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PERMACULTURE DESIGN
BELLEVUE, FRANCE
DESIGNER: FLORENCE GIBERT

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PERMACULTURE DESIGN

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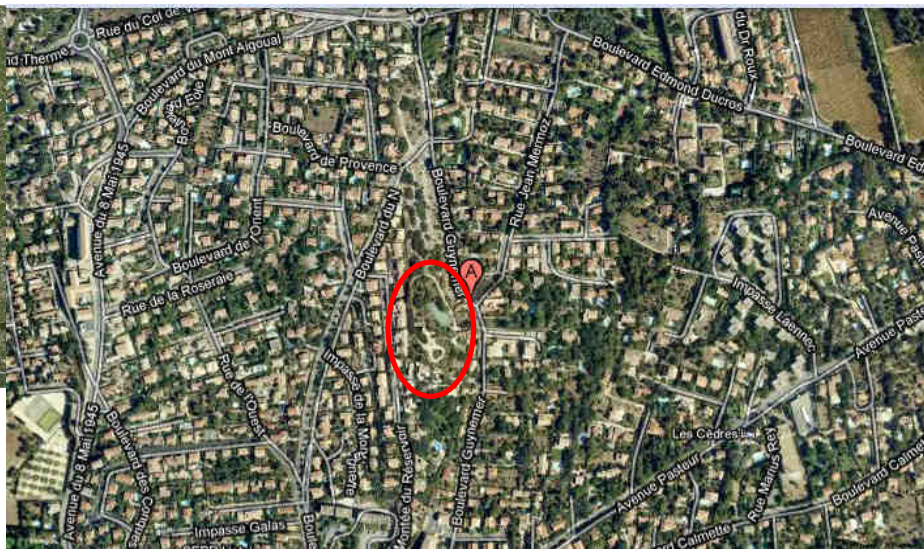
SITE ANALYSIS

SITE LOCALISATION

Address	25, bd Guynemer – 30400 Villeneuve-lès-Avignon (close to the city of Avignon) Département : Gard – Région : Provence – Country : France
Coordinates	Latitude : 43°57’42” N Longitude : 4°46’32” E
Superficy	7186 m² (1.7 acre)
Altitude	About 100 m (320 ft) above sea level (center of Villeneuve-lès-Avignon is 30 m ABSL)
Orientation	Top and eastern part of a hill going North-South.
Public access	Train to Avignon, then 15 mn bus, then 5 mn walk.



CONTEXT DESCRIPTION

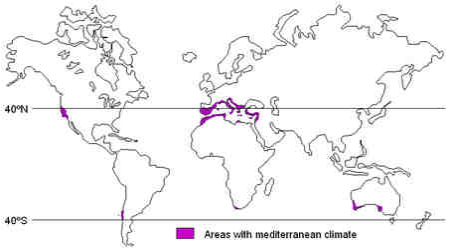
NATURAL ZONE

Ecozone /Biome

Palearctic ecozone includes mostly boreal and temperate climate ecoregions, which run across Eurasia from western Europe to the Bering Sea.

Ecoregion /Bioregion

Mediterranean forests, woodlands, and shrub is a temperate biome, characterized by hot, dry summers and mild, rainy winters.



Ecotope /Biotope

Garrigue is a type of low, soft-leaved scrubland found around the Mediterranean Basin, generally near the seacoast, where the climate is moderate, but where there are annual summer drought conditions. Garrigue is associated with calcareous plateaus (limestone and base rich) and calcium associated plants. UNEP World Conservation Monitoring Centre described it as "discontinuous bushy associations of the Mediterranean calcareous plateaus, often composed of kermes oak, lavender, thyme, and white cistus. There may be a few isolated trees." It is the typical landscape of Provence.

TOPOGRAPHY

Geology[1]

The limestone massif of the Angles and Villeneuve-les-Avignon lies on about 15 km along the left bank of the Rhone. It faces the plain of Avignon and the confluence of the Durance and Rhone. The topography is largely carved by erosion. Plains and hills follow one another, composing diversified and compartmentalized spaces.

Hydrography

Watershed: bassin versant du *Gard Rhodanien*. Superficy : 180 km². (North: Tave watershed, West: Gardon watershed, East: Rhône river) System (subdivision of *bassin versant*): Système de la *Chartreuse*

CLIMATE

The climate is characterized by warm to hot, dry summers and mild to cool, wet winters.

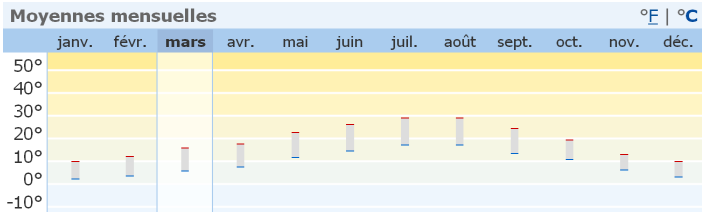
TEMPERATURES

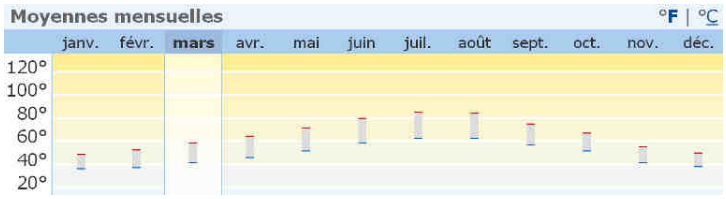
The majority of the regions with Mediterranean climates have *relatively mild winters and very warm summers*. Because most regions with a Mediterranean climate are near large bodies of water, *temperatures are generally moderate* with a comparatively small range of temperatures between the winter low and summer high. During winter, temperatures only occasionally fall below the freezing point and snow generally is seldom seen. In the summer, the temperatures range *from mild to very hot*, depending on distance from a large body of water, elevation, and latitude. Strong winds from inland desert regions can sometimes boost summer temperatures, quickly increasing the *risk of wildfires*.

Average Temperature (Years on Record: 16)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	14	5	6	10	13	16	20	23	22	19	14	9	6

Average High Temperature (Years on Record: 16)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	20	9	11	15	19	23	27	30	30	25	20	13	10

Average Low Temperature (Years on Record: 17)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	8	1	2	5	7	10	14	16	15	13	9	5	2





Highest Recorded Temperature (Years on Record: 17)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	40	19	22	24	30	36	37	38	40	38	32	25	20

Lowest Recorded Temperature (Years on Record: 17)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	-16	-7	-13	-5	-2	2	5	8	8	5	---	-7	-16

Average Number of Days Above 90F/32C (Years on Record: 16)												
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Days	---	---	---	---	---	---	4	10	10	---	---	---	---

Average Dew Point (Years on Record: 18)													
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
°C	8	1	2	4	7	10	14	15	16	13	11	5	3

Average cooling degree days	
Average heating degree days	
Date of first frost	
Date of last frost	Can be end of April

PRECIPITATION

During summer, regions of Mediterranean climate are dominated by subtropical high pressure cells, with dry sinking air capping a surface marine layer of varying humidity and making *rainfall impossible or unlikely except for the occasional thunderstorm*. During winter the polar jet stream and associated periodic storms reach into the lower latitudes of the Mediterranean zones, bringing rain, with snow at higher elevations. As a result, areas with this climate *receive almost all of their yearly rainfall during their winter season, and may go anywhere from 4 to 6 months during the summer without having any significant precipitation*.

Also, climate is characterized by the succession of intense, brutal rainfall and harsh summer dryness. Changes are very abrupt and, following a dry summer without rain, the Autumn rainfall can be torrential, of the order of several hundred mm in a few hours or days. These rainfall intensities are among the highest in France.

