Level 1
Site Assessment

Prepared for:	Shawn and Christine [redacted]
Site:	[redacted] Family Homestead
	[redacted]
	Templeton, CA 93465
Site Visit Date(s):	11/19/2021

Prepared by:

7th Generation Design

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Executive Summary

7th Generation Design was invited by Shawn and Christine [redacted] to visit and conduct an assessment of the 10 acre [redacted] Family Homestead (PFH) located in Templeton, CA. The predominant property features include:

- An easterly-facing portion of a secondary ridge, extending from a location below the main ridge to the road at the primary valley bottom along its length and from the crown of the primary ridge to the bordering secondary valley across its width.
- Temperatures with typical highs between 70-95℉ and lows between 30-55℉, with an average of 800-1200 chilling hours (<45℉) per year.
- Average rainfall of 17.55 inches per year, with approximately 4.76 million gallons of water landing on the property per average rain year.
- High solar exposure, with an average solar insolation level of 6.3 kWh/m^2/day (compared to that of Death Valley, CA at 6.4 kWh/m2/day, and Fairbanks, AK at 3.1 kWh/m2/day).
- Monthly average winds that range from 2 to 6 mph, blowing predominantly from the southwest during the spring and summer and from the southeast during the fall and winter.
- Loam and clay-loam soils with moderate to high fragility, moderate permeability, and moderate to rapid runoff potential.
- Approximately 6,000 sq-ft of structures (including a Main Residence, Garage ADU, Tiny House, Barn, and small storage buildings) and 13,400 sq-ft of hardscape.
- Largely open pasture areas comprised of European annual grasses, with a few stands of oak trees.
- Approximately 5,500 feet of perimeter and internal fencing for animal exclusion comprised of a mix of woven, mesh, and barbed wire.
- Wired alternating current (AC) electrical supply from the neighboring power lines, net-metered roof-mounted solar photovoltaic array, and on-site propane tank.

The [redacted] family homestead has tremendous potential to create a drought-proofed, abundant and beautiful sanctuary that will provide for this generation and those to come. The following opportunities identified for further investigation as part of a whole-site design process include:

- Consider installing a passive water harvesting and drainage earthworks system in the Food Forest and Lower Pastures to slow the estimated 1-3 millions gallons of surface runoff that is currently leaving the property during every average rain year, spread it out along the drier ridges, and infiltrate it into the soils. Further detail on this system can be found in 2.1 - Recommendations for Providing Hydration and 2.2 - Recommendations for Moving Things.
- Consider recommissioning the water storage tanks in order to provide a buffer of stored water in the event of well pump failure. Well water can be pumped to the water tanks and then supplied via gravity to the various end-use spigots on property. Further detail can be found in 2.1 - Recommendations for Providing Hydration and 7.2 - Recommendations for Moving Things.

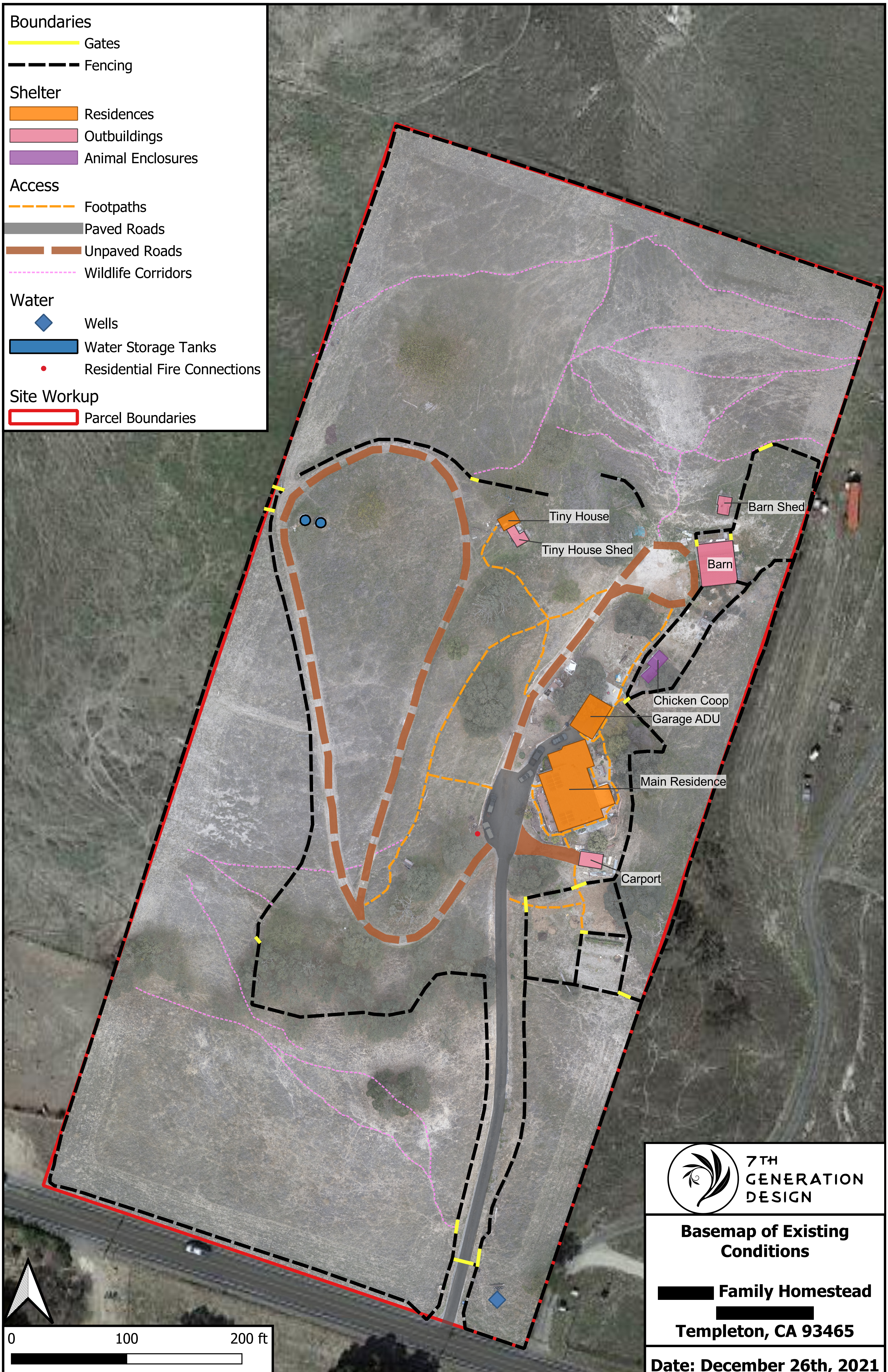
- Consider planting deciduous vegetation to shade human shelters from the sun during the summer time and allow the sun to pass through and warm them during the winter time. Further detail can be found in 4.1 - Recommendations for Sheltering Individuals and Families and 5.5 - Recommendations for Shade Plantings.
- Consider focusing food production as close to the Main Residence as possible. Annual vegetables and herbs and high-value fruit shrubs and trees just outside frequently-used doors and along perimeter footpaths, perennial fruit and nut trees in Food Forest just below Main Residence.
- Consider planting evergreen vegetation along fencelines where there is a view sector from neighbors and passing vehicles in order to provide privacy. Further detail can be found in 5.4 - Recommendations for Privacy Screens.
- Consider reforesting areas outside of the Main Property Hub and other productive zones with a diverse assembly of climate-appropriate (temperature- and drought-tolerant, fire-resistant) plants of varying size and root depth (trees, shrubs, perennial grasses) to prevent erosion and retain soil, prevent runoff and rehydrate the landscape, and prevent devastation from natural fire cycles. Depending upon landowner goals, this could range from a low-maintenance native forestry system to an economically-valuable agroforestry system that integrates food-producing vegetative elements with intensively-managed livestock.

Report Organization

This report is largely organized according to the Keyline Scale of Permanence, presented in order from things human beings are least able to change down to those things that we have greater agency with.

Climate and Geography > Water> Access > Shelter>Living Systems>Boundaries>Energy>Economy

Each of the main chapters of the report begins with a contextual summary and general overview of the topic at hand (i.e. Water) and the general principles employed in its design and implementation when creating resilient and regenerative systems (i.e. Principles of Regenerative Hydrology, Hydrological Cycle Overview etc). Each chapter is then broken out into sections which are defined by ***function*** (i.e. Providing Hydration, Moving Things, Moderating Climate, Providing Re-Creation in the case of Water)*.* Each of these chapter sections then details existing site conditions and lists specific ***element*** recommendations (i.e. swales, infiltration basins etc) designed to serve that *primary function*, with links to other report sections detailing additional functions (i.e. tree establishment) performed by that element.



Boundaries
Gates
Fencing
Shelter
Residences
Outbuildings
Animal Enclosures
Access
Footpaths
Paved Roads
Unpaved Roads
Wildlife Corridors
Water
Wells
Water Storage Tanks
Residential Fire Connections
Site Workup
Parcel Boundaries
Tiny House
Tiny House Shed
Barn Shed
Barn
Chicken Coop
Garage ADU
Main Residence
Carport
0
100
200 ft
7TH GENERATION DESIGN
Basemap of Existing Conditions
[redacted] Family Homestead
[redacted]
Templeton, CA 93465
Date: December 26th, 2021

1. Site Work Up

1.1 General Site Information

Client(s): Shawn and Christine [redacted] - [redacted] Family Homestead

Address: [redacted], Templeton, CA 93465

Parcel Number: [redacted]

Area: 10 acres

Latitude: 35° [redacted]"

Longitude: -120° [redacted]"

Altitude: 1,090 - 1,325

Proximity to Ocean: 15.3 miles

Figure 1.1.1
Satellite image of [redacted] Family Homestead

Figure 1.1.2
Parcel map of [redacted] Family Homestead - #5 on map. (APN# [redacted])

Image removed from sample report to ensure owner privacy.

1.2 Topography

Topography describes the variation in elevation across a landscape. Topographic maps use contour lines to show the shape of the earth's surface in addition to the geographic features included on typical maps, including roads, railroads, rivers, streams, lakes, buildings, built-up areas, boundaries, place or feature names, mountains, elevations, survey control points, vegetation types, and much more.

A contour line joins points of equal height. Contours make it possible to show the height and shape of mountains, depths of the ocean bottom, and steepness of slopes. Basically, contours are imaginary lines that join points of equal elevation on the surface of the land above or below a reference surface, usually mean sea level.

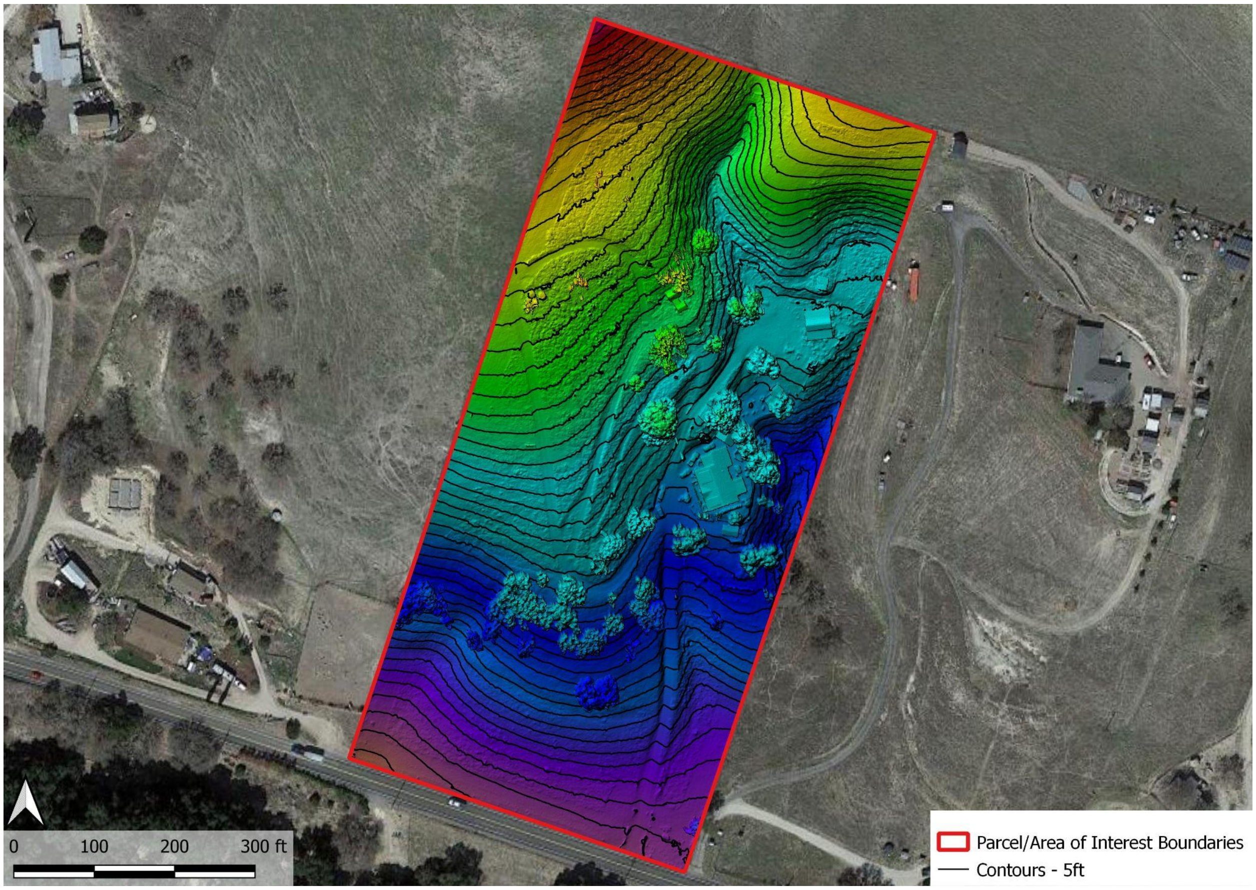
Figure 1.2.1 presents the high level topographical map for [redacted] Family Homestead and the surrounding properties in the Paloma Creek Salinas River Watershed.

Figure 1.2.1
High-level topographical map of [redacted] Family Homestead and surrounding properties.

Image removed from sample report to ensure owner privacy.

The [redacted] Family Homestead lies on a portion of a secondary ridge, extending from a location below the main ridge to the road at the primary valley bottom along its length and from the crown of the primary ridge to the bordering secondary valley across its width. Figure 1.2.2 below shows the PFH property with 5 foot contours underlain with a colorized digital elevation model showing relative elevation change across the property.

Figure 1.2.2
Topography of PFH, with 5 ft contour lines and a colorized digital elevation model showing relative elevation change across the property



1.3 Climate

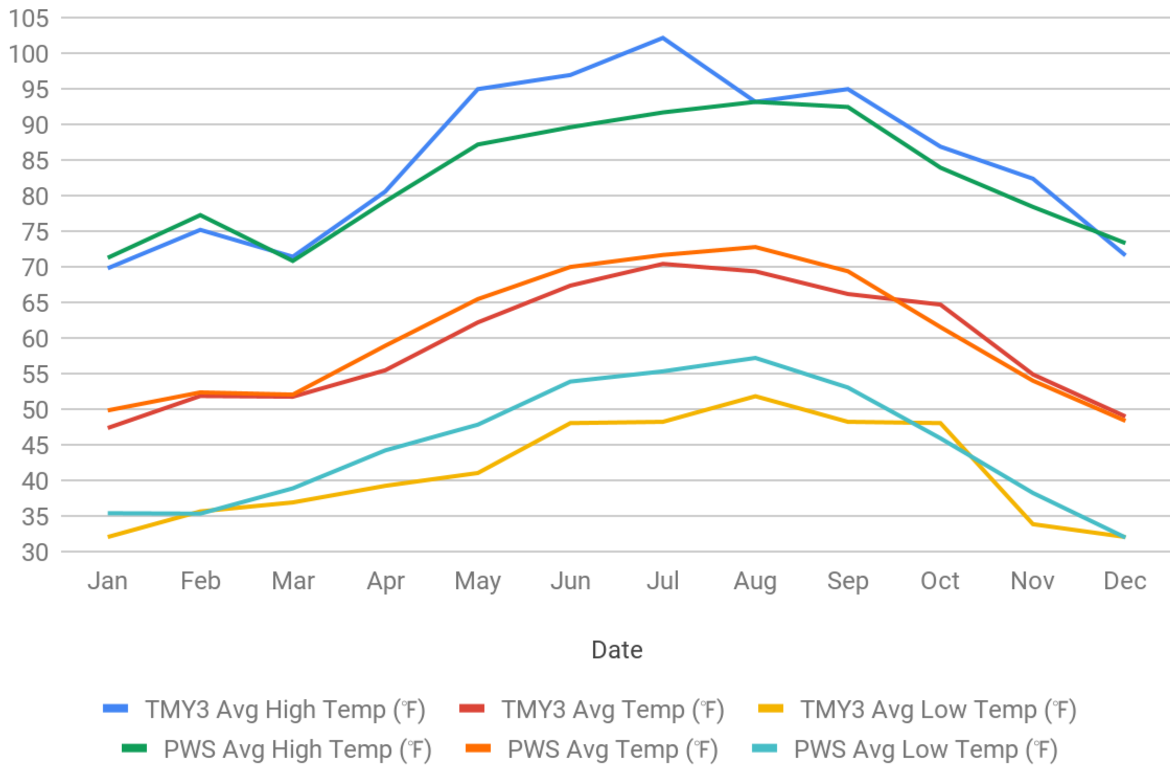
Temperature Data

The closest weather station to PFH with real-time temperature data is the **Wunderground Personal Weather Station (PWS) KCAATASC83**[1], located approximately 1.9 miles away.

PWS KCAATASC83 has also recorded historical daily high, average, and low temperature data since February of 2020. While the PWS data provides helpful insight into recent local temperature trends, it likely does not represent the long-term averages for the location, also known as typical meteorological year (TMY) data. The closest weather station with TMY data, compiled with hourly measurements from 1991-2020, is the Paso Robles Municipal Airport - KPRB, located 11 miles north of PFH. The PWS and KPRB TMY monthly high, average, and low temperature data for a typical meteorological year is shown in Figure 1.3.1.

[1] https://www.wunderground.com/dashboard/pws/KCAATASC83

Figure 1.3.1
Monthly high, average, and low temperature data for the period of 2/2/20-11/30/21 at Wunderground PWS KCAATASC83 (located 1.9 miles away from PFH) and and a typical meteorological year at Paso Robles Municipal Airport (located 11 miles away from PFH).



This data indicates that, as compared to a TMY at KPRB, PWS KCAATASC83 recently saw:

- lower monthly average highs by 5-10℉ during the late spring and early summer, with similar monthly average highs during the fall and winter months,
- similar monthly average temperatures throughout the year,
- higher monthly average lows by 5-7℉ during the spring and summer, with similar monthly average lows during the winter.

The more moderate climate at the PWS is likely due to its closer proximity to the ocean and Cuesta pass as compared to KPRB. These same trends are likely present at PFH.

The record low temperature on record at KPRB is 8℉, measured in December of 1990; the record high temperature is 115℉, measured in July of 1961.

Chilling Hours

Deciduous fruit trees, which lose their leaves in the fall and are dormant throughout the winter, need to accumulate a minimum number of hours below 45℉ during their dormancy in order to set fruit the following year. Knowing the approximate amount of chilling hours an area experiences throughout the cold season enables better selection of fruit trees that are likely to do well in that area.

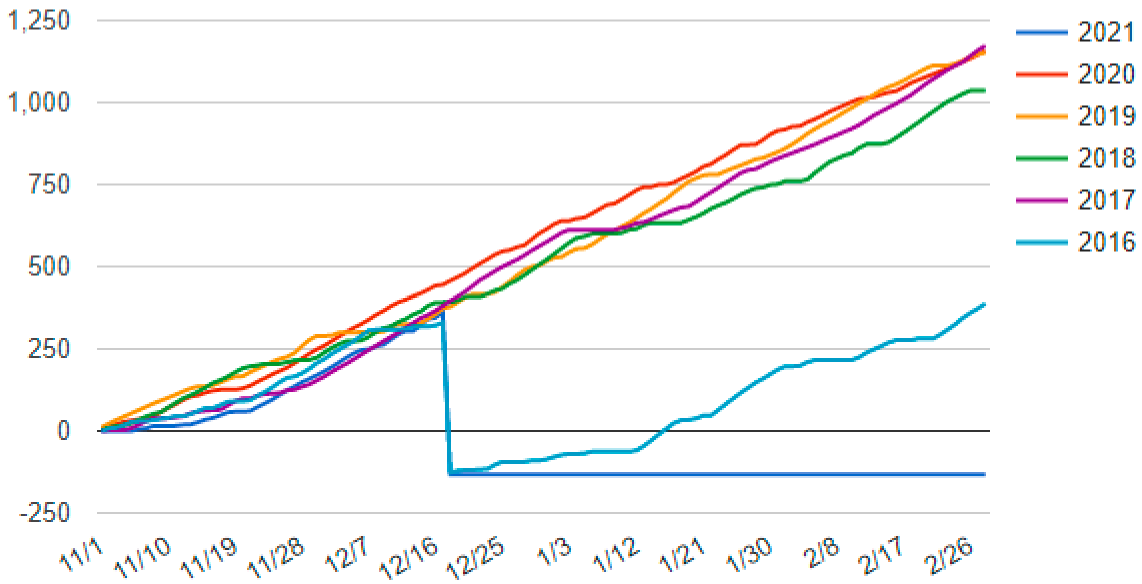
In what is called the *Below 45℉ Model*, chilling hours are the total number of hours below 45℉ accumulated between November 1st and February 28th. A typical meteorological year at Paso Robles Municipal Airport, 11 miles north of PFH, sees **808 hours** below 45℉ during the chill hour window. The CIMIS weather station in Atascadero, CA (approximately 3 miles southwest of PFH) saw **1,152** hours below 45℉ during the 2020-2021 chill hour window. Since the historical weather data for PWS KCAATASCA83 is only available on a daily basis, the total chill hours recorded in the past year at that location are unknown.

