill which ‘catches’ clouds from the prevailing NW direction. The slightly higher mist and rain experienced in this part of Waikanae, combined with the transpiration from the trees in the bush reserve, creates a damper microclimate compared to the drier coastal areas.

The NW aspect, elevated position, and slope of the project site provide good light to much of the site in the afternoon and evening. The slope also provides drainage for water, frost and air allowing these to move across the site rather than settle. And can assist with draining and moving water around the site to benefit the soil and production areas.

The compacted medium loam soil has virtually full grass coverage which is kept longish to shade and protect the soil. The soil has the ability to hold water, and the grass cover helps to retain and slow evaporation of the moisture. This moderates the air temperature and humidity above it, benefiting growth of plants nearby. The soil can contain and hold a lot of water after heavy rain, and small areas of soil without cover tend to dry out quickly. This modifies the microclimate to less favourable conditions as overly saturated wet soils are anaerobic, take longer to warm up, and compacted dry soil doe not absorb water so easily.

The position of existing buildings and boundary fences provides some shelter from wind, and casts shade. The light coloured buildings also reflect light. These factors create different microclimates across the site.

The front yard is open to the street, so is exposed to wind, and cooler temperatures. The house creates shady areas on the areas of the front year closest to the house. The N side of the front fence is one of the sunniest spots on the site as it receives good sun throughout the day and year.

The rear yard is a more sheltered, and is a trap for warmth and sun because it is protected by the buildings and fences, and benefits from reflected light from the house and shed. The influence of the shed on the microclimate immediately around it is noticeable. The concrete foundation is a heat sink that absorbs warmth from the sun which is then released once the temperature cools, and the light coloured cladding reflects a high percentage of light. These effects extend the growing season in the immediate area.

The E side of the house is shaded and acts as a wind funnel for S winds because there is no screening to diffuse the S air flow on this side of the house. The shade and movement of air makes this a cooler part of the site.

Socio Political
The Waikanae Township established around 1886 when the railway line between Wellington and Longburn (Palmerston North) was opened and created a link to main centres for goods and people. The railway is now the North Island Main Trunk Line, with Waikanae station being the final stop on the ‘Kapiti Line’ of the Wellington commuter rail network. A large number of residents commute daily to Wellington for work.

The resident population of Waikanae urban area is 12,708 (census 2018) and is growing. Residents are a mix of retirees and families – parents work locally or commute to Wellington. Approximately 12% of homes in the wider Waikanae area are 'weekenders' with non-permanent residents/owners. *(Source stats.govt.nz)*. The political leaning of the area fluctuates between the two main political parties (National and Labour).

There are several conservation groups active in the area including Friends of Waikanae River, Waikanae Estuary Care Group, and the local Forest and Bird branch. This indicates an acknowledgment, by at least part of the community, of the value of natural features around the area and a desire to protect and restore them.

Market

The Waikanae town centre is located 10-15 minutes' walk or 5 minutes bicycle ride from the site and there is a regular bus service with a stop a few meters around the corner.

The site has drive on access directly from the street which is easy for deliveries and or direct pickups and drop offs by couriers or customers.

There are regular weekly markets at the town centre (week day morning), and at a local park 2.8km away (weekend). Additional weekend markets are held in the town centre at Easter and Labour weekend.

There are other local markets further afield at Waikanae Beach (fortnightly during the summer), Paraparaumu Beach (weekly), TeHoro (monthly), and Otaki (weekly).

Market forces are not so applicable to this project in terms of determining demand and returns for saleable items as there is no intention by the residents to produce a product for sale at this stage. However fluctuations in availability and rising prices of food and other basics are a key driving force to create a system that supports a lifestyle for the residents to be more self reliant and resilient both within the household and the local neighbourhood.

The proposed flexible use separate studio accommodation could from time to time be rented out for an income stream however this is not the key driver behind its inclusion in the design. Any income that it generates will be dictated by the market at that time and is not required to bring in a certain dollar value to make it economically viable. Its construction and the retro fit of the existing land and house on the site needs to be modest and cost effective while achieving optimal results.

Summary of Council Planning Rules

One dwelling, one minor flat, and accessory buildings
Dwelling and minor flat must have access to an outdoor living court area 40m^2 min
Outdoor living court area must:

- Have a minimum dimension of 4 meters
- Be orientated to the N, W and or E side of the dwelling
- Be screened by a fence or vegetation of at least 1.5 meters in height
- Not be used as a vehicle parking area
- Have direct access from the internal living areas

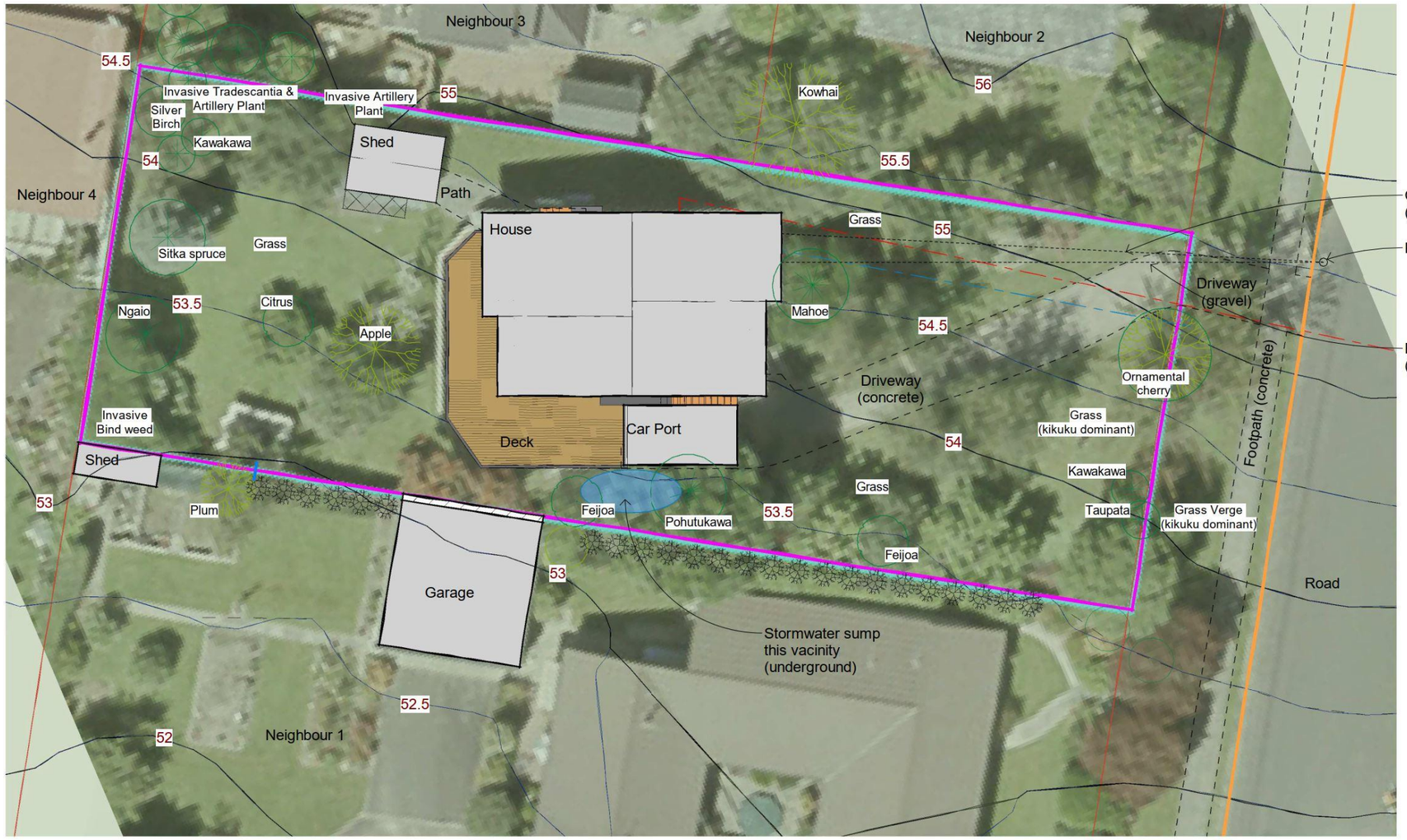
Permeable surface area	30%
Building Height	8m
Accessory building height	6m
Site coverage	40%
Fence height front boundary	1.8m
Fence height other boundaries	2.0m
Minor Flat (excluding decks)	54m^2
Accessory buildings	60 m^2 (combined maximum area)
Building setback front yard (min)	3m (4.5m garage or car port)
Side Yard (dwelling)	3m one side, 1.5m all other yards
Rear yard (dwelling)	3m
Side yards accessory building	1m
Recession plane	2.1m +45^o

Any increase in roof area triggers a requirement to upgrade the existing on site storm water management (additional soak pit capacity)
Relocation of driveway access to a property is a simple application process, and construction to council provided details

Base Maps

Project base maps have been created using Kapiti Coast District Council (KCDC) aerial map with contours; and Land Information New Zealand (LINZ) / Koordinates earth data platform GIS data download with boundary and topography layers as underlay's. The download data was then imported into a CAD Revit 3D model.

Existing Site Topographical Plan



EXISTING TOPO MAP

Aerial imagery sourced from Kapiti Coast District Council (KCDC) GIS Maps
Topography data sourced from Kapiti Coast District Council (KCDC) GIS Maps and koordinates.com / LINZ NZ Primary parcels and Contours 0.5m

LEGEND

Land
- Contour line
- Property boundary

Built
- Structure
- Building / structure
- Paving
- Minor Structure
- Path/ Access way
- Kerb

Services
- Electricity line (overhead)
- Water supply line (under ground)
- Waste line (underground)

Vegetation
- Tree Native
- Tree Exotic (evergreen): hedge / feature / fruit / other
- Tree Exotic (decidious): fruit / feature

NORTH

SCALE 1 : 200
0 2 4 6 8 10 12 14 16 18 20 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	16/06/20	INFORMATION	

STATUS: INFORMATION

PROJECT: SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS: KAPITI COAST

DRAWING TITLE: EXISTING SITE TOPOGRAPHICAL PLAN

DRAWN	CHECKED	DATE
RP		23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated
DRAWING NO.		REVISION
PDC200-G		B

The Existing Site Topographical Plan identifies key natural and built features of the site. Refer Appendix for full size drawing.

A comparison of the downloaded topography data with the observed site conditions show that the download with contours set at 0.5m spacing is sufficiently accurate for planning purposes. On a backyard scale some areas may require more accurate contour analysis for the implementation of an element (e.g. channels for capturing and distributing water). These can be set out on site using laser sights or the A Frame method to more accurately plot features and contours.

Following is a bullet point discussion of the features noted on the topographical plan, and what constraints or impact they may have.

Existing Features Analysis

Services

Overhead power and communication lines cross the property from the street to the existing house near the uphill boundary. Tall trees that could grow into the wires should be planned carefully or avoided in this vicinity.

Underground water and sewer lines cross the property from the street to the existing house near the uphill boundary. Digging or placement of plant species with strong root systems should be planned carefully in this location to avoid damage to pipes. Future access to in ground services also needs to be kept in mind.

There is a storm water soak-pit somewhere on the site near the downhill boundary, likely near to existing Pohutukawa and Feijoa trees.

Front Yard

Key trees on site front yard include

- Silver Birches - shown on aerial photo, lining the driveway, tall and unmanageable, so felled and mulched (Nov 2019)
- Liquid Amber (2No.) - on downhill boundary, recently reduced in height as too tall for their location (shading and blocking views), source of mulch and fire wood
- Ornamental Cherry - on boundary, recently reduced in height as branches growing into street power lines. Suitable for a source of mulch in the short term, mid to long term removal of tree and replacement with more functional species
- Feijoa (2No.) - on downhill boundary, have been neglected
- Kowhai (native, flowering) on Neighbour 2 property pruned to open shape, does not shade, provides screening, food for birds and other wildlife, nitrogen fixing to soil
- Pohutukawa (native, flowering) - recently reduced in height as it was too tall for its location (shading and blocking views), excessively shading the property from winter sun, and limbs dangerously overhanging Neighbour 1. Would like to retain and manage to compact size and shape however very close to carport structure
- Mahoe (native, produces small flowers) - provides screening between house and street, requires periodic pruning as branches grow close to power and communications lines to the house

Rear Yard

Key existing trees on site rear yard include

- Apple – old unkempt, too high to reach top branches even on a ladder, suspect it is a Royal Gala, fruit is small and diseased. Needs attention
- Citrus – old grapefruit, produces prolific sweet flavoursome fruit. The trunk has some damage near the base. Needs care to ensure the trees survival, ongoing attempt to propagate via air layering and cutting methods
- Ngaio (native produces small flowers) - pruned to open shape
- Sitka Spruce – provides screening from neighbour 4, however is problematic as it casts excess shade across the rear yard particularly during mid autumn to mid spring when the sun is at a low elevation/altitude, oozes sticky sap, and creates poor growing conditions under its canopy. Suitable for privacy screening in the short term, mid to long term removal of tree and replacement with a more functional species
- Silver Birch - provides screening from neighbour 4. Host to climbing plants (Pumpkin, and an invasive Jasmine), creates shady corner with invasive Tradescantia growing under it
- Kawakawa (native) - culinary and medicinal uses, common shrub in the area
- Gum – visible on the aerial photo between the deck and the W neighbours garage, tall and unmanageable, dangerous as overhanging garage, blocks sun and views so felled and mulched (Nov 2019)
- Existing trees that are functional and productive can be used as a framework to design around

Existing problem and invasive plants

- Kikuyu grass - dominant on the road verge and in patches throughout the front yard, some patches observed in the rear yard, its creeping and thick stems put down roots readily out-competing other plants and difficult to suppress
- Greater Bindweed - present in the N corner of the site around the boundary and occasional small patches noticed elsewhere. It smothers and strangles other plants as it vines around them. Indicator of poorly decomposed material
- Jasmine - present in the W corner of the site as a thick mass of vines growing up a Silver Birch Tree, currently provides some screening of the adjacent house, and also habitat for native (and introduced) birds
- Wild Asparagus - present in the W corner of the site, growing amongst the Jasmine and forming a thick mass smothering other plants
- Artillery Plant - present along the N part of the W boundary, which comes through from the neighbours garden. It forms a thick mat that smothers other plants
- Tradescantia - present in the E corner of the site, forms a dense carpet smothering other plants. Indicates damp and shady conditions

Structures

Driveway runs diagonally across the front yard which is inefficient use of space, and takes up area that could be used for productive purposes.

Boundary fences

- Vary in condition, with some broken and some a bit rickety
- Ideally fences would not be required, however this is dependent on neighbours, community willingness, pets, children, site access and safety.

Existing Shed

- Approximately 12m^2 footprint
- Light weight timber framed on concrete pad, with metal wall and roof cladding
- Excellent resource as workshop, surplus storage, and rainwater harvesting

Carport

- Located close to the house which is useful on wet days. Could free up more production space by moving closer to the front boundary

Existing dwelling -1960s era house

- 70 m2 house with approx 80m2 footprint (with deep recessed porch area)
- Lightweight timber frame construction. Typical of the era, although has a slightly unconventional inefficient ‘batch’ like layout
- Concrete ring foundation and concrete piles, with reasonable access under the house
- Painted weatherboard exterior (lead paint may be present due to the age)
- Windows are timber and single glazed
- Roof is the original decramastic tile (stone ship on pressed metal)
- A large deck area added in the 1990’s
- Maintenance work is required to keep the building weather tight, and renovation work required to improve efficiency and functionality
- Renovate and retrofit is preferable to demolition and rebuild due to construction waste and costs

A case study GAP analysis of the existing house compared to the ‘ideal’ was undertaken, it is summarised here:

Building orientation & layout

- Squat rectangle shape (1:1.75 ratio rather than ideal 1:4 ratio) with stepped walls on the NNE & SSW (stepped outside walls reduce thermal efficiency)
- Orientation of the house is not ideal, resulting in the long side of the house exposed to afternoon and late sun, causing overheating and glare
- The site dimensions, orientation and zone setback rules constrain ideal ratio and orientation
- Unconventional interior layout is not optimum (ideal is living spaces N, bedrooms SW, utility spaces SE)

Windows - approximate % of window area to floor area compared to guidelines

- NNE face is low, ESE face is suitable, SSW face is a touch high, WNW face is very high contributing to overheating and glare when the sun is low.

Insulation

- No under floor insulation. A vapour barrier was recently installed on the ground under the house and the difference in drier and warmer air in the subfloor space is noticeable
- Poorly insulated ceiling, has easy access to 75-80% of the roof area
- Old timber windows leak air, and single glazing has a low insulation
- Typical of the construction era, insulation in the exterior walls is unlikely

Thermal Mass

- Existing concrete ring foundation acts as a thermal mass even though it does not receive direct sun (shaded by the deck). Regulates the temperature in the house.

Shading

- WNW side of house receives significant solar gain and glare, this is also the direction of views that the residents do not want blocked

Ventilation

- Cross ventilation is most effective on a NE-SW direction with minimal obstruction (by keeping interior doors open).
- Cross ventilation is not easily achievable on NW – SE direction as there are obstructions and require exterior doors to be used, however this creates strong drafts

Building materials

- Damaged and unhealthy materials present

Neighbours properties are noted on the Existing Site Topographical Plan and referred to in the text, orientation of these neighbours relative to the project site are:

- Neighbour I - Downhill, W
- Neighbour 2 - Uphill near North boundary, E
- Neighbour 3 - Uphill near North boundary, E
- Neighbour 4 - Across the back fence, N

Regenerative Design Sector Analysis Plan

EXISTING SECTOR PLAN

LEGEND

Sun - Summer	Sun - Winter
Water	Shade
Wind	Nutrients
Views - Good	Sound / noise
Views - Screen	Property boundary
Community	

NORTH

SCALE 1 : 300
0 3 6 9 12 15 18 21 24 27 30 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	31/03/20	INFORMATION	

STATUS:
INFORMATION

PROJECT:
SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS:
KAPITI COAST

DRAWING TITLE:
REGENERATIVE DESIGN SECTOR PLAN

DRAWN	CHECKED	DATE
RP	-	23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated
DRAWING NO.		REVISION
PDC100-G		B

The **Regenerative Design Sector Plan** identifies external energies that impact on the site and has been prepared by observation over the course of 12-18 months. Refer Appendix for full size drawing.

External Energies Analysis

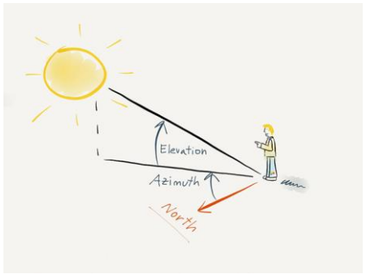
Sun summer & winter

The site receives ample sun, especially into the evening when low evening sun penetrates deep into the house. This provides winter heating, summer overheating, and glare at different times of the year. The rear yard receives a lot of sun especially in summer and may be challenging for some plant species. Seasonal shading for summer protection should be considered. The front yard is sunniest in the area closest to the street and is shaded in the area immediately to the S of the house especially in winter.

Data from www.sunearthtools.com not adjusted for NZ daylight savings time

20 DEC	sunrise	noon	sunset	Day length (hh:mm)
Time	05:43	13:17	20:50	15:17
Elevation (deg)	-0.833	72.55	-0.833	
Azimuth (deg)	122.57	0.13	237.42	
20 MAR				
Time	01:28	13:16	19:31	12:09
Elevation (deg)	-0.833	49.27	-0.833	
Azimuth (deg)	91.05	0.49	269.22	
20 JUN				
Time	08:44	12.00	17:58	9:14
Elevation (deg)	-0.833	22.98	-0.833	
Azimuth (deg)	59.12	20.24	300.89	
20 SEP				
Time	07:12	13:13	19:14	12:01
Elevation (deg)	-0.833	48.04	-0.833	
Azimuth (deg)	89.17	0.09	270.58	

Definitions:



Azimuth - the horizontal angle between North and a celestial body (sun, moon), measured clockwise around the observer's horizon

Elevation – also referred to as altitude, the vertical angular distance between a celestial body (sun, moon) and the observer's local horizon or local plane.
(Description source: photopills.com, graphics source photopills.com and Wikipedia)

Figure 7: Azimuth and Elevation

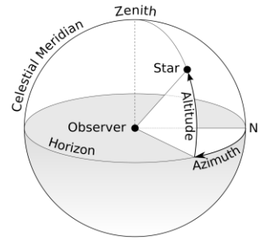


Figure 8 Azimuth, Altitude (elevation) and Horizon

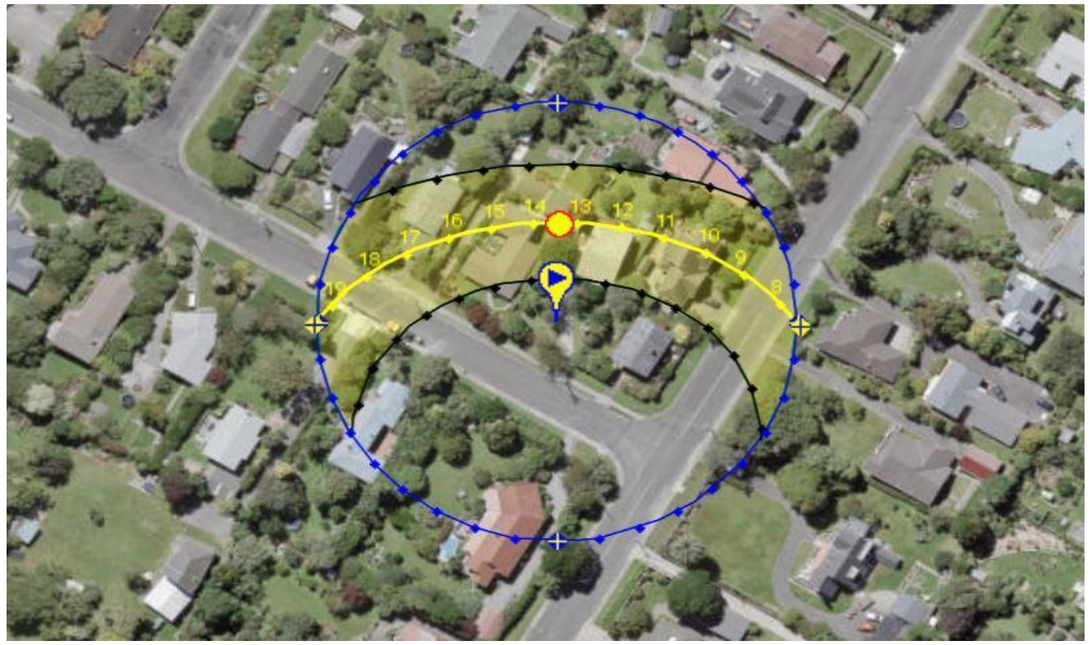
Sun diagrams (Figure 9) for the latitude and longitude of the site generated from www.sunearthtools.com show sun angles throughout the year. These diagrams align with and confirm local observation with the exception of morning sun arrival to the site. The local topography delays the arrival of the sun to site and is not factored in the sun earth tools diagrams.