Average yearly rainfall: around **656 mm** (Carpentras station, 28 km) and **722 mm** (Orange station, 23 km)

Average Precipitation (Years on Record: 40)													
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
cm	61	2	3	4	5	6	4	3	4	6	8	7	5

Average Number of Rainy Days (Years on Record: 40)													
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Days	67	3	4	5	6	6	4	3	5	6	7	7	6

Average yearly snowfall:

HUMIDITY

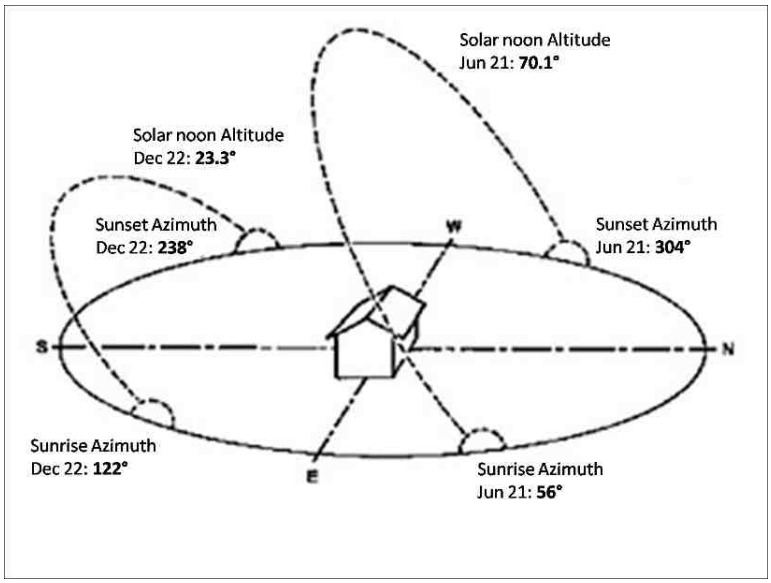
Average Humidity (Years on Record: 18)													
	YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
%	74	79	75	71	70	70	69	66	70	73	82	81	81

SUNLIGHT

Latitude	43°57’42” N (same as Boise,ID - Laconia,NH)
Sunshine	2700 to 2900 hours a year

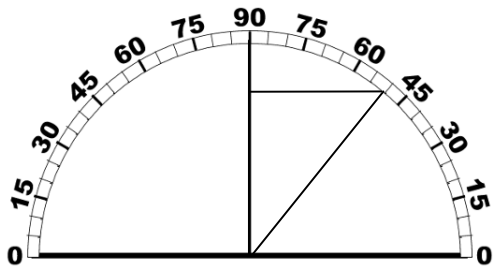
Solar path

Marseille city	Time		Azimuth		Length of day		Solar noon	
Date	Sunrise	Sunset	Sunrise	Sunset	This day	Difference	Time	Altitude
Mar 21, 2011	6:41 AM	6:51 PM	89°	271°	12h 10m 31s	+ 2m 58s	12:46 PM	46.9°
Jun 21, 2011	5:58 AM	9:22 PM	**56°**	**304°**	15h 23m 59s	+ 03s	1:40 PM	**70.1°**
Sep 23, 2011	7:26 AM	7:35 PM	89°	271°	12h 08m 39s	− 2m 55s	1:31 PM	46.7°
Dec 22, 2011	8:08 AM	5:06 PM	**122°**	**238°**	8h 58m 08s	− 01s	12:37 PM	**23.3°**



Width of the eaves

To calculate the width of the eaves, I'll use a solar noon altitude of **50°** (a bit higher than at equinoxes).



Calculation of the width of the eaves: $x = (\tan \alpha) \times h$

α = 90° - angle of the sun
h = height above the ground
x = width of the eaves

Application:
h = 3 m (≈ 10 ft) (height above the ground)
α = 40° (angle of the sun = 50°)
x = 2,5 m (8,3 ft) (width of the eaves)

Blowing from North to South along the Rhône valley, the Mistral is usually a dry wind, and its arrival almost always clears the skies and dries the air. The vegetation in Provence, which is already dry because of the small amount of rainfall, is made even drier by the wind, which makes it particularly susceptible to fires, which the wind spreads very rapidly, sometimes devastating vast expanses of mountainside before being extinguished. In the Rhone Valley and on the plain of la Crau, the regularity and force of the mistral causes the trees to grow leaning to the south. The farmers of the Rhone Valley have long planted rows of cypress trees to shelter their crops from the dry force of the mistral. The mistral can also have beneficial effects—the moving air can save crops from the spring frost, which can last until the end of April.

(rows of cypress trees to shelter the crops from the mistral)

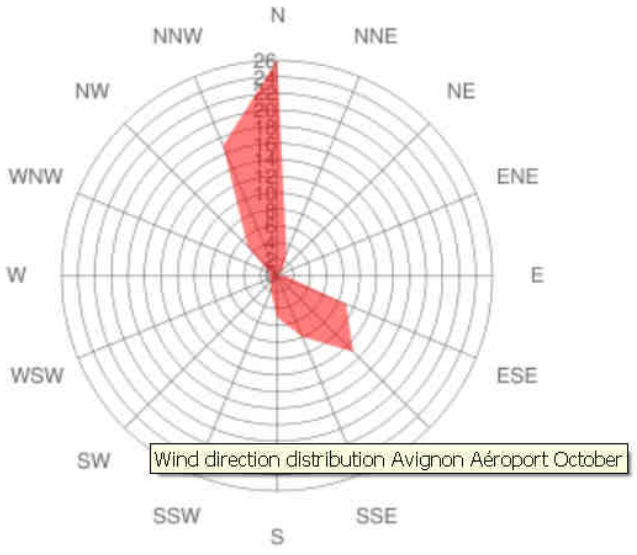
Average annual wind speed 9 knots

Predominant wind direction from North to South

Avignon Aéroport (AVIGNON)

Les statistiques basent sur les obsérvations entre 12/2008 - 4/2011 tous les jours de 7h à 19h, heure locale.

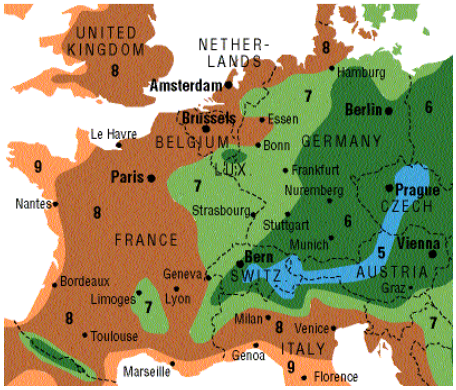
Mois	Jan 01	Fév 02	Mar 03	Avr 04	Mai 05	Juin 06	Jui 07	Aoû 08	Sep 09	Oct 10	Nov 11	Dec 12	TOT 1-12
Direction du vent dominant	↑	↑	↑	↑	↑	↖	↖	↖	↑	↑	↖	↑	↑
Probabilité du vent > = 4 Beaufort (%)	35	53	42	27	33	32	35	27	20	48	27	42	35
Vitesse du Vitesse du vent (Knots)	9	11	10	8	9	9	9	8	8	11	8	10	9
Température de l'air moyenne (°C)	6	8	12	17	20	24	28	27	22	16	12	7	16
Sélectionnez mois (Aide)	Jan	Fév	Mar	Avr	Mai	Juin	Jui	Aoû	Sep	Oct	Nov	Dec	An



PLANTING ZONE AND SEASON

Planting zone: Hardiness zone: 9

Average Annual Minimum Temperature		
°C	Zone	°F
-40 to -35	3	-40 to -30
-35 to -29	4	-30 to -20
-29 to -23	5	-20 to -10
-23 to -18	6	-10 to 0
-18 to -12	7	0 to 10
-12 to -7	8	10 to 20
-7 to -1	9	20 to 30
-1 to 5	10	30 to 40



Planting season

Climate change tendency

BIODIVERSITY

The Mediterranean basin's mosaic of Mediterranean forests, woodlands, and scrub are home to 13,000 endemic species. The Mediterranean basin is also one of the world's most endangered biogeographic regions; only 4% of the region's original vegetation remains, and human activities, including overgrazing, deforestation, and conversion of lands for pasture, agriculture, or urbanization, have degraded much of the region. Formerly the region was mostly covered with forests and woodlands, but heavy human use has reduced much of the region to the sclerophyll shrublands known as chaparral, matorral, maquis, or garrigue. Conservation International has designated the Mediterranean basin as one of the world's biodiversity hotspots.

Flora. The native vegetation of Mediterranean climate lands must be adapted *to survive long, hot summer droughts and prolonged wet periods in winter*. Much of the woody vegetation in Mediterranean-climate regions is sclerophyll ('hard-leaved' in Greek), with small, dark leaves covered with a waxy outer layer to retain moisture in the dry summer months. Much native vegetation in Mediterranean climate area valleys have been cleared for agriculture.

Examples of Mediterranean vegetation:
-Evergreen trees: Pines, Cypress, and Kermes Oaks (*Quercus coccifera)*, Holm Oaks (*Quercus ilex*), Juniper
-Deciduous trees: Sycamores, and Buckeyes
-Fruit trees: Olives, Figs, Citrus, Walnuts and Grapes
-Shrubs: Bay laurel and California laurel, Manzanitas, and Chamise
-Sub-shrubs: Sages, Artemisias, and Sagebrush
-Grasses: Grassland types, Bunchgrasses; Sedges, and Rushes
-Herbs: fragrant Rosemary, Basil, wild Thyme, and Lavender

Fauna. 103 « patrimonial species » (species that have a special interest) have been inventoried. 37 are protected, among them: the genette commune , the écureuil roux , the hérisson d'Europe , the hibou grand duc , the couleuvre à échelons, the fauvette à lunettes.