While the [redacted] Family Homestead is located in a very similar geographical and topographical context as the CIMIS weather station in Atascadero, the chill hours may nonetheless vary. Chilling hours can vary significantly even across the same piece of land; low spots, frost pockets, slopes and wind tunnels or wind buffered areas will all experience different chill hours. The best way to know for a specific site, especially before undertaking any capital-intensive agroforestry project, is to install temperature data loggers on-site and record hourly data during a winter season. However, on cold days and nights valuable information can be gained simply by walking up and down slopes with some bare skin exposed so that you can sense where a thermocline - a thin but distinct layer in the atmosphere in which temperature changes more rapidly with depth than it does in the layers above or below - might persist. Often, the difference in 10 feet of vertical elevation will make the difference between a citrus tree thriving or dying. Knowing these invisible lines in the landscape will inform better decisions about which types of plants will do best where.

Figure 1.3.2 below presents the cumulative chill hours for the past 5 years of dormant seasons at the CIMIS weather station in Atascadero, useful in comparing the range of chilling hours and trend in recent years.

Figure 1.3.2

Six-year cumulative chilling hour data for the CIMIS weather station in Atascadero (3 miles southwest of PFH).



When it comes to fruit tree selection, making selections for staple tree crops with a chilling hours buffer is suggested. For this site, trees that require **800** chilling hours are recommended. While it can be fun to push the boundaries for select plantings, for your staple tree crops staying within this range will create the greatest chance for successful harvests year after year. For additional learning on chill hour calculation models and their use (and limitations) in selecting appropriate tree varietals, visit the University of California's Agriculture & Natural Resource Center's Fruit & Nut Research & Information Center[2].

Precipitation and Groundwater Data

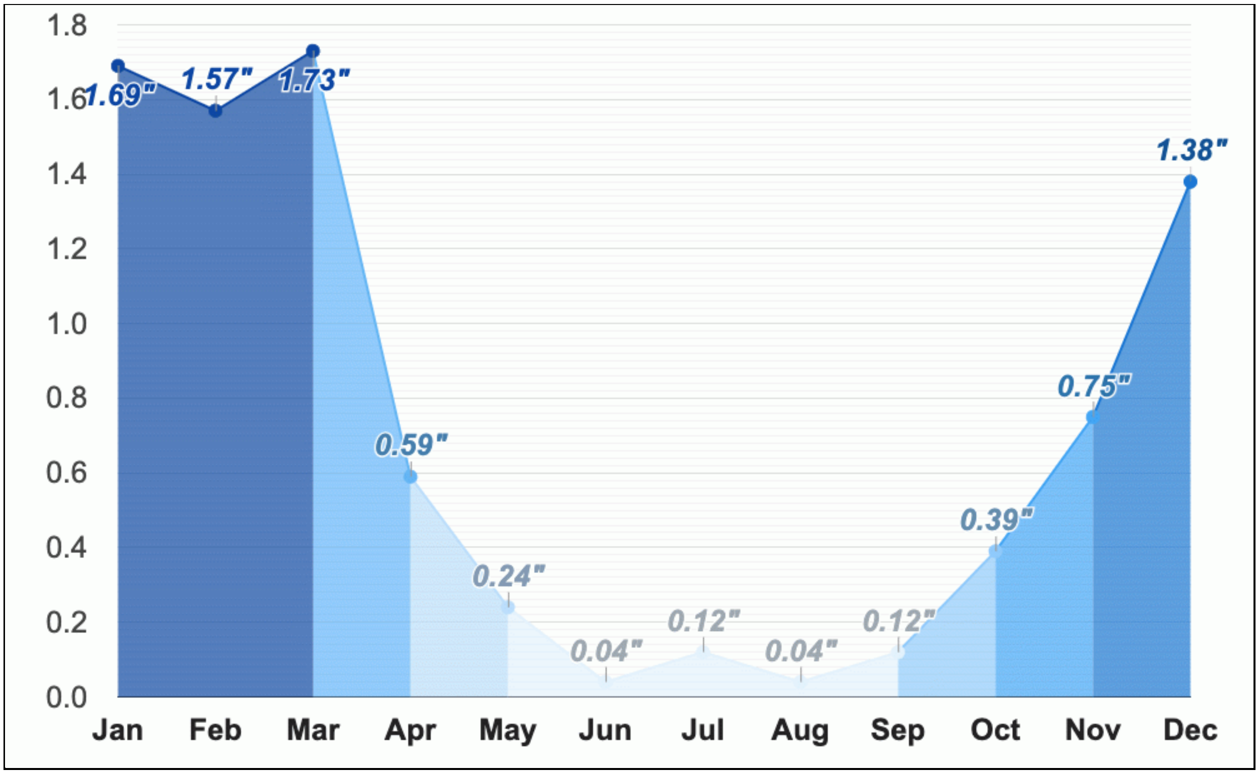
Annual Precipitation Totals

According to the Atascadero News newspaper, the annual average amount of rainfall recorded in Templeton is **17.53** inches. The highest annual total recorded during the last 8 years at the Atascadero Mutual Water Company[3] measurement site located at 6575 Sycamore Road in Atascadero (2 miles west of PFH) was **29.8** inches in **2016-17**; the record low total was **8.8** inches in **2020-21**.

[2] https://fruitsandnuts.ucanr.edu/Weather_Services/chilling_accumulation_models/about_chilling_units/

[3] https://web.amwc.us/resources/Rainfall.pdf

Figure 1.3.3
Average annual rainfall for Paso Robles Regional Airport (source: Weather-US)



During an average rain year of **17.53** inches, the total volume of rainfall that lands within PFH property lines is **4,760,000** gallons, of which an estimated **714,000 - 2,140,000** gallons is lost as run-off. An additional 5.66 acres of catchment on PFH's northwest property boundary sees **2,700,000** gallons of direct precipitation during an average rain year, of which between **400,000 - 1,200,000** gallons is shed onto the PFH property. Detailed calculations are available in the PFH Water Catchment Calculator spreadsheet[4].

A watershed, also known as a drainage basin or catchment, is an area bounded by hills and ridges where any rainfall and runoff leads to a single outlet. Watersheds can be as small as a footprint or large enough to encompass all of the land that drains water into rivers that drain into the ocean. It all depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location.

The [redacted] Family Homestead property is sited on a predominantly southeast facing slope of a secondary ridge descending from a primary ridge running east-west. It has limited yet significant off-property run-on catchments that flow onto the property from the northwest and northeast as

4 https://docs.google.com/spreadsheets/d/19YRVh-V0sdZqb_dwuIdAe19IBWx-7i9ArH33PFD8Lhk/edit?usp=sharing

illustrated in Figure 1.3.4. PFH lies within the greater Paloma Creek Salinas River Watershedas illustrated in Figure 1.3.5.

Figure 1.3.4
Off-property portions of the PFH watershed (any runoff that develops in this area will flow onto PFH property at at least one point)

Figure 1.3.5

PFH's location within the Paloma Creek Salinas River Watershed.

Image removed from sample report to ensure owner privacy.

Annual Distribution of Precipitation

There are an average of **54** rainy days (>.1 inch) per year based on data obtained from Paso Robles Municipal Airport - KPRB. Typically 80 - 90% of total annual rainfall falls between December and March, making this a brittle climate (see "Climate Brittleness", below). The longest period at Paso Robles Municipal Airport - KPRB without precipitation on record was **202** days **(2/28/1997 - 9/18/1997)**. Periods without effective rainfall (moderate intensity rainfall that falls in sufficient amount that it can actually infiltrate and is not immediately lost to evaporation) can be much longer, on the order of **240 - 270 days**.

Rainfall Intensity and Recurrence Interval

Table 1.3.1 below lists rainfall intensity and the recurrence interval for the Templeton area. Water harvesting earthworks design is typically informed by the 500 or 1,000-year recurrence interval event - a rainfall event of certain intensity and magnitude that has a 0.2 - .1% probability of occurring during any given year. In this case, the table below shows the 1,000-year recurrence interval event to be **7.67** inches of rain in a 12-hour period, and **10.5** inches of rain in a 24-hour period. Rainfall intensity during such an event could reach as high as **6.83 inches per hour** over a 5 minute span (this represents a "surge" that the system would need to discharge without destroying itself). This information is used to size spillways, drains, catchment basins and overflows to ensure that the system can endure such an event, and any of lesser intensity, duration and magnitude, without damage.

Table 1.3.1

Rainfall intensity and recurrence interval for [redacted] Family Homestead

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.140** (0.121-0.163)	**0.175** (0.151-0.204)	**0.222** (0.191-0.260)	**0.261** (0.223-0.309)	**0.315** (0.258-0.388)	**0.358** (0.286-0.453)	**0.403** (0.313-0.524)	**0.450** (0.338-0.606)	**0.516** (0.369-0.730)	**0.569** (0.391-0.838)
10-min	**0.200** (0.173-0.233)	**0.250** (0.217-0.292)	**0.318** (0.274-0.372)	**0.374** (0.319-0.442)	**0.452** (0.370-0.557)	**0.513** (0.410-0.649)	**0.577** (0.448-0.751)	**0.645** (0.484-0.868)	**0.740** (0.529-1.05)	**0.816** (0.560-1.20)
15-min	**0.242** (0.210-0.282)	**0.303** (0.262-0.354)	**0.384** (0.331-0.450)	**0.452** (0.386-0.535)	**0.546** (0.448-0.673)	**0.621** (0.496-0.785)	**0.698** (0.542-0.909)	**0.780** (0.586-1.05)	**0.895** (0.639-1.26)	**0.987** (0.677-1.45)
30-min	**0.339** (0.293-0.395)	**0.424** (0.367-0.495)	**0.538** (0.464-0.630)	**0.633** (0.540-0.749)	**0.765** (0.627-0.943)	**0.869** (0.695-1.10)	**0.978** (0.759-1.27)	**1.09** (0.820-1.47)	**1.25** (0.895-1.77)	**1.38** (0.948-2.04)
60-min	**0.501** (0.434-0.584)	**0.627** (0.543-0.732)	**0.796** (0.686-0.932)	**0.936** (0.799-1.11)	**1.13** (0.928-1.39)	**1.29** (1.03-1.63)	**1.45** (1.12-1.88)	**1.62** (1.21-2.17)	**1.85** (1.32-2.62)	**2.05** (1.40-3.01)
2-hr	**0.742** (0.643-0.865)	**0.923** (0.798-1.08)	**1.16** (1.00-1.36)	**1.37** (1.17-1.62)	**1.64** (1.35-2.03)	**1.86** (1.49-2.36)	**2.09** (1.63-2.72)	**2.34** (1.75-3.14)	**2.68** (1.91-3.78)	**2.95** (2.02-4.34)
3-hr	**0.939** (0.814-1.10)	**1.17** (1.01-1.37)	**1.48** (1.28-1.74)	**1.74** (1.48-2.06)	**2.09** (1.72-2.58)	**2.37** (1.90-3.00)	**2.66** (2.07-3.47)	**2.97** (2.23-4.00)	**3.40** (2.43-4.81)	**3.75** (2.57-5.52)
6-hr	**1.34** (1.16-1.56)	**1.69** (1.47-1.98)	**2.17** (1.87-2.54)	**2.55** (2.18-3.02)	**3.09** (2.53-3.80)	**3.50** (2.80-4.43)	**3.94** (3.05-5.12)	**4.39** (3.29-5.90)	**5.01** (3.58-7.09)	**5.52** (3.78-8.12)
12-hr	**1.71** (1.48-1.99)	**2.25** (1.95-2.63)	**2.96** (2.55-3.47)	**3.54** (3.02-4.19)	**4.32** (3.54-5.32)	**4.91** (3.93-6.21)	**5.52** (4.29-7.19)	**6.15** (4.62-8.27)	**7.00** (5.00-9.90)	**7.67** (5.26-11.3)
24-hr	**2.11** (1.91-2.37)	**2.90** (2.62-3.27)	**3.92** (3.53-4.44)	**4.74** (4.24-5.41)	**5.85** (5.06-6.91)	**6.69** (5.66-8.07)	**7.54** (6.23-9.32)	**8.41** (6.75-10.7)	**9.59** (7.38-12.7)	**10.5** (7.80-14.4)
2-day	**2.64** (2.39-2.97)	**3.63** (3.28-4.10)	**4.94** (4.45-5.59)	**6.01** (5.38-6.86)	**7.49** (6.48-8.84)	**8.64** (7.31-10.4)	**9.82** (8.11-12.1)	**11.0** (8.86-14.0)	**12.7** (9.80-16.9)	**14.1** (10.5-19.3)
3-day	**2.97** (2.69-3.35)	**4.07** (3.68-4.60)	**5.55** (5.00-6.28)	**6.78** (6.06-7.73)	**8.49** (7.34-10.0)	**9.85** (8.33-11.9)	**11.3** (9.29-13.9)	**12.7** (10.2-16.2)	**14.8** (11.4-19.6)	**16.5** (12.2-22.6)
4-day	**3.23** (2.93-3.64)	**4.42** (4.00-4.99)	**6.03** (5.43-6.82)	**7.37** (6.59-8.41)	**9.27** (8.01-10.9)	**10.8** (9.12-13.0)	**12.4** (10.2-15.3)	**14.0** (11.3-17.8)	**16.4** (12.6-21.7)	**18.3** (13.6-25.1)
7-day	**3.87** (3.50-4.36)	**5.25** (4.74-5.92)	**7.12** (6.42-8.06)	**8.71** (7.79-9.94)	**11.0** (9.47-12.9)	**12.8** (10.8-15.4)	**14.6** (12.1-18.1)	**16.7** (13.4-21.2)	**19.5** (15.0-25.9)	**21.8** (16.2-30.0)
10-day	**4.30** (3.89-4.84)	**5.81** (5.25-6.56)	**7.87** (7.09-8.90)	**9.61** (8.59-11.0)	**12.1** (10.4-14.2)	**14.1** (11.9-16.9)	**16.1** (13.3-19.9)	**18.4** (14.7-23.4)	**21.5** (16.6-28.6)	**24.1** (17.9-33.1)
20-day	**5.43** (4.92-6.12)	**7.32** (6.62-8.26)	**9.89** (8.91-11.2)	**12.1** (10.8-13.8)	**15.1** (13.1-17.8)	**17.6** (14.9-21.2)	**20.1** (16.6-24.9)	**22.9** (18.4-29.1)	**26.8** (20.7-35.6)	**30.0** (22.3-41.2)
30-day	**6.57** (5.95-7.41)	**8.85** (8.00-9.99)	**11.9** (10.7-13.5)	**14.5** (12.9-16.5)	**18.1** (15.7-21.4)	**21.0** (17.8-25.3)	**24.0** (19.9-29.7)	**27.3** (21.9-34.7)	**31.9** (24.6-42.3)	**35.7** (26.5-49.0)
45-day	**8.03** (7.27-9.05)	**10.7** (9.71-12.1)	**14.4** (13.0-16.3)	**17.4** (15.6-19.9)	**21.6** (18.7-25.5)	**25.0** (21.2-30.1)	**28.5** (23.6-35.3)	**32.3** (25.9-41.0)	**37.6** (28.9-49.8)	**41.9** (31.1-57.5)
60-day	**9.43** (8.53-10.6)	**12.5** (11.3-14.1)	**16.7** (15.0-18.8)	**20.1** (18.0-22.9)	**24.8** (21.5-29.3)	**28.6** (24.2-34.5)	**32.5** (26.8-40.2)	**36.7** (29.4-46.6)	**42.5** (32.7-56.3)	**47.2** (35.1-64.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

**PDS: precipitation data server; PF: precipitation frequency*

Humidity

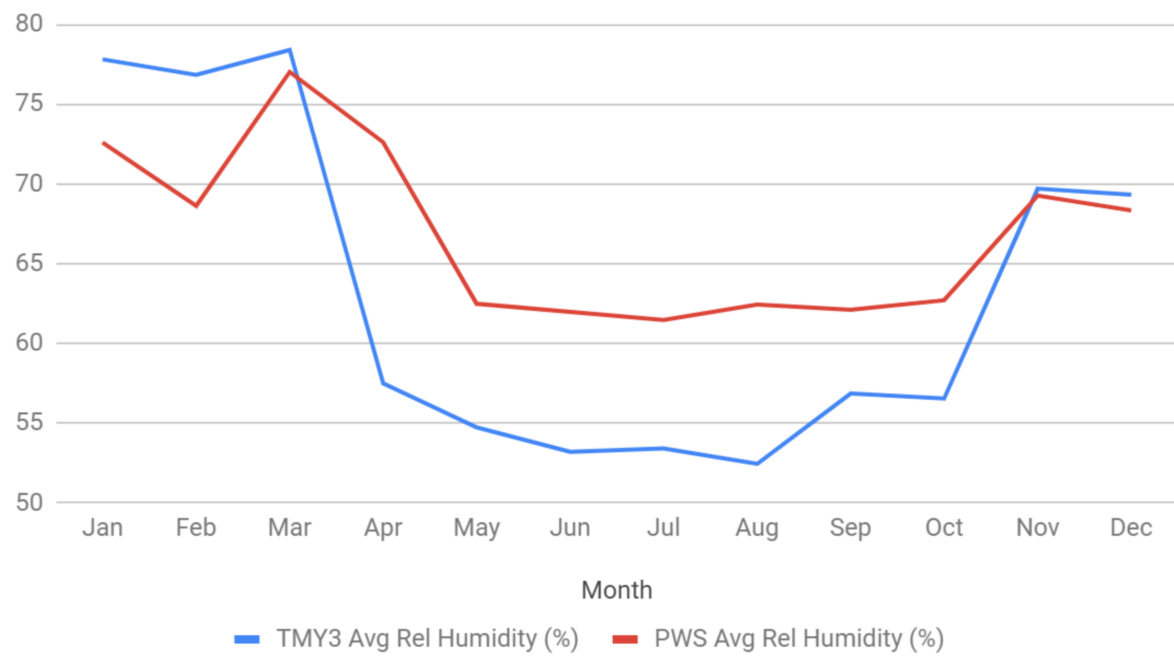
The closest weather station to PFH with real-time humidity data is the **Wunderground Personal Weather Station (PWS) KCAATASC83**[5], located approximately 1.9 miles away.

PWS KCAATASC83 also has recorded historical daily average humidity data since February of 2020. While the PWS data provides helpful insight into recent local humidity trends, it likely does not represent the long-term averages for the location, also known as typical meteorological year (TMY) data. The closest weather station with TMY data, compiled with hourly measurements from 1991-2020, is the Paso Robles Municipal Airport - KPRB, located 11 miles north of PFH. The PWS and TMY monthly average humidity data is shown in Figure 1.3.6. Humidity in both locations is

[5] https://www.wunderground.com/dashboard/pws/KCAATASC83

highest during the late fall, winter, and early spring, with monthly averages ranging from 68-77%. Monthly average humidity levels during the summer months of a TMY at KPRB range between 53-58%, and were consistently between 60-65% at PWS KCAATASC83. The higher relative humidity at PWS KCAATASC83 during the summer months is likely due to the station's closer proximity to the ocean.

Figure 1.3.6
Monthly average humidity for the period of 2/2/20-11/30/21 at Wunderground PWS KCAATASC83 (located 1.9 miles away from PFH) and and a typical meteorological year at Paso Robles Municipal Airport (located 11 miles away from PFH).



Fog

Offshore wind events during the fall and winter bring moist inland air towards the coast, where it gets trapped by the Santa Lucia mountain range. This moist air condenses over the cold inland land areas, causing fog in the Atascadero area. This pattern is the inverse of the coastal pattern, where fog typically develops during onshore wind events in the spring and summer.

Aquifer

The [redacted] Family Homestead does not sit atop a known and documented aquifer, however it is located within a narrow sliver of land between the Salinas Valley Atascadero Area Sub-Basin 3-004.11[6] and the Salinas Valley Paso Robles Area Sub-Basin 3.004.06[7] based on maps available from the California Groundwater Basin Boundary Assessment Tool[8]. The well located at the bottom

[6] https://sgma.water.ca.gov/portal/gsa/print/296
[7] https://sgma.water.ca.gov/portal/gsp/preview/35
[8] California Groundwater Basin Boundary Assessment Tool: https://gis.water.ca.gov/app/bbat/

of the property is likely drawing from one or both of these basins. The Paso Robles Sub-Basin has been in critical overdraft status over at least the past 5 years, with water table levels having fallen up to 70’ compared to historical norms based on 2018 data.

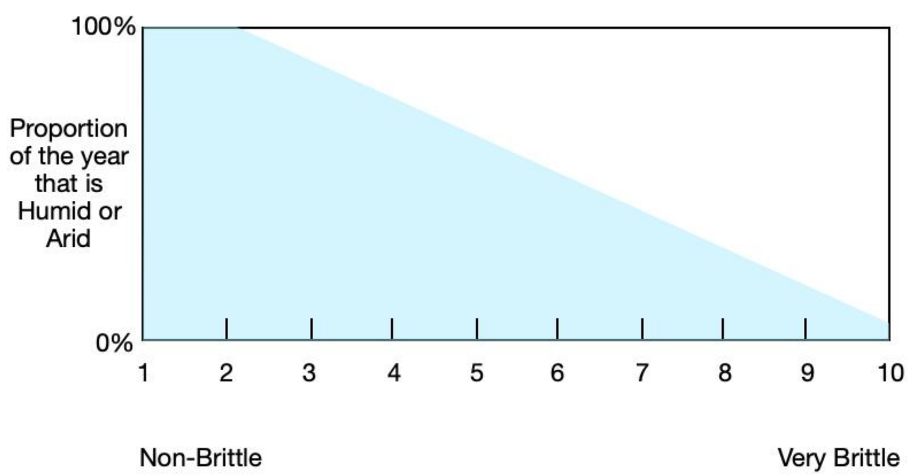
Climate Brittleness

Brittleness gauges climate vulnerability to desertification. The brittleness scale is subjective and has no formula for calculation, but can be thought of as a continuum, ranging from a 1 - very humid with moisture distributed throughout the year (tropical rainforest) to a 10 - very arid with long dry periods(desert). We use brittleness to inform management decisions for a given property or bioregion.