Shade

As described above, the topography shades the site from very early morning sun.

Neighbour 4 house is two story and close to the NE boundary, it casts some shade to the NE portion of the rear yard especially mid autumn to mid spring when the sun is at low elevation. This is exaggerated by the impact of the Sitka Spruce tree that provides visual screening between the properties. The tree is taller than the neighbours house. In summer it has negligible impact, in winter it has a negative impact.

The existing house on the site shades part of the front yard (S side of the house) and deep eaves also shelter the ground from rain - the shaded and dry soil on S side of house hinders plant growth. There is an opportunity to find species more



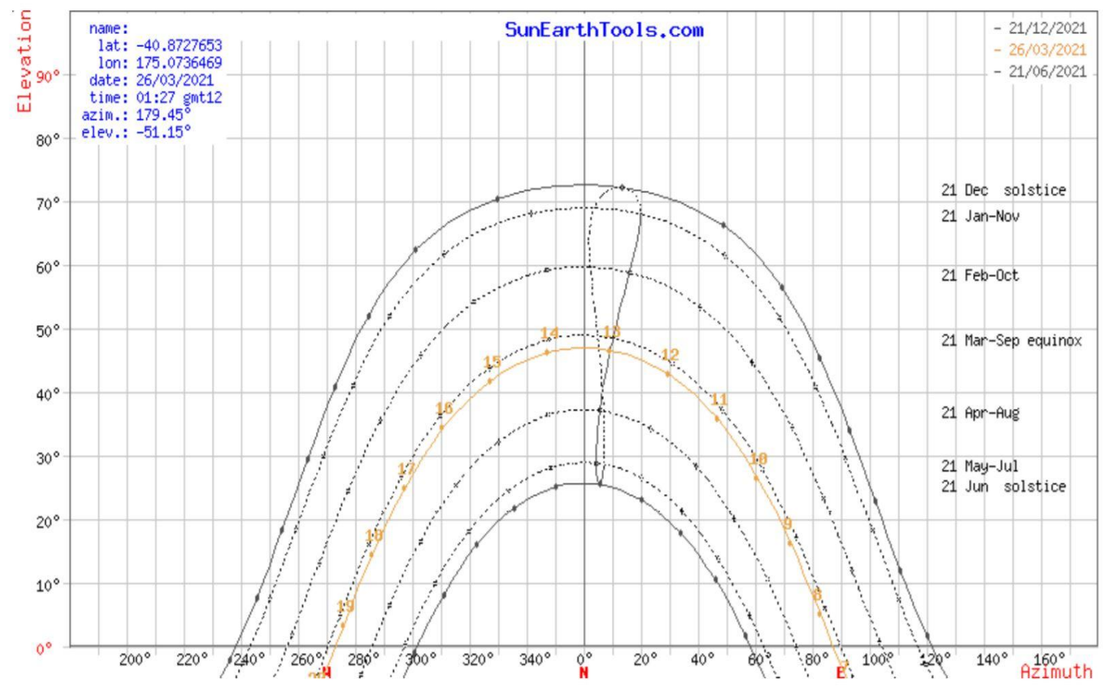


Figure 9: Top - Aerial with sun path diagram overlaid on the site. Bottom – sun information shown in graph form

suited to the cooler, dry shaded area. And improving the soil with compost and irrigation would help support a broader range of species

Shade from boundary fences on the N and W side of the site is negligible in summer, however has a greater impact in winter when sun elevation is low generating some shade, which combines with wetter ground conditions.

Wind
Wind through this site is generally not damaging however some screening to diffuse extremes and provide shelter would be of benefit to the S and NW of the site. Any shelter added should not block views and sun on NW.

- NW prevailing wind - similar direction as the sun, good views and outlook so wind shelter should be managed carefully
- S wind - second most dominant wind and affects the S of the property, a wind break planting on S boundary would be of benefit to diffuse the strength of the winds, insulate the house from cold, and create a warm sun trap in the front yard
- Rear yard - protected from all but the strongest winds by the boundary fences. Diffusion of the wind can be of benefit to slowing the wind speed and ensuring adequate shelter – especially when fruit trees are in blossom to reduce loss

Views – good
Good outlook and views towards the coast and island are currently impacted by tall trees in the neighbourhood (likely to grow taller). These tall trees are shading and dropping leaves on the immediate neighbouring properties. Planning to offer neighbours free tree work to reduce tree density and heights in exchange for the wood and mulch produced. This would help neighbours with their light and help this site with views.

Existing and new trees on the N & W of the site need to be considered in regards to mature height and foliage to prevent blocking views and shading affecting both the project site and neighbours. A tree pruning and maintenance plan is required to ensure trees are kept manageable and appropriate.

Views - screen
Close neighbours on NE & E over look the site and additional screening would improve privacy. The problematic Sitka Spruce tree currently provides reasonable screening on the NE however has become too tall and needs to be reconsidered. Replacement or additional screening should be mindful of neighbours views and sun.

Water
Being a suburban property, the site is connected to the mains water supply which is chemically treated and metered. There is no constant natural water source on the property.

There is no reticulated storm water system in this local area where rain water is discharged from house roofs into storm water soak pits that collect and allow the water to percolate into the soil. In times of heavy or prolonged rain, surface water seeps onto the site from uphill saturated soils.

- Neighbour 1 - surface water flows across, and off the project site through a pipe in the concrete up stand at the base of the boundary fence to Neighbour 1
- Neighbour 3 - a large paved area adjacent to the common boundary prevents water absorbing into the soil, and the large roof area is a likely source of excess water seepage onto the project site. The ground between the dwelling on the project site and the shared boundary fence becomes sodden in wet weather.
- Neighbour 4 - collects rainwater from their deck into a barrel for a small water garden. Overflow has a tendency to run across the N corner of the project site, at times forming a small stream of flowing water towards the pipe to neighbour 1
- Surface water collects and causes the ground to become soggy along the NW downhill boundary
- Species planted along the downhill boundary need to be tolerant of occasional damp conditions

There is opportunity to:

- Increase the biomass on the site to take up excess water
- Collect and store rain water from the roof for irrigation in dry months, and possibly household use in the future
- Collect and channel the surface water runoff and seepage from the uphill properties to divert and direct for productive use including:
    - Slowing the rate of flow across the property to reduce damage and loss of nutrients
    - Divert to ponds and rain gardens for storage and cleaning
    - Irrigation to deliver water and nutrients to productive garden areas

Nutrients
Neighbour 4 has compost bins located next to the common boundary fence and the area of the garden close to this seems to benefit from nutrients leaching through.

Sound
Sound travels on the prevailing NW breeze and sometimes traffic noise from the expressway, railway line, and main road, is noticeable. This could be blocked or diffused by trees however, this needs to be balanced with allowing sufficient light, sun, and maintaining views.

Community
The suburban location and density of people gives an opportunity to get to know neighbours and build a community. The sector plan identifies community building pathways with adjacent neighbours.

Immediate neighbours:

- Neighbour 1 Large rear yard area with some fruit trees and former garden beds, sociable
- Neighbour 2 Retired. gardener (ornamental), sociable, share and swap produce from time to time
- Neighbour 3 Retired, quiet and keeps to herself, gardener (edibles & ornamental)
- Neighbour 4 Retired, sociable, gardeners (mostly ornamental)

The street facing boundary of this site provides a link to the wider community beyond immediate neighbours. Future shelter and privacy planting should take care to maintain this connection.

Concepts

Concept sketches have been prepared to explore and test different design possibilities. Each concept is described and critiqued to identify key elements and relationships to take through into the final design.

Concept - Zone Plan

Description
In permaculture design, there are a series of zones that represent certain characteristics and are arranged in harmony with: landscape patterns, production systems, proximity to houses, and proximity to other notable landscape features.

Zone 0 is the living spaces, the areas where the residents spend the most time.

Zone 1 is closest and most easily accessed from the living spaces. This is the area that requires the greatest attention and management. It is likely to contain: an annual herb and kitchen garden, small fruiting trees, berry bushes, cold frame, propagation area, and worm farm.

Zone 2 is a little further away or not so easily accessed from the house, this area requires a little less attention and management than Zone 1. It is likely to contain: perennial plants such as a home orchard with plant guilds under the fruit trees, compost area, and non edible herbs.

Zone 3 is usually a grazing system or cropping style farm land that is further away, less visited, and requiring less management. It is likely to contain a woodland grazing system with animals grazing amongst nut or large fruit trees.

Zone 4 is part wild, more marginal land not suited to intensive production. It is likely to contain areas such as: stream banks, wind breaks, and timber producing areas that are suited to foraging.

Zone 5 is unmanaged wild natural areas that are minimally impacted by human activity. Likely to contain native species closely resembling a natural ecosystem.

The Concept Zone Plan incorporates Zones 0, 1, and 2 on the site. Following, is a description of the zones as an initial response to: the project overview, site analysis, and base maps.

Zone 0 = House, dwelling, living spaces
Two self contained dwellings comprising, existing house and a new smaller ‘studio
The existing house is:

- Not optimally sized or sited however it is not practical to change these aspects. Changes would target improving efficiency, and insulation

The new studio is:

- Located on the front yard area so as not to impact the rear yard which is currently the best production area due to existing shelter, sun and warmth
- Orientated parallel to the site boundaries for maximum efficiency and minimise negative impact on use of the front yard for production. It is not the ideal orientation for incorporating passive solar design principles (within +- 30^{o} of N). However careful design of the building can mitigate the orientation
- The additional building increases the roof area available for water collection

Zone 1 = Intensive annual vegetable production
The size and shape of this zone is informed by the sunny areas to benefit from light and warmth, and areas most easily and frequently accessed from the dwelling and studio. It incorporates: annual vegetable and herb gardens to feed the Zone 0 residents, garden shed, wood pile, water collection tanks for Zone 1 and 2 use, and possible Zone 0 household use.

Water tanks can be located between the shed and the boundary to collect water from both the house and shed roof. This allows water to be gravity fed to the rest of the property.

This zone includes the deck attached to the house, and the space underneath. Potted plants can be placed on the deck and underneath can be used for: firewood storage, a seedling / potting area, and as thoroughfare from the car port directly to the garden.

This zone also incorporates areas of path and access ways around the site as these areas are used daily allowing observation and management of elements in the zone.

Two separate Zone 1 areas are indicated, adjacent to each dwelling to allow for:

- Privacy and sense of space for each dwelling
- A level of independence if the studio is rented out
- Makes best use of the sun, north facing areas and sun traps created by each dwelling
- Slight overlap of the two Zone 1 areas is deliberate to foster community between all residents

Zone 2 = Intensive perennial fruit and vegetable production
Zone 2 wraps around Zone 1 areas and forms a buffer between the annual garden and the boundaries. It incorporates a perennial home orchard or food forest with an understory of plant guilds, and native shrubs.

Placing small to mid-sized trees and shrubs around the perimeter of the property will soften the edge and provide some screening between neighbouring properties. This placement will also provide a connection or link between planted areas on adjacent properties and form a wildlife corridor (birds, skinks, etc.) around the neighbourhood.

Fruiting trees that are accessed more frequently such as lemons and limes are located nearest to Zone 1 vegetable beds and major access ways to soften the zone boundary and increase the edges. These trees can also provide shelter to Zone 1 during intense summer sun.

Fruiting and nut tree species that need less attention would be located further away from the house and also toward the front boundary which receives good sun. Understory plants and guilds include functional support species that: mine or fix nutrients, bring in beneficial insects for pollination and pest control, and provide food.

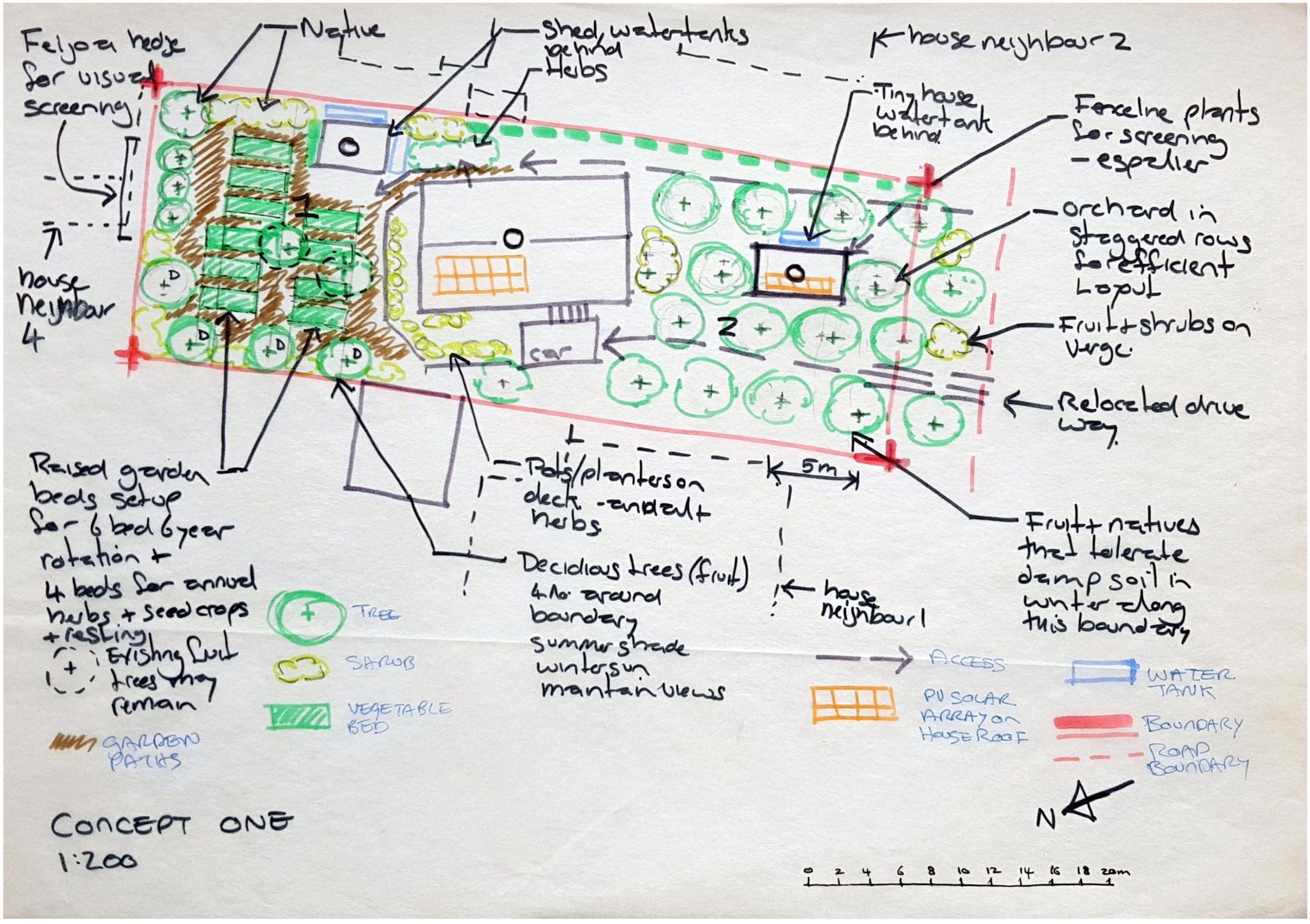
Deciduous trees incorporated on the W and N to provide shade in summer and allow light in winter.

Shelter planting to block and diffuse prevailing winds in particular from the south.

Trees and shrubs take up excess water that comes onto the site. Prunings from the management of these trees can in-turn be used for: Hugelkultur beds, mulch in Zone 1 & 2, and fire wood in Zone 0.

Zone 3, 4 and 5 = The suburban site is not aligned with incorporating these Zones. However these zones are in the vicinity of the site (walking and cycling distance) and easily accessed for farm-gate sales, trade, foraging, and recreation.

Concept - One


Native
Shed, watertanks behind
Herbs
house neighbour 2
Feijoa hedge for visual screening
Tiny house watertank behind
Fenceline plants for screening - espalier
orchard in staggered rows for efficient layout
house neighbour 4
car
Fruit + shrubs on verge
Relocated drive way
Pots/planters on deck - edible herbs
5m
Raised garden beds setup for - 6 bed 6 year rotation + 4 beds for annual herbs + seed crops + resting
Fruit + natives that tolerate damp soil in winter along this boundary
Deciduous trees (fruit) 4 No. around boundary summer shade winter sun maintain views
house neighbour 1
Existing fruit trees they remain
TREE
SHRUB
VEGETABLE BED
ACCESS
WATER TANK
PV SOLAR ARRAY ON HOUSE ROOF
BOUNDARY
ROAD BOUNDARY
GARDEN PATHS
N
0 2 4 6 8 10 12 14 16 18 20m
CONCEPT ONE
1:200

Description – Concept One

Traditional linear bed and home orchard layout

Zone 0
Existing elevated deck around the N and W of the house has planters for herbs and frequently used vegetables which extends the production area.

Zone 1
Raised annual garden beds set up for rotational gardening in sunny and sheltered rear yard area, positioned around existing apple and grapefruit trees. Beds are terraced and on contour.

Zone 2
Perimeter of rear yard planted with fruiting trees and natives. Deciduous where winter sun and views are to be maintained. Evergreen species planted adjacent the Neighbour 3 and 4 boundaries for privacy.

Staggered row planting pattern (space efficient) for a home orchard on front yard with tiny house set amongst the trees. The orchard extends onto verge for connection with wider community – share produce from those trees.

Trees on S side of the site and verge provides shelter from S winds.

Trees and shrubs take up excess water.

Pruning from the management of Zone 2 trees are used as mulch and to build Hugelkultur beds in Zone 1.

Water tanks for rain harvesting tucked in on the shady sides of the buildings to keep the water cool and make use of less productive areas.

Solar PV arrays on roofs to top up electrical energy for the site.

The main driveway is relocated to the downhill side of the front boundary

- Main access relocated to where conditions for production are less ideal in winter (damp and shaded)
- Existing gate (uphill side of the site) is kept and can be used by both the main dwelling, and tiny house so that any inputs brought to site can be loaded-in uphill and gravity used to assist with transporting it around the site.

Critique – Concept One

The layout of the site feels formal.

Layout is efficient and cost effective to implement as the design concept require less alteration to existing features and elements such as the existing house and car port.

Plant pots on deck require extra attention & risk drying out in summer – good interim step and possible to add pergola for shade to act as a nursery or outdoor living.

Re-locatable tiny home or caravan can be placed and moved about to test location prior to final placement and planting layout. Planting would prevent future moving around of the tiny home unless planned trees nearest the top access point are omitted.

Possibly too much shade to the tiny house, unless two planned trees in front of it are omitted to enable a deck to be built and open area to let light and sun in.

Is a tiny house sufficient size or suitable as a studio or accommodation?

- May be a good first step to use a caravan or re-locatable tiny home for guest accommodation to: test the idea, placement, and confirm size requirements.

The orchard acts as windbreak for the house.

Possibly insufficient summer shade to Zone 1 – needs dappled light to protect annual beds from long hot and dry days during the summer months.

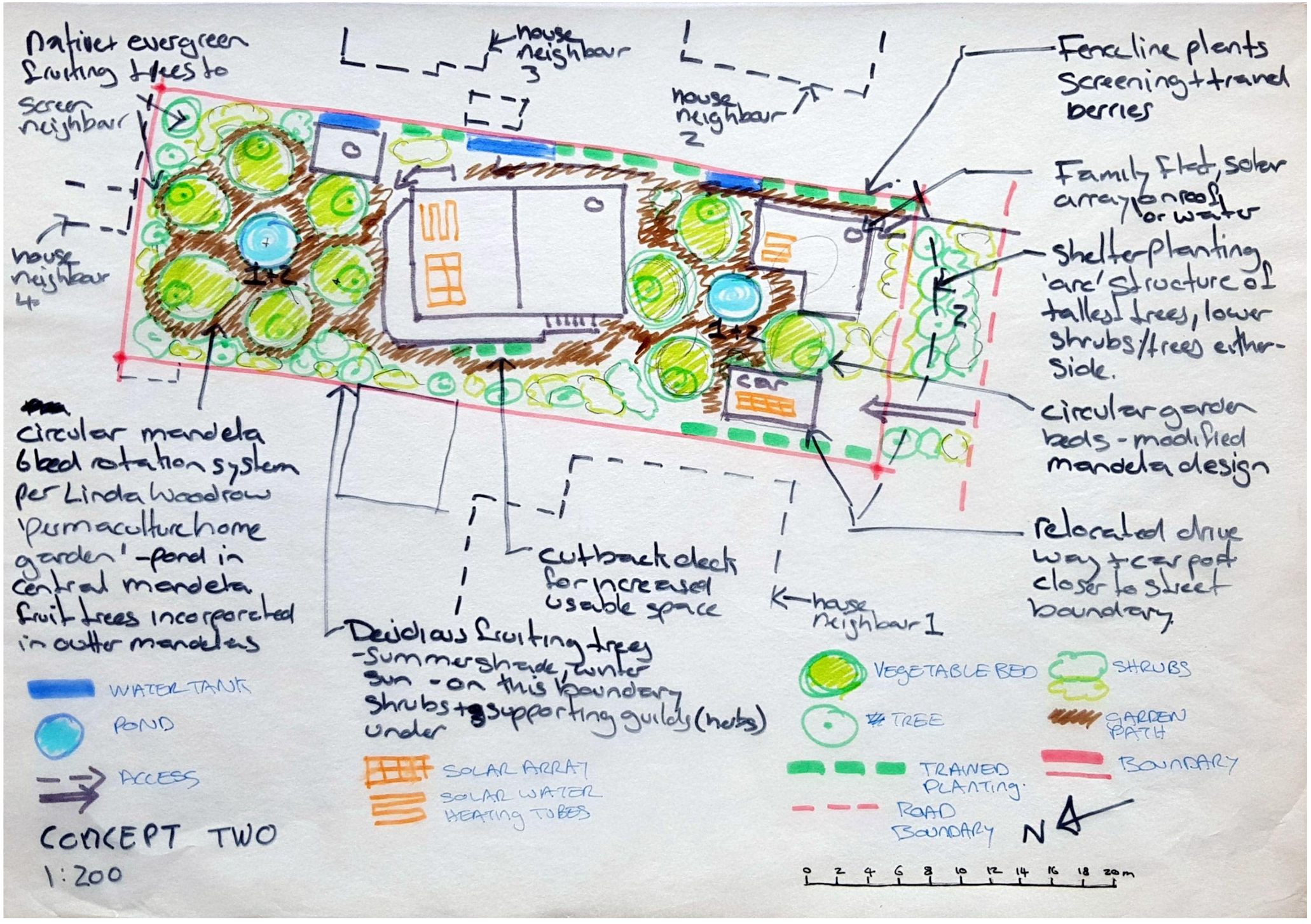
The site is on a gentle slope so terraced Zone 1 linear beds work well orientated along the contour.