Protected Zone : The National Museum of Natural History has classified a large part of the massive and scrubland, covering a line running south-west to north-east of Villeneuve lès Avignon in ZNIEEF (Natural Area of Ecological Floral and Faunal Interest) of the second category (large natural or little modified area and that offers interesting biological and landscape potential). The extent of this ZNIEFF is 630 hectares. Vegetation consists of low scrub Kermes Oak, Juniper, Green Oak and Scorpion Genet. The Hibou Grand Duc, which is on the UICN Red list of vulnerable species, has been seen.

HUMAN

Locale[2] Discontinuous urban fabric (houses and yards). Suburbs of the city of Avignon.

Adjacent Land Uses Urban, agriculture.

With the exception of Villeneuve and The Angles agglomerations, the territory is generally and mainly agricultural, with a significant predominance of vine. There are important AOC. Other productions involve fruits and perennial crops, vegetables and field crops. Market gardening and horticulture are very efficient in the plains, thank to good soil quality, access to water and proximity to the important area of consumption which is the city.

The area is very touristic. The « Festival d'Avignon », most popular theatre festival in France, attracts many visitors each year in July.

LOCAL REGULATIONS

Zoning Land Use Designation/Ordinances[3]

Building Codes

Sewage Authority

Community Agreements Fire prevention regulations

Land Development/Deed Restrictions & Easements

Mineral Rights, Water Rights

RISKS

Threats of development

Pollution[4] None known

Disasters[5] Not on site, but within the local boundaries:
Storms: Novembre 1982
Floods: Août 2004, Décembre 2003, Novembre 2002, Septembre 2002, Janvier 1994, Octobre

1993, Juillet 1991, Août 1987, Août 1986
Landslide due to successive draught and soil rehydration: 1998, 1990

Hazards

Draughts
Wildfire (risk accentuated by the fact that aromatic plants respond to high temperatures by emitting large amounts of volatile aromatics and by the Mistral wind).
Earthquakes: zone de sismicité 1A (i.e. "very low but non negligible")
Technological risks: industrial risk, dam break, transport of dangerous goods

OPPORTUNITIES

Social community	Members of family live nearby. Organic farmers
Potential sharing/bartering[6]	
Potential Markets	Tourits, festival/summer markets, organic markets
Public open space	

SITE DESCRIPTION

Aesthetics and atmosphere[7]	Luminous, dry, noisy (cicadas, cars), windy (Mistral), thorny, recreational, family place, rocky, sloppy, residential, beautiful, vegetal, restful, built, aromatic, hot, sunny, mineral.

HISTORY

Nature[8] The wild *garrigue* is a man-formed landscape. Deforestation of the indigenous oak forest since the Late Bronze Age, for cultivation of olives, vines and grain, the introduction of sheep and especially goats and charcoal-making for heat and iron-working, exposed the land surface to weathering and resulted in erosion of the topsoil.

Land uses[9] The site was wild 80 years ago. It was used for grazing and wood collection There used to be tall oaks, which were cut during WWII. It is now residential (labeled as "discontinuous urban fabric"). It is a part-time occupied recreational place.

People[10] The Gibert family has been owning the place since 1936. They are native of the area and worked as shopkeepers in Avignon. They bought the site to live outside the town and enjoy the countryside (distance to Avignon: 3,2 km, 2 miles).

There has been a lot of human input on the site:

- Henri Gibert era (my grandfather): buying of the house and first piece of land (1943), setting up of a vegetable garden, construction of a swimming pool (1960), construction of terraces to grow vine (1963), partial flattening of the hill to make a sport court (1970). Brought a lot of soil to allow plants to grow on the rocky hill. Attempts of vine tree cultivation failed because it required more work than could be provided by Henri.

- Raymond Gibert era (my father): buying of second piece of land (1958), renovation of the house (1995), renovation of the sport court (2000),drilling of a well (2003), building of the tower (2005), construction of more terraces, bringing of more soil, plantation of trees and plants, construction of a cabin (2010).

- Raymond's children (my siblings): two of the children (Bernard and Bertrand) are helping with the garden work today.

Buildings[11] The family house was built from one part before 1943 and for another part in 1957. It was renovated and divided into three independent flats in 1995. It mainly welcomes Raymond's children and their children during summer holidays. The "medieval tower" was built in 2005 It is the lovely residence of Prince Raymond and his wife, Lady Josette.

The site was donated by Raymond and his wife to their 6 children in 2005, the couple keeping the usufruct till their death. One of the children sold his part to another, so there are now 5 persons entitled to the property at the death of the parents.

LEGAL

Status Private property.

Land Use Capability[12] Residential.

SECTORS

Views[13] Due to the hilly shape of the site, the view is 360°.
The view is nicer eastward (Mont Ventoux).

(View toward the Mont Ventoux)

Sun[14] From the South (site is in Northern hemisphere). 2700 to 2900 hours of sunshine a year (Miami, FL: 2400) In winter, a neighboring house is shadowing eastern part of house.

Water[15] No run-off water coming from a neighboring site (site is top of hill).
Run-off water goes off-site eastward and westward.

Wind[16] From North to South. Can be very strong (yearly average: 9 knots, 35% of time above 4 on Beaufort scale (= Moderate breeze, 13–17 mph)

Wildlife corridors[17]

Upstream/upwind issues	None
Visual, Auditive, Olfactive[18]	Car engine noise
Soil, Air, Water Contamination[19]	None
Electrical Pollutions[20]	None

TOPOGRAPHY

Hills and valleys	Site is on top and Eastern part of a hill going North-South. West part is top of the hill, East part is downhill.
Keylines and keypoints	
Slopes[21]	North of site: gentle slope. Middle of site: 10m cliff South of site: 4 terraces.
Elevation (highest and lowest points)	10 m (33 ft) between the bottom and the top of the property.

SOIL

Texture[22]	
Thickness	Soil is very thin. Rock is showing on the surface in some parts. Earth has been brought for terraces and plantations.
Acidity (ph)	
Nutrients availability[23]	
Drainage/absorption rate[24]	
Degradations[25]	Erosion in some places.
Potential building material	No
Potential obstructions	

WATER

Springs, wells	**Well** Depth: 75 m (246 ft); Flow: 35 000 liters (1 183 840 fl oz or 9 100 US Gallons) an hour; Quality: potable water; Sustainability: unknown.
Streams, ponds	None
Rainwater run-off, drainage	Total roof area: 144 m², water not harvested. Sport court made of a permeable material which does not allow water collection
Flood plain	None

Bogs, marshes	None
Swales, ditches	None

SUN

Sunny spots	Almost everywhere
Microclimates	The southern terraces, the cliff North to the sport court, the garden by the house
Thermal belt	The southern terraces
Solar gain/reflexion	The sport court, the swimming pool, the white tiled terrace
Shadowy spots	The lower southern terrace, the cliff East to the sport court in the afternoons
Frost pocket	same

AIR

Airflows

FLORA

(See annex: Plant chart)
Mainly low-rooted vegetation due to the thinness of soil

Wild	Yes: oaks, thyme, lavender…
Vegetable Garden	No
Ornamental	Yes
Crops	No
Stages of succession	Wild parts: Mature; Managed parts: young or in process

Edible plants	14 olive-trees ☞ 10-15 liters (507 fl oz) of olive oil per year 2 fig-trees 1 almond-tree Pine-trees Aromatic herbs: lavender, rosemary, sage, thyme Wild asparagus

FAUNA

Wildlife	Cicadas, ants, worms, spiders, butterflies, caterpillars, hedgehogs, squirrels… Have disappeared: locusts, grass snakes, mosquitoes
Domestic	Cats and dogs of the neighborhood
Trails and territory	

ECOSYSTEMS

Ecosystem loop[26]

Edges Yes, e.g.: wind/no wind ; rock/brought soil

STRUCTURES

Houses	1 house with three independent parts, area: 124m² (x 1 floor) 1 tower, area: 19,6 m² (210 ft²) (x 2 floors) septic tank under the house, not used any more
Barns/Greenhouses/Outbuildings	One garage, one workshop, both adjacent to the house One cellar under the swimming pool
Recreational	Swimming pool: area 27 m², volume 27 m3 (= 27 000 l.) Sport court: area 15 x 30 m (450 m²) approximately
Sacred places[27]	The 'Memory cave' will be dedicated to the memory of Raymond and his wife.
Footpaths and roads	One path suitable for motor vehicles goes uphill. Woods.
Gardens/fields/pastures/woods	Vegetable garden, terraces.
Underground water network	Water is brought from the well and uphill by a submerged electric pump (380 volts)
Fences, Walls, Ruins, Bridges	None
Windbreaks (natural or planted)	None

SERVICES

Energy	**Electricity**	From grid
	Gaz	None
Drinking water	**House**	From grid
	Tower	From grid
Other water	**Garden taps**	From site (well)

	Swimming pool	From site (well)
Used water[28]	**Rainwater**	To municipal sewage system
	Grey water	To municipal sewage system
	Black water	To municipal sewage system
	Swimming pool water	To municipal sewage system
Garbage[29]	**Organic**	To municipal waste management system
	Recyclable	To municipal waste management system
	Non recyclable	To municipal waste management system
	Toxic	To municipal waste management system
Food transformation		None

CONCLUSION

EVALUATION OF NATURAL RESOURCES AND ENERGY SYSTEMS USE

Current use

At present, the site does not make most of its potential.