Where any given climate falls on the brittleness scale is determined not so much by total rainfall, but rather by the distribution of precipitation and humidity throughout the year. This pattern determines the degree of brittleness. Very brittle environments typically have a long period of non-growth (often due to long periods without precipitation and low humidity) and can be very arid. Brittle environments also tend to accumulate more dead plant material as biological breakdown of carbon-based plant tissues by insects, microbes and fungi all but cease during the long dry season. This can have a negative effect on the health and resilience of the vegetation due to increased risk of catastrophic fire (due to built up fuel levels) and decreased light penetration to young growing tips (blocked by dead, standing vegetation).

Figure 1.3.7

Climate Brittleness Scale



The climate at [redacted] Family Homestead tends towards being **quite brittle**. Long summer dry seasons and fairly short winter wet seasons predominate. There is a significant maritime influence on the property, which brings with it exposure to a fog cycle and some intermittent moisture through dew set.

Dramatically increasing the number of trees on property will have the greatest effect in moderating climate extremes and creating soil that can retain more moisture for longer. Use of ruminant grazing animals should be carefully planned and attentively managed to ensure they are benefiting the larger processes of soil creation and establishment of perennial cover across the property. The property has a history of unmanaged cattle grazing, as evidenced by the existing vegetation cohort and the presence of desiccated and perfectly preserved manure piles estimated to be at least several, if not more, years old.

Evapotranspiration

Evapotranspiration (ET_o - the amount of water released to the atmosphere through plant and soil respiration over mowed, irrigated, perennial grass cover) was **52.3 inches**, as measured from CIMIS [9] Station - **#163** in Atascadero (2.8 miles southwest of PFH) from 12/2020 - 12/2021.

Solar Data

Solar aspect describes the way that the sun moves across the sky at your location during the various seasons. Having an understanding of the sun's seasonal path is critical for properly siting various elements in the property design, designing housing and other structures for passive heating/cooling, and situating solar panels.

Table 1.3.2
Solar aspect information for each season at PFH.

Season Change	Sun Angle*	Shadow Length**	Sunrise Location***	Sunset Location***
Winter Solstice	31.05°	1.66	118.57°	241.42°
Spring Equinox	54.57°	.71	88.43°	270.82°
Summer Solstice	77.92°	.21	60.06°	299.94°
Fall Equinox	54.96°	.7	89.18°	270.57°

** Sun angles measured when highest in sky (peak solar activity) a.k.a. azimuth.*
*** Shadow length expressed as multiple of object height, taken at peak solar activity*
**** Exact locations of sunrise/sunset on the horizon from SET's Sunrise-Sunset Calendar - visit mooncalc.org to get similar data for lunar cycles.*

The longest day length is **14h33m** on the Summer Solstice, and the shortest day length is **9h45m** on the Winter Solstice.

Figure 1.3.8 illustrates the actual times that the Main Residence sees direct sunlight on the solstices and equinoxes.

[9] California Irrigation Management Information System: https://cimis.water.ca.gov/WSNReportCriteria.aspx

Figure 1.3.8

Sunseeker shots from central hub at PFH. TOP: Looking east. BOTTOM: Looking west.

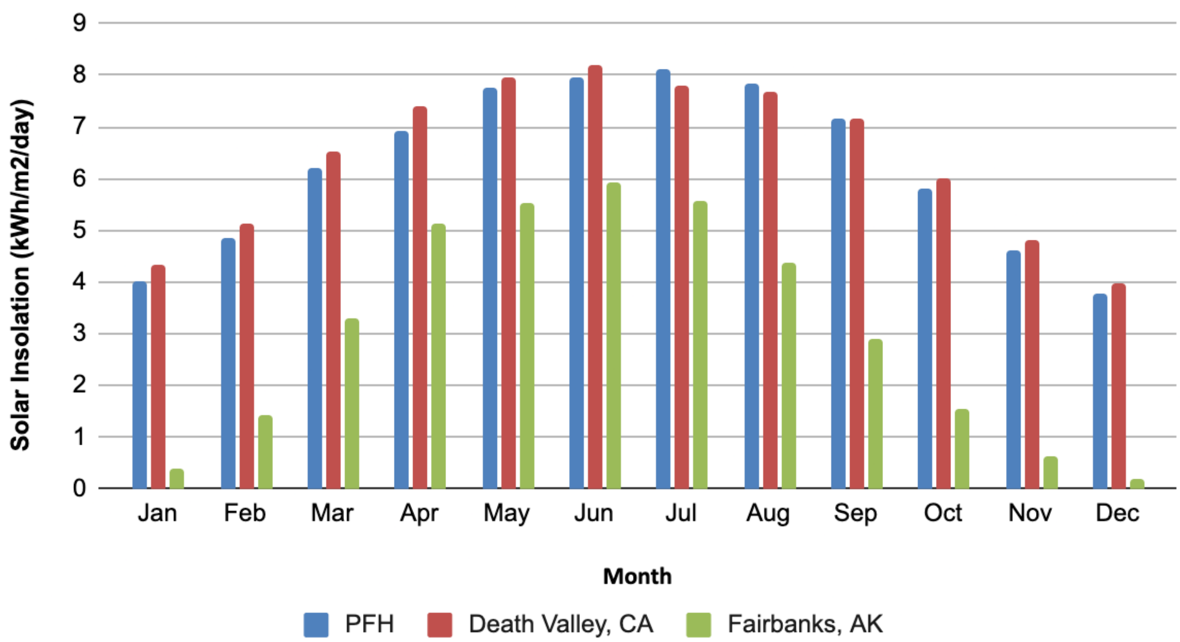
Image removed from sample report to ensure owner privacy.

Image removed from sample report to ensure owner privacy.

The average annual solar insolation (used to measure energy production of solar PV systems, in kWh/m2/day) at PFH is **6.26 kWh/m^2/day** (Range: 3.77 in December to 8.13 in July), compared to that of Death Valley, CA at 6.4 kWh/m2/day, and Fairbanks, AK at 3.1 kWh/m2/day - considered to be among the sunniest and least sunny places in the US, respectively. The monthly average solar insolation at PFH is presented in Figure 1.3.9, and also compared with Death Valley, CA and Fairbanks, AK.

Figure 1.3.9

Solar insolation for a typical meteorological year at PFH, as compared to that of Death Valley, CA and Fairbanks, AK *(data compiled from [NREL's PVwatts Calculator][10])*.

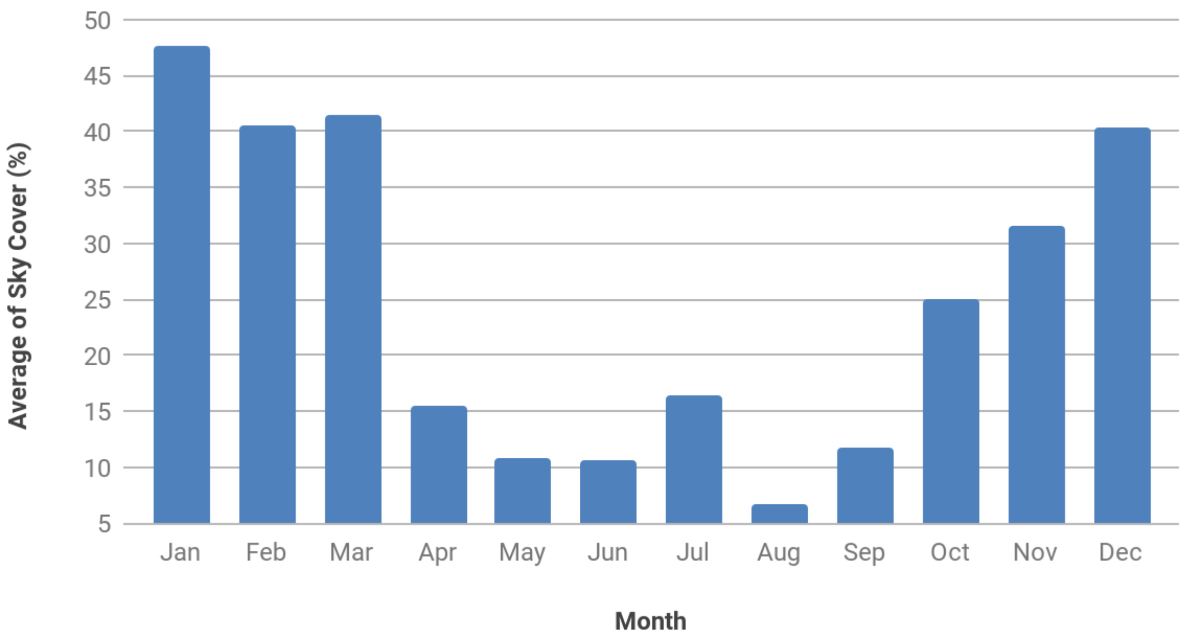


The monthly average percent of sky cover due to clouds during a TMY at KPRB is plotted in Figure 1.3.10. The months with the highest average percentage of cloud cover are December through March, which range from 40-47%. The months with the lowest average percentage of cloud cover are April through September, with monthly ranges from 7 to 17%.

[10] https://pvwatts.nrel.gov/

Figure 1.3.10

The monthly average percent of sky cover at Paso Robles Municipal Airport - KPRB (11 miles north of PFH) away from PFH.



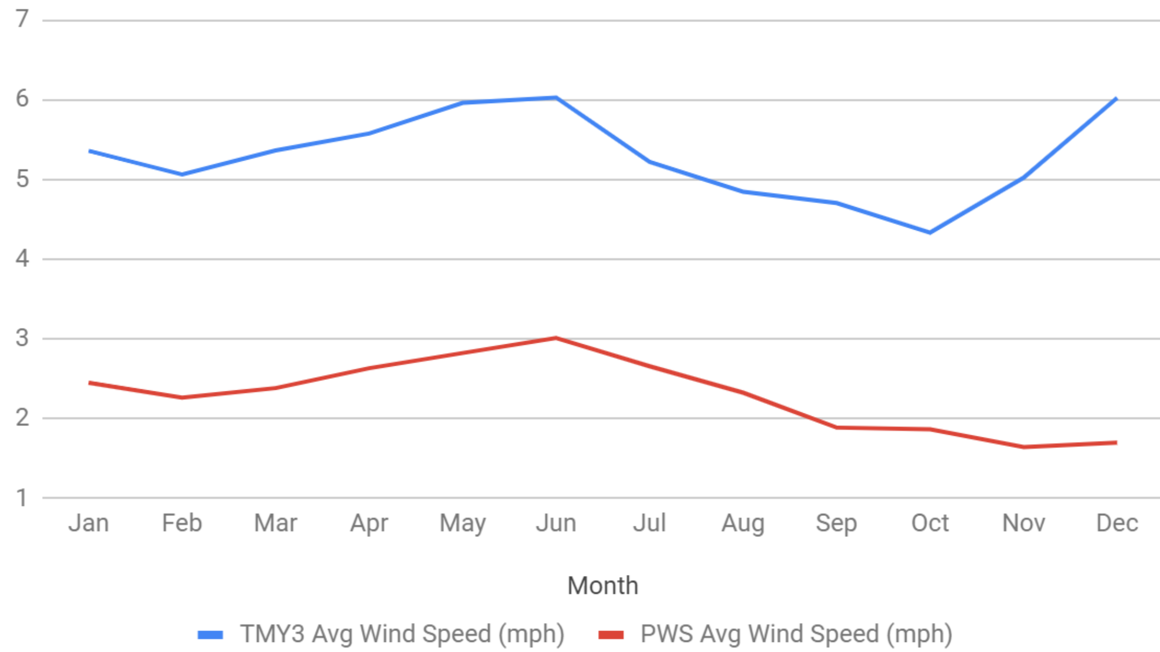
Wind Data

The closest weather station to PFH with real-time wind speed data is the **Wunderground Personal Weather Station (PWS) KCAATASC83**[11], located approximately 1.9 miles away.

PWS KCAATASC83 also has recorded historical daily average wind speed data since February of 2020. While the PWS data provides helpful insight into recent local wind speed trends, it likely does not represent the long-term averages for the location, also known as typical meteorological year (TMY) data. The closest weather station with TMY data, compiled with hourly measurements from 1991-2020, is the Paso Robles Municipal Airport - KPRB, located 11 miles north of PFH. The PWS and TMY monthly average wind speed data is shown in Figure 1.3.11. Monthly average wind speeds at PWS KCAATASCA83 range from 1.5-3mph, and are highest in the late spring and summer months. Average monthly wind speeds during a TMY at KPRB follow a similar monthly trend but are 2.5-3mph higher than recent years at PWS KCAATASCA83. This is likely due to KPRB's location in the midst of a large valley, as compared to PWS KCAATASCA83's location in hilly Atascadero. PFH likely sees a similar trend as KCAATASCA83.

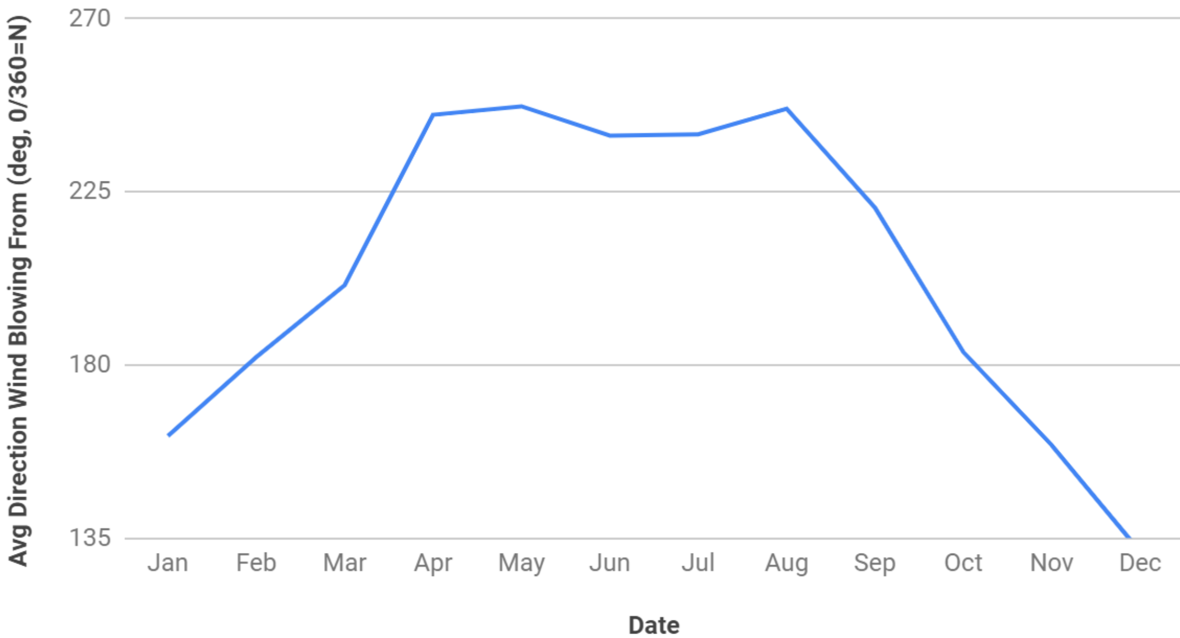
[11] https://www.wunderground.com/dashboard/pws/KCAATASC83

Figure 1.3.11
Monthly average wind speed for the period of 2/2/20-11/30/21 at Wunderground PWS KCAATASC83 (located 1.9 miles away from PFH) and and a typical meteorological year at Paso Robles Municipal Airport (located 11 miles away from PFH).



The average direction the wind blows from during each month of a typical meteorological year at KPRB, as expressed in degrees, is illustrated in Figure 1.3.12. Winds typically range from the southeast, south, and southwest (135-225°) during the fall and winter, and from the southwest and west during the spring and summer. No historical wind direction data was found for a site closer to PFH.

Figure 1.3.12
Average monthly wind direction data for a typical meteorological year at Paso Robles Regional Airport (KPRB), located 11 miles north of PFH.



As with the other climatic sectors, wind speeds and directions can vary significantly over a small area, even on the same property. The information above is a good approximation of the wind conditions at PFH to use as a starting point for plantings, siting windbreaks, etc; however, on-site observation- simply walking around throughout the year, noting wind direction and relative strength at different locations - will provide more refined information. If capital-intensive projects that are heavily influenced by the wind sector are ever considered (such as wind turbines), a detailed study should certainly be performed on-site.

Climate Zones

USDA Hardiness Zone

USDA Hardiness Zones gives an approximation of the lowest temperatures a site will experience in a given year. It is a helpful, if somewhat limited tool in determining what will survive (but not necessarily *thrive*) in an area. Hardiness zones can be determined for a given zip code at https://planthardiness.ars.usda.gov/. Microclimates and site specific characteristics will vary.

The USDA Hardiness Zone for PFH is **8b/9a**. This zone is characterized by cold-season low temperatures that do not generally fall lower than **25-20**ºF, typically occurring between **December - March.**

Figure 1.3.13
USDA Hardiness Zones for Atascadero.

Image removed from sample report to ensure owner privacy.

Sunset Climate Zone(s)

Sunset climate zones take into account length of growing season, timing and amount of rainfall, winter lows, summer highs, wind and humidity. They provide a more detailed climate description than the USDA model, helpful in selecting which plants will not only survive but thrive with local climate variability. List of maps and climate zone descriptions[12].

The Sunset Climate Zone(s)[13] for [redacted] Family Homestead are **Zones 7 (Primary) and 15.**

Zone 7 (Primary): Zone 7 encompasses several thousand square miles west of the Sierra Nevada and Cascade ranges, and in the mountains that separate the Southern California coast from interior deserts. Because of the influence of latitude, this climate lies mostly at low elevations in Oregon's Rogue Valley, middle elevations around California's Central Valley, and at middle to higher elevations farther south. Gray pines define the heart of Zone 7 around the Central Valley, but more adaptable incense cedars replace them farther north and south.

Hot summers and mild but pronounced winters give Zone 7 sharply defined seasons without severe winter cold or enervating humidity. The climate pleases plants that require a marked seasonal pattern to do well—flower bulbs, peonies, lilacs, and flowering cherries, for example. Deciduous fruit trees do well also; the region is noted for its pears, apples, peaches, and cherries.

Gardeners in a few spots around the San Francisco Bay will be surprised to find their gardens mapped in Zone 7. These areas are too high and cold in winter to be included in milder Zones 15 and 16. In the mildest parts of Zone 7—in the extreme southern Salinas Valley, for example—you can get away with growing borderline plants such as citrus, oleanders, and almonds if you choose a spot with good air drainage to take the edge off winter chill. At weather-recording stations in Zone

[12] http://sunsetwesterngardencollection.com/climate-zones
[13] https://www.sunsetwesterngardencollection.com/climate-zones/zone/central-california

7, typical winter lows range from 35 to 26°F (2 to −3°C), with record lows averaging from 18 to -0° F (−8 to −18°C).

Zone 15 (Secondary - due west of PFH ~6-8 miles): Zones 15 and 16 are areas of Central and Northern California that are influenced by marine air approximately 85 percent of the time and by inland air 15 percent of the time. Also worthy of note is that although Zone 16 is within the Northern California coastal climate area, its winters are milder because the areas in this zone are in thermal belts (see explanation below). The cold-winter areas that make up Zone 15 lie in cold-air basins, on hilltops above the thermal belts, or far enough north that plant performance dictates a Zone 15 designation. Many plants that are recommended for Zone 15 are not suggested for Zone 14 mainly because they require more moisture in the atmosphere, cooler summers, milder winters, or all three conditions present at the same time. On the other hand, Zone 15 still receives enough winter chilling to favor some of the cold winter specialties, such as English bluebells, which are not recommended for Zones 16 and 17. Most of this zone gets a nagging afternoon wind in summer. Trees and dense shrubs planted on the windward side of a garden can disperse it, and a neighborhood full of trees can successfully keep it above the rooftops. Lows over a 20-year period ranged from 28 to 21°F (−2 to −6°C), and record lows from 26 to 16°F (−3 to −9°C).

- Thermal belts typically occur on the midslopes of hill faces, where a layer of warmer air will often be sandwiched between a cool air sink at the valley bottom and colder air on the exposed hill tops. South facing slopes are generally warmer as they receive more solar radiation during the day.

Koppen Geiger Climate Classification

The Koppen Geiger Climate Classification System is a widely used climate classification system, useful in tracking large scale climate changes over time. Helpful visualizations are available as .kmz files in Google Earth[14]. Knowing your KGCC rating can be especially helpful in quickly finding climate analogues around the world as a starting place for researching biological systems, management practices and species that will have a high likelihood of success at your location. The Koppen Geiger Climate Classification System map, viewable by county, is available at http://koeppen-geiger.vu-wien.ac.at/.

The Koppen Geiger Climate Classification for Templeton is **Csb.**

- Csb: The C stands for warm temperate, the lower case s for precipitation mode of 'summer dry' and the lower case b for a temperature rating of 'warm summer'. This is generally considered a Mediterranean climate. Expanded definitions for each letter within the code are available here[15].