- Check size of beds to suit the required area for crops in rotation - maybe revise bed lengths to obtain 12 equal size beds for 2 per rotation

Efficient path layout between the Zone 1 beds for easy access to production areas for harvesting and management.

May need to remove existing fruit trees in rear yard to achieve this Zone 1 garden bed layout – however loss of valuable shade and established fruit trees needs to be considered.

Concept - Two


Native evergreen fruiting trees to screen neighbour
house neighbour 4
house neighbour 3
house neighbour 2
house neighbour 1
Fenceline plants screening + trained berries
Family flat, solar array on roof or water
shelterplanting 'arc' structure of tallest trees, lower shrubs/trees either-side.
circular garden beds - modified mandela design
relocated drive way + carport closer to street boundary
circular mandela 6 bed rotation system per Linda Woodrow 'permaculture home garden' - pond in central mandela. fruit trees incorporated in outer mandelas
cutback deck for increased usable space
Deciduous fruiting trees - Summer shade, winter sun - on this boundary
shrubs + supporting guilds (herbs) under
car
1+2
1+3
2
WATER TANK
POND
ACCESS
SOLAR ARRAY
SOLAR WATER HEATING TUBES
VEGETABLE BED
SHRUBS
TREE
GARDEN PATH
TRAINED PLANTING
BOUNDARY
ROAD BOUNDARY
N
0 2 4 6 8 10 12 14 16 18 20m
CONCEPT TWO
1:200

Description – Concept Two

Mandela Garden System based on the system described in the book ‘Permaculture Home Garden’ by Linda Woodrow

One Mandela consisting of 6 circular annual crop beds with keyhole access, set around a central circular pond. The beds work in with a 6 bed rotation which includes a chicken tractor rotation. There is also a productive fruit tree planted on the outer edge of each bed that provides: shade, damaged fallen fruit for organic matter, and nutrients to the soil.

The tree species are selected and positioned to follow a pattern of: harvesting, fallen fruit, shade, and light at the time of year when needed for vegetable bed production. The pond acts as a heat sink, reflects light and provides a habitat for beneficial insects, as well as a pleasant place for the residents to sit and enjoy.

Compost sites are also positioned around the Mandela to locate this element close to where it is used – minimising effort.

This system requires a high degree of planning prior to implementation, and it can be modified to suit irregular shaped spaces. The Mandela beds are Zone 1, and the fruit trees around the outer circle are a transition to Zone 2.

The size and dimensions of the rear yard suit one Mandela and still allows some perimeter planting for privacy, screening, and additional produce. However the position of existing fruit trees does not suit the Mandela set out so would need to be removed.

This concept explores a larger footprint Zone 0 family flat as the second dwelling located in the front yard area. The deck on the W of the Zone 0 house is cut back, and car port is repositioned closer to the street boundary to minimise the area taken up by driveway. This increases the sheltered growing area immediately on the W of the house.

A modified Mandela system including a pond in the front yard makes productive use of the space between existing house, new flat and relocated carport.

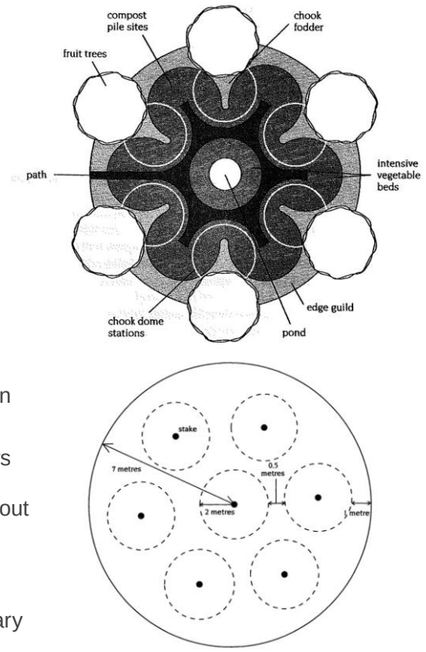


Figure 10 Mandela garden system key elements and dimensioned set out *(reference Linda Woodrow ‘Permaculture Home Garden’)*

An arc shaped Zone 2 windbreak is planted on the street verge. The windbreak consists of taller trees forming a defined arc with a band of lower trees and shrubs either side. The windbreak is permeable rather than dense foliage to diffuse and slow the wind, reducing turbulence. The arc shape helps divert strong wind away from critical parts of the site, and the band of lower trees gently directs wind up and over. The wind break: protects the site from cold S winds, gives shelter from strong damaging S winds, and forms a sheltered suntrap in the front yard space.

Water tanks for rain harvesting tucked in on the shady sides of the buildings to keep the water cool, and make use of less productive areas, and allow gravity feeding to the site.

Pathways around the site and between garden beds are trenches filled with wood mulch to collect surface water that comes onto the property and divert it around the site for passive irrigation. They can also be used to feed water from the storage tanks to the beds during dry spells.

The main driveway is relocated to the downhill side of the front boundary

- Main access relocated to where conditions for production are less ideal in winter (damp and shaded)
- Existing gate (uphill side of the site) is kept and can be used by both the main dwelling, and tiny house so that any inputs brought to site can be loaded-in uphill and gravity used to assist with transporting it around the site.

Critique – Concept Two

The layout feels more natural even though the circles are set out to a regular format.

Good to achieve a 6 year rotation system in the rear yard. The front yard would be a 3 bed system with one spare bed for resting – could be good in a shorter rotation cycle.

The additional work to set up 2 different rotation systems adds complexity. Is it disjointed having the annual beds split between front and rear yard?

Alternative is to implement a Mandela system in the rear yard only, and set up larger beds for staple crops in the front yard.

Fruiting trees integrated into a circular bed design is great as this provides summer shade.

Loss of existing productive trees in rear yard as their positions do not fit the dimensions of the system – to modify the system to enable one or both of these trees to be kept would not be optimal use of the design system. Lost efficiency from retaining 2 trees may conflict with the effort of creating this system.

Is it more work to implement the circular bed layout?

- Edging material – bricks, stones, or other… how easy and cheap to obtain?

The site is a 5^{o} slope – does the Mandela system translate well to this slope?

- Build-ability?
- How to avoid soil and nutrient run off?
- Terraced Mandela?

Paths around and between beds slow travel, this is good to allow time to observe and appreciate the garden. If passive irrigation is incorporated in the paths then this also slows the water flow and aids with delivering nutrients around the system.

Carport required dimensions and set back from boundary constrains the circular bed layout in the front yard.

Figure 11 Illustrated example of a circular bed system (RetroSuburbia by David Holmgren

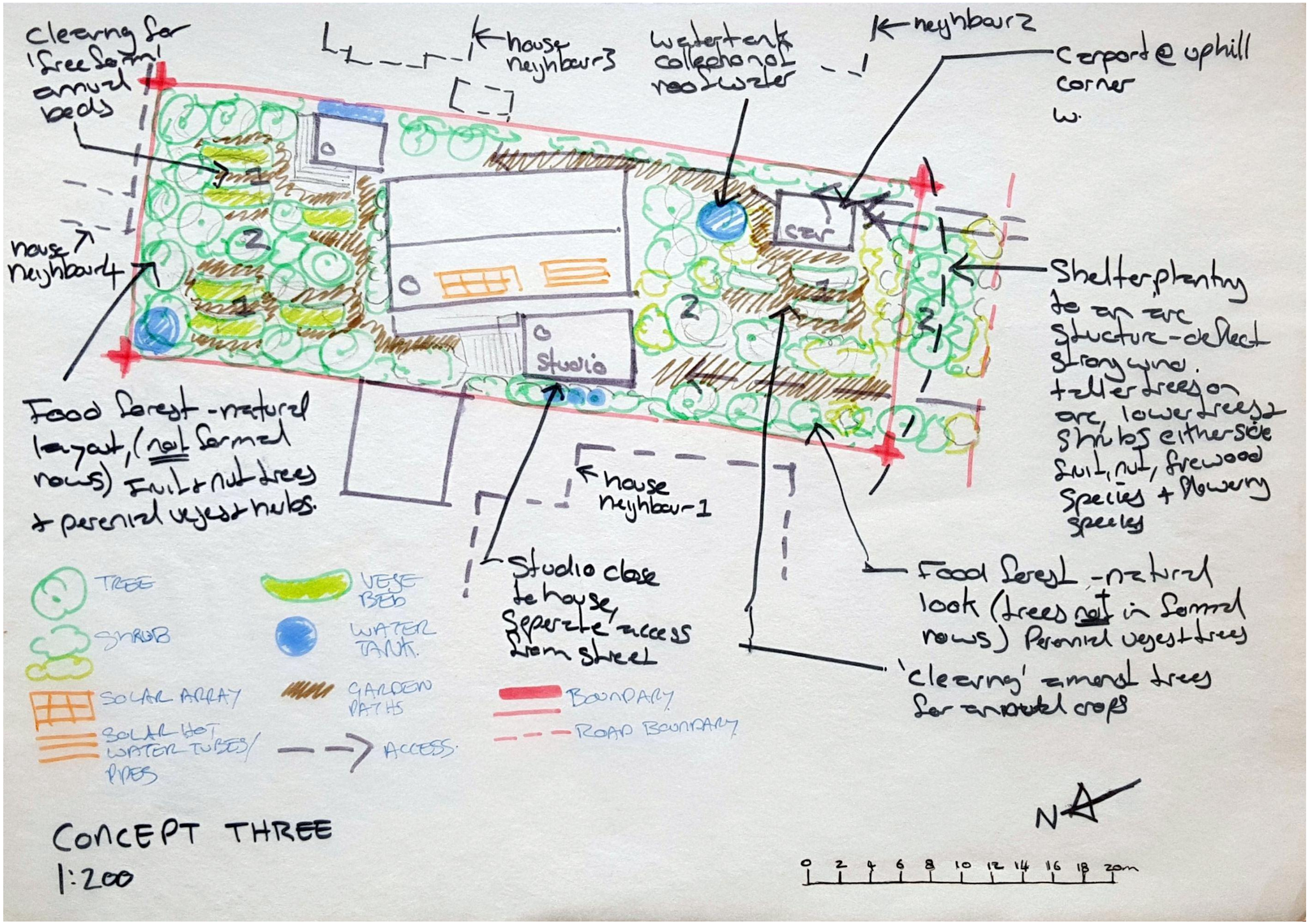
Family flat size and shape, and circular bed systems constrain each other. Is this the best compromise or is one further modified to allow the other to be more efficient – what is the appropriate balance?

Cutting back the existing deck for increased growing areas is good. Perhaps cut back the ‘floor’ area only and retain the structure to minimise re-engineering of the deck. Then fruiting vines (kiwi, passion fruit, and grapes) could be grown up and over the existing structure.

Shelter planting arc is an effective design. Will it provide too much screening from the street therefore too much privacy and disconnection from community and street?

Slim in line water tanks are nice and compact for an urban setting and can tuck nicely away beside fences and structures.

Concept – Three



Description – Concept Three

Food Forest – a Zone 2 dominated system interspersed with small pockets of Zone 1 beds

The whole site planted out with trees, most are fruiting and are interspersed with native trees selected for their ability to support a productive system (Kowhai – nitrogen fixing and deciduous, Manuka for attracting bees for pollination and tolerant of damp areas).

Zone 0

A studio is located on the site of the original car port (moved) and tucks in beside the main house; this consolidates the Zone 0 area and minimizes the impact of the studio on the overall layout of the site. The house deck is cut back to provide outdoor space on the N of the studio to allow light and sun in.

The form of the house is simplified by removing the wall steps, and the roof is re-orientated and elongated towards the N to provide a sheltered outdoor living space in lieu of the reduced size W deck.

Zone 1

Curved shaped raised annual garden beds are located in numerous small clearings within the food forest trees. The beds are raised to improve drainage and aligned on contour to enable passive irrigation. Raised beds are edged with irregular shaped branches and stones found on the site to make use of on-site resources also providing a natural appearance.

Vegetables are allowed to self seed to allow these plants to select the best place to grow. This blurs the boundary between Zone 1 and 2 as some annual vegetables may select a place within the area defined as Zone 2.

Zone 2

Trees are planted on contour across the site to achieve a natural pattern and to make use of contours for passive irrigation. Deciduous trees are used where winter sun and views are to be maintained. Evergreen species are used where windbreaks and privacy screening may be required.

Perennial vegetable and herb varieties are deliberately planted under trees to make use of vertical strata. Annual climbing herbs and vegetables such as pumpkin, can use the trees for support.

Fallen leaves from deciduous trees provide mulch around the vegetable species. The leaf mulch provides cover and humus for the soil ecology to enhance healthy vegetable production. Once the growing cycle of annual vegetable plants is complete they are allowed to die back in place, or are cut at ground level (chop and drop) leaving the cut material on the surface and the root system in the ground to decay. This avoids disturbing the root systems of adjacent plants, and improves the structure and fertility of the soil to support and feed the trees.

Berries and fruiting shrubs are planted under the high pruned tree canopy to make use of the vertical strata and mimic the layers of a natural forest.

Prunings from the management of trees are used as mulch and build Zone 1 Hugelkultur beds.

The trees and shrubs take up excess water reducing management of incoming surface water.

This concept explores the use of round water tanks to hold rain water harvested from the roof areas to test how much space they take up and how they fit in the overall system – which seems compatible with this concept as the more natural forms of the system means that plants screen the tanks and niche plants occupy the spaces in and around them.

The main driveway is relocated to the downhill side of the front boundary to provide access to both the house and studio:

- Main access relocated to where conditions for production are less ideal in winter (damp and shaded)
- Existing gate (uphill side of the site) is kept and can be used by both the main dwelling, and tiny house so that any inputs brought to site can be loaded-in uphill and gravity used to assist with transporting it around the site.

An arc shaped Zone 2 windbreak is planted on the street verge. The windbreak consists of taller trees forming a defined arc with a band of lower trees and shrubs either side. The windbreak is permeable rather than dense foliage to diffuse and slow the wind, reducing turbulence. The arc shape helps divert strong wind away from critical parts of the site, and the band of lower trees gently directs wind up and over. The wind break: protects the site from cold S winds, gives shelter from strong damaging S winds, and forms a sheltered suntrap in the front yard space.

Critique Description – Concept Three

This layout has a good natural forest feel, suitable for foraging, and simpler management.

The production is heavily weighted to Zone 2 perennial crops (primarily fruit); there is less area for Zone 1 annual beds (primarily vegetables).

This is not an intensive system so the efficiency and productivity is reduced, unlikely to meet the requirement for year round nutrient dense vegetables, herbs, and fruit on this size of property.

Utilises the framework of existing elements in the rear yard: house, shed, and fruit trees.

Will the Zone 2 trees provide too much shade?

Round water storage tanks take a lot of room on a suburban size section however seem to fit this style of system.

Retaining the existing access at the top of property works with gravity to move inputs to where they are needed - is good.

Simpler house form (rectangle) and extended for under cover outdoor living improves the living spaces.

The increase in the house roof area gives greater rain catchment area and space for solar energy collection. However an upgrade of the storm water soak-pit will be required by the council and needs to be accommodated and or argued that the extent of planting will take up the additional water. An upgrade to the storm water soak-pit will require excavation to install, the open space to N of the studio, or under the path/drive along the W boundary may be a suitable location.

The location of the studio significantly reduces access to the rear yard along the W side of the site.

Stones used to form raised garden beds can harbour slugs, a current problem in wetter months.

Shelter planting arc is an effective design. Will it provide too much screening from the street therefore too much privacy and disconnection from community and street?

Concept - Dwelling

An outline proposal of improvements to the Zone 0 existing house is summarised here and presented with a concept sketch.

Renovation and retrofit is preferable to demolition and rebuild due to cost and construction waste.

Building orientation & layout. The red dashed lines on Figure 13 sketch show ideal: ratio, orientation, and layout. It is not practicable to change these due to constraints of the site dimensions, orientation, zone rules, and cost.

Minor adjustments to exterior walls within the roofline improve simplicity of building form, and minor interior alterations improve the flow and efficiency of the layout. These alterations may include reviewing the size of windows on the N (increase to improve natural lighting) and W (decrease to manage over-heating and glare).

Insulate under floor and ceiling as there is easy access. The perimeter of the existing roof is difficult to access because of the small gap between ceiling and roof structure in these areas. However change in roof structure would allow the ceiling to be fully insulated or replaced with a 'warm roof' design. The exterior walls can be insulated in areas where renovation work is to be done.

Replacement of the old timber windows with double glazed low e glass windows (thermally broken aluminium, timber, or uPVC frames) and fitting with heavy drapes to improve insulation values.

Shelter planting in an arc shape on S side of the house to buffer cool winter S winds from the house. And create a sun trap as described in Zone 2 description of concepts.

Thermal Mass to regulate the temperature in the house can be added along with a wood burner. The wood burner provides cooking as well as heating, and firewood can be collected from the property and gathered from around the neighbourhood. The thermal mass absorbs and holds heat from the wood burner for slow release as ambient temperature drops.

Shading to the NW / W face to reduce overheating and glare can be achieved through use of: deciduous fruit trees and vines, fixed or adjustable shading devices, awning fixed to the face of the building, louver pergola on deck in front of windows, slat detail on eaves to reduce (diffuse) the amount of sun falling on the exterior walls and windows or entering the house directly to reduce the thermal gains while still allowing in natural ambient daylight, pergola structure with fruiting vines growing on it.

Figure 11: Slats on eaves – Greenhaven Smart Home

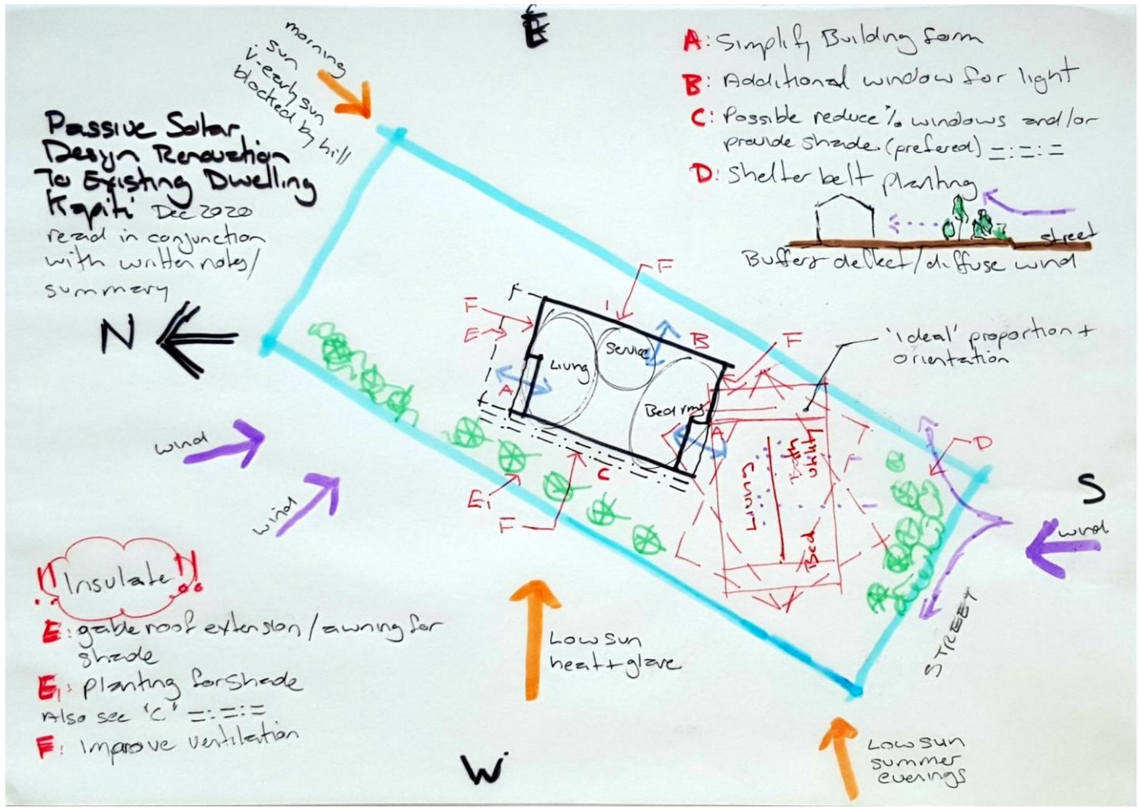


Figure 12: Eco retrofit concept plan

Replacement of windows provides an opportunity to change their configuration to improve effective cross ventilation without creating drafts, including security latches that allow these windows to be kept open during the night in summer. This can be achieved with sliding windows that do not catch in the wind or project into outdoor living areas that could create a hazard, or hopper style windows that open inward. The hopper sashes can be located at low or high level to maintain an uninterrupted eye level view.

