Level 1
Site Assessment

Prepared for: John and Jane Doe

Site: Morning Doe Ranch

0107 Razor Ridge Road

Paso Robles, CA 93446

Site Visit Date(s): January 15th, 2019

Prepared by:

7th Generation Design

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Context

7th Generation Design was invited by the Doe family to visit and conduct an assessment of their 12.57 acre ranch located in Paso Robles, CA. Morning Doe Ranch (MDR) currently has approximately 5,860 sq-ft of structures (roof area; including a main house, shop, and shed) and 14,700 sq-ft of gravel access roads. The predominant land features include:

- Approximately 5 acres of the toe of a southeast facing ridge with annual grasses and forbs and a handful of trees (proposed future home site),
- Two interconnecting valleys at the lowest point on the property linking at total of 136 acres of upstream watershed,
- Approximately 2.5 acres of steep northeast facing hillside, atop which the shop is located.

The Doe family has communicated their desire to create a living and working homestead that is a community gathering spot, retreat space for workshop attendees, and natural capital resource base to support themselves and others. They have a desire to grow their knowledge and experience in homestead food production and animal husbandry.

The Morning Doe Ranch has tremendous potential to create a drought-proofed, abundant and beautiful sanctuary that will provide for this generation and those to come. The biggest opportunities identified include:

- Re-grading of the section of Razor Ridge Road just uphill of the turn onto Turner Way (driveway) to keep water on the west side of the road until it reaches the culvert at the northwest corner of the property.
- Installation of a rolling drop at the intersection of Razor Ridge Road and Turner Road (driveway) to redirect water flow from Nopariel Road onto the property.. A rolling dip is a long, shallow depression in a road with a very slight elevation drop that crosses the road at a diagonal towards a desired lead-out point where water can be safely discharged from the road surface.
- Maintenance of the culvert ditch at the entrance to the culvert to ensure water transits through the culvert without delay. Currently the ditch bottom is lower than the culvert, leading to pooling on the west side of Razor Ridge Road. Either the ditch bottom should be raised (along with a concomitant increase in road height) to meet the lower lip of the culvert pipe to alleviate pooling, or the culvert should be re-dug lower so it is even with the bottom of the culvert ditch.
- Installation of an armored plunge pool (Zuni Bowl)at the exit of the culvert crossing under Razor Ridge Road in the northwestern corner of the property to prevent future headcutting issues.
- Planting of drought-hardy, flood-tolerant species in flow-spreading arcs just downslope of the culvert exit onto the property to help spread, slow and immediately infiltrate incoming flow from the culvert.
- Planting of drought hardy, leguminous pioneer trees along both the West and East Valley bottoms to shade soil, improve infiltration during rain events, improve water retention and

banking throughout the dry season, improve soil fertility for future long-term productive overstory plantings.

- Covering the soil, especially on steep slopes, both with mulch and living cover.
- Establishment of drought hardy, leguminous pioneer trees on steep slopes for shade, wind buffer, soil fertility, erosion mitigation, and potential forage for future livestock.
- Installation of a raingutter system should be installed on the shop roof. Gutters could be patterned into the current water tank supplying the main house, or into an additional tank to create additional storage buffer.
- Reducing use of the two 4WD tracks leading up to the shop from the main house. Due to the fragility of the soil and the steepness of the grade, consistent use will ultimately lead to downcutting, which dramatically increases the erosion risk (and erosion mitigation cost) of this east-facing slope. Use should be minimal or non-existent when soils are wet or during precipitation events.
- Limiting vehicle access to the crest of the southeast-facing ridge on the north side of the property to the access track traversing the spine of the ridge, where the grade only reaches 22% as compared to the 40%+ grades experienced on the west and east facing sides of the ridge, for the same reasons already mentioned.
- Construction of a switchback footpath leading from the house to the shop to create a walkable "commute", taking pressure off of the fragile vehicle tracks on this hillside.
- Consideration of moving the proposed future homesite from the crest of the southeast-facing ridge on the property to partway down the slope. Planting of fast-growing deciduous shade trees around the future homesite and fast-growing evergreen windbreak trees on contour downslope of the home on the south-east facing ridge.
- Building and utilizing mobile a chicken tractor to allow the chickens seasonal access to fresh pasture and other areas outside of the fenced garden zone, improving soil fertility and reducing feed costs.