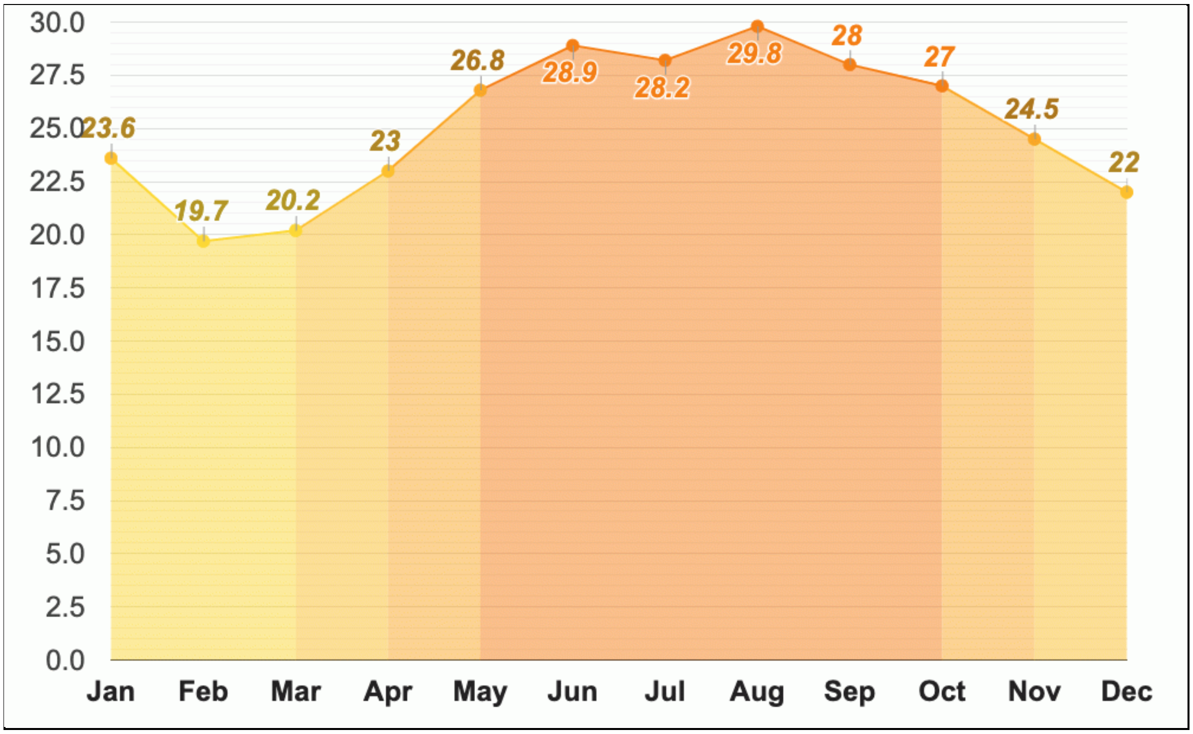
[14] http://koeppen-geiger.vu-wien.ac.at/present.htm#GoogleEarth
[15] https://www.britannica.com/science/Koppen-climate-classification

Growing Season

Late February - Early June. Growing season for climate adapted native plants typically occurs during and immediately following the rainy season (December through March) and tapers by the end of spring, entering some sort of stasis come the hot, dry months of summer. For non-native, food producing, or other plant varietals the growing season is quite long with Templeton's average of 302 sunny days per year assuming supplemental irrigation is provided (in most cases).

Figure 1.3.14

Sunny days per typical meteorological year at Paso Robles Regional Airport (KPRB), 11 miles north of PFH. .



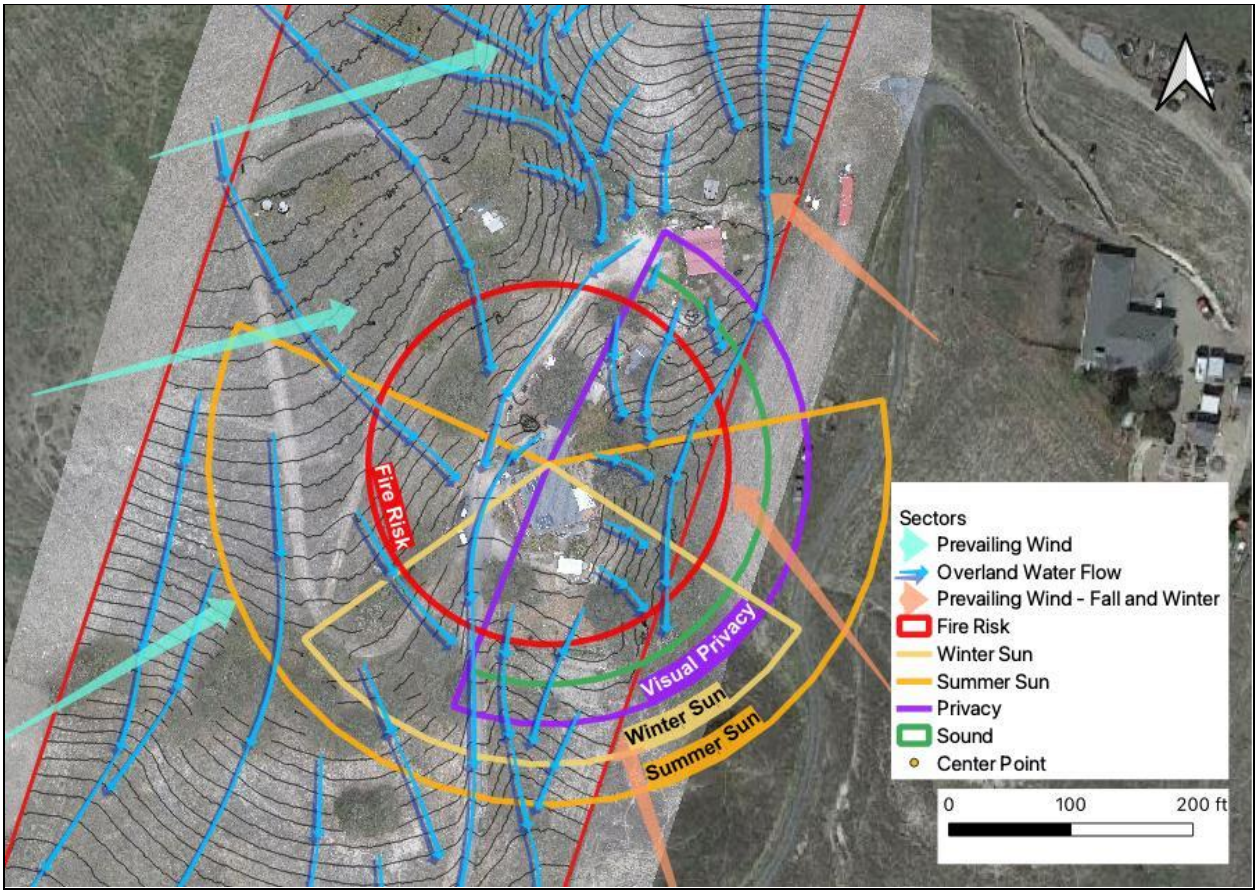
1.4 Sector And Zone Analysis

Sector Analysis

A sector analysis examines the natural environmental factors that affect a site. These are outside influences (energies) that can't be directly stopped or controlled that affect the design area. Sectors are more powerful than we are, and are a critical factor influencing which elements are selected, where they are located, and how and when they will be interacted with.

The sector analysis and a brief written summary of the sectors affecting the central activity hub of [redacted] Family Homestead is provided below.

Figure 1.4.1
Sector analysis of [redacted] Family Homestead.



- Solar Aspect & Access
  - See [Solar Data section](#).
- Sound Privacy / Sensitivity
  - Acoustic privacy and sensitivity sectors range from the northeast to the southeast. Neighbor noise does not appear to be a major factor at PFH. Road noise from the [redacted] is significant anywhere with line of sight to it on the property.
- Visual Privacy / Exposure
  - Similar to the acoustic privacy sector, PFH's main visual privacy sector is along the eastern property line with the two residences located next door. Some of the more open sections will benefit from planted visual privacy screens.
- Wind
  - See [Wind Data section](#).
- Fire
  - Fire danger is 360^{0}.

Zone Analysis

Zones are usage patterns for various areas on the property. Locating elements based on their required or desired frequency of interaction helps to weave order throughout the larger system according to how often an element is used or requires tending. By co-locating elements that require daily tending (like a chicken coop, vegetable garden, and worm bin, for example) efficiencies are created, both in connecting outputs from one element as needed inputs for an adjacent or integrated element, and by keeping them on the same activity path.

The zones at PFH are illustrated in Figure 1.4.2, and descriptions of each zone follow in Table 1.4.1.

Figure 1.4.2
Zone map(s) for PFH.

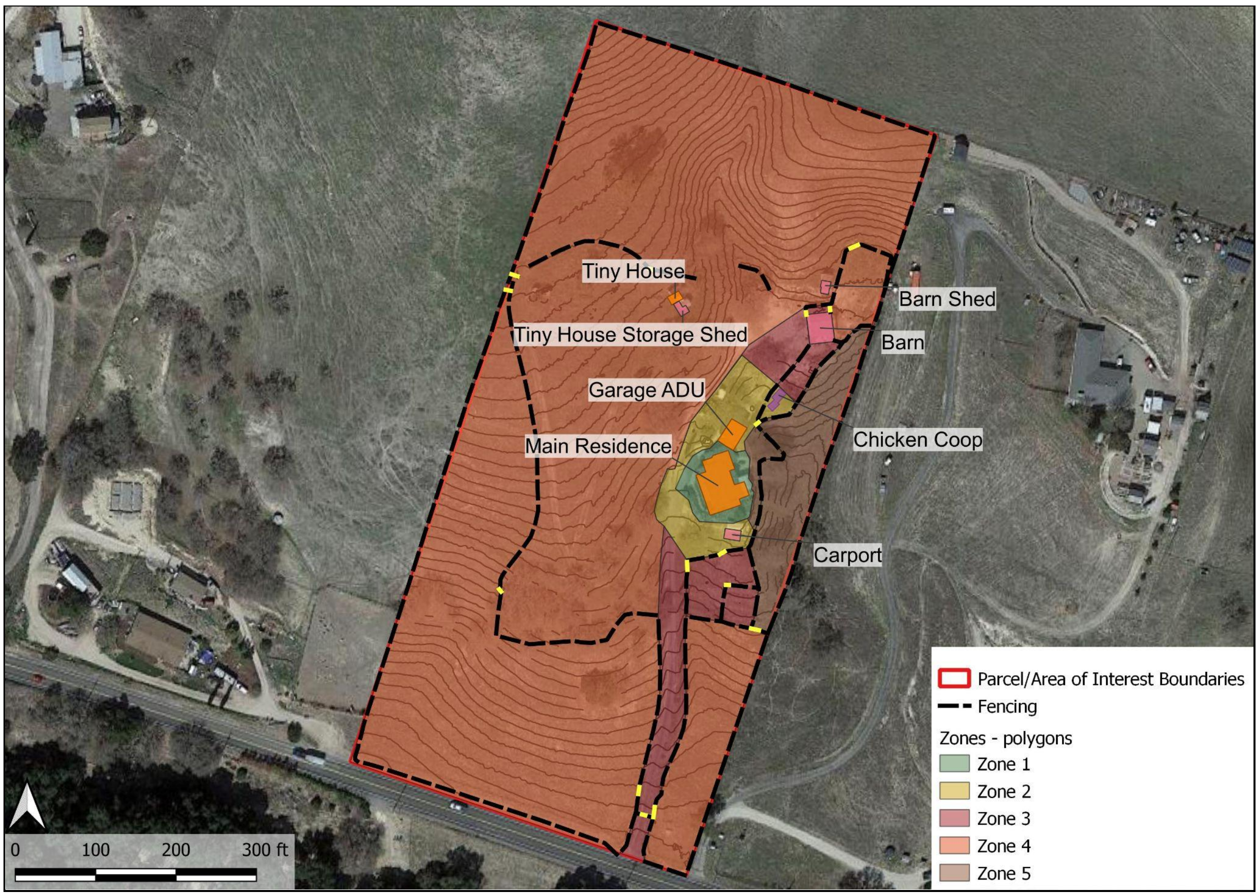


Table 1.4.1
Basic zone descriptions excerpted from Toby Hemenway's *Gaia's Garden*.

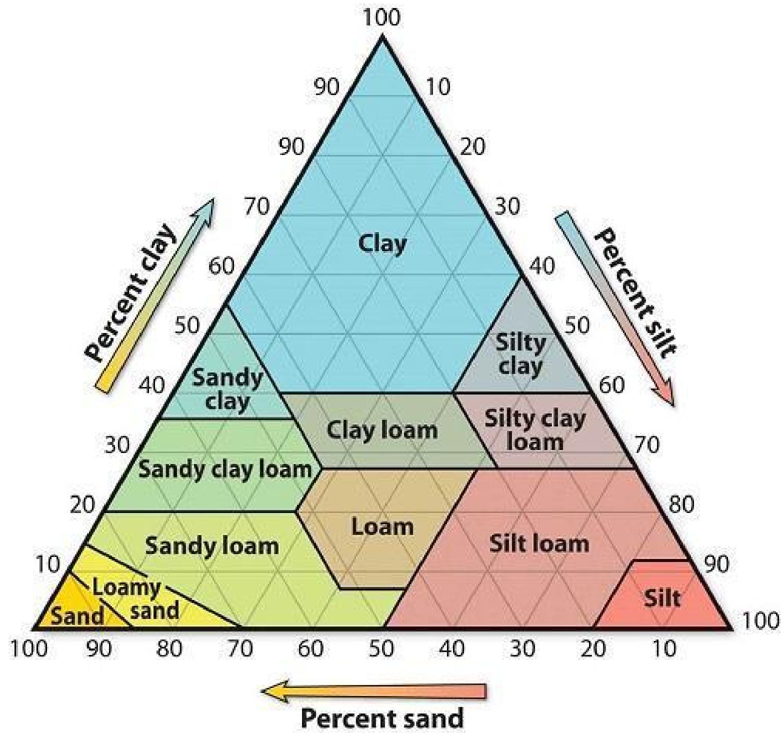
Zone Description	**Frequency Of Use**	**Functions**	**Structures**	**Crops**	**Land Management Techniques**
Zone 1: Most intensive use and care. Zone of self-reliance	Multiple times daily.	Modify house microclimate, provide daily food and flowers, social space, plant propagation.	Greenhouse, trellis, arbor, deck, patio, bird bath, storage, potting shed, workshop, worm bin.	Salad greens, herbs, flowers, dwarf trees, trees for microclimate	Intensive weeding & mulching, dense stacking, square-foot and bio-intensive beds, espalier
Zone 2: Semi-intensely cultivated. Domestic production zone.	Daily to weekly.	Home food production, some market crops, plant propagation, bird and insect habitat.	Greenhouse, barns, tool shed, shop, wood storage, small livestock shelters.	Staple and canning crops, multi-function al plants small fruits and nuts, fire breaks	Weekly weeding and care, spot mulch, cover crops, seasonal pruning.
Zone 3: Low intensity, extensive methods. Farm zone.	Weekly to bi-monthly.	Cash crops, firewood and lumber, pasture.	Feed storage, field shelters for livestock.	Cash crops, large fruit and nut trees, shelterbelts.	Cover crops, coppicing, light pruning, moveable fences.
Zone 4: Minimal care. Forage zone.	Monthly to seasonally.	Hunting, gathering, grazing.	Animal feeders	Firewood, timber, pasture	Pasturing, selective forestry.
Zone 5: Unmanaged. Wilderness Zone.	Variable.	Inspiration, foraging, hunting, nature connection.	None.	Native plants, mushrooms.	Tending the wild, occasional wildcrafting

1.5 Soil Data

Fertile soil is the foundation for a healthy landscape. Soil data provides information for the landowner of what actions will be required to facilitate healthy development of the landscape. This information can be used to determine the best methods to organically build soil to optimal levels.

The soil texture classification triangle is shown in Figure 1.5.1, depicting the different proportions that occur between the three main particles that comprise soil: sand, silt, and clay. The percentages of each of these result in soil classifications such as "loam", "sandy loam", etc.

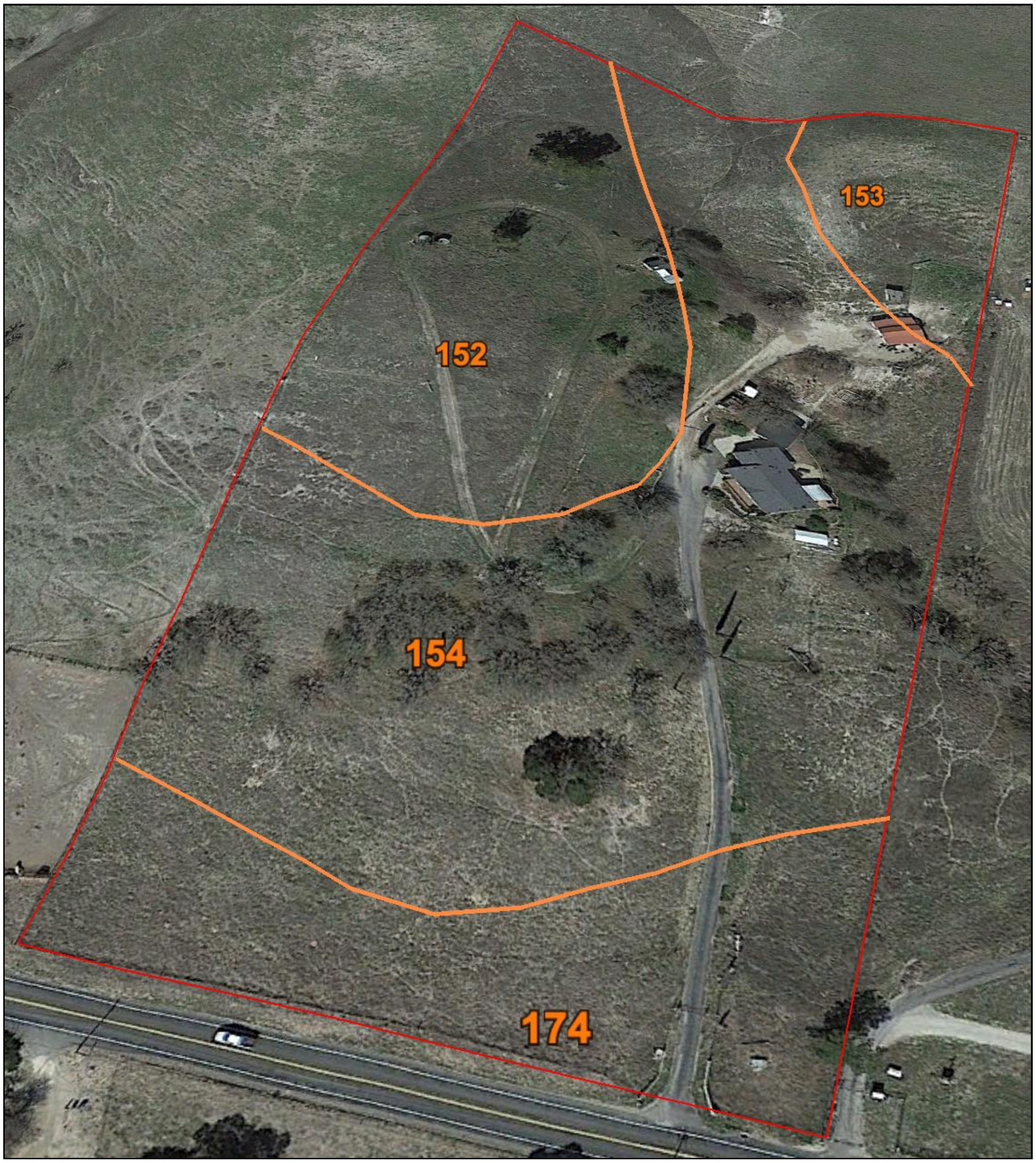
Figure 1.5.1
Soil texture classification triangle.



NRCS Soil Survey

The Natural Resources Conservation Service (NRCS) soil map for PFH is provided in Figure 1.5.2. Detailed descriptions of each soil type shown on the map follow in Table 1.5.1.

Figure 1.5.2
NRCS Web Soil Survey Data[16] for [redacted] Family Homestead and surrounding areas.



16 https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx?aoicoords=((-120.63095%2035.51095,-120.63000%2035.51351,-120.63145%2035.51385,-120.63241%2035.51127,-120.63097%2035.51094,-120.63095%2035.51095))&marker=(-120.63113%2035.51238)

Table 1.5.1
Summary of soil types for PFH. See Appendix B for expanded definitions for Land Capability Classification and Hydrologic Soil Group.

Soil Series	Soil Type	Defining Slope	Property Area	Key Characteristics
Linne-Calodo Complex	152	9-30%	28%	• **Predominant Soil Texture:** Gravelly fine loam • **Parent Material:** Residuum weathered from calcareous shale and/or sandstone • **Run-off Potential:** Very High • **Erosion Potential:** High • **Depth To Bedrock:** 20-40” • **Land Capability Classification*:** 4e • **Hydrologic Soil Group**:** C
	153	30-50%	9%	• **Predominant Soil Texture:** Gravelly fine loam • **Parent Material:** Residuum weathered from calcareous shale and/or sandstone • **Run-off Potential:** Very High • **Erosion Potential:** High • **Depth To Bedrock:** 20-40” • **Land Capability Classification*:** 6e • **Hydrologic Soil Group**:** C
	154	50-75%	49%	• **Predominant Soil Texture:** Gravelly fine loam • **Parent Material:** Residuum weathered from calcareous shale and/or sandstone • **Run-off Potential:** Very High • **Erosion Potential:** High • **Depth To Bedrock:** 20-40” • **Land Capability Classification*:** 7e • **Hydrologic Soil Group**:** C
Mocho Clay Loam	174	2-9%	14%	• **Predominant Soil Texture:** Fine loamy bottom • **Parent Material:** Alluvium derived from sedimentary rock • **Run-off Potential:** Medium • **Erosion Potential:** Moderate • **Depth To Bedrock:** >80” • **Land Capability Classification*:** 2e (if irrigated), 4e (unirrigated) • **Hydrologic Soil Group**:** C
** See Appendix B for expanded definitions of Land Capability Classifications. **See Appendix B for expanded definitions of Hydrologic Soil Groups.*				

All of the predominant soil types present on-property and up-watershed contain significant amounts of clay and are prone to expansion and shrinkage with annual precipitation and soil hydration cycles. Increasing the organic matter of the soil and reducing the frequency that the soil dries out will help to manage this. This will be most effectively achieved by reestablishing coverage of the soil by a diverse assembly of climate appropriate (temperature- and drought-tolerant, fire-resistant) plants of varying size and root depth (trees, shrubs, perennial grasses).

All on-property soils have very high runoff potential and high erodibility with the exception of the strip of mocho clay loam soil running alongside [redacted] at the bottom of the property, which has medium runoff potential and moderate erodibility. Increasing the permeability and water-bearing capacity of these soils and ensuring that any runoff that develops on them does not become channelized will be the best strategies for managing this. This will be most effectively achieved by reestablishing coverage of the soil by a diverse assembly of climate appropriate (temperature- and drought-tolerant, fire-resistant) plants of varying size and root depth (trees, shrubs, perennial grasses) and implementing earthworks such as swales, infiltration basins, and terraces to slow water, spread it out, and allow it to infiltrate the soil.