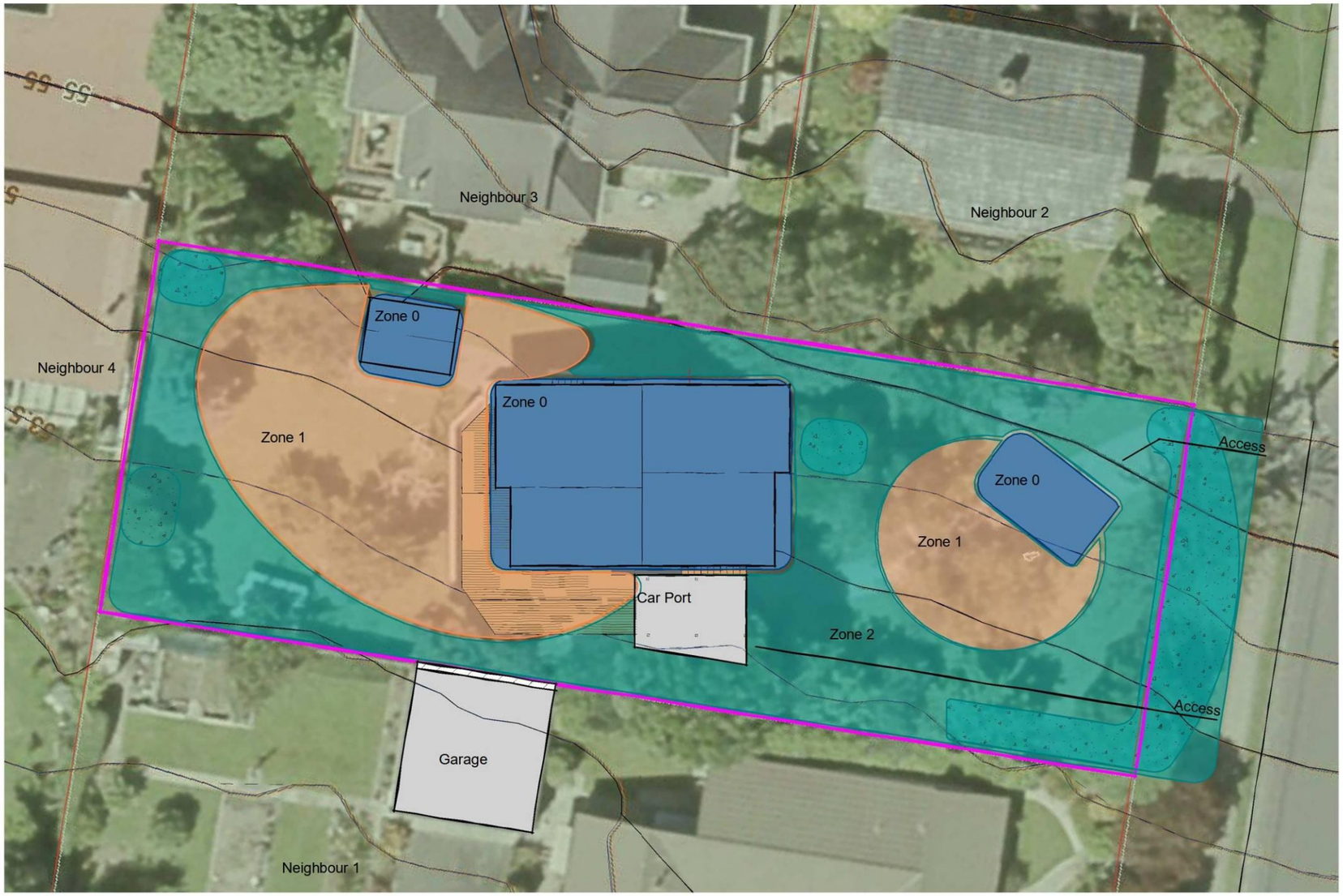
Damaged and unhealthy materials can be removed as part of renovation work. Building projects generally create waste however this can be minimised by:

- Reusing and up-cycling existing items where possible (old windows used to build a greenhouse or cold frames in garden)
- Use materials found on the site (build a heat sink behind the wood burner stove using stones dug out of the garden)
- Use re/up-cycled materials from off-site sources instead of new where possible (demolition timber)
- New materials researched to find local and ethical sourced. The longevity, durability, and performance requirement of the element assessed against any negative credentials.

Final Plans

The following “Regenerative Design Zone Plan” and “Regenerative Design Proposed Plan” build upon and fine tune ideas explored in the preceding concept stage.

Plan - Zone Plan



Zone 5
Native bush reserve (5 mins walk)
- Wider community area off this property
- Wilderness, unmanaged, wildlife
- Forested ridge, small streams, walking tracks

ZONE PLAN

Zone 4/5
Waikanae river (15 mins walk)
- Wider community area off this property
- Largely a natural ecosystem that is being restored/ small pocket of blackberries to forage on river bank

Zone 3
Paddocks and horticulture (10-15 mins walk)
- Wider community area off this property

LEGEND

- Zone 0 Living
- Zone 1 Annual production (Garden)
- Zone 2 Perenial production (Orchard & shrubs)
- Zone 3
- Zone 5
- Zone 4
- Property boundary
- Zone 2 Mixed Perenial production + natives

NORTH

SCALE 1 : 200
0 2 4 6 8 10 12 14 16 18 20 m

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	31/03/20	INFORMATION	

STATUS: INFORMATION

PROJECT: SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS: KAPITI COAST

DRAWING TITLE: REGENERATIVE DESIGN ZONE PLAN

DRAWN	CHECKED	DATE
RP	-	23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated
DRAWING NO.		REVISION
PDC110-G		B

Description
The “Regenerative Design Zone Plan” incorporates Zones 0, 1 and 2 on the site. This suburban site is not aligned with incorporating Zone 3 (farmland or cropping). Zones 4 (part wild or forestry or foraging) and Zone 5 (unmanaged wild natural ecosystem) on the site. However Zones 3, 4 and 5 are in the vicinity of the site (walking and cycling distance) and able to be accessed for ‘farm-gate’ trade, foraging and recreation.

Zone 0 is the living spaces, the areas where the residents spend the most time. It incorporates energy efficient and energy saving design and elements for comfortable and healthy living.

Zone 1 is closest and most easily accessed from the living spaces. This is the area that requires the greatest attention and management. It contains: an annual herb and vegetable kitchen garden, small frequently used fruiting trees, berry bushes, potting and propagation area, cold frame or greenhouse, water tanks used frequently (irrigation), shed, compost tea making area, and worm farm.

Zone 2 is a little further away or not so easily accessed from the house, this area requires a little less attention and management than Zone 1. It contains: perennial herb, vegetable, and fruiting plants including a home orchard with plant guilds under the fruit trees, compost making areas, native small trees and shrubs, non edible herbs, and water tanks for bulk storage.

Zone 0 = Two self contained dwellings consisting of the existing main house and a new smaller ‘studio’.

The existing house is

- Not optimally sized or sited however it is not practical to change these aspects. Changes would target improving efficiency, and insulation
- The existing deck is reduced in size to increase Zone 1 and 2 area / blur boundary between Zone 0, 1 and 2

The new studio is

- Located on the front yard area so as not to impact the rear yard which is currently the best production area due to existing shelter, sun and warmth
- Orientated to 30^{o} west of N (as opposed to parallel with site boundaries) to achieve optimal benefit from employing passive solar design tools
- Small footprint to be efficient and minimise encroachment on production areas. Options to explore a tiny home, cabin or retrofitted caravan style building
- The additional building increases the roof area available for water collection
- Deck area to blur boundary between Zone 0, 1 and 2

Relationships with other zones

- Uses food produced in the other zones
- Increase in roof area increases the potential for solar and rain harvesting for use in Zone 0, 1 and 2
- Food waste provides compost material for use in Zone 1 and 2
- Prunings from Zone 2 is used for kindling and fire wood

Zone 1 = Two annual garden areas sited to make best use of sheltered sun traps, the smaller garden adjacent to the studio increased the flexibility and options for how the studio is used.

The size and shape of this zone is informed by the sunny areas to benefit from light and warmth, and areas most easily and frequently accessed from the dwelling and studio. It incorporates: annual vegetable and herb gardens to feed the Zone 0 residents, garden shed, cold frame or greenhouse, wood pile, water collection tanks for Zone 1 and 2 use, and possible Zone 0 household use.

Water tanks can be located between the shed and the boundary to collect water from both the house and shed roof. This allows water to be gravity fed to the rest of the property.

This zone includes the deck attached to the house, and the space underneath. Potted plants are placed on the Zone 1 deck and storage underneath can be used for: firewood storage, a seedling / potting area, and as thoroughfare from the car port directly to the garden.

This zone also incorporates areas of path and access ways around the site as these areas are used daily allowing observation and management of elements in the zone.

Two separate Zone 1 areas are included, adjacent to each dwelling to allow for:

- Privacy and sense of space for each dwelling, providing a level of independence if the studio is rented out
- Makes best use of the sun, north facing areas and sun traps created by each dwelling
- Incorporate edges of paths used daily
- Slight overlap of the two Zone 1 areas is deliberate to foster community between all residents

Relationships with other zones

- Uses waste from Zone 0 and 2 that has been turned into compost or compost tea
- Uses fallen leaves form Zone 2 as leaf mulch on garden paths and in building of garden beds
- Uses water harvested from Zone 0 roof areas for irrigation
- Uses prunings from Zone 2 for Hugelkultur garden beds
- Provides food for Zone 0 and to swap or share with friends and neighbours

Zone 2 = Perennial garden incorporating edible, shelter and support species and functions.

Zone 2 wraps around Zone 1 areas and form a buffer between the annual garden and the boundaries. It incorporates a perennial home orchard or food forest with an understory of plant guilds, and native shrubs, additional water storage, rain gardens for managing water before it leaves the site.

Fruiting trees that are accessed more frequently such as lemons and limes are located nearest to Zone 1 vegetable beds and major access ways to soften the zone boundary and increase the edges. These trees can also provide shelter to zone 1 during intense summer sun.

Fruiting and nut tree species that need less attention are located further away from the house and also toward the front boundary which receives good sun. Understory plants and guilds include functional support species that: mine or fix nutrients, bring in beneficial insects for pollination and pest control, and provide food.

Placement of small to mid-sized trees and shrubs around the perimeter of the property softens the edge and provide some screening between neighbouring properties. This placement will also provide a connection or link between planted areas on adjacent properties and form a wildlife corridor (birds, skinks, etc.) around the neighbourhood.

Deciduous trees incorporated on the W and N to provide shade in summer and allow light in winter. And shelter planting of evergreen species diffuse prevailing winds in particular from the south.

Pergola structures over Zone 0 decks support fruiting vines to blur the boundaries between zones and benefit Zone 0 by providing summer shade. Understory plants and guilds include functional support species that: also provide food; bring in beneficial insects for pollination and or pest control; nutrient mining or fixing; shelter planting on S to block and diffuse prevailing winds; deciduous trees around N and W sides to provide shade in summer and light in winter. Plantings include native species that provide a beneficial service; they are incorporated in the system for conservation purposes and to support native wildlife.

Trees and shrubs take up excess water that comes onto the site, alleviating some of the surface water / drainage issues.

Incorporates the street verge area and makes productive use of this space that the local council expects the occupiers to maintain.

Relationships with other zones

- Utilises compost and compost tea created in Zone 1
- Uses water harvested from Zone 0 roof areas for irrigation
- Prunings from the management trees used for Hugelkultur beds / mulch in Zone 1 and 2, and fire wood/kindling in Zone 0
- Plants that attract, provide food and habitat for beneficial insects to support production in Zones 1 and 2
- Plants that deter pest species to support production in Zones 1 and 2
- Light and shade management for Zone 0 and 1
- Provides shelter from cooling winds for Zone 0 and 1
- Trees and shrubs take up excess water that comes onto the site.
- Provides food for Zone 0

The main access and driveway is relocated to the W (downhill and shady) side of the site to free up space in the sunnier areas for Zone 0 and Zone 1 & 2 production. The existing (uphill) access point is retained for foot access and gravity assist movement of inputs delivered to the gate around the site.

Zone 3 = Larger scale farmland for livestock grazing, main cropping and orchards

Within walking distance of the site there are: Avocado orchard with ‘farm gate’ sales, regular local markets, horse grazing with ‘farm gate’ sales of pony poo.

Relationships with other zones

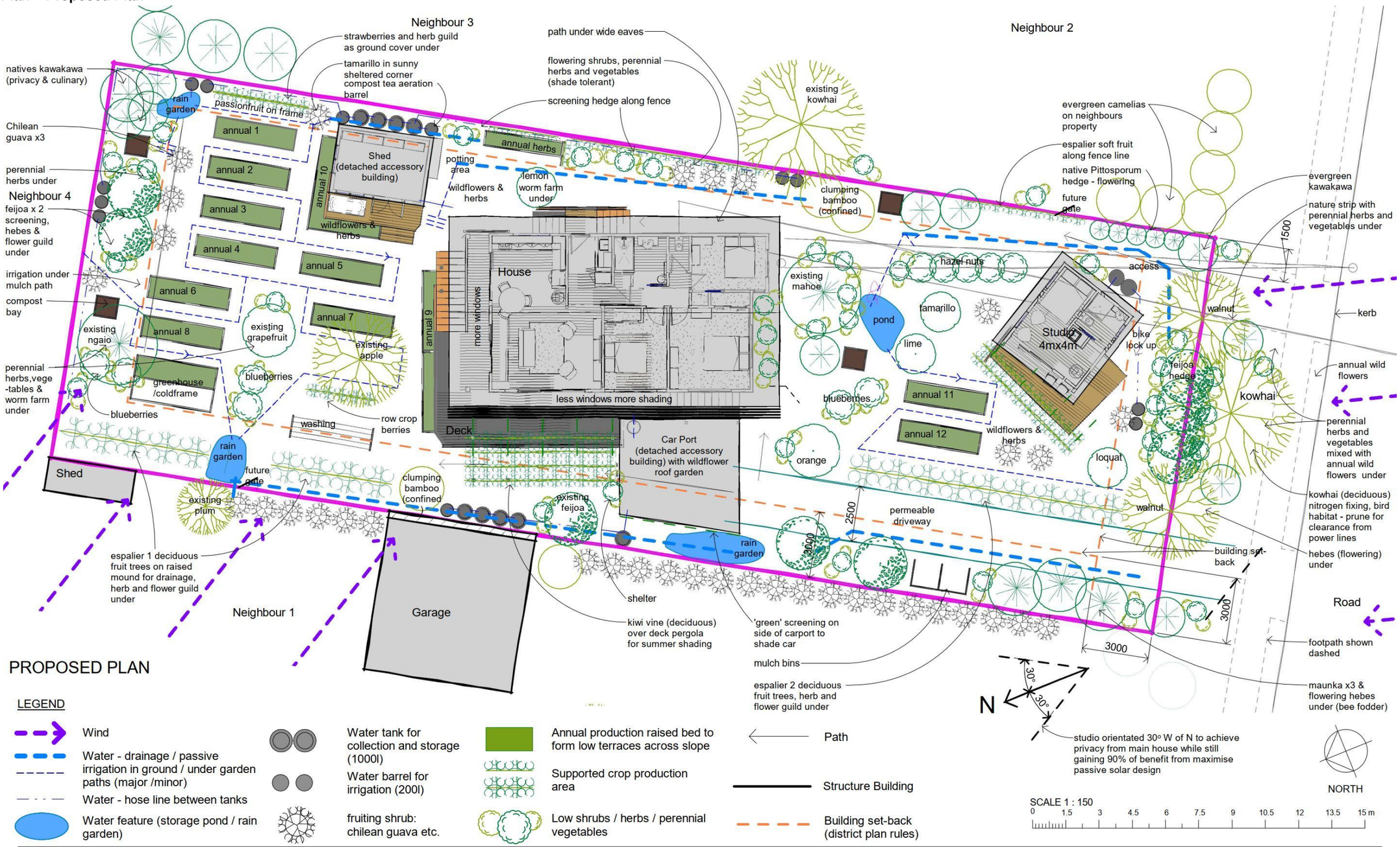
- Trade between Zones 0 and 3

Zone 4 & 5 = Part wild, and unmanaged wild ecosystems – the wider community area

Relationships with other zones

- Foraging fallen branches and leaves for compost and mulch in Zone 1 and 2
- Foraging cut branches and tree trunks for firewood in Zone 0
- Working in with neighbours for tree cutting services in return for keeping the trimmings for mulch and fire wood
- Developing relationships and building community amongst neighbours
- Foraging fruit from trees planted on street verges and edges of parks for food use Zone 0
- Foraging building waste suitable for use in building projects in Zones 0, 1 and 2
- River and stream foraging wild growing blackberries and nasturtium flowers (for salads)
- River and Bush reserve wilderness for recreation

Plan – Proposed Plan



PROPOSED PLAN

LEGEND

- Wind
- Water - drainage / passive irrigation in ground / under garden paths (major /minor)
- Water - hose line between tanks
- Water feature (storage pond / rain garden)
- Water tank for collection and storage (1000l)
- Water barrel for irrigation (200l)
- fruiting shrub: chilean guava etc.
- Annual production raised bed to form low terraces across slope
- Supported crop production area
- Low shrubs / herbs / perennial vegetables
- Path
- Structure Building
- Building set-back (district plan rules)

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
A	01/06/21	INFORMATION	

STATUS: INFORMATION

PROJECT: SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS: KAPITI COAST

DRAWING TITLE: REGENERATIVE DESIGN PROPOSED PLAN

DRAWN	CHECKED	DATE
RP	-	01/06/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated

DRAWING NO. PDC301-G

REVISION A

Overview

A permaculture system is one that is designed such that: every element has a function, a diverse range of elements and species are included for resilience, all parts of the system support each other, and with regenerative outcomes.

I have applied my interpretation of permaculture to the "Regenerative Design Proposed Plan" by creating a diverse and functional system that uses patterns, relationships and systems found in nature. The 12 permaculture principles have guided my thinking process through the initial information gathering stages of: brief taking, site analysis, exploring conceptual ideas. And concludes with the development of a design to create a system that: becomes integrated, sustainable and regenerative. Application of the permaculture principles are noted in *(italic)*.

The proposed plan is an intensive production system surrounding renovated living spaces and structures to closely integrate the zones with each other (*Integrate rather than segregate* | *Produce no waste)*.

The renovated house will have some modifications to support both the residents and the productive zones: be more energy efficient, better utilise and manage sun to maintain a comfortable environment, utilise air flow to maintain a comfortable environment, capture sun energy, and harvest rain water. The new flexible use studio is built and sited to optimise use of the sun, balanced with a building foot print and placement that maintains a usable production area. It will employ the same elements as those employed in the renovation of the main house. *(Use and value renewable resources and services* | *Catch and store energy)*.

The intensive production system is made up of Zone 1 and 2 with a structured linear planting layout for ease of management (netting for protection/support/harvesting), and to maximise production on the small site. A diverse range of species can be included in this structure. The edges between the zones are softened by the use of supporting plant guilds around the main productive perennial species, inter-planting within the annual beds, and productive perennial support species (including existing trees) planted in a scatter pattern *(Design from patterns to details* | *Use edges and value the marginal* | *Integrate rather than segregate* | *Obtain a yield)*.

Zone 0 contains the main house (existing renovated / retrofitted) and studio (new), both using elements and techniques to be energy efficient and environmentally considered.

Zone 1 areas containing annual garden beds mimic clearings in a forest and represent early to mid succession species (vegetables & mixed herbaceous requiring soil B:F (Bacteria: Fungi) ratio of 0:1 – 1:1).

Zone 2 areas containing the perennial fruit and vegetable species mimic a forest, make use of vertical strata with diverse species including ground covers, herbs, shrubs, and vining species planted amongst the taller trees, and represent mid to late stage succession species (perennial vegetable and fruit shrubs & fruiting trees requiring soil B:F ratio of 1:1-1:100).

The design attempts to create soft and blurred boundaries between the Zones. For example Zone 0 outdoor living spaces are designed to overlap with Zone 1 and 2, vining annuals such as runner beans will be planted near the base of perennial trees so that the trees can provide support. Self seeding of Zone 1 annual crops will be allowed and where they take up positions within Zone 2 left to grow as they have naturally selected the spot that best suits them and adds to the diversity of Zone 2 (*Creatively use and respond to change)*.

Zone 2 includes the 3.5m deep street verge to blur the boundary between the property and the street, to make use of otherwise vacant land (*Use edges and value the marginal*), and to engage with the community by extending into 'common' space (*Integrate rather than segregate)*.

Plant species will also provide support to the Zone 0 house by way of evergreen shelter planting at the S boundary to protect from cold and wind. Deciduous trees on the W support the dwellings and annual garden beds by providing summer shade while allowing light through in the winter. The leaves from these trees will provide material for compost and mulches. *(Use and value renewable resources and services).*

Being a suburban setting, consideration needs to be given to neighbours sun and views. For ease of harvesting, the trees will require regular pruning to keep their size and shape manageable *(observe and interact),* this keeps the tree heights down so as not to impact on the neighbours. The prunings from the trees will provide carbon rich material for creating Hugelkultur annual beds, and to chip for mulch (*Produce no waste* | *Use and value renewable resources and services).*

Spent annual plants and food waste from the Zone 0 house will be composted to provide nutrition back to both annual beds and perennials (*Produce no waste)*.

The system will use succession management to become balanced and regenerative as it becomes more established. For example:

- Organic waste composted and provided back to the system to provide nutrients to maintain production and build soil quality – slowly adjusting the B:F ratio along the ecological succession scale to support the growth of annual and perennial vegetables, herbs and fruit
- A diverse range of intensively planted species will help to develop a healthy and diverse soil, and a healthy and diverse range of food
- As the soil improves plant species perceived as 'weed' or problematic will naturally become less dominant
- Less reliance on imported resources (water/energy/compost) reduces pressure and reliance on public infrastructure and resources

The design aims to produce year round seasonal produce *(Obtain a yield)* for the residents, so includes a diverse range of functional plant species and varieties all selected for high nutritional value, and disease resistance for ease of management. (*Use and value diversity)*.