As for the **inputs**, apart from the water provided by the well which is used for the plants and the swimming pool, the site is highly dependent on off-site resources:

- Water for drinking, cooking and sanitary use (shower, toilets, washing machine, dish-washer).

- Energy for heating the air and the water, cooking, pumping the well's water, lighting and running appliances (all these functions are powered by electricity)

- Food, apart from a little of olive oil production (transformation is processed off-site)

As for the **outputs**, all wastes are left to the municipal care. Organic matters and dead vegetal material are not used for compost and soil production (mainly because it would create a fire hazard).

The **swimming-pool** is maintained cleaned with a filtration system run by an electric-pump-powered filter and with chlorine.

Few **plants** are edible. Some terraces are not planted. Some places have too poor a soil to be planted.

There is no protection from the **wind**.

Sun, wind and rainwater are not harvested.

Recommendations

In an objective of resilience, the site should produce sufficient energy and food to cover minimum needs.

EVALUATION OF EXISTING DESIGN

Current design

The **family house** has good orientation and design: the long side facing South, with working rooms (garage, workshop) at the north side. Unfortunately, it is not well insulated: walls are cinder-blocks; two of the three living-rooms are single-glazed verandas. The house is electric-dependant for all its devices (except doors opening). The place is hardly visited in wintertime because it is difficult and expensive to heat.

The roof is in flat baked clay tiles, which is a great material for rainwater harvesting.

Recommendations

The house should be better insulated and produce some of its energy. Another solution could be to build a new dwelling house, using bioclimatic conception and insulating materials to make it passive (which is possible at this latitude of 43°N). The old house would then become a place for various activities.

SWOT MATRIX

	Positive	**Negative**
On-site	**Strengths**	**Weaknesses**
	Well provides water Nice view Charming stone tower Recreational places: pool and sport court Four independent habitations Different sun exposure Different wind exposure Slope can allow water collection Sun can allow energy production Wind can allow energy production 360° orientation Mediterranean agreeable climate Multiple terraces Mature trees Cliff allows vertical garden Sun reflection: pool, sport court, tiled terrace House roof material allowing rainwater harvesting Lovely spots hidden in tree bushes Owner motivated to improve the place Italian garden Some fruit trees Path suitable for motor vehicles goes uphill Latitude makes it possible to build a passive house	Thin soil Violent wind Regular summer draughts Noisy (cars) Fire hazards Grid dependant for energy and drinkable water Too many people involved to make a decision Sport court mobilize an important area Far from main residence (Paris): 687 km, 426 miles) Non-permanent occupation Strong desire from the owner to keep with existing structures because of high working input and family history

Off-site	**Opportunities** *(recommendations)*	**Constraints**
	Relatives live nearby Site reachable by public transport Services are nearby (shops, schools…) Competent people are available nearby Neighboring properties protect from intrusions Highly tourist attractive region may provide visitors/clients Good quality food available nearby High cultural life nearby	Urban nuisances (engine motor noise) Urban regulations (e.g. may prevent from building windmill, from lighting fires…)

RECOMMENDATIONS

To improve the resilience of the place as well as serve a demonstration purpose, the following improvements of the site should be achieved:

Water: The area faces regular draughts. Water is - and will even be more in a near future - a critical issue. Therefore, even if municipal water is available and if a well can provide for non drinkable water, water harvesting and conservation techniques are to be set up. Rainwater should be collected and stored by all means to serve as back-up, and also as educational purpose for the neighborhood.

Energy: Even if the site is connected to the grid, wind and sun should be harvested to produce energy. This will allow to save money and to improve resilience. All the more as wind and sun are both abundantly available in this very sunny and windy area.

Dwelling: Because most energy on a dwelling is spent on heating and cooling it, all the more in this hot area, a passive house, using bioclimatic techniques (localization, orientation, material, design…) should be build in order to have no further needs of energy to heat, nor to cool the house. Such energy passivity is possible to achieving at this latitude. The old house can be better insulated and dedicated for various activities.

Food: The site is not situated in the rich alluvial Rhone valley plain, but on top of a limestone massif hill. The soil is so thin that rock outcrops. Food will be difficult to produce on site and at the same time, it is available off-site abundantly and in good quality. Focus will therefore not be made on food production. Nevertheless, to achieve a minimum of resilience purpose, soil should be improved and more edible plants planted. A Mediterranean food forest should be tried to be set up. THis will require bringing soil.

Education: Neighboring people face the same situation of draught, leading to high water and air conditioning consumption. There may be in a near future water and energy restrictions. The site should tend to be an example for the neighborhood in both water harvesting and collection and in passive housing. The urban localization of the site is turned into an opportunity to be a demonstration and training site for people wishing to improve their resilience.

Recreation: As a Gibert family gathering place, the place should stay beautiful and recreational: tower, tennis, swimming pool, petanque court, old house for varied activities, new house on stilt, etc. It is a place for the family to gather and to rest and the children to play.

PERMACULTURE DESIGN

VISION

List

To improve the resilience of the place as well as serve a demonstration purpose:

1. Focus on water catchment and storage and on passive housing.

→ Rainwater should be collected through swales and roofs and stored for use during summer draughts.

→ A passive house should be built that would not need energy to warm or cool the air.

2. Better food and energy security.

→ Wind and sun should be harvested to produce energy.

→ Soil should be improved and more edible plants planted.

3. Education in sustainability living for the neighborhood.

The place should serve as a demonstration site for solutions to two issues faced by people living in the area: water shortages and heat waves.

Symbol

In addition: **a recreational place for the family to gather**.

Convivialité, loisir, détente, retraite, tranquillité, méditation, sécurité
Histoire familiale, retour aux racines, mémoire, paternel, hommage
Retrouvaille, partagé, investi par les enfants

PROGRAM

Functions and needs for 5 people full time on site.

SHELTER NEEDS

For people A family of 5.

For activities Food transformation, workshops and permaculture trainings

For animals Chicken pen

WATER NEEDS

ITEM	# liters	# times	# users	TOTALS		
				per week	per month	per year
Kitchen		**per week**				
Dringking/Cooking	10	7	1	70 l.	280 l.	3920 l.
Hand dish washing	5	7	1	35 l.	140 l.	1960 l.
Machine dish washing	20	5	1	100 l.	400 l.	5600 l.
Bathroom		**per week**				
Faucet washing	2	7	5	70 l.	280 l.	3920 l.
Showering	35	6	5	1050 l.	4200 l.	58800 l.
Bathing	150	1	5	750 l.	3000 l.	42000 l.
Machine cloth washing	200	1	1	200 l.	800 l.	11200 l.
Toilet flushing	7	0	0	0 l.	0 l.	0 l.
Garden		**per year**				
Plants	50 000	1	1	50000 l.	200000 l.	2800000 l.
Animals	100	1	1	100 l.	400 l.	5600 l.
Swimming pool	27 000	1	1	27000 l.	108000 l.	1512000 l.
TOTAL					**317220 l.**	**4441080 l.**
					31,7 m3	**444,1 m3**

FOOD NEEDS

People For 5 persons: 2100 Kcal/person/day

Animals For 5 chicken : xx kg/year

ELECTRICITY NEEDS

APPLIANCE #	POWER	USE	TOTALS		
			per day	per month	per year
Air cooling	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Air heating	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Boiler	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Ceiling bulb	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Coffe machine	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Desk lamp	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Desktop	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Dishwasher	watts	hour per week	0 kW/h	0 kW/h	0 kW/h
Fan	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Food processor	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Freezer	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Hi-Fi	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Iron	watts	hour per week	0 kW/h	0 kW/h	0 kW/h
Laptop	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Microwave	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Oven	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Recharge of electronic devices	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Refrigerator	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Television	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Vacuum cleaner	watts	hour per week	0 kW/h	0 kW/h	0 kW/h
Washing machine	watts	hour per week	0 kW/h	0 kW/h	0 kW/h
Water heating	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
Water pumping	watts	hour per day	0 kW/h	0 kW/h	0 kW/h
TOTAL			**0 kW/h**	**0 kW/h**	**0 kW/h**