The strip of mocho clay loam soil at the bottom of the property would also benefit from revegetation with a diverse assembly of perennial trees, shrubs, and grasses - however, with careful management, the intensive growing of annuals can be safely achieved there.

Livestock should only be integrated on the low-to-moderately sloped soils, and only after perennial vegetation has been reestablished, and only with careful and intensive management.

Infiltration Tests

Infiltration tests were performed at the locations on property illustrated in Figure 1.5.3. The number of seconds were measured for 1 gallon of water to infiltrate into a **80.5** sq in area of soil, and that infiltration rate was extrapolated over the larger area this test site represented. The data gathered from these tests is summarized in Table 1.5.2, and was used in developing and sizing the earthworks plan for water infiltration.

Figure 1.5.3
PFH infiltration test locations.

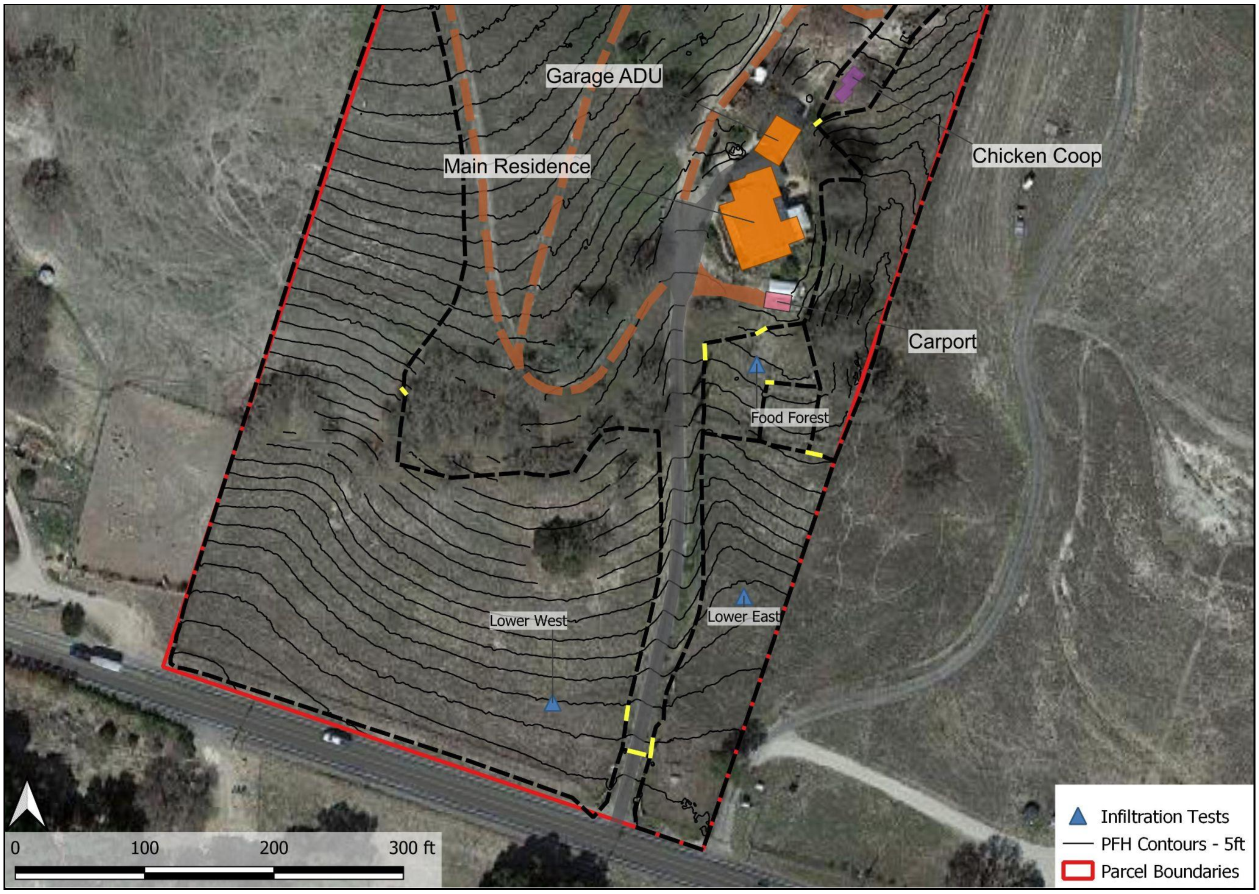


Table 1.5.2
Infiltration test results for various locations at PFH.

Infiltration Test Location	Time Elapsed (sec)	Infiltration Rate (gal/sq.ft./min) Standing Water	Infiltration Rate (in/min) Standing Water	Infiltration Per Acre Per Min (gal/acre/min) Standing Water	Infiltration Per Acre Per Hour (gal/acre/hr) Standing Water
Food Forest Zone	300	0.36	0.57	15,584	935,052
Lower East	30	3.58	5.74	155,842	9,350,519
Lower West	30	3.58	5.74	155,842	9,350,519

Existing Vegetation

Existing vegetation can reveal a great deal of diagnostic, historical and climatological information about a landscape. The type and quantity of species present, as well as their patterning across the landscape, can reveal helpful information regarding the current state of soil health and fertility, land use history, pH, and climate. Based on what is observed to be growing well on-site, climate analogue profiles can be created to help identify useful trees and plants from other locales that should do well at PFH.

Table 1.5.3
Existing wild/nativized vegetationat PFH.

Common Name	Scientific Name
Red Stem Filaree	*Erodium cicutarium*
Star Thistle	*Centaurea solstitialis*
Common Mustard	*Brassica rapa*
Black Mustard	*Brassica nigra*
Sahara Mustard	*Brassica tournefortii*
Milk Thistle	*Silybum marianum*
White Horehound	*Marrubium vulgare*
Blue Oak	*Quercus douglasii*
Swamp Mahogany (Eucalyptus)	*Eucalyptus robusta*
Lemon Eucalyptus	*Corymbia citriodora*
Oat Grass	*Danthonia californica*
Narrow leaf milkweed	*Asclepias fascicularis*
Olive	*Olea spp.*
Oleander	*Nerium oleander*
Black locust	*Robinia pseudoacacia*
Coyote Brush	*Baccharis pilularis*
Elderberry	*Sambucus nigra*

The indicators of note based on the existing vegetation survey for PFH are illustrated in Figure 1.5.4 and Figure 1.5.5. NOTE: These charts are inferences based upon observation. They should be confirmed with soil tests and prolonged site observation before informing any potential interventions. Minerals with votes in both the "High" and "Low" categories display a weaker signal than minerals with votes in only one category.

Figure 1.5.4

Likely PFH soil mineral profile characteristics based on present indicator plant and tree species. Any plant, or soil characteristic that indicates a high or low level of a certain mineral is counted as a "vote" for that profile.

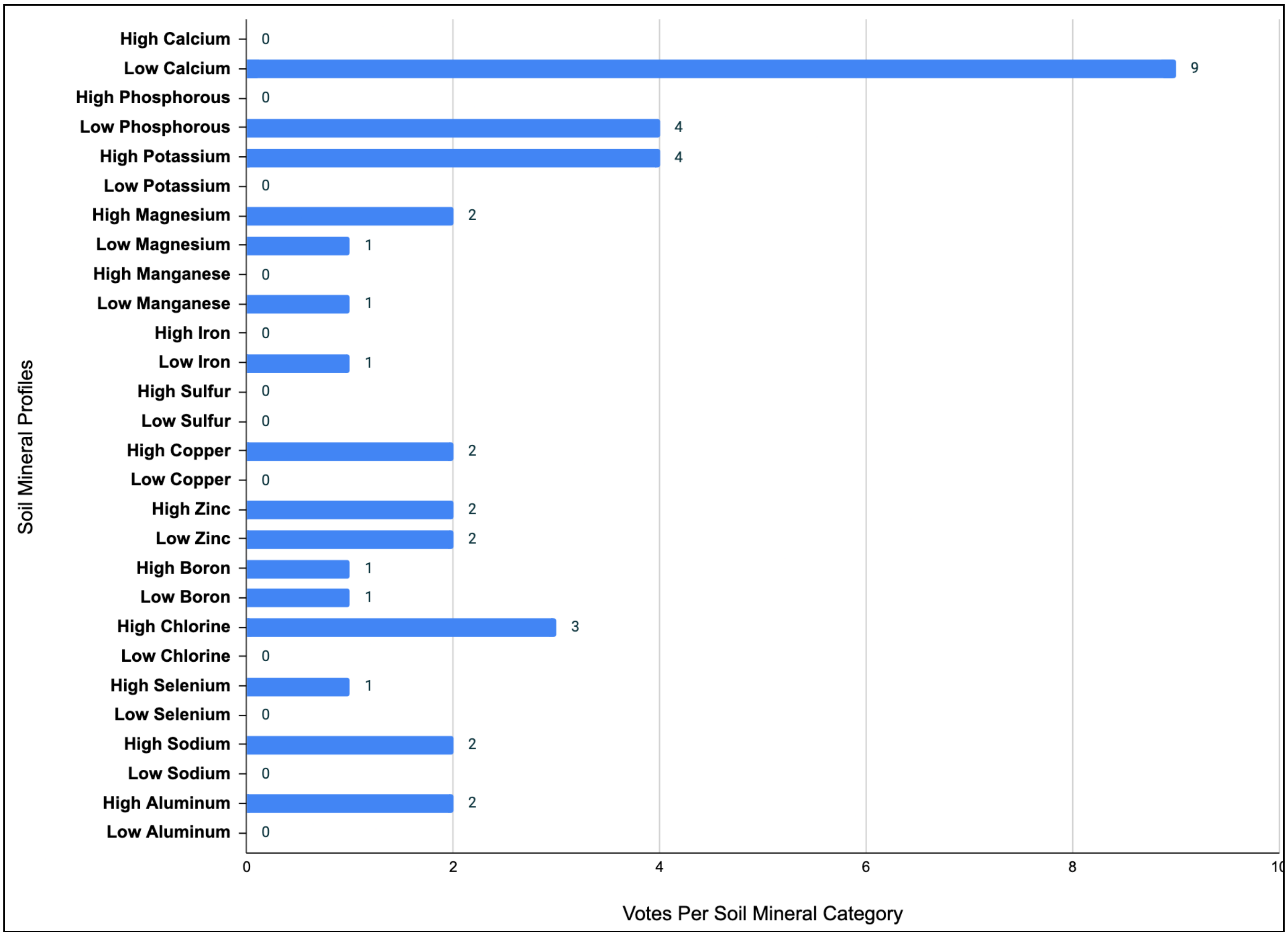
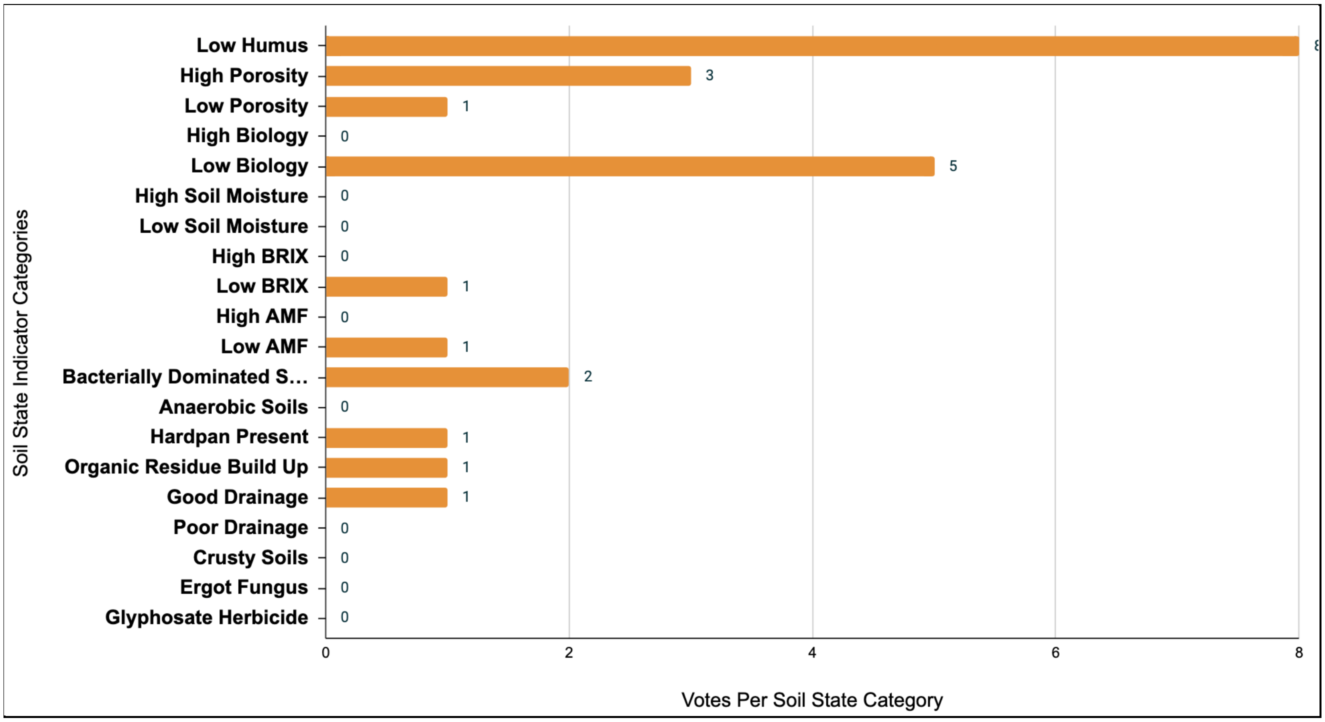


Figure 1.5.5

Likely soil state conditions at PFH based on present indicator plant and tree species. Any observed water, plant, or soil characteristic that indicates a high or low level of a certain mineral is counted as a "vote" for that profile.



- **Humus:** the mysterious but very important soil element for developing healthy, thriving soils.
- **Porosity:** Measure of how much pore space is present in the soil profile. Highly porous soils generally have high infiltration rates.
- **Biology**: A measure of how much diversity is present amongst soil biota. High biology soils tend to be diverse, fertile and resilient.
- **Soil Moisture:** Indicator of how much water is stored in the soil profile, and for how long.
- **BRIX:** Measure of plant sugars present in leaf tissues. Generally, higher BRIX equates to increased disease resistance, less frost damage, and more productive and nutritious plants.
- **AMF:** Arbuscular mycorrhizal fungi **-** important plant root associates.
- **Bacterially Dominated:** A measure of the degree to which bacteria or fungi dominate the soil.
- **Anaerobic Soils:** Indicates that anaerobic soil conditions may be present, which generally lead to higher incidences of disease and undesirable weed species.
- **Hardpan Present:** Indicates that a compacted sub-surface layer may exist that impedes water infiltration and/or root penetration to deep soil strata. Mostly commonly seen in agricultural lands frequented by heavy machinery.
- **Drainage:** Good = soil drains quickly, Poor = waterlogging, anaerobic conditions more likely to present.
- **Crusty Soils:** Indicates formation of a cryptogamic crust on the soil surface that may increase run-off and decrease infiltration of rainfall.
- **Ergot Fungus:** Indicates presence of this toxic fungus. Mostly a problem for livestock foraging on browse present on site.
- **Glyphosate Herbicide:** Indicates that glyphosate may have been used in this location in the past.

1.6 Legal and Utilities

Zoning

Per the San Luis Obispo County Land Use Ordinance Code (SLO CO LUOC), PFH is zoned Residential Rural (RR). A summary of potentially relevant information to the design and development of PFH is provided in the following paragraphs. A detailed breakdown of all allowable land uses and their permitting requirements can be found in the SLO CO LUOC online document viewer[17].

Notable land uses that are allowed subject to the approval of a "Land Use Permit" or "Land Use Permit Required by the Specific Use Standards" are: animal keeping, crop production and grazing, certain cannabis activities, certain energy-generating facilities, forestry, fisheries and game preserves, nursery specialties, specialized education and training schools, and temporary events.

Notable land uses that are permitted subject to the approval of a "Zoning Clearance" or "Site Plan Review" include: accessory dwellings, agricultural accessory structures, caretaker quarters, home occupations, mobile homes, residential care, residential vacation rentals, single family dwellings, temporary dwellings, farm equipment and supplies sales, child day care, bed and breakfast inns with 3 or fewer units, and storage facilities.

Notable land uses that are allowed subject to the approval of a "Minor Use Permit" or "Conditional Use Permit" include: agricultural processing, fowl and poultry ranches, and religious facilities,

Notable land uses that are not allowed include: multi-family dwellings, agricultural worker housing, hog ranches, any industrial, manufacturing, and processing,

The following are exempt from land use permit requirements:

- Ordinary repair to buildings, provided that such repair do not include any change in the approved land use of the site or building, or increase the total floor area of the building.
- Walls and fences:
  - Walls or fences of 6'6" or less in height, located in compliance with SLO CO LUOC Section 22.10.080.
  - Open wire fences of any height in the Agriculture and Rural Lands land use categories (AG and RL).
- Minor construction - the erection, construction, enlargement, removal or conversion of any building or structure, where:
  - the total valuation of work does not exceed $1,500 as determined by the county fee ordinance and both the building or structure and the proposed expansion or modification are in conformity with all applicable provisions of the SLO CO LUOC; or

[17] https://library.municode.com/ca/san_luis_obispo_county/codes/county_code?nodeId=TIT22LAUSOR

    - a one time expansion of the structure does not exceed 10 percent of the total floor area, and both the building or structure and the proposed expansion or modification are in conformity with all applicable provisions of the SLO CO LUOC.
- Agricultural accessory buildings - structures designed and built to store farming implements, hay, grain, poultry, livestock, or horticultural products (not including commercial greenhouses or buildings associated with agricultural processing activities (Section 22.30.060)), in which there is no human habitation and which is not used by the public, are not required to have a land use permit unless the structure meets one or more of the following criteria:
    - The structure is proposed in an area designated other than Agriculture or Rural Lands by the Land Use Element; or
    - Is located within an airport review or flood hazard area combining designation; or
    - Is located on a site of less than 20 acres; or
    - Is located within 100 feet of any adjacent property or public road; or
    - Has a gross floor area exceeding 5,000 square feet or contains more than a single story plus storage loft; or
    - No existing or apparent agricultural use on the property.

  An agricultural accessory building that satisfies any of the above criteria requires a Zoning Clearance. An agricultural accessory building that is not required to have a land use permit is still subject to the standards of Section 22.30.060 B, C and D (Agricultural Accessory Buildings) and any other applicable provisions of the SLO CO LUOC.

- Crop production and grazing. No land use permit is required for crop production, provided that industrial hemp cultivation is subject to the standards of Section 22.30.244, and where an Agricultural Offset Clearance is required for new or expanded irrigated crop production using water from the Paso Robles Groundwater Basin (excluding the Atascadero Sub-basin). No land use permit is required for grazing activities where allowable.

Septic Codes

Septic systems/hookups are required at this site.

Home-Owners Associations

The property is not associated with any home-owners associations known to the design team.

1.7 Land History

Atascadero, a Spanish name which, loosely translated, means "a muddy place", was originally home to the Salinan Indian tribe. Salinan villages were once located throughout the entire Salinas Valley, with their northern boundary near what is now the city of Salinas, southward to the Santa Maria River. On the coast, they ranged from as far south as today's Guadalupe in Santa Barbara County northward to Dolan Rock, and their eastern boundary was marked by the Diablo and Temblor Ranges and the Carrizo Plains. The name Salinan, which was taken from the nearby Salinas River, is believed to have come into use in the 1890's, but local tribal tradition indicates that their native name is T'epot'aha'l, meaning “The People”. The language of the Salinan tribe is Hokan, which dates back as far as 6,000 to 8,000 years and is one of California’s oldest known languages.

The native Salinan people are quite likely to have sometimes been drawn to a natural, low lying and shallow basin where water from rainfall and run-off would have gathered and that would one day become known as Atascadero Lake.

In the half century between 1769 and 1823 the Spanish Franciscans established 21 missions along the California coast, including the nearby Mission's San Miguel Archangel, and San Luis Obispo de Tolosa. In 1821, Mexico won its independence from Spain, and California became a Mexican province.

The settling of what is now known as Atascadero began with the Franciscan clergy who managed the 60,000-acre Rancho Asuncion until 1833, when the Mexican government secularized the mission lands. Governor Rio Pico then granted Pedro Estrada nearly 40,000 acres, part of which would eventually be a portion of the 23,000-acre Rancho Atascadero.

At some point during that time, a stage stop known as Cashin Station was developed where Paloma Creek flows into the Salinas River (close to Halcon Road behind the State Hospital). A man named Juan Araujo settled nearby in 1851 (a year after California became a state). This settlement grew to include a small rural school, a general store, and a flag stop for the Southern Pacific railroad, and became known by a variety of names including Cashin, Dove, Paloma and Eaglet.

The land that made up Rancho Atascadero continued to change ownership until Edward Gardner Lewis, a successful magazine publisher from the East, gathered investors and purchased it from J.H. Henry in 1913 for $37.50 an acre to found the planned utopian colony of Atascadero.

In 1914 the land was surveyed and subdivided. Thousands of acres of orchards were planted, a water system was installed and construction began on an 18-mile road (now Highway 41 west) through the rugged Santa Lucia Mountains to the ocean.

Atascadero was incorporated in 1979, and is now the third largest city in San Luis Obispo county with nearly 28,000 residents.