- Approx 55-60m^2 (growing area, excludes pathways) of raised annual garden beds using vertical trellising/ arches and inter-planting to increase the available growing dimension in both height and time
- Approx 30 different fruit tree/shrub varieties producing food and includes different varieties of species (apples, blueberries, feijoas etc) for early, mid and late ripening varieties to extend the seasons of these fruits.

Inter-planting in Zone 1 and plant guilds in Zone 2 are also designed to support, protect and nourish the main productive plant as well as each other (*Integrate rather than segregate*). Guilds will be built around the following criteria:

- Food/edible
- Nitrogen fixer
- Dynamic accumulators – plants that accumulate and produce mineral rich biomass for compost and mulch
- Pest repellent – strong scented plants to deter and confuse pest insects
- Pollinators – year round flowers to attract and provide food for beneficial insects
- Ground cover – to protect the soil from mineral oxidation, erosion, drying out
- Taproot – to mine minerals, and improve the soil structure by opening pathways for soil biology and water

The design of the Zone 0 house retrofit aims to create a home with a more functional layout, that is easy for the residents to use, manage and maintain. By becoming a more functional, energy efficient building the house fits into the overall system benefiting from and supporting other zones (*Integrate rather than segregate*).

- Improve energy efficiency by minimising heat loss and the need to use energy to heat through insulation
- Make use of incoming energies for heating and ventilation *(Use and value renewable resources and services)*
- Make use of recycled, up-cycled, renewable, sustainably produced materials where possible (*Produce no waste)*
- Support Zone 1 and 2 by harvesting rainwater for garden use (*Catch and store energy)*
- Reduce reliance on external services (electricity / water)
- Allow the occupant to create home based employment
- Increase connection to and blur boundaries between Zones 1 and 2

Zone 0 also incorporates a small studio building

- Flexible use (studio office, guest accommodation for visiting friends, short term rental to provide an income stream, accommodation for Helpex/ WOOFer or similar in return for help on the property)
- Energy efficient by site position, and good insulation
- Make use of incoming energies for heating and ventilation *(Use and value renewable resources and services)*
- Make use of recycled, up-cycled, renewable, sustainably produced materials where possible (*Produce no waste)*
- Constructed using energy efficient methods, materials and design
- Support Zone 1 and 2 by harvesting rainwater for garden use (*Catch and store energy)*
- Reduce reliance on external services (electricity / water)
- Allow the occupant to create home based employment
- Increase connection to and blur boundaries between Zones 1 and 2

The various elements included in the system are selected to interact in ways that improve the health and resilience of the system over time (*Use slow and small solutions*). The design also offers the opportunity to engage with neighbours to share knowledge and build a strong resilient local community (*Observe and interact*).

The design of the system achieves regenerative outcomes by improving:

- The quality of the soil through diverse, thoughtfully designed and functional planting, and recycling garden/food waste back into the system by mulching and composting
- The energy efficiency and comfort of the dwellings using thoughtfully sourced materials and functional design
- The quality of life of the residents by growing organically produced nutrient dense food, food security, a comfortable healthy home, and opportunities to build community

Description of the elements in the system

The various elements within the system are designed to interact in ways that improve the health and resilience of the system over time (*Use small and slow solutions*).

Regenerative design

Diversity is crucial to the design to mimic natural systems that are stable, resilient, and sustainable. The system is therefore made up of a diverse range of species and elements. The diverse range of species and elements support and sustain each other and keeps the overall system in balance with no one species or element dominating (*Use and value diversity)*.

It is the diversity of the species and elements that creates resilience. A system that lacks diversity becomes vulnerable to threats, like the saying 'Don't put your eggs all in one basket'. If there is an event that affects a particular plant or animal, diversity is critically useful because a different species can help to manage or mitigate the effects of the problem.

If a particular species is detrimentally affected then diversity means that there will be alternatives to fill the gap until that population can recover, and allow the system to 'bounce back' quickly. Examples are:

- Companion plants and plant guilds to attract pollinating and other beneficial insects
- Alternative food crop if one is wiped out by pest or disease
- Predator insect that keeps pest insects down

This is regenerative because the natural, diverse and stable systems of the site have been lost through development and typical suburban use over the last 70-100 years. Increasing the diversity of species and elements of the system creates

- A more resilient, sustainable and healthy lifestyle for the residents
- Accelerates the succession process to improve the health of the soil to support production
- Attracts diversity of other species to bring the system into balance, avoiding or buffering the effects of loss of a crop through pest, disease, adverse weather
- Lowers the risk of erosion or damage

Ecosystem

A healthy ecosystem is measured by the number and diversity of organisms that live in the habitat (*Use and value diversity)*. The different zones create a food-web that incorporates:

- The residents that eat the plants and produce food scraps that are composted to provide organic material to the soil (*Produce no waste*)
- Decaying organic material of spent plants in the intensive growing areas (mulch / compost)
- Soil organisms that allow the plants to obtain nutrients
- Aerobic soil conditions to provide the correct habitat for beneficial organisms
- Plants that produce food for the residents (*Obtain a yield*)
- Plants that support food producing plants (*Obtain a yield*)
- A comfortable and healthy living habitat to support the wellbeing of the residents

The design creates an ecosystem. A diversity of species and elements is included in the design to support and increase the health, efficiency, and resilience of the ecosystem.

Water and the landscape

Water (rain and surface water runoff from adjacent properties) is managed and used to irrigate plants, prevent erosion and over saturation of the soil, prevent loss of nutrients, and transport nutrients around the site (*Produce no waste* | *Use and value renewable resources*):

- Increased biomass of plants to take up water
- Rain harvested and stored in tanks and barrels for use primarily in Zone 1 and 2
- Use of gravity to feed water from storage into urban swales/passive irrigation channels around production areas – a gravity feed system does not require energy inputs to pump and move the water around
- Collection and diversion channel along uphill boundaries to slow the flow of the water
- Harvested water is actively diverted to passive irrigation bulk carbon pathways around production areas, used to transport nutrients to the production areas
- Flows through rain-gardens to slow and clean the water preventing soil saturation, erosion and loss of nutrients, and to manage surplus water in the wetter months
- Uses natural dips in the landscape to make use of natural landscape features and minimise earthworks
- Pond to modify the microclimate incorporates a bio-dynamic flow form water feature to aerate and clean the water in the pond and prevent build up of anaerobic pests and diseases. The movement of the water through the flow form also increases negative ions in the air: improve mood, lower stress levels, decrease drowsiness, and stimulate more mental energy. (Small solar pump and battery to maintain continual water flowing through the pond and flow-form system in dry spells).

Figure 13 Biodynamic Flow-form examples

Water management is common to and links all 3 zones on the site (*Integrate rather than segregate)*.

Drainage channels are located across the uphill boundary between the fence and Zone 0 buildings to pick up the incoming water from uphill. The channels direct it away from Zone 0 where it could cause damage, instead directing it towards production areas where it can be channelled around Zones 1 and 2 as passive irrigation in bulk carbon pathways and trenches filled with wood chip and mulch.

Rain harvesting (*Use and value renewable resources*) from the roof areas of Zone 0 buildings will initially be used as irrigation. Once the soil has improved to have good structure, water holding capacity and be less reliant on irrigation, the harvested rain will become primarily for supplementary household use. Rainwater collection and storage is via 1000L tanks connected in pairs close to the collection points, and recycled 200L food barrels that are scattered around the site and connected together by hose.

Slim line 1000L tanks are chosen for this suburban site as they can be positioned alongside walls and fences with less space impact on areas suited for growing plants. They are sited for ease of collection from source (downpipe), ease of distribution (gravity feed down the slope), and shade to protect the quality of the water.

200L recycled food grade barrels are positioned around the site for delivery of irrigation to specific areas and allow the trialling of rain harvesting and irrigation delivery prior to investing in larger more expensive tanks that once positioned are more difficult to move (*Apply self regulation and accept feedback* | *Use small and slow solutions* | *Produce no waste*)

Figure 14 Line up of recycled barrels for rainwater harvesting

The design includes 8No. 1000L tanks that are installed initially to catch and store between 6,000 L and 8,000 L water for irrigation use over the January to February hot dry spell. An additional 2 No. 1000 L tanks are to be added when the studio is constructed.

The 1000L tanks are located behind the shed to collect water from the shed and ½ house roofs, behind the studio to collect water from the studio roof, and close to the wall of the neighbour's garage on the downhill boundary to collect water from the other ½ of the house roof. These locations are shaded and the first two locations allow the water to be gravity fed

to the smaller barrels which are positioned to be handy to areas requiring active irrigation. The water from the tanks on the downhill boundary can be pumped to the tanks and barrels at higher elevation using a small solar or electric pump.

Rain-gardens and a small pond are incorporated into the design and located to clean the water as it passes through these elements, and to take up surplus overflow water from the rain-harvesting system during heavy rain events. The pond is lined with stones and rocks to enhance the heat sink qualities of the water body and to reflect light to extend the growing season of the adjacent crops. A flow form as part of the pond system aerates the water to maintain a healthy water ecosystem and provide a natural, soothing visual and aural element for the residents.

Rain harvesting and storage will factor into the overall onsite storm water management required by the local council. An additional or enlarged storm water soak-pit may be required with an increase in roof area, however the soak-pit capacity may be reduced with: water storage tanks, areas planted in trees and shrubs that soak up water, and irrigated areas. Supporting calculations would be required. Should a new soak-pit be required, it can be located under the new permeable driveway using a trafficable system so as not to impact on the size of the production areas.

Once the production areas become more established and the soil structure improves to have better water holding capacity there would be less need for reliance on irrigation, at this point any rain harvesting infrastructure could be redeployed for household use.

Earthworks
Earthworks have the effect of disrupting soil structure and biology; they should be carefully considered and limited to the specific conditions and requirements of the site for the purpose of improving water holding capacity, distributing water, aerating the soil to accelerate improvements in the soil ecosystem and water holding capacity.

Proposed earthworks are:

- Initial double digging preparation for garden beds to remove large stones and break up dense rocky layers around 300-400mm below the surface
- Annual broad forking of Zone 1 garden beds (not built as Hugelkultur beds) to aid aeration and water holding capacity of the beds which leads to improvement of the soil ecosystem
- Urban swales - passive irrigation channels filled with mulch between Zone 1 garden beds and around Zone 2 plantings
- Drainage channel along uphill boundary to collect and distribute water from the uphill property(s) and divert it away from buildings
- Minor digging and forming of basins to create rain gardens, ponds and installation of biodynamic flow-form

Proposed earthworks are of the scale suitable for hand digging, a small digger may be used for the main drainage channel along the uphill boundary (*Observe and interact* | *Use slow and small solutions* | *Apply self regulation and accept feedback)*.

Microclimate
The design utilises and builds on existing features to create favourable microclimates that enhance the Zone 0 living spaces, and Zone 1 and 2 production areas (*Design from patterns to details* | *Observe and interact)*.

The existing aspect and slope benefit the site for sun and light exposure to assist crops and warm the house. This effect is maintained and enhanced by the use of deciduous tree species on the N and NW sides of the site to:

- Allow the light and warmth to penetrate during the winter months when it is needed, and
- Provide shade and shelter during summer when overheating in the dwellings, and hot dry conditions can stress the plants in the Zone 1 garden

The existing slope assists in directing water around the site and between the on contour crops to minimise erosion and improve drainage, direct water for irrigation, and direct water to ponds. The slope assists in draining any frost that occurs and 'frost drains' between raised planting areas, and plants arranged at a slight angle to the slope help stop frost from settling.

The increased biomass on the site via Zone 2 tree and shrub plantings will increase the humidity in the air due to the transpiration of the trees. This will moderate the air temperature in the summer and make moisture available for other plants to take up via their leaves. This increased biomass also provides an insulating effect that moderates the night time temperature under the canopy to retain warmth and reduce the risk of frost to tender crops. The increased biomass also takes up excess water on the site to reduce water logging of the soil. Waterlogged soil is anaerobic and does not support a healthy soil food web, it also takes longer to warm up in the spring and summer. Healthy aerobic soil supports healthier and more resilient plants.

The effect of the existing slope and aspect on wind is modified to diffuse and moderate wind with shelter / windbreak planting on the street verge and the row of deciduous trees along the W boundary.

The street verge on the southern boundary is planted with mainly evergreen fruiting and non-fruiting tree and shrub species to create a windbreak for shelter to diffuse and redirect wind and cold air coming from the South. The windbreak shelter provides insulation for the main dwelling and studio and creates a warm sun trap in the front yard which is currently open and exposed yet sunny.

The windbreak is made up of taller trees planted in a soft arc shape with shrubs, and perennial productive species below that will direct the airflow away from the front yard. Central to the windbreak is a kowhai grown from a seedling found growing on the site that was potted up and is to be relocated to the verge. A closely planted productive feijoa hedge is to be planted on the front yard side of the shelter planting and pruned to keep low in height to help to reduce turbulence as air moves over the shelter planting.

The shelter plantings will be kept pruned to maintain a slightly open structure that will diffuse the airflow and reduce turbulence. The slightly open structure is also important to: let light through, maintain a connection to the street for building community connections, and for allowing passive surveillance (security).

The existing Sitka Spruce tree near to the NE boundary effectively screens the house on neighbour 4 property. It has grown taller than the house that it screens, and casts excess shade over the rear yard. It blocks light to the Zone 1 Annual garden beds, in particular mid autumn to mid spring when the sun is lower in the sky. This tree is replaced with 2 productive feijoa trees, the two replacement trees will improve the effectiveness of the screening. Once at mature height they do not exceed the height of the neighbour's house so will provide adequate screening without shading, as well as providing an edible crop.

The Sitka Spruce appears to hinder growth of plants in the understory, likely by shading and removing moisture from the soil. There are no clear references to cite, however research has turned up that conifer species contribute to altering the soil by creating an acid pH and locking up nutrient. In addition, dripping sap from pruned branches of this tree is messy. Based on this, the tree is better use to the site as mulch.

Soil is kept cool and shaded from drying out by maintaining a longer grass length of the areas in lawn; these areas will be progressively replaced with planting including ground covers and mulched area to reduce the amount of lawn needing mowing. The ground cover plants and mulch protect, feed and moderates the soil temperature. The resulting improved texture, structure, and soil conditions increase the water holding capacity and reduce loss through run off or evaporation.

Drainage and rain gardens described in the water and the landscape section above, works to prevent unhealthy soil that is waterlogged, cold and anaerobic. Part of the water management element is the building of ponds with flow form shapes to aerate the water. A flow form is a device that churns the water up similar to a gentle rapid in a stream. As well as aerating the water, it increases the moisture in the air available for plants to take up through their leaves.

The pond element including: the biodynamic flow-form, the rocks around the edges, and the water moderates the climate and act as a heat sink - absorbing warmth during the day and slowly releasing it as the temperature cools in the evening - so extending the growing time of nearby plants. Light reflecting off the surface of the water increases the light available to the plants which aids in the growth of the plant and ripening of fruits.

Another device that reflects light and also acts as a heat sink is the existing shed. Light reflects off the existing light coloured cladding, and warmth is absorbed and released by the concrete foundation. These features are retained and adjacent taller planting managed to ensure light and heat access the shed during winter when the light and warmth is most needed.

The concrete ring foundation of the existing dwelling also acts as a heat sink even though sun does not fall on it directly due to the deck. Combined with the addition of a vapour barrier over the ground under the house to keep the air under the house dry, the heat sink effect keeps the dwelling warm and moderates the temperature over the course of the day. The vapour barrier also keeps the dwelling drier and cheaper to heat when required because it is easier to heat dry air than damp air.

Soil
The implementation section of this document outlines a proposed management plan for this site to move and maintain the succession stage of the previously damaged land to one that is suitable for growing nutritious food for the residents. It incorporates many elements that all work together to collectively improve the soil ecology. Some of the elements are discussed in greater depth in other sections of this description and bullet point listed here:

- Implement drainage to create and maintain an aerobic environment in the soil
- No-till / minimal cultivation where possible so as not to harm, kill or damage soil biology and structure
- Increase plant diversity using beneficial or cooperative plant species to improve the soil food web and ecology through the exudates that they produce, including mixed species cover crop on land awaiting development
- Rotate crops to increase plant diversity (and in turn biological diversity in the soil through the production of exudates by a wider range of plant species) and prevent build up of soil borne pests
- Eliminate use of chemical pesticides that are damaging to plant, soil and human health, attract beneficial insects instead
- Keep vegetable garden beds covered with a mulch or low growing cover crop to protect the soil from damage from rain, wind, loss of C and N to the atmosphere - as the mulch breaks down the decomposed organic material will become incorporated into the soil and feed the soil structure, biology, and chemistry
- Feed / inoculate the soil to increase soil organic matter, nutrients, and soil micro organisms to build a strong soil food web – chop and drop, and compost

Chop and drop is the cutting of green manure plants, weeds, or spent vegetable material, and leaving the cut greens lying on the surface to decay and be slowly incorporated into the soil. The root of the plant is left in the soil to decay, supplying organic material directly to the soil and leaving open paths for the movement of water and soil organisms.

Composting is common to and links all parts of the system (*Integrate rather than segregate* | *Product no waste*). Spent vegetable plants and food waste from the house, annual, and perennial gardens will be composted in a worm farm and compost bins dotted around the site. Producing compost close to the inputs and where the outputs will be used reduces the effort required to move material about the site. The sites are located so that leachate from the compost making provides benefit to various productive areas. 240 L compost bins are used so that the locations can easily be changed and moved over time to benefit greater areas of the garden. Several compost bins on the go allows different styles of compost making, and different stages of compost maturity at any one time.

The wider community provides an additional source of compostable material to supplement what is available on the site. Sources are local parks and trees planted on street verges in the neighbourhood for fallen leaves and twigs, and nearby neighbours (see community section) vegetable scraps. The resulting compost, vermicast, and worm wee will be used in the Zone 1 and 2 areas as compost, compost tea, and foliar spray to support the growth of the plants and feed the soil biology. (*Produce no waste)*

Social / Community

Community is an important element for both the implementation and the development of the system over time to improve the health and resiliency of the residents and the wider community (both near neighbours and others in the area with common outlooks). As a strong sense of community is formed the members can share, help, and support each other in many ways to build greater resilience of the group.

The diversity of knowledge, skills, and experiences present amongst a group of people is greater than that of a small household, and creates greater strength and resilience *(Observe and interact | Use and value diversity | Integrate rather than segregate).*

The residents would like the project to be a catalyst for information sharing which will help to develop relationships and make connections with others which in turn builds the community.

Develop relationships with the neighbours and discuss the project

- Meet the neighbours, engage in conversations, and introduce neighbours to each other
- Investigate possibility of incorporating unused yard(s) to extend the boundaries of the design, and convince the neighbour(s) how it could be a win-win arrangement
- Investigate removing fences or installing gates between yards to blur property boundaries and foster sharing of resources
- Keep lines of communication open by discussing plans especially when they impact on the neighbour – such as discussing removal of the problem Sitka Spruce tree in the rear yard, and replacement with new trees of different variety
- Maintain awareness of neighbours privacy and aim not to shade or screen their views
- When hiring equipment to mulch pruning's offer to trim neighbours trees in return for keeping the mulch produced – win-win
- Organise a street party or street working bee

Meet other like minded people

- Attended a local garden trails and chat with hosts and other visitors
- Attend local garden group and Forest and Bird meetings

Be active on social media to share experiences and meet and learn from others

- Local community face book page
- Waste Free Kapiti face book page
- Permaculture in New Zealand face book page

Join the Share Waste Compost Collective web page https://www.sharewaste.org.nz/

See also the implementation section of this document.

Buildings/living spaces (**Zone 0**)
This incorporates renovation of the main house, and the addition of a new small studio /secondary dwelling to the front yard area. As well as consideration to energy efficiency, and resilience, these elements aim to blur the boundaries between the zones. (*Integrate rather than segregate).*

The new studio increases the flexibility of use of the site by providing an office outside of the house that can also be used for accommodation. Used as accommodation the studio will play a role in establishing contact with like minded people and building community, as well as potential for income generation or trading accommodation for help on the property. Used as an office it opens opportunity to host small meetings bringing a wider variety of people onto the site and stimulate discussions about the property and the project.

The studio is intended as a simple bush cabin or container house type structure with a deck to increase the living area, and incorporate a composting loo and shower. The concept and placement of the studio will first be tested by placing a second hand caravan on the site to provide immediate guest accommodation. This allows the orientation and location to be tested before committing to a more permanent structure. *(Use slow and small solutions | Apply self regulation and accept feedback).*

The proposed location for the studio is very sunny (including winter afternoons) so is suited to implement passive solar design techniques. The orientation of the 'building' to within 30^{o} of N allows for the best application of passive solar design principles in its design. The studio will be constructed for energy efficiency and warmth, and be orientated for sun and light. Its final form and position will be fine tuned as the rest of the plan is implemented and needs around the studio are further defined and established - including the balance between production area and additional dwelling/living space.

The existing dwelling is imperfect in terms of passive solar design principles so the renovation and retrofit focuses on items that can be changed and that create the greatest gains.

Make the house more energy efficient by minimising heat loss and the need to use energy to heat through improved insulation. Achieved through:
Increase insulation in easy to access areas of under floor and ceiling space to higher standard than the Zealand Building Code (NZBC) minimum requirements. TerraLana NZ wool insulation blanket R2.6 under floor and R4 ceiling. NZ made from pre production waste wool blended with polyester made from recycled PET bottles, is a BRANZ appraised, natural, and easy to handle product. The NZBC minimum requirement is R1.3 and R3.3 under floor and ceiling respectively. Limitations are access.

Increase insulation in external walls where renovation works gives access to the exterior wall cavity (replacing interior wall linings, replacing exterior cladding. Pink Batts Ultra R2.8 is maximum achievable with the existing 90mm timber framing size (TerraLana achieves R2.4). Pink Batts are glass wool blankets made from 80% recycled glass, this product is also BRANZ appraised. Comment – a new build would be able to use 140mm framing and greater R value insulation. NZBC minimum requirement is R2.0. Limitations are access requires demolition of internal linings or external cladding.