This report provides a description of the existing conditions that need to be understood and worked with to properly create a design that will bring the Doe's vision to life, and a brief description of the low-hanging fruit identified during the L1 site visit that, if implemented, will improve the resilience of the property. Detailed writeups of these recommendations, including design overlays with detailed callouts, as well as a complete design of Forestry, Economy, and Energy for the site, are available in a Level 2 Whole Site Design.

Site Work Up

General Site Information

Client(s): John and Jane Doe - Morning Doe Ranch

Address: 0107 Razor Ridge Road, Paso Robles, CA 93446

Parcel Number: 111-11-11 (parcel #11 on aggregate map)

Area: 12.57 acres

Latitude: 35°40'36.00"N

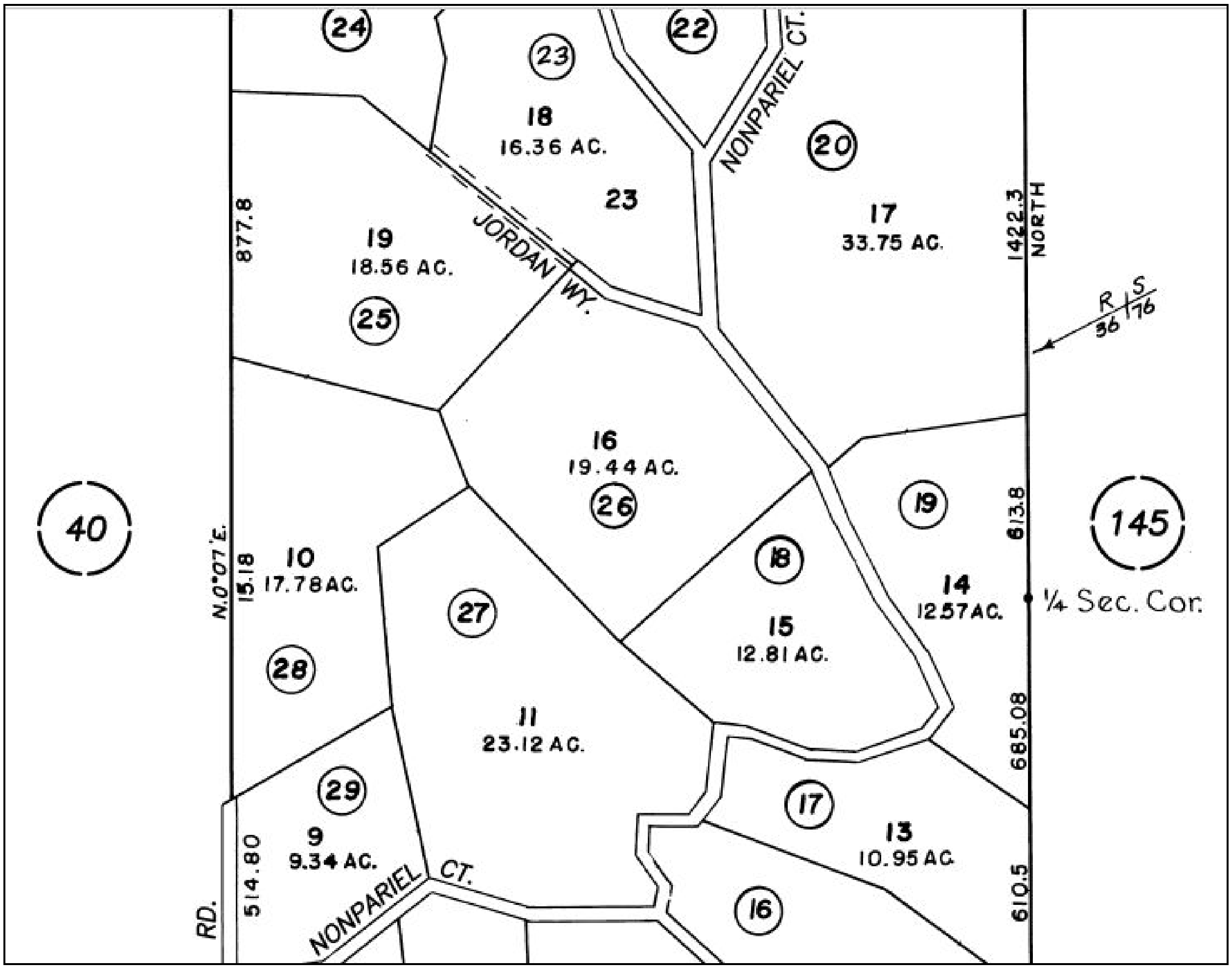
Longitude: 120°41'41.01"W

Altitude: 792'