OTHER ENERGY NEEDS

	Need	Possible solution
Cooking	xx Joules	Gaz, biogaz
Refrigeration	xx Joules	Cellar in the cliff
Air heating	xx Joules	Passive house, geothermal
Air cooling	xx Joules	Passive house, geothermal
Water heating	xx Joules	Solar thermal system
Transportation	Yes	Biogaz

ECONOMICAL NEEDS

What is free, can be shared, bartered?	Tools and seeds.	Shared
	Products.	Bartered
	Children education	Free
	Clothes	Free
What is to pay/buy?	Taxes	xx euros
	Complementary food	xx euros
	Complementary energy,	xx euros
	Cultural products	xx euros
	Transportation out of the city	xx euros
	Telephone	xx euros
	Internet	xx euros
Accessible markets	Organic markets, summer markets	
Products/skills that can be source of cash	*Goods*: Provence herbs, olive oil, honey, jam.	xx euros
	Services: hosting people during the Avignon Festival	xx euros
	offering trainings in permaculture, designing landscapes.	xx euros

SOCIAL NEEDS

Well being	Feeling of security, protection from nuisances
Interactions	With family, friends, neighbors
Learning	
Culture and leisure	
Childcare and education	

	Problem	Possible solution
Biodiversity	Biodiversity has dramatically decreased probably with the use of pesticides by suburban gardeners and nearby farmers.	Host pollinators and small animals by planting adequate plants
Soil building	The soil is very thin, and in some parts inexistent: the rock is showing on the surface.	Build the soil. Maybe even bring soil of agricultural quality (humus) in the places dedicated to the forest garden and the vegetable garden.
Erosion prevention	In the sloppy places, the rock is showing on the surface.	Swales will help restore the soil. They will also collect water.
Protection against		
Intrusions	No: the site is surrounded by other properties, only the gate is bordering the street. The northern fence adjoins a piece of unused land.	
Fire	Yes: there is an important fire hazard. This is why local regulations ask for annual removal of dead vegetal materials. Fortunately, the path going uphill is making a firebreak since it borders the site on the North and the fire, pushed by the wind, should come from the North.	Remove dead vegetation
Noise	Yes: engines of cars in the street.	Insulation of the house
Pest control	No.	

ELEMENTS OF DESIGN

SHELTER

Passive housing is one of the objectives for both resilience and demonstration purpose. A passive house is built according to bioclimatic principles and doesn't need external energy to be heated during winter nor cooled during summer.

Check-list for a passive house:

Building structure	
Situation	The new house will be build at the North part of what is now the sport court. Opportunity is taken from the cliff which will protect the house from the wind. If the house is partly buried in the hill, this will allow moderation of temperature. Also, when the winter sun will reflect on the sport court to the house.
Orientation	The house is facing South
Material	Earthship (tires filed with earth)? Wood and straw?
Building features	
Solar roof	Yes
Solar chimney	Yes
Trombe wall/bow window	Yes
Insulated windows	Yes
Thermical mass	Yes
Rocket stove	Yes
Eaves	Yes
Pergola+deciduous vine	Yes
Deciduous vine on walls	Yes
Additional features	
Greenhouse	No
Shadehouse	Yes, on the top level

The house is on two levels: the lower level is at the level of the sport court and the future vegetable garden, the upper level is at the level of the top of the hill.

The existing house is a weatherized as much as possible (double glazed windows) and is converted into a workshop place for activities like transplanting, food processing and conservation, permaculture teaching.

WATER

Should the well dry out or its water become improper to use, rainwater is collected and stored for a back-up purpose as well as a demonstration one.

The water needed for the site functioning is 444 m3 (see Program).

WATER COLLECTION

Water will be collected from roofs of all structures: the old house, the new house, the tower. It will also be collected through swales dug in the slopes.

Water could be collected from the sport court, provided it is covered with an impervious material, which is not the case at the moment.

Catchment needed

Water requiered per year	444	m3
Rainfall	0,7	m/year
Area needed	**634,3**	m²

Catchment available

Roof catchments	**runoff coef**	**superficie**	**yearly rainfall**	**catchment per year**	**Item**
Asphalt shingle roof	0,90	100 m²	0,7 m	63,00 m3	new house
Sheet metal	0,95	0 m²	0,7 m	0,00 m3	
Cement tile	0,65	20 m²	0,7 m	9,10 m3	tower
Clay tile (machine made)	0,35	124 m²	0,7 m	30,38 m3	old house
Clay tile (hand-made)	0,30	0 m²	0,7 m	0,00 m3	
Ground catchments	**runoff coef**	**superficie**	**yearly rainfall**	**total per year**	**Item**
Asphaltic	0,85	0 m²	0,7 m	0,00 m3	
Concrete	0,90	20 m²	0,7 m	12,60 m3	tiled terrace
Brick	0,80	0 m²	0,7 m	0,00 m3	
Concrete-lined	0,75	0 m²	0,7 m	0,00 m3	
Compacted dirt	0,60	0 m²	0,7 m	0,00 m3	
Cement soil mix	0,35	0 m²	0,7 m	0,00 m3	
Gravel yard	0,35	0 m²	0,7 m	0,00 m3	
Buried plastic sheet	0,35	0 m²	0,7 m	0,00 m3	
Compacted loess soil	0,15	0 m²	0,7 m	0,00 m3	
TOTAL catchment		**264 m²**		**115,08 m3**	

If the site had to rely only on rainwater, the catchment area should be multiplied by three.

WATER STORAGE

The rainwater collected will be stored in polyethylene tanks for use during summer draughts.

Water consumption per month	31 m3
Longest period of time between good falls of rain	2 months
Water that needs to be stored	**62 m3**
Tanks capacity	20 m3
Number of tanks	**3,1 tanks**

Water of the well is also stored:

- In the swimming pool
- In the energy storage system uphill.

The pool serves both a leisure and storage purpose in case of long summer drought. A plan filtration system is set up to clean the water. Plants to filter the water are… To protect the water from evaporation, nenuphar, laitue d'eau, jacinthe d'eau are planted in the pool.

FOOD

VEGETAL FOOD PRODUCTION

The site is not ideal for plant growing: the soil is very shallow and the rock is showing on the surface on some parts. The soil has to be built and even good soil has to be brought.

Food is grown in different places:

- Vegetable garden: South of the new house, on half of the sport court.
- Herb garden: North of the new house
- Vertical garden: cliff
- Forest garden: Southern terraces
- Crop culture: South of the Tower

VEGETABLE GARDEN

SPRING AND SUMMER

VEGETABLE


Ail


Artichaut


Aubergine


Bette


Chicorée


Chou brocoli


Cornichon


Courgette


Echalote


Fève


Haricot


Melon

Petit pois


Piment


Poivron


Pomme de terre


Radis


Tomate

SMALL FRUITS


Cassissier


Fraisier


Framboisier


Groseillier à grappes

AUTOMN AND WINTER

VEGETABLE


Betterave


Carotte


Céleri branche


Céleri-rave


Chou Cabus


Chou de Bruxelles


Chou de Milan


Chou fleur


Endive


Epinard


Mâche


Navet


Poireau

SMALL FRUITS


Fraisier remontant


Framboisier remontant

Ail (garlic)
Allium sativum

Aneth (dill)
Anethum graveolens

Basilic (basil)
Ocimum basilicum

Ciboulette (chives)
Allium schoenoprasum

Fenouil (fennel)
Foeniculum vulgare

Marjolaine (marjoram)
Origanum majorana

Persil (parsley)
Petrosilenum crispum

Romarin (rosemary)
Rosmarinus officinalis

Sauge (sage)
Salvia officinalis

Thym(thyme)
Thymus vulgaris

VERTICAL GARDEN

A vertical garden is set up on the cliff, hosting edible vines like kiwi. The cliff is in the shadow in late afternoon.

FOREST GARDEN

A forest garden is a way of growing edible plants on the seven layers of a forest: canopy, small trees, shrubs, herbaceous, ground cover, roots and vines. A Mediterranean forest garden has to be designed with plants that support the Mediterranean climate, i.e. wet winters and dry summers. This forest garden is planted on the southern part of the site, both on top of the hill and on the terraces that go downhill. Gravity will help for irrigation.

The Southern terraces offer a range of different microclimates since they are protected from the wind. The lower terrace is humid and shadowy.

If needed, the Northern part of the site could be turned into terraces. There is a slope of xx° going down eastward. The soil is very shallow there. Concrete low walls could be constructed parallel to the contour line and good soil brought from off-site. To protect the terraces from the wind, fences of bamboo grown on-site would be set up.

See annex for the list of species.