Increase insulation of windows by replacing with new argon gas filled double glazing with low-e glass windows. The low emissivity coating on the glass and argon gas in the air space improves the insulation properties of the window units. Good quality uPVC or timber frames offer the best R value. uPVC offers the same R values as timber, and requires less maintenance, however the high quality units that provide best performance and longevity are imported from Europe.

Ongoing research into the suitability of uPVC R0.51 vs. timber vs. thermally broken aluminium frames with a slightly lower R value R0.41 (cost, durability, and environmental impact) will be worked through by the residents. The NZBC minimum requirement is R0.26. Limitations are dollar value cost, embodied carbon 'cost', and maintenance requirements.

Comparison of typical window (frame and glass) R-values (Rwindow), single and double glazing

Window frame material	Single glazing	IGU with 4 mm glass and 8 mm air space	IGU with 4 mm glass and 12 mm air space	IGU with 4 mm glass, 12 mm air space and low-e pane	IGU with 4 mm glass, 12 mm air space, low-e pane and argon gas fill
Aluminium	R0.15	R0.25	R0.26	R0.31	R0.32
Thermally broken aluminium	R0.17	R0.30	R0.31	R0.39	R0.41
Timber	R0.19	R0.34	R0.36	R0.47	R0.51
uPVC	R0.19	R0.34	R0.36	R0.47	R0.51

Figure 16 Window R values comparison chart from BRANZ Level online publication

Increase insulation of windows with curtains .The insulation performance of windows can be increased by adding drapes or heavy, thermally lined curtains: fitted using the existing and extended pelmets, ensuring generous overlap at sides of frame, and touching the floor to trap a still air layer between the glass and the curtain. Effectiveness requires active use of curtains by the residents.

Simplification of the building form. By altering the exterior wall on NE elevation to straighten out the existing wall, the weakness of heat leakage & incoming draughts created by the wall step can be removed. Enclosing the existing deep entry porch on the NW side also simplifies the building form by removing extra wall steps and corners, this also creates an office or 3rd bedroom.

Enclosing the entry porch leads to either the back porch becoming the main entry, or for-going a formal entry and welcoming visitors directly into the living space through doors from the porch.

Limitations of an entry straight into a living space is the loss of warm inside air the when the exterior door is opened. So converting the rear porch into the new main entry is preferable as the door would open to a hallway and interior doors to the rooms can be closed to minimise heat loss.
(Obtain a yield).

Make use of incoming energies for heating and ventilation. Achieved through:
A solar water heating collector panel is connected to the hot water cylinder for water heating (supplemented by electricity on sunless days). According to BRANZ research, water heating makes up a large proportion of the electricity usage in most homes and up to 38% of the annual household hot water heating needs can be provided by solar energy.

A slat feature on the NW roof eaves and a pergola structure supporting deciduous kiwifruit vines built on the NW side of the house provide afternoon shade and prevent overheating. These built elements reduce and diffuse the amount of summer sun entering the house directly through windows, and reduce thermal gains while still allowing in natural ambient daylight. The dimension and spacing of the eaves slats create differing amount of shade or light to the face of the house depending on the sun elevation angle, regulating the direct sun and heating on the sunniest side of the house. During summer the amount of shade to the NW of the house is increased by the foliage on the kiwifruit vines which also creates a cool and sheltered outdoor living space. During winter when the light and warmth from the sun is required, the vines have lost their leaves allowing more light and sun to enter the house.

Figure 17 https://www.bhg.com.au/pergola-designs-and-ideas

Figure 18 Slats on eaves – Greenhaven Smart Home

Ceiling fans installed in the main bedroom and lounge rooms create gentle air movement, to use the air temperature to warm or cool these rooms, and help to regulate the temperature. In winter the fan is set to gently push the warm air from the top of the room down assisting with heating the space. In summer the rotation direction is reversed to draw air upward, across the ceiling and down the walls creating a light breeze.

Figure 15 Ceiling fan

It is the air movement across the skin makes the temperature feel cooler Placement of opening windows on each face of the house, and configuration of windows with sliding and hopper style opening sashes, allows the residents to open windows as required to create gentle cross breezes for ventilation/ fresh air, cooling in the summer, and airing out the house during the winter.

A Photo Voltaic (PV) panel on the shed roof converts solar energy to electricity which is stored in a battery. This is primarily for used to run small systems (water pump / ceiling fan).

An efficient wood burner installed between the kitchen and living area provides multi functional heating during the colder months as it provides both warmth and cooking facility. Wood from prunings can be used as kindling and to supplement firewood that is sourced from tree work on neighbouring properties, and traded, with purchasing firewood a last option (it is unlikely that sufficient fire wood can be sourced from the site and will need to be bought in).

To maximise the use of heat from the fire a ducted heat transfer system between the living spaces and other rooms will move heat around the house, in particular to the bedrooms on the S of the house.

Behind the wood burner is a false wall built with stones removed from the ground in the garden areas creating a thermal mass. This element reduces the length of time that the wood burner needs to operate and saves on the quantity of fire wood required by absorbing heat and then slowly releasing it once the ambient temperature starts to cool. *(Use and value renewable resources | Obtain a yield | Produce no waste).*

Make use of recycled / up-cycled / renewable / sustainably produced materials where possible, Achieved through: Renovation work on the house will use re/up-cycled materials instead of new where possible, for example: demolition floor boards to repair existing and building new floors, demolition sarking used to line interior walls for timber interior linings.

Building waste is minimised by reusing and up-cycling existing items where possible, for example old windows used to build cold frames for the garden, joinery repurposed as workshop bench and storage.

New materials and fittings will be researched by the residents prior to purchasing to weigh up the longevity, durability, performance of the material or item against any less than ideal credentials. Locally sourced and or manufactured items will be factored in and given priority where possible. *(Use and value renewable resources | Produce no waste).*
Examples are

- uPVC vs. thermally broken aluminium vs. timber framed windows
- Locally and ethically sourced plantation hardwood for exterior cladding vs. fibre cement product that is more dimensionally stable however is dangerous to breathe the dust when it is being cut or sanded
- Natural oils manufactured locally to finish timber instead of paint or polyurethane
- Cement to bind stones from the garden to build a heat sink wall vs. adhesive fixed wall tiles
- Ply joinery instead of plastic laminated finished MDF board

Support Zone 1 and 2 by harvesting rainwater for garden use. Is discussed in the water management section. Irrigation is usually only required during the summer months and can be collected and stored when needed to 'bank water' ahead of known dry spells. When not required to be harvested it is allowed to run through the passive irrigation channels and normal (onsite) storm water system.

Grey water systems can be used for irrigation and for flushing the toilet. This has not been included in the system at this stage because sufficient rainwater can easily be collected for irrigation as well as additional capacity to supplement household use. Grey water needs to be used on a regular basis and flushed with clean rainwater from time to time to wash away any residues.

In the future if the rainwater harvesting system is expanded to include year round household use then a grey water system that diverts to irrigation when needed, and also used for flushing the toilet, can be reconsidered and implemented.
(Use and value renewable resources | Produce no waste).

Reduce reliance on external services. Achieved through:
The elements discussed under 'Making the house more energy efficient…' and 'Making use of incoming energies…' reduce the reliance on external services. In addition to these, energy efficient long life LED lighting, water efficient low flow plumbing fittings, and low electricity and water use appliances, contribute to reducing reliance on external services as the retrofitting work on the house is progressed and implemented.
(Use and value renewable resources | Produce no waste).

Allow the occupant to create home based employment. Achieved through:
The creation of an office space / third bedroom within the house initially allows the residents to work a 'city/office' based job from home rather than frequently commute to an office. In the future as different opportunities arise having this space allows a smoother transition to other home based employment options. The future addition of the studio provides a space for the residents to work and meet with others without imposing on the house, the use or function of which may from time to time conflict with hosting clients, meetings, or other work activities. For example preserving of food at harvest time may hinder other residents holding a business meeting at the same time.
(*Use small and slow solutions | Apply self regulation and accept feedback).*

Increase connection and blur boundaries to Zones 1 and 2. Achieved through:

- The Pergola structure with kiwifruit vines on NW of house creates both an overlap of Zone 2 & Zone 0 on the deck, and an outdoor garden living space
- New stairs leading from deck outside to kitchen to the Zone 1 garden improves access and connection to the outside for gathering produce for meals
- Wildflower garden on the roof of the carport makes use of the structure for garden space
- The carport is a covered area that also serves as shelter for a vehicle, storage area, and a sheltered outdoor work space

(Integrate rather than segregate).

These key elements discussed for the house renovation and retrofit also apply to the construction of the studio.

Intensive annual garden (Zone 1)
The annual garden is made up of low raised beds set out in rows for ease of building and management. The raised beds are constructed along the contour to avoid loss of soil and nutrients. The soil requires improvement in nutrient profile and structure so bringing in organic garden mix and building raised beds to lift the garden off the compacted soil allows production to begin straight away whilst also initiating improvement to the soil. The soil will be inoculated with compost and worm (vermicast) teas made on the site from kitchen and garden waste to enrich and improve the soil.

Figure 20 Zone 1 beds with edging to create a terraced garden on a gentle slope

Constructing raised beds allows the slope to be slightly terraced, increasing the usability of the site y creating flat garden beds. The bed layout also allows for passive irrigation channels under the paths between the beds (discussed in the water management section).

Beds will be constructed using a modified Hugelkultur method of digging a shallow trench in the soil, loosening the soil in the bottom of the trench, creating a mound of biomass such as logs, branches, leaves, grass clippings, straw, cardboard, newspaper, compost etc., then topped with soil. Untreated rough sawn boxing timber will be used for edging to contain the soil and create neat edges.

The Hugelkultur method holds moisture and builds fertility in the beds as the biomass decays. It also reduces the amount of top soil that needs to be brought onto the site.

The formed edging helps with management of the beds as they will be closely spaced and require the ability to cover with net from time to time to keep out birds and white butterfly that would otherwise damage the crops and reduce the yield. The untreated wood decays over time (several years) and adds to soil improvement. As the bed edges will need to be rebuilt from time to time, this allows for adjustments to position, width and length of the beds, allowing the residents to test and refine the bed size and layout to suit their needs. (*Use slow and small solutions | Produce no waste).*

Arches and trellis frames made from recycled and salvaged materials will be used between and within the beds to grow climbing plant varieties, freeing up bed space to: plant species that do not climb; produce a greater diversity of plants; and increase quantity of yield.

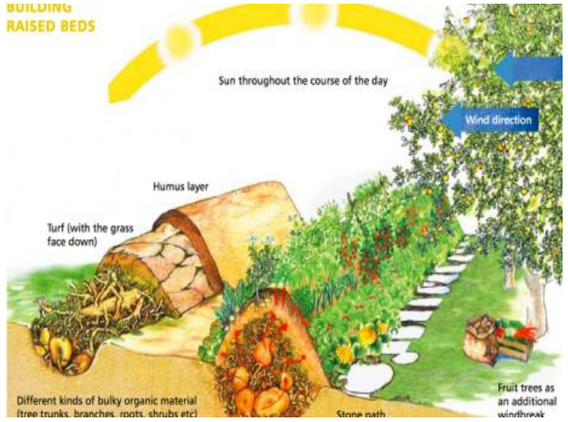


Figure 19 Hugelkultur

The residents will create a planting plan based on: healthy foods they enjoy, the quantity and variety needed to provide year round seasonal harvesting, and with some surplus for preserving so that there is food available when there is not so much to harvest. The planting plan will be based initially on a 6 bed rotational system and include inter-planting to extend the growing seasons. Inter-planting with vegetables and annual herbs and flowers also allows the plants to support each other with: shade, physical support, living mulch, pest repellent, and beneficial insect attracting services.

Criteria in selecting varieties will be: heritage/heirloom varieties selected for high nutritional value, pest and disease resistance, suitability / naturalised to the area, and a range of different varieties of a species with a spread of harvest times to provide a diverse diet and to extend the season of particular species. (*Obtain a yield | Use and value diversity)*.

Between the raised beds bulk carbon pathways (trenches filled with wood mulch / wood chip) are connected to drainage channels and water feeds from storage tanks to act as passive irrigation (also discussed in the water management section) to the beds. The mulch will decay to compost that can eventually be turned onto the garden beds to increase organic material in the beds and the trenches filled with fresh wood mulch or wood chip material. As it decays, and over time, the mulch will also assist in improving and building the soil around the beds (*Use slow and small solutions).*

Together the Hugelkultur style beds and carbon pathway/trenches will regenerate and build the soil in Zone 1 which will lead to healthier more resilient and nutritious vegetables for the residents.

The existing shed is located within the annual garden area, it is modified to increase its flexibility in use and to blur the boundaries and increase the edges between zones. The addition of a small deck with a sunken bath on the W side of the shed creates a sunny afternoon outdoor living and relaxing space surrounded by Zone 1 gardens. The shed door is relocated and enlarged to open to the new deck which also becomes an extension to the shed workspace. A trellised screen planted with fruiting vines on the NE provides additional privacy screening from neighbours. Rainwater collection from the shed roof is discussed in the water management section.

A plant propagation and aerated compost tea making area is set up beside the shed to provide shade to tender plants, and is close to the house, close to power, and close to water tanks needed for making aerated compost teas.

Cold frames or a small greenhouse within the intensive annual garden is included to extend the growing season of the site. The sheltered and warm microclimate inside the cold frames or greenhouse can be controlled to provide warmth, light and airflow which create an environment suitable to:

- Start seeds so that they can be transplanted into the main garden beds as seedlings which is a more efficient use of the beds as direct sown seeds take up space in the main beds while they are germinating that can otherwise be used for a plant that is producing a yield
- Start crops early to get established seedlings into the beds early in the growing season
- Grow a crop at the beginning and end of the season when it is too cold/ wet etc outside
- Grow a crop that requires more regulated, warmer conditions and microclimate than is available in the garden beds

Cold frames are like mini greenhouses made from a frame with a hinged glass lid, e.g. old windows that can be propped open. The cold frame can be set up as a permanent growing space similar to a low greenhouse.

Initially cold frames will be used and built to the same dimensions as the garden beds so that they can be moved and used in place on different beds depending on the crop, as well as used to protect and propagate seedlings. A greenhouse can be added later once the main effort and build work to create the garden is complete, and the garden is up and running. The greenhouse will increase the functionality of the covered growing and propagation area (*Use slow and small solutions).*

Garden structures, rainwater harvesting system, and the bath set into the shed deck make use of discarded and recycled elements either salvaged from local building sites or purchased through building recyclers to divert useful material and elements from landfill (*Produce no waste*).

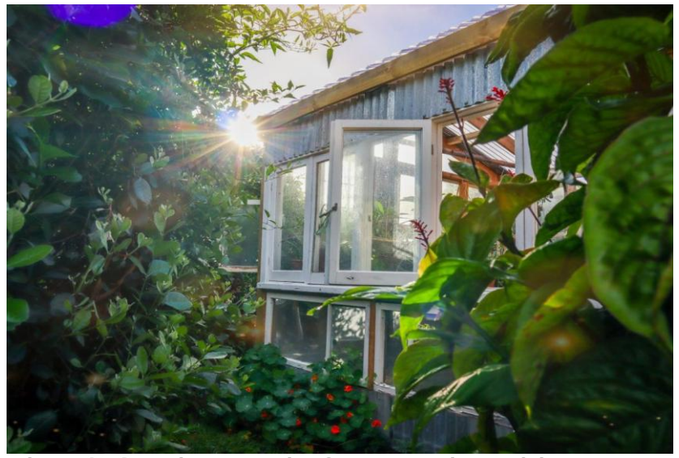


Figure 21 Greenhouse made of repurposed materials

Figure 22 Coldframe
https://www.milkwood.net/2020/05/04/making-a-mini-greenhouse-to-extend-your-growing-season/

Intensive perennial 'fruit' garden (Zone 2)
The perennial garden is made up of trellised and trained fruit trees, and shrubs set out in rows and mini hedges for intensive production and ease of management. Support frames will be made from recycled and salvaged materials where possible, and simple metal Y posts with wires running horizontally to train the trees along. There are also fruiting and non-fruit shrubs and trees scattered amongst the more formal layout of the design to incorporate the existing apple, grapefruit, feijoa, and key native shrubs and trees. The scatter layout enables best placement of the variety for the site and microclimate, and softens the otherwise very structured layout.

Criteria in selecting varieties will be heritage/heirloom varieties selected for high nutritional value, pest and disease resistance, suitability, naturalised to the area, and a range of different varieties of a species with a spread of harvest times to provide a diverse diet and to extend the season of the species. (*Obtain a yield | Use and value diversity).*

A forest structure of trees, small trees, shrubs, herbs, climbers, tap root, and ground cover informs placement of species within the design. (*Integrate rather than segregate).*

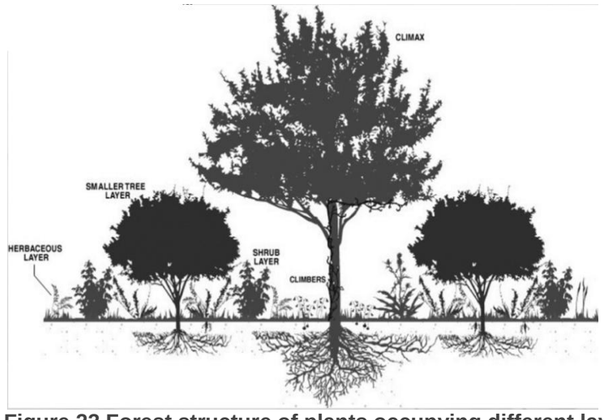


Figure 23 Forest structure of plants occupying different layers

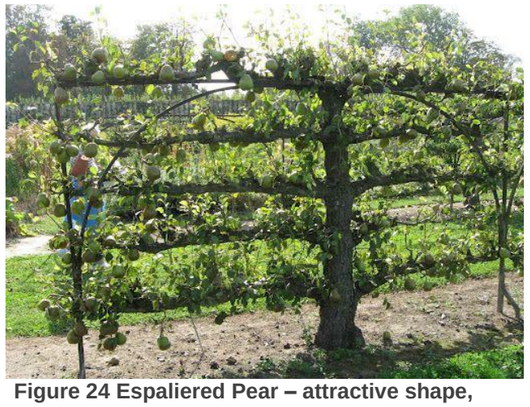


Figure 24 Espaliered Pear – attractive shape, easily managed and harvested

Rows of mixed espaliered deciduous pip and stone fruit trees are planted on the W boundary of the rear yard (Espalier 1) and along the side of the relocated driveway in the front yard (Espalier 2).

The mixed species increases the diversity of plant species and produce. The species are alternated by pip and stone varieties, and mixed up in the rows to confuse pests and minimise the spread and risk of disease. Together with the existing trees they form the small tree forest layers.

Espalier 1 and 2 provide summer shade and winter light to the Zone 1 annual gardens, Espalier 1 also partially shades a row of Raspberries from full sun in summer. The row of raspberries is planted parallel and on its own frame to be accessible from both sides for ease of management and harvest, it adds diversity and a lower shrub layer of plants to the forest structure.

The espaliered trees are heritage varieties selected for self fertility disease and pest resistance, eating and storage qualities, and nutritional value. Varieties include: Apricot (Fitzroy), Plum (Hawera), Peach (Sweet Perfection), Apple (Monty Surprise), as well as Pear (Winter Nelis & Comice), and Nashi (varietyTBC).

Espalier 1 is planted on mounds because it on the downhill side of the site which becomes damp in periods of wet weather. The mounds act like the berm of a swale, roughly on contour and aids in channelling surplus surface water towards the rain-garden, and provides passive irrigation for the trees while avoiding the roots getting waterlogged.

The rain garden located partway along the row is discussed in the water management and earthworks sections.

Deciduous Kiwifruit vines are planted at the base of the cut back deck to form a canopy accessed from ground level, they are also trained to grow up and over a new pergola frame structure providing summer shade to the W face of the house (discussed in Microclimate and Building /Living spaces sections.

The autumn leaf fall of the deciduous plants provide material for compost, Zone 1 garden beds, and mulching around Zone 1 and 2.

Two mini hedges of feijoa have multiple functions forming screening from the neighbours on the NE boundary, and part of the shelter planting on the S boundary discussed in the microclimate section. Feijoas are selected for this element as they are a fruiting evergreen and a favourite fruit of the residents. The planting of different varieties selected for flavour, fruit quality, and harvest time (early, mid and late season) to extend the fruiting season, aids with reliability of crop in case one tree underperforms in any given year.

Non espaliered fruit and nut trees in the design are: Grapefruit (existing sweet variety), Apple (existing assumed as a Royal Gala), Lemon (Meyer), Orange (Parent Navel), Lime (Tahitian), Hazelnut and possible Walnut, Persimmon, Tamarillo and Loquat. They are grouped with support species shrubs and blur the formality of the linear layout of other plantings.

Berry canes and fruiting shrubs are positioned to benefit from shelter and partial shade of the small tree layer. Blueberry (Rabbit eye to suit the central New Zealand climate and daylight hours) shrubs are placed in pairs to aid in pollination and are dotted around in places where they too receive some shelter and shade from nearby trees, replicating their place in a forested system.

Passion fruit and other varieties of berries and currants are trained on frames along portions of the E fence line and provide screening from neighbours. The passion fruit is set forward from the fence to allow access for maintenance, while the berries and currants can be pruned back without removing the plant if their portion of the fence needs attention.

A small stand of dwarf clumping bamboo is placed near the fence line as a screening hedge and to provide stakes to use in the garden to build supports and frames. The fences in general are old and will require maintenance although it is preferred to remove them to blur the boundaries with neighbours and to foster a stronger community however this is dependent on neighbours, community willingness, pets, children, site access and safety. In the meantime the fences can be replaced with simple post and wire to create a more 'open' and friendly feel in areas where higher levels of privacy are not so important.

Perennial varieties of herbs, flowers, vegetables, and ground covers are assembled in guilds beneath the trees and shrubs, forming the lower growing levels of the forest strata.

Perennial vegetables included are: yams, rhubarb, runner beans, asparagus, multiplying and bunching onions. Plant guilds will be designed and established to create support, protection and nourishment of the main productive plant, guilds will include ground cover, herbs, shrubs, vines/ climbers, and trees to utilise vertical space, and provide a secondary crop such as fruiting strawberries as ground cover under a plum tree, or Marjoram herb as a ground cover under citrus and passion fruit.