References:

- Santa Margarita Historical Society
- City of Atascadero

2. Water

Water is an essential input for all living organisms on Earth (as far as humans know) - animals, plants, fungi, bacteria, and protists. In some organisms the percentage of body weight made up of water exceeds 90%; in humans, this number ranges from 60%-75%. A loss of just 4% of a human's total body water leads to dehydration, and a loss of 15% can be fatal. Likewise, a human can survive beyond a month without food, but wouldn't survive 3 days without water.[18]

Why is water so essential to life? Water serves a number of essential functions for living organisms, including:

- A building medium and lubricant for cells, the DNA and proteins within them, and the membranes that surround them;
- A solvent, dissolving food into the nutrients needed for cellular metabolic processes;
- A vehicle, transporting those nutrients to cells throughout the body for those metabolic processes and removing wastes;
- A temperature buffer for cells and the bodies that contain them (through sweating and respiration in animals, transpiration in plants);
- An electrical conductor and battery, moving and separating charge throughout a living cell as it metabolizes food and performs its essential functions[19];
- A recorder, transmitter and imprinter of molecular and vibratory information.

This information alone makes water the most necessary of homestead requirements, however, water also has properties that make it well-suited in providing for a number of other functions, including moving things, moderating climate, and recreation.

The water used on most properties for household and landscape is typically piped in from a municipal water company or pumped from a drilled well. While, for many landowners, the day-to-day consistency of these sources provide a convincing case for water security, others are quickly realizing the hard way that these water sources are not as secure as once thought. Landowners on a municipal water supply are subject to the pricing and whims of the utility, which is subject to the whims of the politicians, special interest lobbies, the environment, electrical grid, and water supply. Well owners are also subject to the whims of the electrical grid (or solar/wind systems) – but additionally, in many areas well owners are coming to find their flow rate dropping or even disappearing altogether as underground aquifers are depleted.

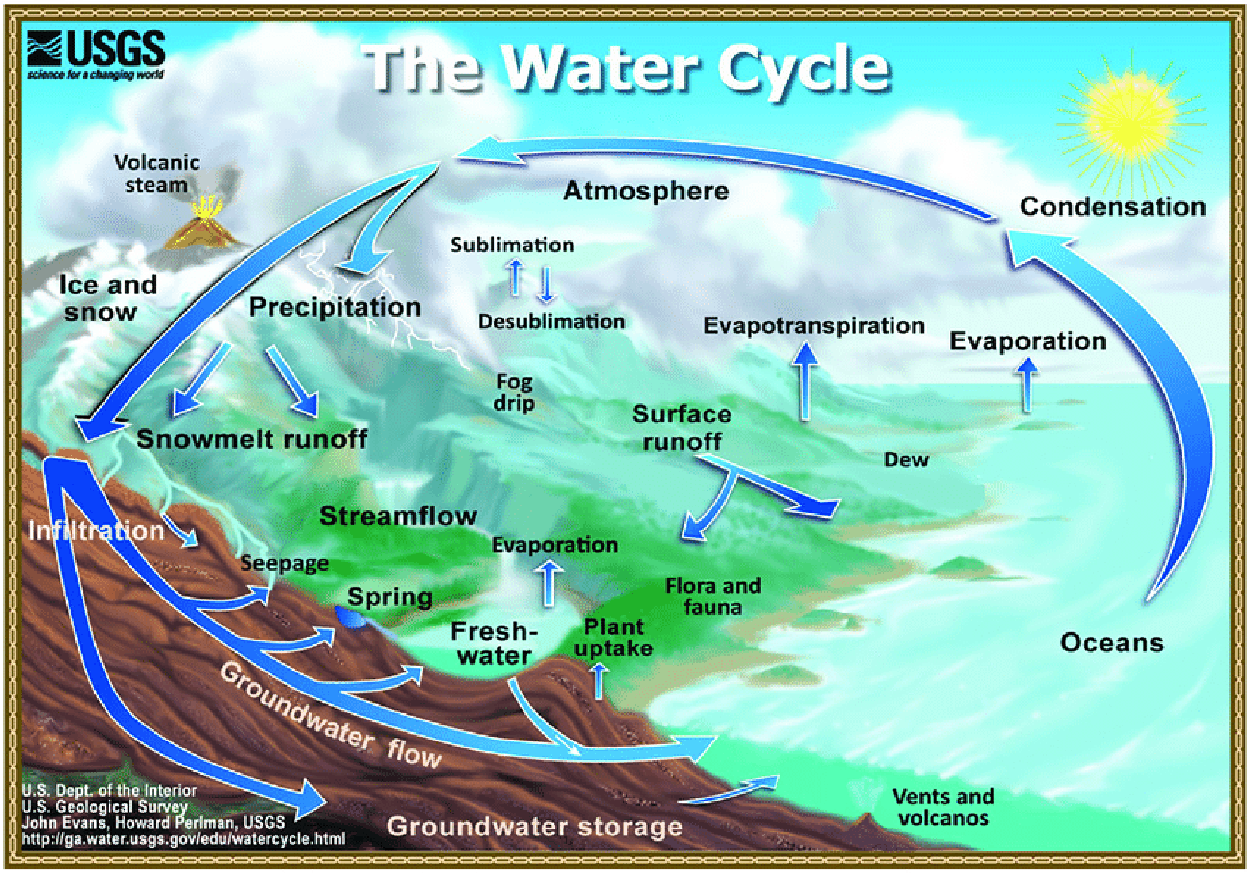
These issues speak to the critical need for landowners to work with water and embrace its presence on-site - and beyond that, to actively tend to the hydrological health of the watershed in which their property lies.

[18] https://sitn.hms.harvard.edu/uncategorized/2019/biological-roles-of-water-why-is-water-necessary-for-life/
[19] https://www.youtube.com/watch?v=nSbg3cuZNRQ

The Four R's of Regenerative Hydrology

The actions of regenerative hydrology can be expressed in terms of sound fiscal budget management. The 4 R's of a water budget - **receive, recharge, retain, and release** - are equivalent to income, deposit, savings, and expense. Landowners should ensure that the water balance of local watersheds is in the blue and not in the red, that liquid assets continually produce a high-quality return on investment, and re-invest returns back into local watersheds to continue building principal.

Figure 2.0.1
The water cycle.



Receive = Income

Watersheds only receive water as snowfall, rainfall, dew condensation and fog precipitation. Annual precipitation is the only true source of ***income*** to re-supply a property's water budget allowance. Everything else (drafting fossil aquifers, importing from other areas) is drawing down on principal.

Regenerative hydrology advocates the adaptive management of watershed lands to optimize rehydration by promoting land use patterns that enhance the receptive capacity of a watershed in times of excess and the retentive capacity in times of drought.

Recharge = Deposit

Recharge processes are critical for the landscape to annually refresh itself via the deposit slip called infiltration. The capacity to make water deposits depends on the watershed's recharge potential. Precipitation received by the watershed must percolate and be absorbed, or else there is no replenishment of the water savings account.

Recharge potential and functions are impaired by the hardening and paving over of natural recharge areas, the disconnection of rivers from their floodplains, the deforestation of native vegetation, and the draining of wetlands.

Retention = Savings

The retention of recharged precipitation is like a savings account asset that yields interest. The storage of water is often the most challenging aspect of water supply management. Regenerative hydrology strategies should appropriately slow water down, increasing the residence time of water storage in our watersheds. This will optimize the amount of water available for local expense by living processes.

A landowner (and their surrounding community) is wise to avoid overdrafting of their local watersheds. To be in the blue, a healthy albeit challenging goal is to never extract out of storage (groundwater) in amounts greater than what is annually received and recharged. While this can go on for a while, eventually a penalty must be paid. In situations where this is currently occurring, landowners can take steps to mend the broken hydrological cycle to ensure that as much water as possible is being returned and put to highest use in the landscape before it leaves.

Release = Expenditure

Ideally, expenditure of water assets will go to further increase the reception, recharge and retention capacities (the first 3 R's) of the watershed.

Water is released naturally to the ocean, land and atmosphere in a process known as the water cycle. Through seasonal snow and ice melts, groundwater springs and seeps, water is returned to creeks and rivers. Solar evaporation and the evapo-transpiration of plants help to form new clouds and feed the cycle anew. The infinite nature of this cycle is to continually flow and be in flux as the expense of one stage produces income for the next.

Common modern development and land management practices (creating impervious surfaces, channelizing stormwater, poorly-managed animal grazing, etc.) tend to increase the rate and volume of storm water's return to the ocean via excessive runoff and heightened flood discharges. This directly reduces the landscape's ability to retain water and diminishes the amount of water available for later release during the dry season when it is most needed.

2.1 Providing Hydration

Plants hydrate themselves primarily through their roots and associated symbioses with fungi in the soil, while animals hydrate themselves by drinking water directly and through the consumption of plants and other living organisms. Thus, some key design goals for water on our homesteads should be to ensure that our soils and local atmosphere are properly hydrated and we have secure access to drinking water.

This report classifies water elements that provide hydration to plants and animals into 3 main categories: open water bodies, passive water harvesting systems, and active water harvesting systems.

- **Open Water Bodies -** Open water bodies can be naturally occurring or man-made, and include springs, creeks, rivers, pools, ponds, and lakes. These water bodies, in most cases, have associated riparian habitats that are highly diverse and productive, given their location at the intersection between the terrestrial and the aquatic. Open water bodies can be a tremendous benefit to the local ecology, providing water, food and habitat to a broad range of creatures and bringing them all into close contact and relation with one another (humans included).
- **Passive Water Harvesting Systems -** Passive water harvesting works by shaping the earth to slow the velocity of runoff, infiltrate it into the soil, and direct it to where it can be beneficially used by vegetation. Passive water harvesting features include swales and berms, dry stream beds, infiltration basins, retention ponds, pumice wicks, and more. They are typically less expensive, simpler to build, lower maintenance, and longer lasting than active water harvesting systems.
- **Active Water Harvesting Systems -** Active water harvesting uses rain barrels, cisterns, pools and other types of containers (including earthen ones) to store rainwater for later distribution. The stored water can be used outdoors to irrigate vegetation or indoors for non-potable (toilet flushing, laundry washing) and potable (with proper filtration and disinfection) uses. Active water harvesting systems can "extend" the rainfall season and maximize the use of collected water, but are also significantly more expensive than passive systems.

Existing Conditions

Existing water elements that are providing hydration to plants and animals at the site include:

- Groundwater, electrically pumped from a drilled well in the southeast corner of the property to a pressure tank in the Main Residence, from which it is distributed to the various water fixtures on the property. Spigots located throughout the most habited zones of the property, including an RFC at the southwest corner of the driveway parking area.
  - Groundwater was previously pumped to water storage tanks located atop the West Ridge. The supply line from the well pump and distribution lines to the various

fixtures around the property are still in place, however the water tanks have been decommissioned in favor of the pressure tank at the Main Residence.

Recommendations

The following elements for providing hydration should be considered in the development of a whole-site design:

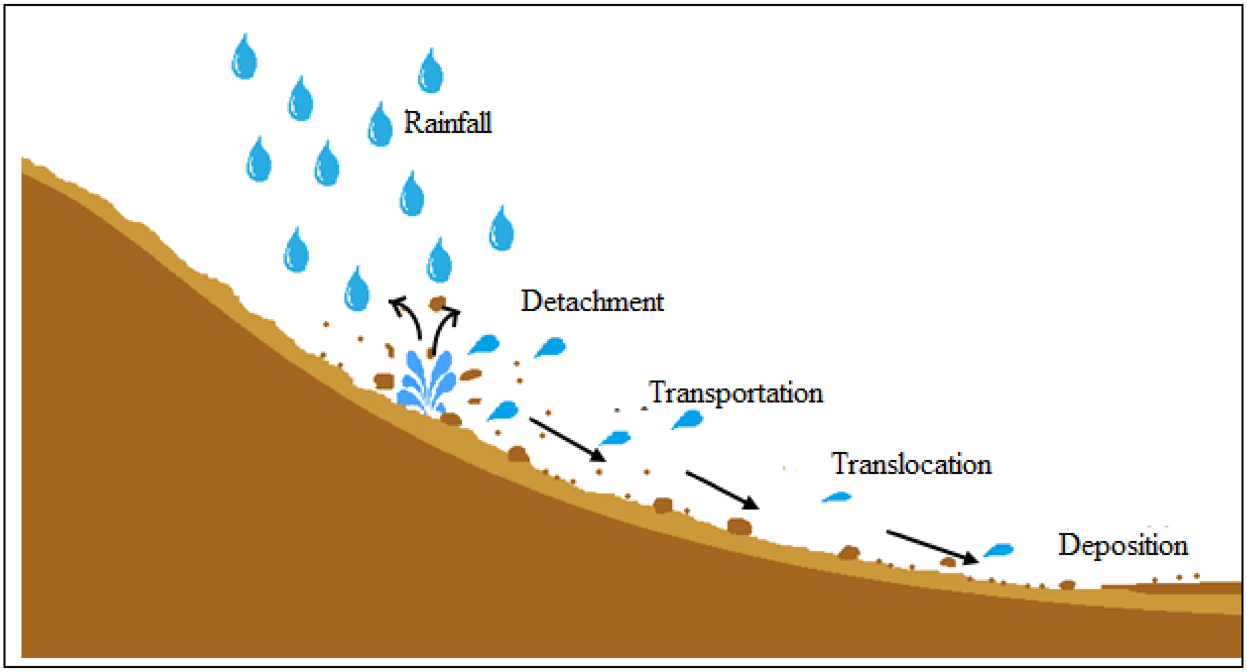
- Install a passive water harvesting system (consisting of a network of swales, terraces, and energy dissipation pools) in the Food Forest Zone and Lower Pastures in order to capture and infiltrate into the soil the estimated 0.49 - 1.25 million gallons of water that is currently being lost as runoff in that area per average rain year. This will keep the soils downslope of these areas hydrated for longer into the dry season and recharge groundwater levels at the bottom of the property.
- Consider recommissioning the water storage tanks in order to provide a buffer of stored water in the event of well pump failure. Well water can be pumped to the water tanks and then supplied via gravity to the various end-use spigots on property. If greater water pressure is needed at specific locations than can be provided by gravity with the tanks in the current location, consider relocating the water storage tanks to a location higher up in the NW corner of the property and/or adding a booster pump integrated with a pressure tank at the end-use location. If greater water storage capacity is desired, consider adding additional water storage tanks.

2.2 Moving Things

Water moves from higher areas on the landscape to lower areas as a result of Earth's gravity. This energy source is responsible for the moving water features in our natural landscapes like streams and waterfalls and also in our built-environments in the form of rivulets of runoff down a sloping driveway and sheetflow off of a roof. And where there is moving water, there will be the movement of material - called erosion. Erosive processes are not an inherently negative thing - they are responsible for the creation of rich floodplain soil and some of the most beautiful forms found in nature. However, erosion can also be damaging to natural and built environmental function and integrity when it occurs in large amounts, high rates or for long time periods at scales greater than the ecology (or built structure) can handle.

Erosion is most pronounced on bare soils where rain drops impact the ground at high speed. The impact of the droplet breaks apart soil particles into finer and finer pieces, continually sifting the finest pieces to the top. These "fines" are often the important ingredients that distinguish living soil from dirt - organic matter, humus, sticky substances exuded by bacteria and earthworms that bind particles together etc. As the precipitation continues, eventually sheet flow begins, where a constant sheet of water flows over the soil surface, sweeping all of the fine materials downhill. The heavier and more intense the rainfall, the thicker the sheetflow, and the greater its capacity for moving larger pieces of material.

Figure 2.2.1
Unimpeded raindrops are tremendously destructive to bare soil.



Erosive processes can be halted using earthworks (like the passive water harvesting systems discussed above), living systems (plantings), and geological systems (rock-armored flow control structures), or - most often - a combination of all three. All of these techniques collect and allow for the settling of the material being carried by moving water, recreating the soil layers that have been lost.

While topsoil loss is generally undesirable, the same characteristics of moving water that result in erosion can also be leveraged to intentionally and beneficially move other materials - from small materials like soil particles from hands being washed in a sink to large floating barges moving materials downstream. Moving water can also be used to rotate shafts connected to machinery to do work.

This section describes elements at the site where moving water is and can be used to move things. The systems beyond gravity that provide for the movement of water itself, including fossil fuel- and electricity-powered pumps, will be discussed in greater detail in the Energy chapter.

Existing Conditions

The elements that are currently utilizing water to moving things (including where undesired, in the case of erosion) are:

- There is evidence of erosion on the western side of the Driveway where runoff from the Main Property Hub pad is getting trapped and flows all the way down to [redacted].

Recommendations

The following elements for moving things with water (or eliminating the unwanted movement of things by water) should be considered in the development of a whole-site design:

- If the Food Forest and Lower Pastures Passive Water Harvesting System presented in 2.1 - Recommendations for Providing Hydration is pursued, an accompanying water drainage system consisting of a network of geologically-armored spillways, geologically-armored erosion control structures, and a culvert should be installed in the Food Forest and Lower Pastures to non-erosively transmit overflow water between the passive water harvesting elements.
- Consider adding rain gutters to the Main Residence, Garage ADU, Barn, and Tiny House. Main Residence and Garage ADU run-off should be patterned directly into the Food Forest Swale. Barn and Tiny House run-off should be patterned into nearby productive plantings zones.
- Consider installing channel drains at regular intervals on the Driveway to collect run-off from the Main Property Hub (including hard- and soft-scapes and structure roofs) that currently flows down the west side of the Driveway and non-erosively move it into the Food Forest Zone and Lower Pastures Passive Water Harvesting and Drainage Systems.
- Consider installing a lead out ditch/rolling dip across the turn-around in front of the Barn to help water move across this zone without puddling. Water collected by this element can be patterned through poultry yard growing systems and ultimately into the East Drainage.
- Consider installing water bars and/or rolling dips integrated with lead-out ditches above the steepest section of the West Ridge Loop Road to prevent entrapment and accumulation of water on the slightly entrenched road surface. Driving on this section should be limited unless absolutely necessary to prevent further entrenchment. Consider utilizing the lengthier but more gently-graded eastern half of the loop to reach the Tiny House or Water Tanks.

2.3 Moderating Climate

Water has a volumetric heat capacity more than twice that of concrete and three times that of bricks - meaning that it can absorb and release either twice as much heat as in the same volume of concrete or the same amount of heat in only one-half of the volume of concrete, or three times as much heat in the same volume of bricks or the same amount of heat in only one-third of the volume of bricks. This property makes it an excellent material for moderating climate, whether it be for an area around a water tank where plants more sensitive to extreme temperatures can be raised or for the interior of a house with water tanks strategically placed inside.

This section describes the elements at the site where water is (or can be) used to moderate climate.

Existing Conditions

Existing water elements that moderate the climate at the site include:

- The water storage tanks at one point were providing climate moderation to the surrounding area, however they are currently decommissioned.

Recommendations

The following elements for moderating climate with water should be considered in the development of a whole-site design:

- If the water tanks are recommissioned, consider planting species around the tanks to screen and shade the tanks. Species can be trialed here that would benefit from the moderated climate not available elsewhere on property.

2.4 Providing Re-Creation

The benefits of water recreation are not always readily apparent, nor easily measured. The time and energy spent installing a water tank has the tangible benefit of stored water for use at a later time. In contrast, a day of immersion in a pool provides nothing in hand, but, instead, offers refreshing experiences and pleasant memories. This, however, is the purpose of recreation: to re-create or to renew.

Fortunately, water elements that provide for recreation also provide for at least one of the other functions already described in this report - hydration, the movement of things, and the moderation of climate - and often multiple.

This section describes those water elements at the site that provide for recreation.

Existing Conditions

There are no existing water elements onsite that provide for recreation.

Recommendations

No recommendations for improving existing recreational water elements have been identified at this time. Additional recreational water elements should be considered in the development of a whole-site design.

3. Access

Access is how humans and animals get in and around a site, particularly in relation to water and activity patterns. Access can often be a restricting factor when selecting appropriate management strategies. Additionally, access routes present huge opportunities for passive water harvesting on- and off-property. While access routes, especially roads, are costly to create or modify, a well-designed and placed access route can result in lower long-term maintenance costs, and efficient movement of people, animals, and materials around a property – while a poorly designed access route can lead to huge erosion issues, extensive maintenance costs (until the route ultimately becomes infeasible to maintain and access is lost), the sacrifice of water harvesting opportunities, and unnecessarily spent energy in trying to move about the property.

Site topography and its resultant influence on the movement of water through and within the site is the primary influencer of access route placement. How water interacts with any access route, be it a hard top road or a deer trail, will determine the route's long term stability and required level of maintenance. The following list summarizes the rules of thumb for good access design:

- Harmonize with the patterns of water already present in the landscape when planning, installing or remodeling access routes. This will always lead to better performance and lower maintenance costs. Good access at minimum maintains watershed function, and ideally improves it.
- Cross valleys, whenever possible, along dam/pond walls or following contour; traverse a landscape on contour as much as possible; and ascend and descend the landscape along ridge lines (these areas have the least potential to accumulate water in destructive volumes).
- Drain water from access routes as often as possible, and always at first chance and last chance locations. Erosive runoff water should be diverted from the access roads[20] as shallow, non-erosive flow using rolling dips, crowning, cut-off drains, and water bars into passive water harvesting systems such as swales and retention basins.
- Maintain access routes regularly - A stitch in time saves nine.

For reporting purposes, access routes have been divided into two categories: roads and human/animal access paths.

3.1 Wheeled Access

Wheeled access refers to any access routes that are designed and built to accommodate people and things being transported on wheels (vehicles, heavy equipment, trailers, animal-drawn carts, etc) - typically referred to as roads. Roads typically have a specially prepared surface to designed to sustain wheeled traffic across as much of the year as possible - in urban and suburban areas with heavy wheeled traffic this surface is usually asphalt or concrete laid on a compacted base course,

[20] https://www.7thgenerationdesign.com/vehicle-access-drainage-prescriptions/

but most ranch and farm roads still utilize dirt and gravel road surfaces and may only provide access for part of the year.

Existing Conditions

Existing elements that provide access for wheeled transport include:

- Paved driveway leading from [redacted] directly upslope to a paved parking area in front of the Main Residence totaling 7,288 square feet in surface area and 515 feet in length. Driveway shows some moderate erosion damage due to water becoming trapped on the road surface all the way to the bottom.
- Unpaved parking area immediately south of the Main Residence totalling ~ 770 square feet.
- Unpaved driveway continuing to the Barn, including turnaround in front of barn totaling approximately 4,780 square feet and 260 feet in length.
- Unpaved West Loop Road that leads up to Water Tanks 1 and 2 and the Tiny House site. Total length is approximately 1,080 feet. Some sheet erosion is occurring on the steeper downhill section running north x south.