Example of one forest garden guild: the olive tree

CROP CULTURE

A cereal is to be grown on site, and this could the **Petit Epeautre (*triticum monococcum*)** (**Einkorn wheat** in English). Einkorn wheat was one of the earliest cultivated forms of wheat, alongside emmer wheat (*T. dicoccum*). Grains of wild einkorn have been found in Epi-Paleolithic sites of the Fertile Crescent. It was first domesticated approximately 7500 BCE (7050 BCE ≈ 9000 BP). Its cultivation decreased in the Bronze Age because slower to grow and gave less yield than other varieties). Today, it is a relict crop that is rarely planted. It remains as a local crop, often for bulgur (cracked wheat) or as animal feed, in mountainous areas of France, Morocco, the former Yugoslavia, Turkey and other countries.

Einkorn wheat often survives on poor soils where other species of wheat fail. It needs little water and no fertilizer nor pesticides. In addition, this cereal has a very high energetic and caloric yield: 100 grams bring the daily necessary quantity of proteins.

There is one drawback though: Einkorn wheat impoverishes the soil and it is necessary, after one year of culture, to grow other crops for a couple of years, like chickpeas, lentils, lavender. Maybe the technique of Fukuoka could make it possible to grow Einkorn wheat each year?

ANIMAL FOOD PRODUCTION

Apiary

Bee hives could be set up on the site.

Poultry

Chicken or ducks are necessary for manure and for the cereal production.

Aquaculture

Aquaculture could be set up in the pool.

FOOD TRANSFORMATION

Honey making, transformation of olives in oil... The tools necessary for this should be shared with other sites.

FOOD CONSERVATION

Each type of food should have a proper way of being stored, like drying, canning, transformation in jam…

Food is stored in the cellar under the pool.

ENERGY

The site needs an input of xx kWh electricity yearly (see program).

Even if the site is connected to the grid, electricity will be produced onsite as a back-up. It is better to have several systems, each one being a back-up for the others. Windmill production is given priority over photovoltaic panels since the later are not ecological.

WINDMILL PRODUCTION

The site is proper to wind taping with a yearly average speed of 9 knots (4,63 m/s). Windmills can be set up at the very North of the site, where the wind blows without interference. A local installer estimates for this speed a yearly production of 2 325 kWh with a windmill powering 2 kW and of 11 820 kWh with a windmill powering 10 kW.

PHOTOVOLTAIC PRODUCTION

The roof of the old house can provide for 3x 20m² for photovoltaic panels installation.

Panel power per m²	0,145	kWc
Exploitable area of panel	60	m²
Sunshine in the area	1284	kWh / kWc
Annual production estimation	**11 171**	kWh/an

(with optimal orientation and inclination)

RETURN ON INVESTMENT

A =	Installation cost	euros
B =	Savings on buying electricity from the grid	euros/year
	+ Benefits on selling overproduction to the grid	euros/year
A/B =	**Amortization period**	**years**

ENERGY STORAGE

The energy produced is stored in the grid when not needed: it is sold to the electricity company.

Batteries are used as a back-up for the grid.

Ultimate energy storage is through water storage: water is pumped uphill when the energy is produced. When electricity is needed at a time when it cannot be produced, the stored water is released and runs a microhydroelectric generator by gravity. This storage of water is also a backup of water (e.g. for irrigation). This is not a very efficient system: a microhydroelectric generator produces 300 watts when 5 liters of water fall by 10 meters each second. Therefore, 9 m3 (2377 gallons) need to be stored to produce the energy for one 75 watts light bulbs to run for two hours.

WASTE

Organic A compost pile is set up where it is more humid, i.e. at the bottom of the cliff, between the pool and the sport court.

Non organic Non organic waste and recyclable waste are left to municipal collection.

Grey waters Grey waters (wastewater with no human wastes) are treated through a grey water system (depuration by plants) which is set up South of the new house, West of the vegetable garden. Therefore, the waters coming from the house can be used to water the garden.

Black waters Black waters (wastewater with urine and feces) are not produced since instead of flushing toilets, nutrient recycling toilets are set up in both the new and old houses. Two systems can be used: composting toilet (transformation of feces and urine in compost) and separation toilets (for separate use of urine and feces).

ECONOMICAL AND SOCIAL ACTIVITIES

GOODS

Many good products are produced in the region: olive oil, herbs (lavender, thyme, rosemary…), so it is difficult to compete, especially with the site small size. [Map of local production]

SERVICES

The site is close to Avignon, where a very famous theatre festival takes place every year. This attracts a lot of tourists and could be an opportunity of economic activity like hosting people and hosting plays.

Also, the site could take advantage of its permaculture design to be a demonstration and training site in permaculture design, passive house design, recycling (plastics, paper is turned into bricks that can be burnt, glass is recycled into countertops…), bicycle repair… All these workshops will take place in the old house.

ECOLOGICAL SERVICES

SOIL BUILDING

Soil has to be built in most parts where plants have to grow. For this, techniques like compost fabrication and spreading, as well as “lasagna” mulching, will be used.

POLLINATOR ATTRACTION

Flowers are planted on the top of the hill, North of the Tower, in order to attract butterflies and insects.

SOLAR GAIN/PROTECTION

Solar protection will be sought on the vegetable garden. Plants will have to be protected from the harsh noon summer sun with screens.

EROSION PREVENTION

Erosion is avoided as much as possible with soil covering. Where erosion has already taken place, soil is build with different techniques like mulching and swales digging.

WIND PROTECTION

Wherever needed, protection from the wind is achieved with trees and windshield of bamboo grown onsite.

FIRE PREVENTION AND PROTECTION

There is a legal requirement to clear bushes in order to avoid fire propagation. This could be done with goats hired from a breeder. Maybe there will be no need as the land will be covered only with proper plants.

PRINCIPLES

Relative location	The passive house is located in a sun trap. The vegetable garden is next to the house and can benefit from its grey waters The herb spiral is at the kitchen level at the upper level of the house
Each element performs many functions	Some plants produce food and attract pollinators and enrich the soil. The swimming pool is used for recreation and water storage.
Each important functions is supported by many elements	Electricity: the grid, windmills, solar panels. Water: the grid, the well, rainwater collection through roofs and swales Food: onsite production of various elements (vegetable, cereals, herbs, oil, fruits) and local markets
Efficient energy planning/zoning	The vegetable garden is next to the house. The plants on the terraces are watered by gravity irrigation.
Using biological resources	The wind is harvested to produce electricity. Organic wastes, humanure, vegetal wastes are used to build the soil.
Energy cycling	Organic wastes are recycled to compost. Animal manure and green manure are turned into the earth. Greywaters flows to the garden.
Small-scale intensive systems	The whole site produces a lot on a small scale (7186 m² - 1.7 acre)
Accelerating succession & evolution	The forest garden will eventually reach maturity.
Diversity	Various types of food are produced (vegetable, cereals, herbs, oil, fruits). Energy is produced through different systems.
Edge effects	
Attitudinal principles	The wind is turned into an opportunity: energy production.

ZONING

The zoning depends on the frequency of care for each element.

Zone 0 The house, or home centre. Here permaculture principles would be applied in terms of aiming to reduce energy and water needs, harnessing natural resources such as sunlight, and generally creating a harmonious, sustainable environment in which to live, work and relax.	the new house
Zone 1 The zone nearest to the house, the location for those elements in the system that require frequent attention, or that need to be visited often, such as salad crops, herb plants, soft fruit like strawberries or raspberries, greenhouse and cold frames, propagation area, worm compost bin for kitchen waste, and so on.	the vegetable garden the plant filtration system
Zone 2 This area is used for siting perennial plants that require less frequent maintenance, such as occasional weed control (preferably through natural methods such as spot-mulching) or pruning, including currant bushes and orchards. This would also be a good place for beehives, larger scale home composting bins, and so on.	the forest garden the herb garden the vertical garden the pool if aquaculture

Zone 3 The area where maincrops are grown, both for domestic use and for trade purposes. After establishment, care and maintenance required are fairly minimal (provided mulches and similar things are used), such as watering or weed control once a week or so.	the insect garden the flower garden in the old house
Zone 4 A semi-wild area. This zone is mainly used for forage and collecting wild food as well as timber production. An example might be coppice-managed woodland.	the crop culture
Zone 5 A wild area. There is no human intervention in zone 5 apart from the observation of natural eco-systems and cycles. Here is where the most important lessons of the first permaculture principle of working with, rather than against, nature are learned.	the woods

Other part of the hill

The other part of the hill is unused land, property of the municipality. Maybe the city would agree to its use for a permaculture project. This would double the area.

Part A: actual site.
Part B: unused land belonging to the municipality.
Part C: public garden.

RELATIONS BETWEEN ELEMENTS

NUTRIENT CYCLING

Nutrient pulled from the earth by vegetable are returned to the earth through composting of kitchen scraps (compost pile) and composting of human wastes (nutrient cycling toilets). Vegetal wastes are also composted.