The guilds are an excellent way to incorporate functional diversity into the system, to build the soil, and support both the Zone 1 and 2 production areas. *(Use and value diversity).*

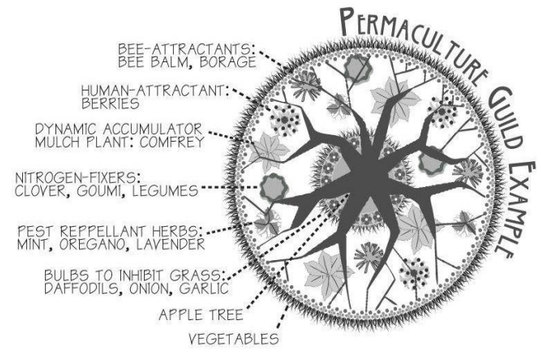


Figure 25 Permaculture Guild example for an Apple tree from permies.com

The planting of guilds over time is managed to utilise the natural order of succession to improve the soil, enabling it to support and allow the next plant species in the guild to thrive.

Guild plan for a snapshot of 3 fruit tree species only - a full guild design for all planned species included in the system will be developed by the residents as part of their implementation process.

Main crop	Plum	Apple	Feijoa
Nitrogen fixer	clover, peas	clover, dwarf beans,	clover
Dynamic accumulator	borage, chives, parsley, yarrow	chamomile, borage, yarrow	borage, chives, parsley
Pest repellent	chives, marigold	chives, sage, nasturtium	Nasturtium, marigold, rosemary
Pollinator and beneficial insect attractants	lemon balm (S, A), yarrow (S,A,Sp) marigold	anise hyssop (S,A,W,S), Hebe (W), Manuka (Sp), yarrow (S,A,Sp)	alyssum, marjoram, hebe (W)
Ground cover	chives, strawberry,	chives, thyme, violets,	alyssum, chives, marjoram
Taproot	chicory, parsley	dill, queen anne's lace	dandelion, parsley

Flowering season of perennial pollinator /beneficial insect attractants (S) = summer flowering, (A) = autumn flowering, (W) = winter flowering, (Sp) =spring flowering

The guild species are selected based upon being a component of the forest strata and consider adjacent species incorporated in the overall system. Plants included in the guild may provide more than one function – for example chives as both a pest repellent and a ground cover.

The aim is to incorporate as diverse a range of species across the guilds as possible to provide benefit throughout the year. For example the species and varieties of flowering plants across the site are selected to achieve year round flowering to provide year round food for beneficial insects.

There will be some natural overlap in species between different guilds. Due to the intensive system, guilds are matched to particular crops, however there is also consideration to services they provide for the overall system.

Nitrogen fixing services will generally be provided by low growing clover, peas, and dwarf beans especially when in close proximity to the main crop species. Nitrogen fixing is also provided by an existing native Kowhai tree near the uphill boundary so is incorporated in the overall system (the scale of the project site is such that tall Nitrogen fixing trees would be too dominant when combined with the fruiting species). Additional Kowhai species are included with careful attention to placement and growing size:

- Evergreen kowhai variety planted on the verge area as part of the shelter planting (seedling of the kowhai above)
- Prostrate / dwarf kowhai incorporated as a low shrub in areas of understory on boundary planting areas with other buffer and native trees
- Experiment with espaliering a kowhai along fence lines to keep the growth compact as hedge or screening

This intensive system of growing requires regular pruning to keep trees and shrubs to manageable sizes and trained to desired shapes so that the trees can be netted to protect the fruit from birds, and be a manageable size for harvesting. The prunings provide carbon rich material for Zone 1 Hugelkultur, bulk carbon pathways, compost, and firewood, to support the whole system, *(Integrate rather than segregate).*

The trees and shrubs produce yields that are able to be used across the other zones on the site including: eating the produce, composting waste, deciduous leaf fall for composting/mulching/ topping up pathways, chipping / mulching branches for mulch and topping up pathways, building Hugelkultur beds.

A variety of natives (non-fruiting and non-edible) are included in the system both for the services that they can provide and to include conservation diversity for the native bird and insect species, among the natives are:

- Kowhai for its Nitrogen fixing services and flowers providing food for birds
- Manuka for its flowers which are great bee fodder to support pollinating bees, and wood (from pruning) which is good kindling/fire wood
- Hebe, a low growing shrub with a long flowering season to attract bees and beneficial insects
- Pittosporum as hedging and screening, and for its flowers which attract beneficial insects

Animals

In a system that incorporates managed animals, the animals provide grazing and efficient conversion of fodder species into rich organic material to feed and regenerate the soil to support healthy plants.

As domesticated animals are not to be incorporated in this system grass areas will be minimised in favour of low maintenance ground covers. Small areas of grassed areas will be trimmed by the residents, composted, and used to make highly nutritious compost tea and foliar sprays for efficient uptake by the plant species.

A worm farm is incorporated into the design to process and compost kitchen food scraps. As long as the worms are fed regularly and vermicast harvested then worms require minimal maintenance and management.

Wildlife in the form of birds and insects provide pollination and pest control services.

Birds and crops must be managed to allow the birds' sufficient access to production areas without causing damage and loss of yield. Sharing some of the fruit yield with birds is acceptable as the birds help to manage other pests, however they need to be kept out of beds and garden areas from time to time to prevent large scale losses.

- Net annual beds where seedlings have been freshly planted and seeds sown to prevent damage by birds digging for soil insects
- Net rows of berries and espalier trees when fruit is ripening to prevent bird peck damage to fruit
- Allow the birds access from time to time to clean up small or damaged fruit, and work over garden beds

Wildlife in the garden also provides manuring services to increasing the diversity and fertility in the soil.

Implementation

Successional changes in the development of the system

Proposed management and implementation plan for the site has the aim to bring and maintain the succession stage of the previously damaged land to one that is suitable for growing nutritious food for the residents. It incorporates many elements as they all work together to collectively improve the **soil ecology**:

- Testing and observation (*Observe and interact*)
    - **Initially** - to establish a base line
    - **On going** - to measure progress, what is working and not working, to aid maintaining the succession at the right stage for the production area (will differ between the vegetable dominated annual garden in Zone 1 requiring a fairly balanced F:B ratio, and the tree dominated perennial home orchard/garden in Zone 2 requiring a more fungi dominated soil ecology)
    - Lab and field testing of (3-4 selected sites on the property) used to support and add additional context to observations. This includes soil organism surveys, soil properties (colour / texture / type), brix tests of produce
    - Keep a diary record including photographs, measures of yields, noting positives and negatives
    - Modify management practices in response to negative or unwanted changes
- Implement drainage to create and maintain an aerobic environment in the soil with use of
    - To collect water runoff from uphill properties and divert it away from the buildings
    - Passive irrigation around production areas
    - Pond with biodynamic flow-form to aerate the water
- No-till cultivation to minimise harm, kill or damage soil biology and structure
    - Use sheet mulching and raised bed modified Hugelkultur techniques
    - Initial preparation requires some digging to remove large stones as they form a barrier to root development and movement of biology and water in the soil
    - Ongoing no till or once yearly only broad fork aeration technique (bio intensive)
    - As the mulch and wood in the raised beds break down they will improve the structure and ecology of the soil beneath
- Increase plant diversity using beneficial and cooperative plant species to give off exudates that attract and feed fungi and bacteria, improve the soil food web and ecology, as well as above ground attract pollinating insects and insects that prey on pest insects to eliminate use of chemical pesticides that are damaging to plant, soil and human health.
    - Over time reduce to zero the area given over to lawn
    - Areas in lawn mowed and the lawn clippings used in compost and mulch to improve the fertility of the soil. Mow using a higher mowing height to shade and protect the soil
    - Mixed species cover crop on land awaiting development / planting, and retain it in Zone 2 as a mixed species meadow ground cover. Cover crop species to include sunflower, buckwheat, plantain, chicory, clover, peas, faba beans, phacelia. Work with these and add in wild flowers to incorporate diverse plant species with different roles, N fixing, breaking up soil, mining nutrients, attracting beneficial insects.
    - Mix up crops in vegetable garden with inter-planting and crop rotation (example mix leafy and root vegetables, and onion and brassica families) to
        - Break disease cycles
        - Use characteristics and services of one crop to prepare the beds for the next crop
        - Increase diversity distribution and avoid areas of monoculture - disrupt pest species as well as improved diversity of roots for the soil organisms
    - Plant guilds under trees using known beneficial plant species and grouped to provide a range of services
- Keep vegetable garden beds covered with a mulch or low growing cover crop to protect the soil from damage from rain, wind, loss of C and N to the atmosphere. The mulch feeds the soil organisms as the organic material breaks down and becomes incorporated into the soil.
- Rotate crops and periodically rest beds with a cover crop to break pest and disease cycles, and boost fertility
- Feed / inoculate planted areas to increase soil organic matter, nutrients, and soil micro organisms
    - Add home-made compost to vegetable beds, and around the base of fruit and nut trees
    - Mulch around the base of fruit and nut trees using mulch made from tree trimmings and leaf mulch
    - Aerated compost tea and or worm wee as a general application to production and land awaiting development / planting
    - Organic only, no chemical inputs to avoid damage and compounds that are toxic to the life in the soil
    - Foliar spray made form compost tea

Proposed management and implementation plan for the dwellings/living spaces has the aim to improve the efficiency and comfort of these spaces for the residents. It incorporates the different elements covered in the description of elements section as they all work together to collectively improve the efficiency and comfort of the **dwellings/living spaces**:

- Observe and measure (*Observe and interact*)
    - **Initially** - to establish a base line
    - **On going** - to measure progress, what is working and not working, to aid progression towards healthier living spaces. Make observations after each implementation stage
    - Keep a diary recording comfort levels of the buildings <subjective>
    - Keep a diary of energy and water services usage <data obtained from energy and water usage bills>
    - Note of how the spaces are used, and residents discuss how they would like to use the spaces in the future
    - Observe climate to assess suitability or appropriateness of planned design changes
- Implement insulation starting with cheap and simple methods in easy to access areas, suggested steps:
    - Under floor ground vapour barrier, fit old blankets to the backs of curtains
    - Install under floor insulation, replace curtains with thermal style, install ceiling insulation
- Use temporary solutions to test planned design changes prior to implementing:
    - Fit an exterior awning or place row of small trees in pots along sunny W windows to assess impact of shading, for example how is the view affected, how effective is the shading, test the positioning
    - Fit old blankets to the backs of curtains, notice the difference in night time warmth (if any)

Managing resources

To minimise the financial outgoings and divert perfectly good materials and items from landfill, resources are proposed to be managed by using and repurposing resources from the site and the local area where possible.

Where this is not possible cost effective / economical materials locally produced / sold is the next preferred option to support local businesses and minimise carbon footprint of the item(s). If items are not produced in the local area, then ideally they are made in New Zealand. This supports the local community / economy and reduces harmful effects on the planet.

Imported items may be unavoidable if type, quality, and/or durability are not available in New Zealand made items.

This requires a behavioural change by the residents in how they ‘procure’ and acceptance of what might be a different aesthetic due to what options are available. The resulting aesthetic may be eclectic and quirky, and will ultimately be more meaningful with stories attached to items. For example: the research, the maker, where it was found, how it was collected, and new friendships/community connections/networks made along the way.

- Collect fallen leaves from local streets / reserves
- Forage /salvage discarded building material from local building sites
- Buying second hand – curtains, demolition wood/recycled wood – from local op shops/trade me

Capturing observations

Observations are to be captured by the following methods so that they can be used to compare changes over time. The changes provide feedback on the effectiveness of the management plans and allow the plan to be changed to respond to any undesired changes. (*Apply self regulation and accept feedback).* The recording methods need to be simple and easy so that it does not become overwhelming and hard to maintain.

- Soil – annual testing, results collated in a digital diary / spreadsheet to enable easy comparisons over time
- Garden – digital photo diary, photos dated. Diary recording of when crops were planted, harvest dates and quantities, weather readings (daily / weekly rainfall, daily temperatures)
- Dwelling - indoor temperature, days where heating is required, days when the spaces over heat, differences in different parts of the house, and how the shed compares to the house, airflow patterns. Including times of day and days of year
- External services (electricity / water) – keep water and electricity bills to establish usage levels – enter into a spreadsheet or use the energy suppliers app to track and compare usage over time to check on efficiencies of alternative sources (rain and solar harvesting)
- Community - what is happening in the neighbourhood that may impact on the site (both positive and negative)
    - Resource availability /quality
    - Local council rule changes
    - Services

Planning

Implementation will be planned in achievable bites and in small steps to prevent over reach. In some cases implementation may be able to be sped up or slowed depending on commitments and enthusiasm however speeding up should not shortcut the *observe and interact* and *use small and slow solutions* principles as it may lead to negative outcomes.

The residents will utilise a '12 week plan' technique to break the years planned work into manageable chunks, and assign tasks according to season.

Zone 0 Dwelling plan for years 1-5

Year 1

Live in the dwelling to get a 'feel for it' and understand positive and negative features that may not be apparent without experiencing a whole year | capture ideas and research materials, local suppliers, local trade's people | create basic concept plans to explore different ideas | Implement simple changes that are low cost, make a difference, and can be undone or put aside with very little 'cost' implications (reuse / recycle /up-cycle items no longer required) | purchase a second-hand 'retro' caravan to test the idea of the studio/ additional accommodation and as support space for when changes are done to the main dwelling |

Year 2

Critique concept plans and work up a developed design maybe including some 'options' | list preference for materials and products | establish what can be reused, recycled and what needs to be new | cost and value engineer |

Detailed drawings for changes | detail and implement shed alterations first as this is a small scale and when complete provides a support space while work is done to the main dwelling | building consents |

Year 3

Recruit contractor(s) and agree scope and level of labour input to be provided by the residents | Implement alterations |

Year 4

Minor finishing items by residents | observe and review the studio requirements | create basic concept plans for studio to explore different ideas to suit refined requirements |

Year 5

Developed design | cost and value engineer | detailed drawings for studio |

The studio may become: a personal project of the residents to build a relocatable tiny house built from recycled materials; a converted container; a modular prefabricated structure purchased from an environmentally conscious company that builds to standard plans; a bespoke new build; or something in between these variants. Timing of the implementation will adjust accordingly and be in line with end function and need

Zone 1 Annual vegetable and herb beds plan for years 1-5

Year 1

Plan bed layout | dig 3 garden beds into the lawn to loosen, aerate and de-stone the soil | test the soil pH, worm count and make up | buy in organic garden mix /compost to improve the fertility and structure of the soil |

Create paths between beds with cardboard and purchased wood/leaf mulch to suppress the grass | use stones removed from the soil to edge the beds and hold down the cardboard |

Plant with basic variety store bought annual seedlings and easy sow seeds | plant whatever varieties are on hand in whatever space there is | mulch beds | record planting/sowing dates and locations |

Set up a barrel to catch rainwater from the shed roof to use for irrigation | hand irrigate with watering can noting frequency and volumes of water at different times of the year |

Observe seasonal changes in light, warmth, wetness, bugs and other pests and diseases | keep monthly photo diary | record yields |

Plant green manure and wildflowers in adjacent areas to increase species diversity for improvements in the soil and attracting beneficial insects |

Year 2

Adjust size and position of bed layout based on ease of use, amount of sun/shade/shelter | expand number of beds digging new beds into the lawn per year 1 | test the soil pH, worm count and make up | edge beds with untreated timber boxing | top up with bought in organic garden mix /compost and homemade compost to improve the fertility and structure of the soil |

Top up and create paths between new beds per year 1, and existing beds with wood/leaf mulch from on site or locally collected pruning's leaves | remove the stones |

Raise basic variety annual seedlings from seed in seed trays to plant out, supplement with store/local market bought seedlings | mulch beds | record planting/sowing dates and locations |

Set up a basic gravity fed irrigation system with hoses and basic fittings attached to the rain barrel, supplement with hand irrigation by watering can noting frequency and volumes of water at different times of the year and comparing to year 1 |

Observe seasonal changes in light, warmth, wetness, bugs and other pests and diseases and comparing to year 1 | experiment with physical crop protection at critical times in response to previous years pests observations | keep monthly photo diary | record yields and compare to year 1 |

Save some seed | create a list of vegetables and herbs to grow based on food preferences, and research growing requirements and nutritional value (ongoing) | work up a basic crop rotation and inter-planting plan | find local source of information for when to sow and plant different crops |

Develop and upgrade the beds ready for spring planting, research vegetable varieties and plan rotation and inter-planting in winter |

Plant green manure and wildflowers in adjacent areas to increase species diversity for improvements in the soil and attracting beneficial insects |

Year 3

Further adjustments to size and position of bed layout based on previous years observations | test the soil pH, worm count and make up | expand number of beds digging new beds into the lawn per year 1 | edge beds created the previous year with untreated timber boxing | top up with bought in organic garden mix /compost and homemade compost to improve the fertility and structure of the soil |

Dig irrigation channels into the paths between the beds | top up and create paths between new beds per year 1, and existing beds with wood/leaf mulch from on site or locally collected pruning's leaves | remove the stones from the paths created in the previous year |

Raise increased variety of annual vegetable and herb seedlings from seed in seed trays to plant out, including saved seed, supplement with store/local market bought seedlings | mulch beds | record planting/sowing dates and locations |

Improve the basic gravity fed irrigation system with additional barrels, hoses and basic fittings | create a feed to the irrigation channels | supplement with hand irrigation by watering can noting frequency and volumes of water at different times of the year and comparing to previous years |

Observe seasonal changes in light, warmth, wetness, bugs and other pests and diseases and comparing to previous years | keep monthly photo diary | record yields and compare to previous years | record quantity of produce purchased over the year |

Save seeds | adjust the list of vegetables and herb to grow based on food preferences, results, growing knowledge, research growing requirements and nutritional value (ongoing) | tweak the crop rotation and inter-planting plan to include the additional beds | use local sources of information for when to sow and plant different crops, give koha or contribution in return |

Develop and upgrade the beds ready for spring planting | research vegetable and herb varieties and plan rotation and inter-planting in winter |

Plant green manure and wildflowers in adjacent areas to increase species diversity for improvements in the soil and attracting beneficial insects | allow self seeding |

Year 4 & 5

Adjustments to size and position of new bed layouts based on previous years observations | test the soil pH, worm count and make up | expand number of beds digging new beds into the lawn per year 1 | edge beds created the previous year with untreated timber boxing | top up with homemade compost supplemented with bought in organic garden mix /compost if required to improve the fertility and structure of the soil |

Expand the irrigation channels under the paths between beds created the previous year | create paths between new beds per year 1 | top up paths and irrigation channels with wood/leaf mulch from on site or locally collected pruning's leaves | remove the stones from the paths created in the previous year |

Raise increased variety of annual vegetable and herb seedlings from seed in seed trays to plant out, supplement with local market bought / swapped seedlings | record planting/sowing dates and locations | integrate some annual climbing and readily self seeding crops into the establishing Zone 2 perennial 'fruit' garden as guilds |

Tweaks to the gravity fed irrigation system so that it feeds the expanded irrigation channel system | add additional barrels / tanks | build rain garden and link into irrigation channel system | supplement with hand watering where needed noting frequency and volumes of water at different times of the year and comparing to previous years to see if the water holding

ability of the soil is improving, and if the management of the zone with mulching, intercropping and cover cropping is reducing the amount of irrigation required |

Observe seasonal changes in light, warmth, wetness, bugs and other pests and diseases and comparing to previous years | keep monthly photo diary | record yields and compare to previous years | record quantity of produce purchased over the year |

Save seeds | tweak the list of vegetables and herb to grow based on food preferences, results, growing knowledge, and research growing requirements and nutritional value (ongoing) | tweak the crop rotation and inter-planting plan to include the additional beds and increased variety of species | use local sources of information as a guide for when to sow and plant different crops, (give koha or contribution in return) adjusted to suit the site based on observations | plan quantity of seeds to sow based on required food and seed yields to reduce quantity of produce purchased and allow for a surplus | share or trade surplus |

Years 6 →
After year 5 the planned beds should all be built, and systems developed and in place. Ongoing observation, recording, tweaking and maintenance as well as enjoying the yields | sharing learned knowledge with others | rebuild bed edging from time to time as necessary |

Zone 2 Perennial 'fruit' garden plan for years 1-5
The residents will work up their 5 year plan for this zone. It will be largely based upon and follow a similar pattern to the Zone 1 plan - creating, observing, and adjusting. It will start out with a small area and small number of varieties including the existing apple, grapefruit and feijoa trees in years 1-2, and then in the following years expand to include the greater diversity included in the site plan drawing. Planning and research will to include:

- Prepare planting sites with mixed species green manure and wild flowers
- Heavily prune old apple tree to bring it back to manageable size and shape for ongoing management and harvesting
- Use a spreadsheet to chart varieties that the residents like to eat, research varieties for characteristics and harvest month to extend season of each fruit with early, mid and late season varieties of the species, and to achieve a year round supply of seasonal fruit
- Confirm placement of plant species and varieties against the plan
- Design guilds for each main crop
- Overlay the guild designs to consider the system as a whole

The 5 years of the plan allows time to implement slowly, observe and adjust the plan balanced with the necessity to get trees planted sooner rather than later. Trees are more difficult (or expensive if buying larger trees) to fast track as they generally take number of years before initial fruiting and longer for yields to ramp up to full production. Implementing Zone 2 over a 5 year time frame rather than longer accelerates the production of yields of food and prunings to use in the other zones, and reduce reliance on bringing resources in from outside the site.

Social Strategy / Community Support
Strategy:

- Create a list of tasks, and inputs, help is required to for the residents to achieve each component
- Research local sources for physical elements and knowledge
- Find out who the local trades/specialists, and other local people (permaculture practitioners, organic growers, eco renovation specialists) are who can assist. Build networks and reach out to these local people
    - Develop a clear 'story' and a condensed 'elevator pitch ' version so the residents can speak clearly about themselves and the project, and know their goal when approaching people and doing research
    - Keep up with what is happening locally and attend events, groups, talks etc where there are likely to be like minded people
    - Practice communication ☺
    - Be authentic, approachable, and friendly, ask people questions
- Identify key people to work with, including potential mentors
    - Investigate terms of service where 'payment' is required – do they accept alternative forms of payment such as local currency, barter, time swap/time bank.