Proximity to Ocean: ~ 24 miles as the crow flies

Figure 1-1
Satellite image of Morning Doe Ranch

Figure 1-2
Parcel map of 0107 Razor Ridge Road (Parcel 14)



Climate

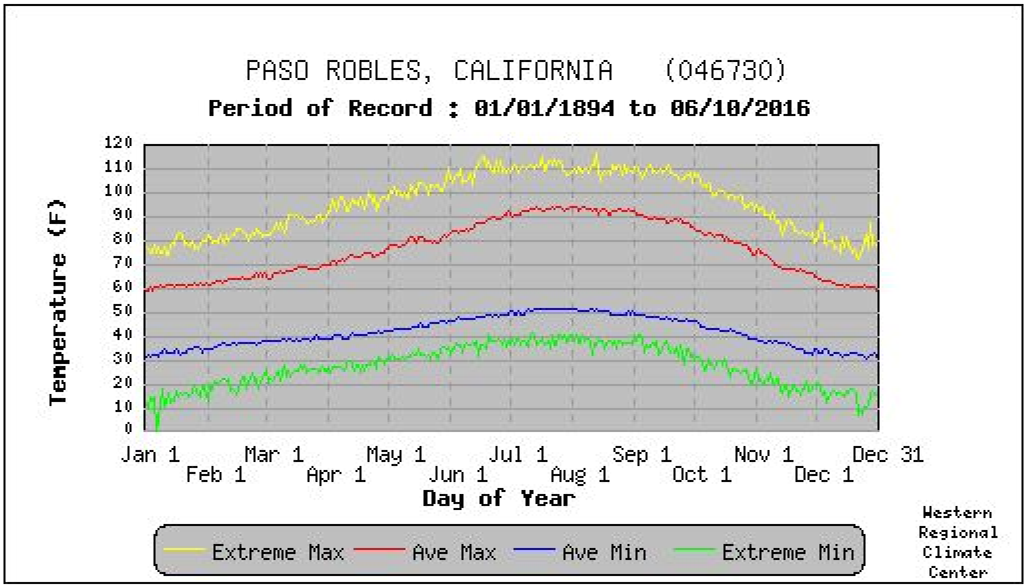
Temperature Data

The closest weather station to MDR with real-time weather data is [KCAPASOR85](), located at Vista Serrano Vineyard 1.6 miles away.

The closest weather station with historical data is at the Paso Robles Regional Airport, 5.1 miles away from MDR [[Link 1](), [Link 2]()]. Annual temperature data for typical meteorological year at the Paso Robles Regional Airport is shown in Figure 1-3. The coldest months of the year are December through February; the hottest months are July through August. The average daily low temperature is 34℉ (record low is 0℉, 1913); the average daily high temperature is 90℉ (record high is 115℉).

Figure 1-3

Average monthly temperature data for Paso Robles Regional Airport (5.1 miles away from MDR)



The range between the high and low temperatures in Paso Robles is large, especially compared to San Luis Obispo and even more-so the coastal towns in the county. This is due to the 2,000 foot tall Santa Lucia mountain range that separates Paso Robles from the coast. The range serves as a tremendous climactic barrier-it blocks all significant influence of the maritime air, allowing Paso and other nearby towns to achieve the highest daytime highs and the lowest nighttime lows in the region.

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 each year while the tree is dormant. Paso Robles Regional Airport (5.1 miles away from MDR) sees an average of **1,534 hours** below 45℉. A full chart of hourly temperature distribution for a typical meteorological year at Paso Robles Regional Airport is provided in Appendix A.

While the Paso Robles Regional Airport is located in a similar area geographically and topographically as MDR, the chill hours at MDR 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.

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 1,200 chilling hours or less 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.

Precipitation Data

Annual Precipitation Total

The average and mean amounts of annual rainfall recorded at Paso Robles Regional Airport (5.1 miles away from MDR) from 1894-2016 are 15.21 inches and 14.77 inches, respectively [Link 1, Link 2]. The record high annual total during that period was 29.19 inches in 1941; the record low total was 2.78 inches in 2013.

Annual Distribution of Precipitation

There are an average of 42 rainy days (>.1 inch) per year. 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 Regional Airport 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 the order of 240-270 days.

Rainfall Intensity and Recurrence Interval

Paso Robles Regional Airport has experienced 4-5"+ of rainfall in a 24 hour period numerous times during the recorded period from 1894-2016.