Recommendations

The follow elements should be considered in the development of a whole-site design:

- Consider installing an access road that leads from the carport into the upper part of the Food Forest via a tractor access gate and along the Food Forest's eastern fence line to another tractor access gate leading to the Lower East Pasture. This will allow for the efficient movement of materials throughout the Food Forest and to the Lower East Pasture using the tractor.

3.2 Foot Access

Foot access refers to any access routes that are specifically designed to accommodate walking/running animals (including humans). They may be large enough to accommodate a wheelbarrow or handcart, but generally exclude motor vehicle or trailer access due to width, grade, turning radii and/or vegetative cover.

Existing Conditions

- All of the wheeled access roads double as foot access paths.
- There are footpaths located throughout the Main Residence and Garage ADU pad, which lead:
    - around the perimeter of each structure,
    - to neighboring seating areas,
    - to a fenced garden area below,
    - to the Chicken Coop, and
    - to the Barn.

- There are footpaths that lead from the Main Residence and Barn parking areas to the West Ridge, including to the Tiny House.

Recommendations

No recommendations for improving existing recreational foot access have been identified at this time. Additional foot access elements should be considered in the development of a whole-site design.

4. Shelter

Shelter refers to any elements that are designed to harvest and/or block environmental sectors - energies coming from off of a design site such as rain, wind, sun, heat, and cold, views, noise, etc. In functional design, shelter elements (such as homes, sheds, barns, greenhouses, etc) are placed in relation to on-site water and access patterning and desired/necessary frequency of interactions. This interconnected, efficient approach to element placement saves large amounts of energy over the lifetime of the site. As an example, siting a home for a view at the highest point on the property is often not the best practice, as inefficiencies increase due to the reliance on mechanical and/or electrical sources to bring pressurized water to the site, comfort levels decrease (or shelter construction costs increase) due to higher wind speeds and greater temperature swings, and the cost of placing and maintaining a road up a slope is greatly increased.

Designing with a consideration for the entire site provides foresight that enables expansion to happen intentionally and consciously. When site patterns are examined, such as topography, natural water features, access, and environmental and human sectors, the ideal positions for the various design elements quickly reveal themselves. Even if a home or other shelters were already present in less than ideal locations when the land was purchased, any future structures can be placed with these principles in mind.

4.1 Sheltering Individuals & Families (Residences)

Residences for the purposes of this report are permanent structures intended to provide shelter and comfort for human individuals and families.

Existing Conditions

- **Main Residence -** The Main Residence on the [redacted] Family Homestead is a single-level home oriented with the entry and longest side facing southwest. Large viewing windows on the southwest-facing wall, and the absence of any substantial roof overhang or shade structure, contributes to excess thermal gain during the long summer days. The total roof area of the house and attached overhangs is approximately 3,030 square feet. The backyard area has both covered and open-to-the-sky seating.

Figure 4.1.1
Main Residence at PFH.

- **Garage -** The Garage is located immediately north of the Main Residence, separated by the concrete parking area and by a narrow walkway leading into the backyard of the Main Residence. The structure is oriented lengthwise running southwest x northeast. Its total roof area is approximately 745 square feet. A concrete patio is located outside the rear entrance to the structure, of approximately 400 square feet in size.

Figure 4.1.2
North side of the Garage ADU and the attached patio at PFH.

- **Tiny House -** The Tiny House located approximately 200' north of the Main Residence, and was inherited from the prior owners. The structure is largely complete, but needs some interior finishing and exterior clean up to be ready for habitation. The roof area is approximately 180 square feet. The house is oriented lengthwise on a northeast by southwest axis. A small storage shed is located immediately adjacent to the Tiny House to the southeast, and part of the space between the two is sheltered by a shade awning.

Figure 4.1.3
Tiny House at PFH.

Recommendations

The follow elements should be considered in the development of a whole-site design:

- **Main Residence**
  - Addition of some form of overhead shade trellising along the southwest wall and roofline to develop warm season shade and mitigate the intensity of late day warm season sun. Planting deciduous vines in wicking bed planters along the deck railing will provide shade during the summer and preserve low-angle light penetration into the main living space to assist in keeping it warm during winter.
  - Addition of gutters to capture and direct roof run-off away from the home's foundation and into productive plantings (such as the planned Food Forest zone south of the Main Residence).
- **Garage / ADU**
  - Addition of gutters to capture and direct roof run-off into productive plantings (such as the planned Food Forest zone south of the Main Residence or to future backyard rain garden plantings).
- **Tiny House**
  - Similar to the Main Residence, some form of overhead trellising over the front double doors will provide a structure for deciduous vines to grow and create shade from the intense summer sun, while still permitting low-angle winter light to enter the structure.
    - Alternatively, a shallow-pitched awning that will still permit winter light to enter the structure while blocking high angle summer sun from entering

through the double doors will also benefit the thermal regulation within the structure. A small covered front porch area is also tremendously useful for tiny house living (being able to remove dirty or wet clothing and shoes *outside* the house counts for a lot when living tiny).

  - Add awnings or thermal shutters (mounted on the exterior of the house) to the southwest and southeast facing windows to prevent excess thermal gain during the warm season.
  - Add gutters to collect and channel roof run-off into nearby productive plantings.

4.2 Sheltering Community (Gathering Spaces)

"Community shelters", or gathering spaces, refer to any areas sheltered from at least a single sector energy that are designed, whether intentionally or by happenstance, as places where people gather. They are shared by family members, multiple families, households, extended households or neighborhoods. This includes community kitchens, offices, schoolhouses, music rooms, pergolas, covered decks, kids play zones, etc.

When intentionally designed to foster human-to-human connection, these spaces rapidly develop a gravity of their own and become the place to see, be seen, and interact with family, friends and community members - the "heart" of a healthy human habitat. *A Pattern Language*[21] by Christopher Alexander et al. is an excellent resource for learning and applying organically evolved patterns of human habitation to the process of creating places that facilitate healthy patterns of being amongst groups of people.

Existing Conditions

- **Main Residence Backyard -** The Main Residence Backyard is a primary gathering area for groups of people at PFH. A triangle of bench seating, an outdoor dining table, covered sitting area, and outdoor charcoal and gas grills provide the bones for an excellent gathering area.

[21] https://www.patternlanguage.com/

Figure 4.2.1
Main Residence backyard hang out and gathering area.

- The **Treehouse** located in one of the blue oaks to the northwest of the Main Residence will be an irresistible draw to kids in the near future.

Figure 4.2.2
Treehouse and swing set amidst a great climbing tree.

- **Garage Back Patio -** Behind the Garage is a concrete patio approximately 400 square feet in area. It is currently home to a foursome of chairs and a small portable fire circle.

Figure 4.2.3
Garage Back Patio.

Recommendations

No recommendations for improving existing community gathering spaces have been identified at this time. Additional community gathering elements should be considered in the development of a whole-site design.

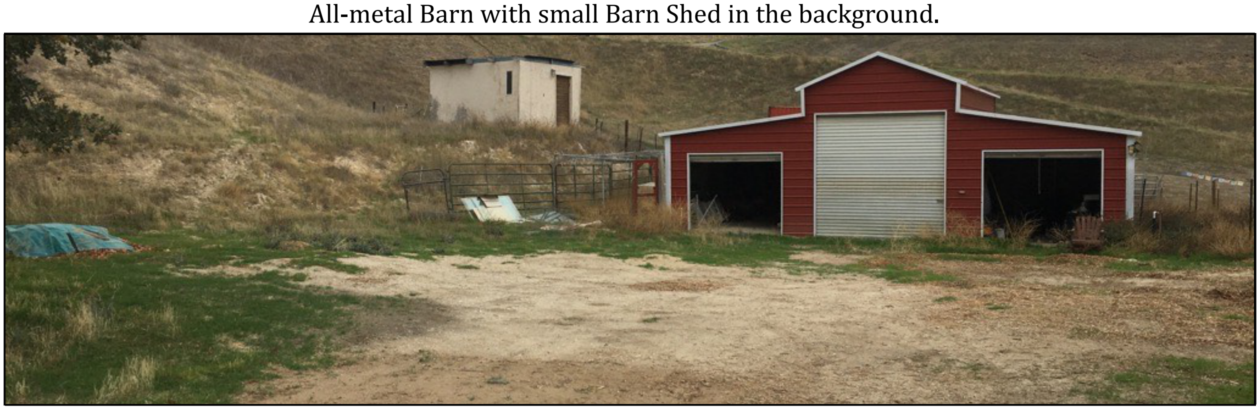
4.3 Sheltering Things (Shops/Sheds/Outbuildings)

Shops and sheds are structures designed to provide either indoor working space or storage. They are typically located with the anticipation of long-term or permanent placement.

Existing Conditions

- **Barn -** The Barn is located northeast of the Main Residence approximately 170'. It is of all-metal construction and has a roof area of approximately 1,160 square feet. Three roll-up doors on the front lead to three bays, the middle being the largest and with the highest ceiling. A single roll-up door permits entry to the Barn Paddock out the rear of the structure. A large flat turn-around area in front of the Barn provides for easy vehicle and tractor access. The structure appears to be relatively new and in good repair. It is currently where the PFH tractor and numerous other farm implements, equipment and tools are stored.

Figure 4.3.1
All-metal Barn with small Barn Shed in the background.



- **Barn Shed -** A small shed is located behind the Barn. The structure is quite dilapidated and currently not functional as weather-proof storage.
- **Tiny House Storage Shed -** The storage shed immediately adjacent to the Tiny House also has an awning that shades some of the space between the two structures. The shed and awning together have a total roof area approximately equal to that of the Tiny House (~180 sq.ft.). See Figure 4.1.3.
- **Carport -** The Carport currently serves as a place to store farm implements and materials in a place partially protected from rain. The structure qualifies as temporary and could be readily moved or disassembled. It is located immediately south of the Main Residence on the pad connected to the paved driveway. The roof area of the Carport is approximately 260 square feet. It could provide covered parking for a single vehicle or the tractor.

Figure 4.3.2
Carport.

Recommendations

The follow elements should be considered in the development of a whole-site design:

- **Barn**
  - Installing rain gutters on the Barn roof edges will allow for roof run-off to be captured and directed to productive use at a relatively high location in the landscape. This could prove very valuable for irrigating downslope plantings and providing water to livestock.

4.4 Sheltering Animals (Barns/Coops/Pens)

Animal shelters are designed to protect animals from the sun, rain, and large temperature fluctuations. They can be either permanent, portable or temporary.

Existing Conditions

- **Chicken Coop** - The Chicken Coop is located northeast of the Main Residence on a gentle south-facing slope. The run is open to the sky and is fenced with chicken wire. The coop is connected via a protected chicken wire run to a semi-outdoor covered area wrapped completely in chicken wire.

Figure 4.4.1
Existing animal shelters at CFR.

- **Barn and associated Barn Paddocks -** the Barn (see Figure 4.3.1) could be (and once was) utilized to shelter livestock. The fenced paddock behind the barn is approximately .13 acres in size, and can be accessed by people via the two human-sized gates on the north side of the Barn and via the tractor-sized gate at the paddock's northwest corner.

Recommendations

No recommendations for improving existing animal shelterings at PFH have been identified at this time. Additional animal shelter elements should be considered in the development of a whole-site design.

5. Living Systems

This chapter on Living Systems pertains to the biological components of all existing and proposed elements and systems at PFH. This includes but is not limited to vegetative systems (terrestrial and aquatic), animal/insect growing systems, mycological systems and bacterial systems.

There exist abundant possibilities for what can be grown on any piece of land. The process of whittling down the mountain of possibilities to readily implementable, maintainable and in some cases marketable elements will require intimate examination of the landowners' values, desires and goals for their life on this property. The Minimum Holistic Goal created at the outset of this consultancy will serve as a valuable lens through which to evaluate the congruence of any and all elements within the landowners' shared vision. Understandably, the 7GD team will have injected some personal biases into interpreting the landowners' shared vision, and by no means are the elements detailed here the "best" or only way to proceed. Each element is a suggestion, a jumping off point, for future iterations, followed by many enjoyable years of tending and adjusting this landscape as it matures.

The contents of this chapter are organized and presented through a functional lens. Each recommended element has a detailed write up associated with it, and is located in the section pertaining to its primary function. Secondary functions are linked to additional sections within the chapter and report. The purpose of this format is to help illustrate the **web of connections** between the various recommended living elements, so that as the design evolves throughout the implementation and establishment phase, an understanding of necessary functions that must be performed for the land to be in a generative state are central to the decision-making and SADIMEA design iteration process[22].

Context

PFH is located in what broadly qualifies as a Mediterranean climate. It is located in Sunset Climate Zone 7 for California, also known as California's Gray Pine Belt, which is characterized by hot summers and mild but pronounced winters that create sharply defined seasons. Plants and trees that appreciate a marked change of the seasons do well here. Sunset Zone 7 is noted as a successful growing region for pears, apples, peaches, cherries and other deciduous fruits. The Koppen Geiger Climate Classification further reinforces the Sunset Zone with a Csb rating - standing for warm temperate climate characterized dry summers that are dry and warm to hot.

The soils are largely composed of weather residuum from calcareous shale and sandstone with a moderate water holding capacity and tend to be rather thin, except in the case of the valley bottom soils. Soil fertility is quite low, and building it will have to be a primary focus prior to planting high value tree and plant species.

[22] SADIMEA Design Iteration Process: https://www.7thgenerationdesign.com/process/

Deer, gophers and ground squirrels inhabits the PFH property and surrounding area, many of which will act as potential pests for plants and predators for future livestock. Proper predator/pest deterrence and exclusion methods will be a necessary and important part of establishing and maintaining all living systems elements implemented at PFH.

5.1 Soil Building & Fertility

Soil is the thin, living layer that exists at the interface between the biological and geological. Soil is different from dirt, in that soil is alive and capable of feeding new life. As such, no system can ever be regenerative (i.e. truly sustainable) if it does not create soil by default. Healthy, fertile soil is *the* essential building block for creating a beautiful, productive and profitable landscape. Methods and techniques for creating and stewarding it will infuse into the selection, design, and management of every element in this design.

Discussed below are elements and processes involved in soil building.

Existing Conditions

- Soils at PFH are very low in biological activity at present. A survey of existing vegetation and observed soil characteristics has indicated the soil is likely low in calcium and high in potassium and phosphorus, which is consistent with the low observed levels of soil biology, thatching (accumulation of dead plant matter at the soil surface, not breaking down), persistence of old manure clods (at least several years old by now, again not breaking down), and proliferation of grassy weeds.

Recommendations

The follow elements should be considered in the development of a whole-site design:

- **Livestock** - Intensively managed high-density grazing with smaller livestock (goats, sheep) will help to jump-start the stagnant soil biology without placing too much pressure on the fragile soil structure at PFH, especially on the steeper slopes. Timing the movement of the animals with the seasonal emergence of various weedy species, will, over time, help to shift the ecological community (currently dominated by annual grasses and non-native broad-leaf weed species) into a more stable perennial-based plant community.
- **Nutrient cycling systems**
    - **Vermicomposting**[23] - worm composting systems are an excellent way to process numerous types of kitchen and household organic wastes into a very nutrient and biologically rich substance (worm castings) that provide an excellent inoculum to jump start healthy soil biology communities.
    - **Compost Tea**[24] **-** utilizing the worm castings as biological inoculums to brew high-biology aerobic compost teas is an excellent way to get a lot of biology into the

[23] https://www.7thgenerationdesign.com/nutrient-cycling-for-homesteads-part-1-vermicompost/
[24] https://www.7thgenerationdesign.com/nutrient-cycling-for-homesteads-part-3-compost-tea/

soil over a broad area quickly. Compost teas can also be applied through foliar application to boost plant health.

- ○ **Charcoal and biochar**[25] **-** utilizing excess carbonaceous material from on-site (oleanders that are to be removed, dead oak branches, or essentially any other woody material) to make charcoal is an excellent way to *keep* biomass from the property on the property. Charcoal is a stable substance that will persist in the soil for millennia, and offers a huge array of benefits for soil health and function, especially when inoculated with beneficial microorganisms and nutrients to form biochar.

5.2 Food Production

In nature, food is produced at or very near the point of consumption. The creature that does the eating has to go to the food. The modern food system, with vast monocultural production systems and thousand mile supply chains, (dys)functions in exactly the opposite manner - food is grown or produced far away, and brought to the eater via a very complex and energy-intensive system. A critical piece of recreating a regenerative food supply (i.e. modeling natural pattern) is living in close proximity to, and often in relationship with one's food supply.

This section explores climatically and energetically regenerative ways to produce food close to home. Discussed below are elements of the design with food production as their *primary function*.

Existing Conditions

- There is currently a fenced garden area downslope to the south of the Main Residence where some initial in-ground garden beds were constructed.

[25] https://www.7thgenerationdesign.com/biochar/

Figure 5.2.1
Existing in-ground beds in the future Food Forest Zone.

- Raised beds for annual vegetable production are covered with insect screen and located on the south-east facing wall of the house, adjacent to the railroad tie walkway.

Figure 5.2.2
Covered raised beds for annual production on southeast wall of the Main Residence.

Recommendations

The following food production elements should be considered in the development of a whole-site design:

- Gardens
  - Annual production interspersed on the planned terraces within the Food Forest Zone.

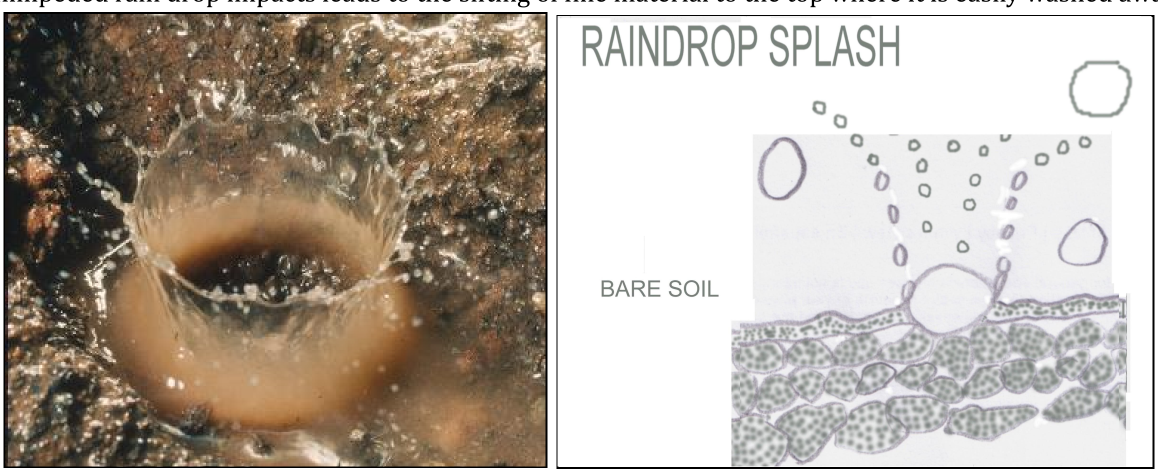
    - Plantings of herbs and daily-use greens integrated within landscaping of the Main Residence Backyard to keep them as close to the kitchen as possible.
- Food Forest plantings throughout the planned terraces within the Food Forest Zone.
- Agroforestry systems in the Lower East and West Pastures, with potential for integration of livestock.

5.3 Erosion Control

Vegetation reduces and prevents erosion in several ways. First, vegetation creates impedance, whereby the rain drops are intercepted prior to hitting any soil, and their energy is greatly reduced. Second, vegetation increases roughness, meaning that instead of being able to flow straight downhill, water has to twist and turn around every bit of vegetation it encounters, increasing its transit time through the landscape and thus increasing the opportunity for it to be infiltrated. Third, the roots of vegetation actually create infiltration channels for water to move down into the soil profile. This improves infiltration rates and the ability of the land to absorb and retain water that would have otherwise run off quickly.

Figure 5.3.1

Unimpeded rain drop impacts leads to the sifting of fine material to the top where it is easily washed away.



Existing Conditions

There were no plantings specifically intended for erosion control observed at PFH during the site visit.

Recommendations

Plantings for erosion control are recommended in the following areas:

- Perennial grass or shrub cover should be planted in areas of the Food Forest and Lower Pastures that the soil is disturbed when the Passive Water Harvesting and Drainage Systems are installed (described further in 2.1 - Recommendations for Providing Hydration and 2.2 - Recommendations for Moving Things).

5.4 Privacy Screens

Privacy screens are plantings of trees/shrubs that serve to block either an unwanted view from a location or the unwanted viewing of a location. The same characteristics that define a good windbreak species (fast-growing, dense growth habit) also define a good privacy screen species.

Existing Conditions

The trees planted east of the Main Residence create a seasonal privacy screen from the neighbors to the east.

Recommendations

Privacy screen plantings in the following locations should be considered in the development of a whole-site design:

- Along the Lower East and West Pasture fencelines.
- Along the east fenceline of the Lower East Pasture closest to the neighboring house.
- Along the east-facing edge of the Food Forest Zone facing the neighbors.

5.5 Shade Plantings

Species within shade plantings are typically fast-growing, umbrella-shaped trees specifically selected to provide shade for human occupants, animals, or structures underneath or nearby. This provides relief from sun exposure, more even lighting for gatherings/workshop/events,, and respite from hot weather. Deciduous trees (trees that lose their leaves in the fall and enter dormancy for the winter) are often desirable in shade plantings in a coastal California climate as, in addition to tempering the light and heat during warmer months when they are leafed out, they also allow light and radiant warmth from the sun into a space during the colder winter months.

Existing Conditions

- The long southwest-facing side and the southeast facing wall of the Main Residence currently lack shade.

Figure 5.4.1
Lack of shade around the Main Residence on its most solar-exposed aspects.

Recommendations

Shade plantings in the following areas should be considered in the development of a whole-site design:

- Umbrella-canopied deciduous shade tree planting around the southwest corner of the Main Residence to cast shade over the southernmost portion of the deck and to keep some direct summer sun off the southeast facing wall of the home during peak summer sun. Low-growing enough to avoid casting shade on the roof-top solar panels.