WATER CYCLING

The water collected onsite goes eventually to the site underground: water pumped from the well or collected from the rain is used to water the gardens, greywaters are cleaned and used to water gardens.

ENERGY CYCLING

The site produces a good part of the energy used.

IMPLEMENTATION

TOOLS AND SKILLS NEEDED

SCHEDULE OF IMPLEMENTATION

YEARLY ORGANIZATION

Spring

Summer

Fall

Winter

CONCLUSION ON THE STUDY

METHODOLOGY

How has the design been influenced by the routine **observation?**
How have **opportunities** been taken advantage of? (e.g. existing microclimates and/or created ones; existing slopes, aspects; existing thermal belt, ridges; ponds)
How have **constraints** been moderated? (e.g. steep slopes, cold sink conditions, erosion, wind).
How have **social & economic principles** been incorporated into the design? (e.g. neighborhood LETS system)

PERSONAL FEELING

As this was my first permaculture design, I learnt a lot about the methodology of this technique. I spent much of the time gathering tools for future designs.

Because I couldn't go the place, I had to gather second-hand information and make up for missing information. This turned out to be very difficult, even to prevent any design. Nothing can make for on-site observation.

I learnt that it is very important to spend a lot of time in observation and research. Not only because this is necessary to design the more suitable system, but also because this will give ideas and reveal solutions for the design.

ANNEXES

SOURCES

BOOKS

Introduction to Permaculture, by Bill Mollison and Reny Mia Slay.

Mollison, Bill, and Reny Mia. Slay. *Introduction to Permaculture*. 2nd ed. Tasmania: Tagari, 2009. Print.

Gaia's Garden: A Guide to Home-Scale Permaculture, by Toby Hemenway, 2nd Edition.

The Transition Handbook: From Oil Dependency to Local Resilience by Rob Hopkins.

Toolbox for Sustainable City Living by Scott Kellogg and Stacy Pettigrew.

Un jardin (presque) sans eau by Michèle & Jean-Claude Lamontagne, Rustica éditions

WEBSITES

Maps

Maps (allows visualization of cadastral map on physical map) http://www.geoportail.fr

Cadastral maps (only useful for superficies calculations) http://www.cadastre.gouv.fr

Administrative data http://www.annuaire-mairie.fr

Natural risks http://www.prim.net

Climate data

Temperature, rainfall and sunshine data http://www.weatherbase.com

http://climat.meteofrance.com/chgt_climat2/climat_france?73928.path=climatnormales%252FFRANCE

Wind http://fr.windfinder.com/windstats/windstatistic_avignon_aeroport.htm

To order wind profile https://public.meteofrance.com/public/plateforme_donnespubliques

> *Back-up sites: Temperature and rainfall charts*
> *http://meteo.msn.com/monthly_averages.aspx?wealocations=wc:8523053&q=Villeneuve-l%C3%A8s-Avignon%2c+Gard+forecast:averagesm*
> *http://www.holidaycheck.fr/climate-wetter_Villeneuve+l%C3%A8s+Avignon-ebene_oid-id_10205.html*

Solar data

All solar calculations http://www.timeanddate.com/worldclock/city.html?n=195

Designing Shading Overhangs with Google SketchUp http://www.sketchup.com/

Latitude and longitude of US cities (to see what places receive equivalent sunshine)
http://www.realestate3d.com/gps/latlong.htm

Backup sites
Sunset and sunrise times calculator
http://fr.weather.com/climate/sunRiseSunSet-Villeneuve-l%C3%A8s-Avignon-FRXX1163
http://www.srrb.noaa.gov/highlights/sunrise/sunrise.html
Solar position calculator
http://www.srrb.noaa.gov/highlights/sunrise/azel.html
http://www.jgiesen.de/SolsticeAzimuth/index.html

Plants

Data-base of plants in Europe http://eunis.eea.europa.eu

French botanique network http://www.tela-botanica.org/

Chrologie (liste des taxons avec nom latin et nom vernaculaire) par département

http://www.tela-botanica.org/page:chorologie_carte?format=html&module=chorologie&action=acces_par_carte

Plant for a Future (gives Edible, Medicinal and other uses of over 7,000 plants http://www.pfaf.org

Housing

Resources for passive houses http://www.builditsolar.com

Plans of houses http://www.builditsolar.com/Projects/SolarHomes/plansps.htm

Plans for sale http://www.sunplans.com/select/plan/__details/Atrium

Energy

Energy needs calculation http://www.energies-nouvelles.net

Calcul rendement panneau PV http://www.energies-nouvelles.net/outil-calcul-rendement-panneau-photovoltaique-4.html

PERSONS

(…)

MAPS

EXISTING CONDITIONS

Base Map

On white paper and at appropriate scale, the Base Map shows the site's existing conditions.

It indicates:	**It follow the rules**:
• fences, buildings, patios, decks, septic systems, • gardens, trees, fields, shrubs, ponds, creeks, wells, • roads, driveways, sidewalks, • drainage, utility poles, underground utility lines, • vehicle/pedestrian traffic flow, wildlife corridor, • microclimates, wind direction (winter and summer) • features of adjoining properties that affect the property (wind, breaks, shade, slope run-off)	All text to read is in one direction Trees are drawn to scale at full maturity North arrow and Wind arrow are apparent Contour lines or slope arrow (pointing down) Section Cut Arrow Scale Elevation and size of site

Sector Diagram
On tracing paper centered on your house/site, the Sector Diagram depicts external factors:

• Sun exposure (summer and winter sunrise and sunset)
• Winds exposure (cold winter winds, summer breezes)
• Flooding risk
• Fire risk
• Intrusion risk
• Views (good and bad)
• Wildlife Corridors

Layer analysis
On tracing paper, overlays fitting the Base Map show the following:

• SOIL: Nature of the soil
• WATER: Existence of Water on the ground : underground water web, points of access to water, pools and ponds, springs, wells, taps and drainpipres, monthly and yearly rainfall
• SUN: Exposition to sun, microclimates, ombre portée l'hiver
• VEGETATION: trees are darker than herb layer
• WIND AND FIRE: spots fire-prone, spots exposed to/protected from wind
• ZONES: Existing zones 1 to 5 if any.

The layers show their information in color, without repeating the contours that are on the base map (or they are made on copies of the basemap on drawing paper, but this does not allow overlapping the layers for information crossing). They show with shaded tones what is productive/ok and what is not productive/we want to change. When different heights are shown (e.g. layers in the vegetation), the higher the darker.

Site Profile

On drawing paper, at the same scale as the base map, the Site Profile shows all existing site features in profile (house, slope, creek...).

PERMACULTURE PROJECT

Permaculture Design Plan

On drawing paper, the Permaculture Design Plan is a color map which shows all elements of the design. It uses the same conventions as the Base Map.

Proposed Zone Map

On tracing paper, the Proposed Zone Map is an overlay fitting the Permaculture Design Plan and showing the new 1 to 5 zones.

Proposed Site Profile

On tracing paper, the Proposed Site Profile is an overlay fitting the Site Profile. It show anything added which shows up in profile (pond, dam, swale, forest, etc.), in addition to what was existing.

MEDITERRANEAN FOREST GARDEN

French	English	Latin	Type	Light preference	Soil preference	Tolerances	Weaknesses	Human use	Animal uses	Site regulation uses	Problems	On site
			1A-Tall deciduous tree	full sun	alkaline soil	soil pollution tolerant	fears drought	edible	Wildlife habitat	biomass production (mulch)	invasive	
			1B-Tall evergreen tree	partial shade	acid soil	air pollution tolerant	fears cold	tea, seasoning, spice	Poultry forage	Soil stabilization (ground cover)	toxic	
			2A-Small deciduous tree	shade	sand	drought tolerant	fears humidity	medicinal	Other animal forage or browse	Nutrient accumulation	allelopathic	
			2B-Small evergreen tree		bog	salt tolerant		crafting	honey bees	Nitrogen fixation	thorny	
			3-Shrub		water	pioneer		fire wood		beneficial insect attraction		
			4A-herbaceous perennial		siliceous soil	wind tolerant		Poles		insect pest repulsion		
			4B-herbaceous biennial		deep soil	poor soil tolerant		ebenisterie		Hedgerow/windbreak		