So that the project can be a catalyst for information sharing during the implementation phase relationships with others who can help /guide/mentor are important. Some ideas:

- Develop relationships with neighbours - discuss the project, investigate possibility of incorporating unused back yards to extend the boundaries of the design, and convince the neighbour how it could be a win-win arrangement
- Attended a local garden trails to meet others who can help with information sharing or possibly mentoring, example: a garden designer who lives nearby and understands the soil conditions and microclimate; others who have completed PDC's and/or have used permaculture as a framework for their home property.
- Social media: local community face book page; Waste Free Kapiti face book page; Permaculture in New Zealand face book page
- Sign up to the Share Waste Compost Collective web page https://www.sharewaste.org.nz/ and similar

Where there is a clear project that the residents require help and further guidance with a mentor can be valuable to get on board. Prior to engaging with potential mentors a clear project including clearly identified goals and reasons for working together will be established. This ensures getting the right mentor(s) involved, the best outcome and experience from the mentoring relationship.

A project or element that the residents have little experience in that would be of benefit to both the residents and the building /establishment of their local community is a time swap/ banking system. Becoming involved in or creating such a system would allow local people to swap skills / labour with others building a more self reliant and resilient community where everyone has a valuable skill or knowledge to contribute.

Some steps to find suitable mentors for this project are:

- Networking/talking to people and keeping an ear to the ground as to who is out there and what they are doing
- Clearly identifying the end goals of the project
- Thinking about who would align with the project

A mentor may be willing to simply share knowledge however the arrangement should be of mutual benefit. This may be: by payment / consultative; residents volunteer as an assistant / trade unpaid work for learning; the project may give the mentor publicity / exposure in their field; a mentor may be interested due to the potential to build community networks; if more than one mentor works on the project it may be an opportunity for them to work with others that they respect.

Appendix

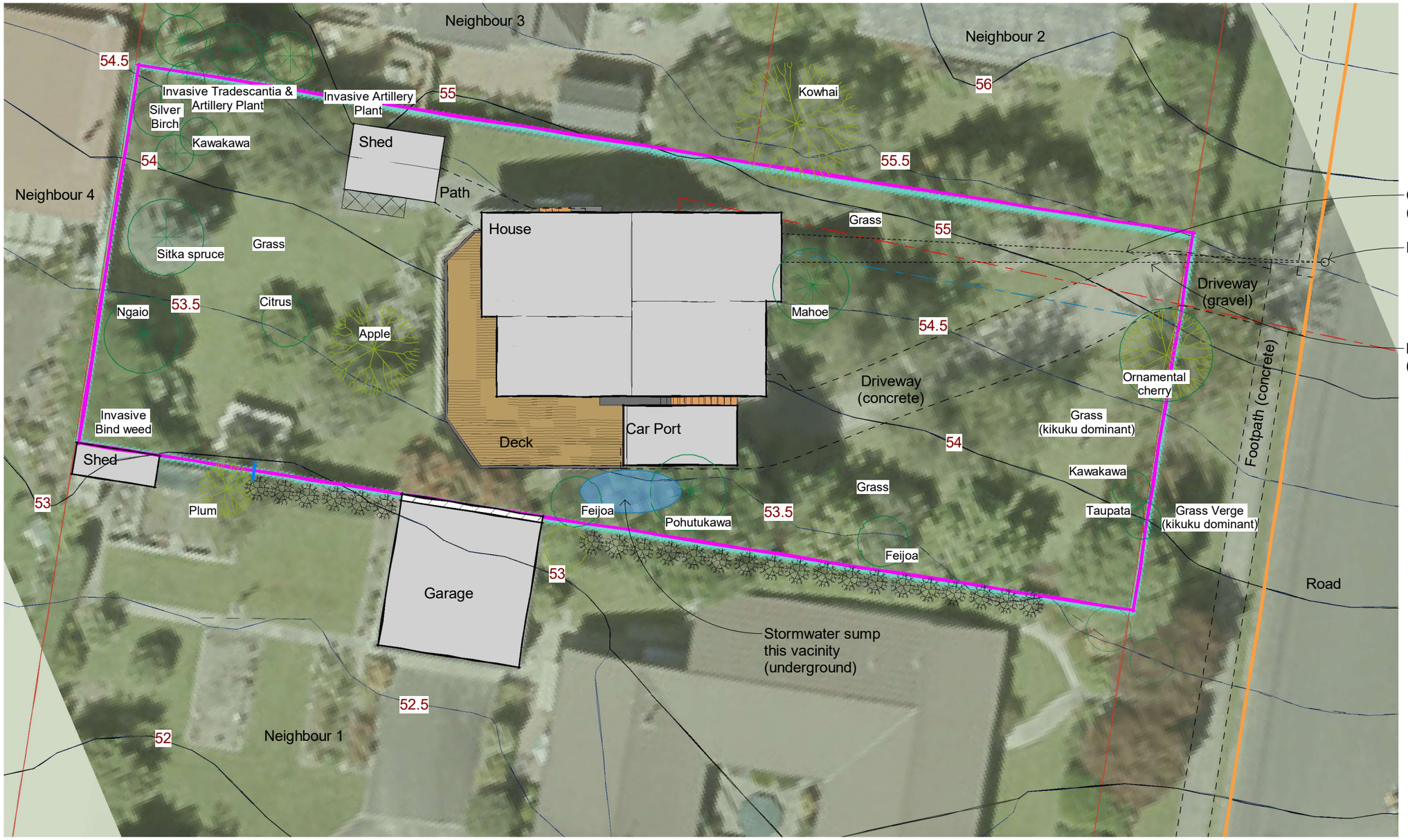
Existing Site Topographical Plan – drawing **PDC200-G rev B**

Soil Critter Count – drawing **PDC120-G-B**

Regenerative Design Sector Plan – drawing **PDC100-G rev B**

Regenerative Design Zone Plan – drawing **PDC110-G rev B**

Regenerative Design Proposed Plan – drawing PDC301-G rev A



EXISTING TOPO MAP

LEGEND

Land

- Contour line
- Minor Structure

Built

- Property boundary
- Path/ Access way
- Kerb
- Structure
- Building / structure
- Paving

Services

- Electricity line (overhead)
- Water supply line (under ground)
- Waste line (underground)

Vegetation

- Tree Native
- Tree Exotic (evergreen): hedge / feature / fruit / other
- Tree Exotic (decidious): fruit / feature

Aerial imagery sourced from Kapiti Coast District Council (KCDC) GIS Maps
Topography data sourced from Kapiti Coast District Council (KCDC) GIS Maps and koordinates.com / LINZ NZ Primary parcels and Contours 0.5m

NORTH

SCALE 1 : 200
0 2 4 6 8 10 12 14 16 18 20 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	16/06/20	INFORMATION	

STATUS:
INFORMATION

PROJECT:
SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS:
KAPITI COAST

DRAWING TITLE:
EXISTING SITE TOPOGRAPHICAL PLAN

DRAWN	CHECKED	DATE
RP		23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated

DRAWING NO.
PDC200-G

REVISION
B

SOIL CRITTER COUNT

Location & Date
Survey completed in April 2020, Kapiti Coast, Wellington.

Method
Firstly any loose mulch cover was removed from the area to be tested. Then a hole 500mm x 500mm x approx 150-200mm deep was formed. The soil from the hole was placed onto a sheet set to one side.

Once all the soil was removed it was sorted through and any organisms present were picked out and transferred to a bucket. After this was completed the soil was returned to the hole and the organisms in the bucket sorted into categories of species (worm, grub, larvae etc.).

The number of different species and their populations were counted and recorded.

Limitations
Only organisms that were present at this time of year and visible to the naked eye were able to be measured in this survey.

The soil, and vegetation cover varies greatly across the property so the outcome is not expected to apply to the whole property.

Observations
There was no evidence of grass / ground cover species remaining under the loose mulch cover, these had all decomposed. There was a distinct layer of darker soil at the top 20-30mm of the hole.

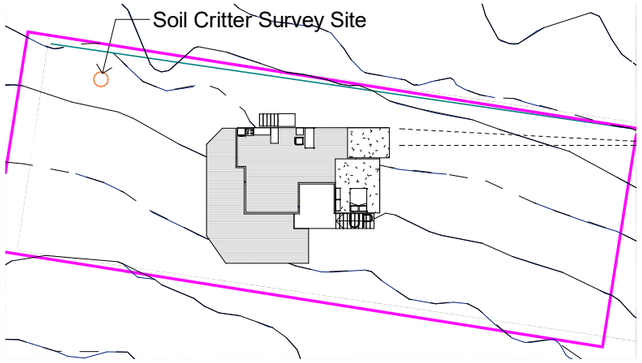
Outcome
Only one species was present, this was the New Zealand native worm, identifiable because the clitellum (the flat part of the body) is located towards one end rather than mid way along the body.

The population count was 111.

Conclusion
The presence of worms indicates the presence of organic matter in the soil, however the worm count and lack of other species was initially concerning.

The survey was done at a time when worm activity is NOT at its peak (the soil is still dry comming out of summer). On comparison the numbers of worms appears good, and shows that the soil has a good base line on which to build. The slow growth rate of vegetables in the adjacent garden bed prepared October / November 2019 directly into the soil by digging, breaking up and turning over the clods of grass. The only addition was 40L compost dug in lightly over the 3sqm garden bed. requires amendment to improve its health and biodiversity.

A follow up survey in July/August when worm activity and numbers normally peak is rcomended to validate these results and build a more rounded conclusion



Critter Count Location

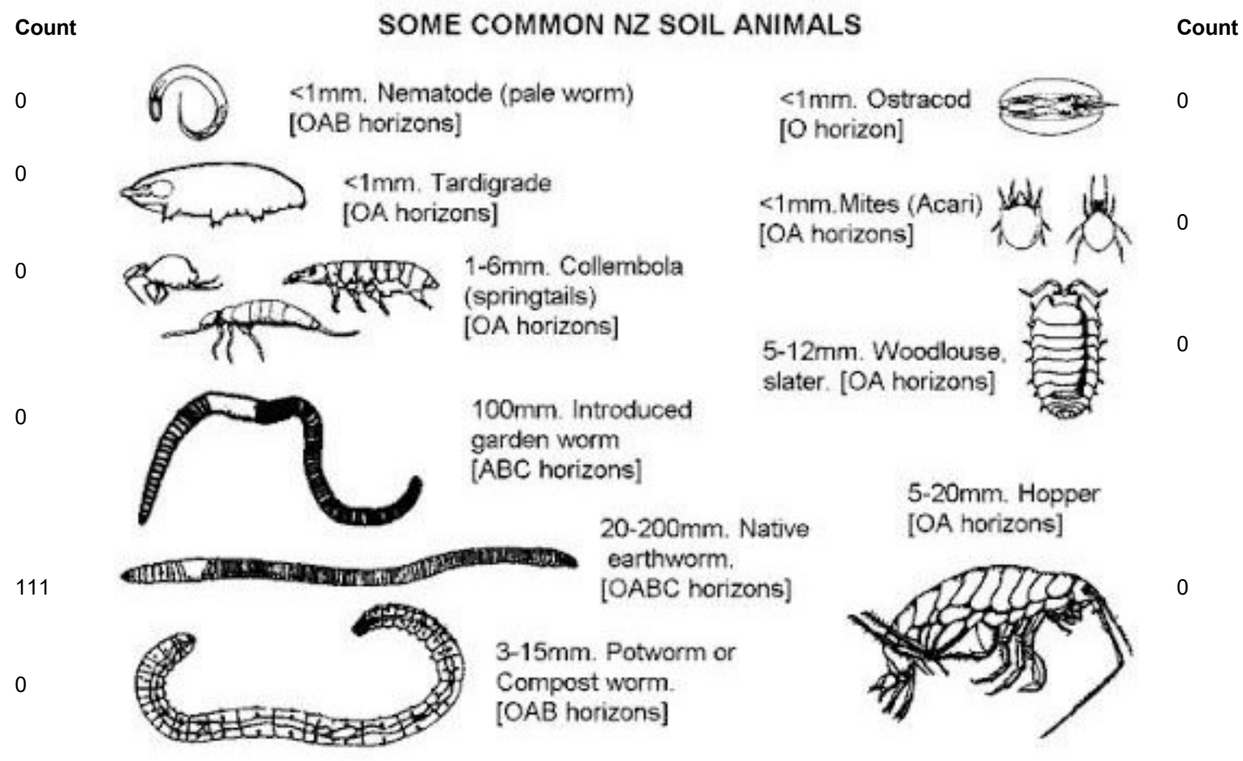
1. Digging the hole

2. Measuring the hole 500-500mm x 150-200mm deep

3. Sorting the soil

4. Collecting the critters into a bucket

5. Counting Critters



Critter Count Results

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	16/04/21	INFORMATION	
A	20/4/20	INFORMATION	

STATUS:

PROJECT:
SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS:
KAPITI COAST

DRAWING TITLE:
ECOSYSTEMS SOIL CRITTER COUNT

DRAWN	CHECKED	DATE
Author	Checker	16/04/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated
DRAWING NO.		REVISION
PDC120-G		B

EXISTING SECTOR PLAN

LEGEND

- Sun - Summer
- Sun - Winter
- Water
- Shade
- Wind
- Nutrients
- Views - Good
- Sound / noise
- Views - Screen
- Property boundary
- Community

NORTH

SCALE 1 : 300

0 3 6 9 12 15 18 21 24 27 30 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	31/03/20	INFORMATION	

STATUS:
INFORMATION

PROJECT:
SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

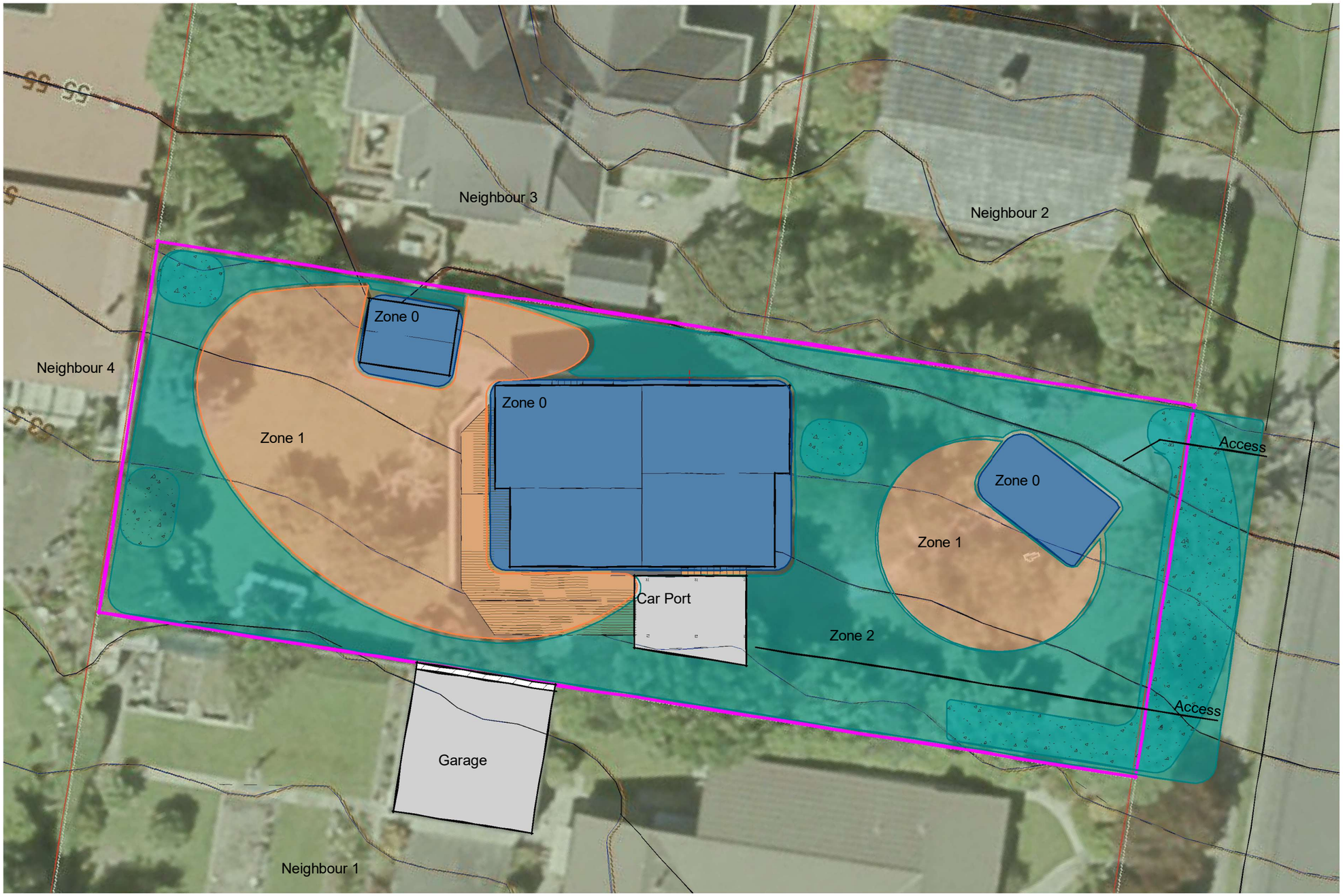
ADDRESS:
KAPITI COAST

DRAWING TITLE:
REGENERATIVE DESIGN SECTOR PLAN

DRAWN	CHECKED	DATE
RP	-	23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated

DRAWING NO.
PDC100-G

REVISION
B



Zone 5
Native bush reserve (5 mins walk)
- Wider community area off this property
- Wilderness, unmanaged, wildlife
- Forested ridge, small streams, walking tracks

Zone 4/5
Waikanae river (15 mins walk)
- Wider community area off this property
- Largely a natural ecosystem that is being restored/ small pocket of blackberries to forage on river bank

Zone 3
Paddocks and horticulture (10-15 mins walk)
- Wider community area off this property

ZONE PLAN

LEGEND

- Zone 0 Living
- Zone 1 Annual production (Garden)
- Zone 2 Perenial production (Orchard & shrubs)
- Zone 3
- Zone 5
- Zone 2 Mixed Perenial production + natives
- Zone 4
- Property boundary

NORTH

SCALE 1 : 200
0 2 4 6 8 10 12 14 16 18 20 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
B	23/03/21	INFORMATION	
A	31/03/20	INFORMATION	

STATUS:
INFORMATION

PROJECT:
SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS:
KAPITI COAST

DRAWING TITLE:
REGENERATIVE DESIGN ZONE PLAN

DRAWN	CHECKED	DATE
RP	-	23/03/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated

DRAWING NO.
PDC110-G

REVISION
B

Neighbour 3

Neighbour 2

Neighbour 4

natives kawakawa (privacy & culinary)

strawberries and herb guild as ground cover under

tamarillo in sunny sheltered corner

compost tea aeration barrel

path under wide eaves

flowering shrubs, perennial herbs and vegetables (shade tolerant)

screening hedge along fence

existing kowhai

evergreen camelias on neighbours property

espalier soft fruit along fence line

native Pittosporum hedge - flowering

future gate

evergreen kawakawa

nature strip with perennial herbs and vegetables under

1500

kerb

Chilean guava x3

perennial herbs under

feijoa x 2 screening, hebes & flower guild under

irrigation under mulch path

compost bay

perennial herbs,vege -tables & worm farm under

rain garden

passionfruit on frame

annual 1

annual 2

annual 3

annual 4

annual 5

annual 6

annual 7

annual 8

annual 9

annual 10

annual 11

annual 12

annual herbs

Shed (detached accessory building)

potting area

wildflowers & herbs

lemon worm farm under

clumping bamboo (confined)

House

more windows

less windows more shading

Deck

Car Port (detached accessory building) with wildflower roof garden

existing mahoe

pond

tamarillo

lime

hazel nuts

access

Studio 4mx4m

bike lock up

walnut

existing ngaio

existing grapefruit

existing apple

blueberries

greenhouse /coldframe

row crop berries

washing

rain garden

Shed

future gate

existing plum

clumping bamboo (confined

existing feijoa

rain garden

orange

blueberries

wildflowers & herbs

loquat

feijoa hedge

kowhai

annual wild flowers

perennial herbs and vegetables mixed with annual wild flowers under

kowhai (deciduous) nitrogen fixing, bird habitat - prune for clearance from power lines

hebes (flowering) under

2500

3000

permeable driveway

building set-back

walnut

espalier 1 deciduous fruit trees on raised mound for drainage, herb and flower guild under

Neighbour 1

Garage

shelter

kiwi vine (deciduous) over deck pergola for summer shading

'green' screening on side of carport to shade car

mulch bins

espalier 2 deciduous fruit trees, herb and flower guild under

Road

footpath shown dashed

maunka x3 & flowering hebes under (bee fodder)

N

30°

30°

studio orientated 30° W of N to achieve privacy from main house while still gaining 90% of benefit from maximise passive solar design

NORTH

PROPOSED PLAN

LEGEND

- Wind
- Water - drainage / passive irrigation in ground / under garden paths (major /minor)
- Water - hose line between tanks
- Water feature (storage pond / rain garden)
- Water tank for collection and storage (1000l)
- Water barrel for irrigation (200l)
- fruiting shrub: chilean guava etc.
- Annual production raised bed to form low terraces across slope
- Supported crop production area
- Low shrubs / herbs / perennial vegetables
- Path
- Structure Building
- Building set-back (district plan rules)

SCALE 1 : 150

0 1.5 3 4.5 6 7.5 9 10.5 12 13.5 15 m

THE TREE HOUSE

REVISION	DATE	DESCRIPTION	ISSUED
A	01/06/21	INFORMATION	

STATUS: INFORMATION

PROJECT: SUBURBAN PERMACULTURE PROPERTY RETRO-FIT

ADDRESS: KAPITI COAST

DRAWING TITLE: REGENERATIVE DESIGN PROPOSED PLAN

DRAWN	CHECKED	DATE
RP	-	01/06/21
JOB NO.	SHEET SIZE	SCALE
PDC 01	A3	As indicated

DRAWING NO. PDC301-G

REVISION A