5.6 Reforestation

While there are a large number of precise and varying definitions for a forest, incorporating factors such as tree density, tree height, land use, legal standing, and ecological function, for the purposes of this report, a forest is a large area dominated by trees. They provide a crucial and irreplaceable role in Earth's ecology: they are the second largest storehouse of carbon and producer of oxygen on the planet, provide habitat for a myriad of plants, animals, and fungi, and provide food, fuel, shelter, and water (through their immense influence on climate and the water cycle) for humans.

Existing Conditions

- Most of the PFH property is currently open, low quality pasture at present. Some blue oaks do well on the more protected, east facing aspects. A stand of small, densely packed blue oak trees is located on the steepest portion of the south-face of the ridge leading down to [redacted].

Recommendations

The following forestry elements should be considered in the development of a whole-site design:

- Consider reforesting Zone 4 and Zone 5 areas with a diverse assembly of climate-appropriate (temperature- and drought-tolerant, fire-resistant) plants of varying size and root depth (trees, shrubs, perennial grasses) to prevent erosion and retain soil, prevent runoff and rehydrate the landscape, and prevent devastation from natural fire cycles. Depending upon landowner goals, this could range from a low-maintenance native forestry system to an economically-valuable agroforestry system that integrates food-producing vegetative elements with intensively-managed livestock.

6. Boundaries

Boundaries within a landscape can occur in numerous forms. They can be physical (gates, fences, terrain, dense vegetation etc.), legal (property lines, easements etc.) and energetic (felt within the landscape). Understanding what boundaries exist, and how they can or will need to be reinforced, removed or modified, along with what boundaries are required that are not yet in place, is essential to managing a healthy, thriving landscape, no matter the size. Boundary markers help to determine what types of management are required where, and consequently what the energetic, financial and material cost of that management will be, and are therefore essential when planning an enterprise.

One of the most universally recognizable boundaries are fences. Fences serve several important functions, including confining and protecting animals and crop areas, providing visual barriers, supporting trellised growing systems, blocking wind, collecting snow and much more. There are three broad categories of fencing: permanent, semi-permanent, and temporary.

- **Permanent Fencing -** Permanent fences are typically used for boundary and subdivision fences on land that's owned by the user—and whose usage is not likely to change. They are usually constructed of strong wood, steel or fiberglass posts that support high-tensile solid wires, woven wire, wood slats, rope or wide tape—of which one or more strands are electrified. They are more reliable and durable than other options but more expensive to install. A professional installer is often needed.
- **Semi-Permanent Fencing -** Semi-permanent fences are typically used for applications that require seasonal or annual movement. They can also be a barrier that is assembled until a more permanent one is installed. This allows for testing of fence and gate locations to see what works best. The construction could consist of electrified net or multiple electrified strands under low tension, or possibly made of pallets or straw bales. These require more maintenance than permanent fences, but often reduce up-front costs to establish barriers.
- **Portable Fencing -** Portable (temporary) fencing is typically used in applications that require daily or weekly movement. They should be quick to install and remove and eliminate the need for large end and corner posts, and the fence strands (whether single, multiple or a mesh/netting) must be only hand-tensioned. They must also be electrified properly.

Within each of these categories are dozens of different fencing options. The choice of fencing for any given area should be made based on what purpose it serves.

Table 6.0.1
Typical fencing types for managing livestock.

Fence Type	Best For	Components	$/linear foot	Pros	Cons
High-Tensile Wire	Perimeter fences	Permanent posts (often rot-resistant timber), high-tension wire	$0.89-$1.50	Long lifespan	Immobile, technical installation
Woven / Welded Wire	Permanent perimeter fences, paddocks/ corrals	Woven wire, sunken posts (T-posts)	$1.50-$3.00	Strong	Expensive
Electrified Portable Net Fencing	Cell grazing	Woven poly-wire mesh, fiberglass stakes	$0.75-$1.25	Affordable, flexible	Steep learning curve to effective use, mowing alleys
Electrified Single Strand / Rope / Tape	Large livestock already trained to electric fence	Strand and temporary fence posts with non-conductive attachment points	$0.20-$.050	Cheapest	Least durable

NRCS Fencing Grant Information

Federal cost-share funding is available for internal fencing improvements through the NRCS Environment Quality Incentives Program[26] (EQIP). Farmers or ranchers working to implement a Grazing Management Plan can submit their plan and apply for funding assistance with various types of fencing installation. For more information look up Code 110 - Grazing Management Plan[27].

6.1 Security/Privacy

Various types of visible and invisible boundaries can be employed to enhance physical security and visual/acoustic privacy.

Existing Conditions

- Security
    - The property boundary is fenced along its entire length, mostly with barbed wire fencing. The barbed wire fencing is easy to pass through on foot, for both humans and animals (as evidenced by the deer).

[26] NRCS EQIP Program: https://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/programs/financial/eqip/
[27] NRCS Grazing management Plan- Code 110: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ca/programs/financial/eqip/?cid=stelprdb1247016

- The driveway to PFH off of the [redacted] is accessed via a keypad activated gate at the bottom.

Figure 6.1.1
Gate at the bottom of the PFH driveway.

- Privacy
  - There are no built privacy boundaries currently in existence at PFH.
  - The mature trees planted east of the Main Residence at the edge of the Main Residence Backyard provide seasonal visual privacy to the Main Residence from the neighbors uphill to the east.

Recommendations

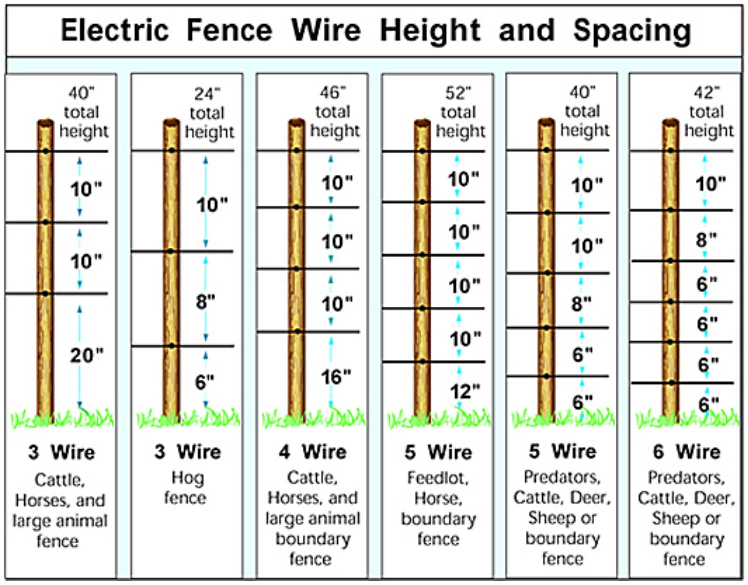
The following boundary elements for security and visual/acoustic privacy should be considered in the development of a whole-site design:

- Existing and future fencing around property can be enhanced with a densely-planted hedge, which will double as a wind screen and privacy screen. This is also discussed in Section 5.4 - Recommendations for Privacy Screens.

6.2 Animal Confinement/Exclusion

Confining livestock animals to where their presence is desired and beneficial is an important part of managing a healthy population. Likewise, excluding them from where their presence is not desired or beneficial is critically important to prevent ecological and financial damage.

Figure 6-1
Polywire fence spacing



Existing Conditions

- The PFH property is completely fenced with fencing capable of keeping larger livestock *in*. In many places, particularly along the upper sections where an old, barbed wire fence is in place, the fenceline is quite porous to humans and animals alike.
- The Chicken Coop is surrounded by a larger yard to which the birds are able to access at the discretion of the owners. A mix of hog panel fencing and chicken wire forms the barrier for this area.
- The Barnyard located on the backside of the Barn is fenced to keep livestock in with a mix of fencing materials.
- The Food Forest Zone on the ridge slope south of the Main Residence has a fenced garden area, with fencing capable of excluding deer.
- The Upper Pasture is currently connected with the area around the Main Residence and Barn due to gaps in the fenceline.

Recommendations

The following boundary elements for animal confinement or exclusion should be considered in the development of a whole-site design:

- Gopher wire will be required around the root zones of any in-ground garden beds or high-value perennial plantings to get them established.
- "Deer-deflection hedging" is a concept popularized by Toby Hemenway in his book *Gaia's Garden*. On the outside of the hedge, food is planted *for the deer* and other wildlife, the middle of the hedge is full of thorny, spiny, or otherwise too-dense foliage for the deer to

want to pass through (especially when they already had easy food in front of them), and on the inside of the hedge choice species are planted for personal consumption.

7. Energy Systems

Energy is a challenging concept to define. Attempts often start by listing specific energy *sources*: electricity, natural gas, propane, etc. These sources of energy do work: they move things, whether those things are people, electrons, water, heat, etc. **Energy is the ability to do work.**

Toby Hemenway, author of *The Permaculture City*, proposes that it is useful to think of energy as a sector - an influence coming from off the design site, as other influences from off-site such as road noise, winds, etc are similarly defined as sectors. There are three ways to interact with sector energies: we can 1) harvest, collect, or store them, 2) deflect or block them, or 3) let them pass by unaltered. These three approaches to energy as a sector are a useful starting point for designing energy systems.

Another useful approach to designing energy systems outlined in *The Permaculture City*, that works well in conjunction with the sector approach above, is to start with what jobs the energy needs to do - what functions it will perform. This is a whole-systems, pattern-based approach, as opposed to the detail-centric approach that typically is used to design energy systems of listing the items that will need energy and then matching them to an energy source. There are three jobs that energy typically performs: **moving heat**, **moving things**, and **moving electrons**

This whole-systems approach to energy design provides a much greater opportunity to identify the ways that the energies already present on-site can be harvested and stored (such as sun, in the form of radiant heat and also in a condensed form like wood), deflected (such as wind), or left to pass by in order to meet an energy function like heating, as opposed to the modern approach of placing a gas-fired heater wherever heat may be required. This design approach has been utilized in preparing the energy recommendations at PFH.

7.1 Moving Heat

Moving heat is typically done in two ways: first, releasing and concentrating heat in furnaces, heaters, and stoves so that it can be delivered to living spaces, for household water, or for cooking food, and second, removing heat via cooling equipment such as air conditioners and refrigerators. This work can be done with a wide array of fuels and forces, including burning liquid and gas fuels, wood, or coal; by electricity; by expansion and compression of gas; via friction; and using the sun.

Existing Conditions

The existing systems for moving heat onsite include:

- A propane tank is located just east of the carport. 7GD assumes that propane is used for cooking, water, and space heating needs in the Main Residence and Garage ADU.
- 7GD assumes that refrigeration and space cooling needs in the Main Residence and Garage ADU are provided by electricity.

Recommendations

The following elements for moving heat should be considered in the development of a whole-site design:

- Consider implementing passive solar design principles in the future residences and other structures in order to reduce heating needs during the winter and cooling needs during the winter (also discussed in 4.1 - Recommendations for Sheltering Individuals and Families.
- Consider planting deciduous shade trees on the south side of existing and future shelters in order to provide shade during the summer and allow sunlight to pass through during the winter (also discussed in 5.5 - Recommendations for Shade Plantings)
- For active heating (including cooking!), consider systems that can be fueled by locally-sourced fuelwood rather than electricity. This can positively impact the local ecology environment through the contribution to wildfire fuels reduction and increased forest health (if managed properly). Consider the inclusion of fast-growing fuelwood production systems as part of the development of a Whole Site Design.

7.2 Moving Things

Moving things typically includes spinning fans and motor parts, compressing gases in refrigerators, pumping water, and raising and lowering objects. This is most often achieved by making a shaft spin in a motor or pump, and then translating that rotational energy into linear force or a pressure change. Electricity is the most common power source for this, but fluids (liquid and gaseous) such as water, compressed air, or wind will also do the job. Internal combustion engines, steam, and other turbines are also commonly used to move things, as well as human and animal muscles.

Existing Conditions

The existing systems for moving things onsite include:

- An electric pump is used to move groundwater from the drilled well to the pressure tank in the Main Residence, where it is then distributed to the various fixtures on property.

Recommendations

The following elements for moving heat should be considered in the development of a whole-site design:

- If the water tanks are recommissioned as suggested in 2.1 - Recommendations for Providing Hydration, the electric well pump should be used to move groundwater to the water tanks instead of the pressure tank.

7.3 Moving Electrons

Electricity is the primary energy form here, and it's doing tasks that are almost impossible to do in other ways, such as computing and communicating over long distances.

Existing Conditions

Elements that are currently moving electricity onsite are:

- Supply wiring for an electrical grid connection currently runs from the utility wires bordering [redacted] to a pole near the main residence.
- A solar photovoltaic (PV) array is located on the roof of the Main Residence. This PV array is integrated with the grid connection to sell power back to the utility during periods of production.

Recommendations

The following elements for moving heat should be considered in the development of a whole-site design:

- Consider installing a battery-backup system at the Main Residence in order to provide for greater resilience in the event of utility interruptions.

Appendix A - Water Catchment Calculations

Distinct Catchment Areas

Catchment Name	Area (sq. ft.)	Area (ac)	Run-off Coefficient	Direct Precipitation Totals (gal)	Low Run-Off Estimate (gal)	High Run-Off Estimate (gal)		
RUN ON: Northwest Run-On Catchment	246,593	5.66	Pasture - Heavy Soil	2,694,530	404,179	1,212,538	**Rain Fall Amount (in):**	17.53
RUN ON: Northeast Run-On Catchment	334,443	7.68	Pasture - Heavy Soil	3,654,470	548,170	1,644,511	**Property Acreage:**	10
RUN ON: East Pickup Catchment	152,632	3.50	Pasture - Heavy Soil	1,667,815	250,172	750,517	**Whole Property Direct Precip. Total (gal):**	4,759,816
Whole Property	435,600	10.00	Pasture - Heavy Soil	4,759,816	713,972	2,141,917	**Whole Property Direct Precip. Total (acre feet.):**	14.61
Garage ADU	745	0.02	Roofs	8,141	6,105	7,734	**Off-Property Run-On Watershed Area (sq. ft)**	733,668
Main Residence	3,028	0.07	Roofs	33,087	24,815	31,433	**Off-Property Run-On Watershed Area (acres)**	16.84
Tiny House	183	0.00	Roofs	2,000	1,500	1,900	**Off-Property Direct Precip Total (gal):**	8,016,814.69
Barn	1,163	0.03	Roofs	12,708	9,531	12,073	**Off-Property Run-On Low Estimate (gal):**	1,202,522
Barn Shed	180	0.00	Roofs	1,967	1,475	1,869	**Off-Property Run-On High Estimate (gal):**	3,607,567
Carport	258	0.01	Roofs	2,819	2,114	2,678	Custom Sum Watershed Area (sq. ft.):	0
Tiny House Storage Shed	180	0.00	Roofs	1,967	1,475	1,869	Custom Sum Watershed Area (acres):	0.00
Chicken Coop	262	0.01	Roofs	2,863	2,147	2,720	Custom Sum Direct Precip Total (gal):	0
Garage Hardscape	503	0.01	Drives and	5,496	4,122	4,672	Custom Sum	0

Catchment Name	Area (sq. ft.)	Area (ac)	Run-off Coefficient	Direct Precipitation Totals (gal)	Low Run-Off Estimate (gal)	High Run-Off Estimate (gal)		
			Walks				Run-Off Low Estimate (gal):	
Driveway Hardscape	7,288	0.17	Drives and Walks	79,636	59,727	67,691	Custom Sum Run-Off High Estimate (gal):	0
Unpaved Driveway Parking	768	0.02	Drives and Walks	8,392	6,294	7,133		
Barn Driveway Hardscape	4,778	0.11	Drives and Walks	52,209	39,157	44,378		
FF EW Gross - Minus Duplicates	72,106	1.66	Pasture - Heavy Soil	787,905	118,186	354,557		
LEP Swale Earthen Catchment	18,376	0.42	Pasture - Heavy Soil	200,795	30,119	90,358		
LEP Swale Driveway Catchment	2,410	0.06	Drives and Walks	26,334	19,751	22,384		
LWP Swale Catchment	134,826	3.10	Pasture - Heavy Soil	1,473,248	220,987	662,962		

Earthwork Specific Catchment Calculations

Catchment Name	Area (sq. ft.)	Run-off Coefficient	Direct Precipitation Totals (gal)	Low Run-Off Estimate (gal)	High Run-Off Estimate (gal)	Infiltration Medium Designation	Infiltration Throughput (gal/min) Standing Water
% Total Property Area =>	**55.1%**		**2,620,357**	**488,099**	**1,246,930**		**586,845**
FF Top Swale Catchment	84,193		919,980	217,242	471,226	Food Forest Zone	30,121
LEP Swale Catchment	20,786		227,129	49,870	112,742	Lower East	74,365
LWP Swale Catchment	134,826	Pasture - Heavy Soil	1,473,248	220,987	662,962	Lower West	482,359

Earthwork Specific Volume & Infiltration Estimates

Designation	Infiltration Medium Designation	Length (ft)	Depth From Sill (ft)	Width (ft)	Volume At Bank Full (cubic ft.)	Volume At Bank Full (gallons)	Bank Full Infiltration Rate Of Earthwork/ min (gallons)	Bank Full Infiltration Rate of Earthwork/ hr (gallons)
		527			**1581**	**11,826**	**7627**	**457,598**
Food Forest Swale	Food Forest Zone	95	1	2	285	2,132	164	9,846
Lower East Pasture Swale	Lower East	82	1	2	246	1,840	1416	84,990
Lower West Pasture Swale	Lower West	350	1	2	1050	7,854	6046	362,762

Appendix B - Soils

Table B.1
NRCS landscape capability classification descriptions.

NRCS Landscape Capability Classification			
The capability class (number) tells you how limited the soil is for agricultural uses. The subclass designation (letter) tells you what kind of limitation is the main problem.			
Class	**Capability Class Description**	**Subclass**	**Subclass Description**
1	Class 1 soils have slight limitations that restrict their use.	**e**	Subclass e is made up of soils for which the susceptibility to erosion is the dominant problem or hazard affecting their use. Erosion susceptibility and past erosion damage are the major soil factors that affect soils in this subclass.
2	Class 2 soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.	**w**	Subclass w is made up of soils for which excess water is the dominant hazard or limitation affecting their use. Poor soil drainage, wetness, a high water table, and overflow are the factors that affect soils in this subclass.
3	Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.	**s**	Subclass s is made up of soils that have soil limitations within the rooting zone, such as shallowness of the rooting zone, stones, low moisture-holding capacity, low fertility that is difficult to correct, and salinity or sodium content.
4	Class 4 soils have very severe limitations that restrict the choice of plants or require very careful management, or both.	**c**	Subclass c is made up of soils for which the climate (the temperature or lack of moisture) is the major hazard or limitation affecting their use.
5	Class 5 soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.		
6	Class 6 soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.		
7	Class 7 soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.		
8	Class 8 soils and miscellaneous areas have		

	limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for esthetic purposes.		

Table B.2
NRCS Hydrologic Soil Group rating descriptions.

NRCS Hydrologic Soil Group Descriptions	
In its simplest form, hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present). The least transmissive layer can be any soil horizon that transmits water at a slower rate relative to those horizons above or below it.	
Group	**Description**
A	**Soils in this group have low runoff potential when thoroughly wet.** Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.The limits on the diagnostic physical characteristics of group A are as follows. The saturated hydraulic conductivity of all soil layers exceeds 40.0 micrometers per second (5.67 inches per hour). The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches]. Soils that are deeper than 100 centimeters [40 inches] to a water impermeable layer and a water table are in group A if the saturated hydraulic conductivity of all soil layers within 100 centimeters [40 inches] of the surface exceeds 10 micrometers per second (1.42 inches per hour).
B	**Soils in this group have moderately low runoff potential when thoroughly wet.** Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.The limits on the diagnostic physical characteristics of group B are as follows. The saturated hydraulic conductivity in the least transmissive layer between the surface and 50 centimeters [20 inches] ranges from 10.0 micrometers per second (1.42 inches per hour) to 40.0 micrometers per second (5.67 inches per hour). The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches]. Soils that are deeper than 100 centimeters [40 inches] to a water impermeable layer and a water table are in group B if the saturated hydraulic conductivity of all soil layers within 100 centimeters [40 inches] of the surface exceeds 4.0 micrometers per second (0.57 inches per hour) but is less than 10.0 micrometers per second (1.42 inches per hour).
C	**Soils in this group have moderately high runoff potential when thoroughly wet.** Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.The limits on the diagnostic physical characteristics of group C are as follows. The saturated

	hydraulic conductivity in the least transmissive layer between the surface and 50 centimeters [20 inches] is between 1.0 micrometers per second (0.14 inches per hour) and 10.0 micrometers per second (1.42 inches per hour). The depth to any water impermeable layer is greater than 50 centimeters [20 inches]. The depth to the water table is greater than 60 centimeters [24 inches]. Soils that are deeper than 100 centimeters [40 inches] to a restriction and a water table are in group C if the saturated hydraulic conductivity of all soil layers within 100 centimeters [40 inches] of the surface exceeds 0.40 micrometers per second (0.06 inches per hour) but is less than 4.0 micrometers per second (0.57 inches per hour).
D	**Soils in this group have high runoff potential when thoroughly wet.** Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential. All soils with a depth to a water impermeable layer less than 50 centimeters [20 inches] and all soils with a water table within 60 centimeters [24 inches] of the surface are in this group, although some may have a dual classification, if they can be adequately drained.The limits on the physical diagnostic characteristics of group D are as follows. For soils with a water impermeable layer at a depth between 50 centimeters and 100 centimeters [20 and 40 inches], the saturated hydraulic conductivity in the least transmissive soil layer is less than or equal to 1.0 micrometers per second (0.14 inches per hour). For soils that are deeper than 100 centimeters [40 inches] to a restriction or water table, the saturated hydraulic conductivity of all soil layers within 100 centimeters [40 inches] of the surface is less than or equal to 0.40 micrometers per second (0.06 inches per hour).