			4C-herbaceous annual		nitrogen	grazing golerant				shadow casting		
			6-Root		rocky							
			7A-Deciduous climber									
			7B-Evergreen climber									
			7C-Annual climber									
Abricotier			1A-Tall deciduous tree	full sun	deep soil		fears drought	edible	honey bees	beneficial insect attraction		x
Agave			3-Shrubs					medicinal			thorny	
Ail		allium spp	4A-herbaceous perennial					tea, seasoning, spice				
Amandier	almond tree	prunus dulcis	1A-Tall deciduous tree	full sun	deep soil	poor soil tolerant		edible (amande), wood (furniture)		beneficial insect attraction (mellifère, early spring), late leaves (no shadow during spring), early flowers (attract insect)		1 almond-tree
Aneth	Dill	*Anethum graveolens*	4C-herbaceous					tea, seasoning, spice	honey bees			

			annual									
Arbousier		Arbutus unedo	2A-Small deciduous tree	full sun	alkaline soil	drought tolerant		edible	honey bees			
Aristoloche			7C-Annual climber							shadow casting	toxic	
Asperge sauvage	Wild asparagus		4A-herbaceous perennial									oui
Aubépine		crataegus	1A-Tall deciduous tree	partial shade	alkaline soil	grazing golerant		ebenisterie	honey bees		thorny	
Basilic	Basil	*Ocimum basilicum*	4C-herbaceous annual					tea, seasoning, spice				
Caroubier			3-Shrubs					edible		N-fixer, med use (children diarrhea), edible seeds (chocolate taste), forage		
Cerfeuil	Cherv il	*Anthriscus cereifolium*	4C-herbaceous annual					tea, seasoning, spice				
Chêne vert	green oak	quercus ilex	1B-Tall evergreen tree	full sun	whatever soil	drought tolerant		wood, edible (gland, var. macrocarpa)				x
Chèvrefeuille			7B-Evergreen climber									

Ciboulette	Chives	*Allium schoenoprassum*	4A-herbaceous perennial					tea, seasoning, spice			can be grown as annual	
Clématite		clematis cirrhosa	7A-Deciduous climber						honey bees	shadow casting	toxic	
Cognassier	quince	*Cydonia oblonga*	2A-Small deciduous tree					edible				
Coriandre	Coriander	*Coriadrum sativum*	4C-herbaceous annual					tea, seasoning, spice	honey bees			
Estragon	Tarragon	*Artemisia dracunculus*	4C-herbaceous annual					tea, seasoning, spice				
Fenouil			6-Root					edible tea, seasoning, spice				
Feuille de cari	Curry Leaf	*Murraya koenigii*	4A-herbaceous perennial					tea, seasoning, spice				
Fève			4C-herbaceous annual			poor soil tolerant, drought tolerant		edible	honey bees	Nitrogen fixation		
Figuier	fig tree	ficus carica	2A-Small deciduous tree	full sun, partial shade	whatever soil	drought tolerant	fears cold	edible (fig), latex (sap)		shadow casting		2 fig-trees
Figuier de		*Opuntia ficus-indica*	3-Shrubs					edible			thorny	

Barbarie												
Genévrier		*Juniperus oxyicedrus*	3-Shrubs					tea, seasoning, spice				
Glycine	wisteria		7A-Deciduous climber						honey bees	shadow casting Nitrogen fixation		
Grenadier			2A-Small deciduous tree					edible				
Hysope	Hyssop	*Hyssopus officinalis*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Jujubier			2A-Small deciduous tree					edible			thorny	
Kiwi			7A-Deciduous climber					edible medicinal				
Laurier rose												x
Laurier sauce	Bay Leaf	Laurus nobilis	3-Shrub					tea, seasoning, spice				
Laurier tin												x
Lavande	lavender		3-Shrubs	full sun	alkaline soil	drought tolerant		medicinal		beneficial insect attraction		
Lentisque	Pistacia lentiscus		**small tree**					edible				
Lierre			7B-Evergreen							shadow casting	toxic	

			climber							beneficial insect attraction		
Lilas												x
Lupin	lupine	lupinus spp	4A-herbaceous perennial					edible		Nutrient accumulation Nitrogen fixation		
Luzerne arborescente			3-Shrubs		rocky soils				honey bees	Nitrogen fixation		
Marjolaine	Marjoram	*Origanum majorana*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Mélisse	Lemon Balm	*Melissa officinalis*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Menthe	Mint	*Mentha spicata*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Mimosas			2A-Small deciduous tree	full sun, partial shade					honey bees	Nitrogen fixation		
Mûriers d'Espagne												x
Myrte	Myrtle	*Myrtus communis*	3-Shrub					tea, seasoning, spice				
Néflier du Japon			1A-Tall deciduous tree	?								
Olivier	olive	olea	1B-Tall	full	what	droug	fears	olive (fruit and	forage	soil		14 olive-trees: 10-

	tree	neuropea	evergreen tree	sun	ever soil	ht tolera nt, wind tolera nt	humidity	oil), wood (furnitures and small artefacts), lighting (oil), heating (grignon)	(grignon=re main from olive)	enrichment (grignon)		15 liters (507 fl oz) of olive oil per year
Origan	Orega no	*Origanum vulgaris*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Ortie			4A-herbaceous perennial		nitro gen			edible medicinal			toxic	
Palmier phénix			1B-Tall evergreen tree							shadow casting		
Pêcher			1A-Tall deciduous tree	full sun	dee p soil		fears drought	edible	honey bees	beneficial insect attraction		
Persil	Parsle y	*Petroselinu m crispum*	4A-herbaceous perennial					tea, seasoning, spice				
Pin parasol		pinus pinea	1B-Tall evergreen tree	full sun	silic eous soil			fruit (pignon) wood (menuiserie et charpente),		shadow casting, needles and pommes can be used for cover of ground	acid needles wich do not degrade easily	x
Pois			7C-Annual climber							shadow casting Nitrogen fixation		
Pois chiche			4C-herbaceous annual			poor soil tolera nt, droug ht tolera		edible	honey bees	Nitrogen fixation		

						nt						
Réglisse			4A-herbaceous perennial	shade	deep soil			tea, seasoning, spice		biomass production (mulch) Nitrogen fixation		
Romarin	rosemar	Rosmarinus officinalis	3-Shrubs					tea, seasoning, spice	honey bees			oui
Roquette			4C-herbaceous annual					edible				
Rose trémière			4B-herbaceous biennial						honey bees	Nutrient accumulation		
Salsepareille	prickly ivy	smilax	7B-Evergreen climber					edible medicinal		shadow casting Nitrogen fixation		
Salsifi			**6-Root**					edible				oui
Sarriette	Savory	*Satureja montana, satureja hortensis*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			
Sauge	Sage	*Salvia officinalis*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			oui
Sésame			4C-herbaceous annual					tea, seasoning, spice				
Thym	Thyme	*Thymus vulgaris*	4A-herbaceous perennial					tea, seasoning, spice	honey bees			oui
Tournesol			4C-herbaceous annual					tea, seasoning, spice		beneficial insect attraction		

Verveine	Lemon Vervain	*Lippia citriodora*	4A-herbaceous perennial					tea, seasoning, spice	honey bees				
Vigne	vine		7A-Deciduous climber					edible	honey bees	shadow casting			

Notes

[1] E.g. valley, ridge, plain
[2] E.g. city, town, suburbs, countryside
[3] E.g. yard setbacks, parking
[4] Stewardship, abuse
[5] E.g. fire, flood, hurricane, tornado, drought, contamination
[6] E.g. people, business, plants/seeds, biomass, timber, mulch
[7] E.g. beautiful, ugly, peaceful, sanctuary, hostile, fearful, wasted, sad, fun…
[8] Original native vegetation, virgin wildlife habitat type, topography
[9] E.g. residential, cropped, pasture, logged, graded, wetland
[10] E.g. native tribe, colon, invadors
[11] Use, historical significance
[12] E.g. wilderness, agriculture, residential, mining, lumber, hunting
[13] Good and bad
[14] Direction (north or south), azimuth of sunrise and sunset, elevation at noon, number of hours a year.
[15] Run-off coming from off-site and to off-site
[16] Direction and strength during summer and winter
[17] E.g. deer paths, bluebird trail.
[18] E.g. road traffic, airplane flight path, rifle range
[19] E.g. pesticides, factory emissions, acid rains, toxic farm runoff
[20] E.g. power lines, transmission boxes.
[21] Direction and gradient: gentle, medium, steep
[22] Proportions of sand, silt, clay.
[23] C, H, O, N, S, P, L, Ca, Mg, trace elements
[24] Percolation test: observation of how quickly a known volume of water dissipates into the subsoil of a drilled hole of known surface area
[25] E.g. lack of organic matter, contamination, compaction, acidification, salinisation, erosion, desertification.
[26] Ecosystem loop: e.g. fungi->plant->caterpillar->frog->snake->haws->fungi
[27] E.g. springs, groves, old tree. Use your 6th sense.
[28] E.g. septic, municipal, composting. Where does the sewage go?
[29] E.g. municipal, composting, recycling. Where does the garbage go?