Table 1-1 lists rainfall intensity and the recurrence interval for the Paso Robles area. This information is helpful in determining capacity for installed earthworks, drains, basins and other structures or design elements that will need to be able to move, absorb or withstand these expected volumes and intensities if they are to last across generations.

Earthworks design is typically informed by the 1,000-year recurrence interval event - a rainfall event of certain intensity that has a 0.1% probability of occurring on any given year. We use this information to size spillways, drains, catchment basins and overflows to ensure that the system can endure such an event without damage.

In this case, the table below shows the median 1,000-year recurrence interval event to be 5.95 inches of rain in a 12-hour period and 7.96 inches of rain in a 24-hour period.

Table 1-1
Rainfall intensity and recurrence interval at Morning Doe Ranch

PDS-based point 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	0.110 (0.095-0.129)	0.140 (0.120-0.165)	0.181 (0.155-0.213)	0.216 (0.183-0.257)	0.265 (0.215-0.329)	0.304 (0.241-0.388)	0.346 (0.265-0.455)	0.390 (0.289-0.531)	0.451 (0.318-0.647)	0.501 (0.339-0.749)
10-min	0.158 (0.136-0.185)	0.201 (0.172-0.236)	0.259 (0.222-0.306)	0.309 (0.262-0.368)	0.380 (0.308-0.472)	0.436 (0.345-0.556)	0.495 (0.380-0.652)	0.558 (0.414-0.760)	0.647 (0.456-0.927)	0.718 (0.486-1.07)
15-min	0.191 (0.164-0.224)	0.243 (0.208-0.285)	0.314 (0.269-0.370)	0.374 (0.317-0.446)	0.459 (0.373-0.571)	0.527 (0.417-0.673)	0.599 (0.460-0.788)	0.675 (0.501-0.920)	0.783 (0.552-1.12)	0.868 (0.587-1.30)
30-min	0.260 (0.224-0.305)	0.330 (0.284-0.388)	0.427 (0.366-0.504)	0.509 (0.431-0.606)	0.625 (0.508-0.777)	0.718 (0.568-0.916)	0.815 (0.626-1.07)	0.919 (0.682-1.25)	1.07 (0.751-1.53)	1.18 (0.799-1.77)
60-min	0.367 (0.316-0.431)	0.467 (0.401-0.549)	0.603 (0.516-0.712)	0.719 (0.609-0.857)	0.883 (0.717-1.10)	1.01 (0.802-1.29)	1.15 (0.885-1.52)	1.30 (0.963-1.77)	1.51 (1.06-2.16)	1.67 (1.13-2.50)
2-hr	0.562 (0.483-0.659)	0.710 (0.610-0.835)	0.914 (0.783-1.08)	1.09 (0.921-1.30)	1.33 (1.08-1.66)	1.53 (1.21-1.95)	1.73 (1.33-2.28)	1.95 (1.45-2.66)	2.26 (1.59-3.24)	2.51 (1.70-3.75)
3-hr	0.706 (0.608-0.829)	0.893 (0.767-1.05)	1.15 (0.982-1.35)	1.36 (1.16-1.63)	1.67 (1.36-2.08)	1.92 (1.52-2.44)	2.17 (1.67-2.86)	2.45 (1.82-3.33)	2.83 (2.00-4.06)	3.14 (2.12-4.69)
6-hr	1.01 (0.866-1.18)	1.28 (1.10-1.50)	1.65 (1.41-1.94)	1.96 (1.66-2.33)	2.39 (1.95-2.98)	2.74 (2.17-3.50)	3.11 (2.39-4.09)	3.50 (2.59-4.76)	4.04 (2.85-5.79)	4.48 (3.03-6.69)
12-hr	1.31 (1.13-1.53)	1.68 (1.45-1.98)	2.19 (1.88-2.59)	2.62 (2.22-3.12)	3.21 (2.61-3.99)	3.68 (2.91-4.69)	4.16 (3.20-5.48)	4.68 (3.47-6.37)	5.39 (3.80-7.72)	5.95 (4.02-8.89)
24-hr	1.70 (1.54-1.91)	2.22 (2.01-2.50)	2.92 (2.64-3.31)	3.50 (3.14-4.00)	4.31 (3.73-5.08)	4.94 (4.19-5.95)	5.60 (4.62-6.91)	6.28 (5.04-7.97)	7.22 (5.56-9.56)	7.96 (5.92-10.9)
2-day	2.07 (1.88-2.33)	2.73 (2.47-3.08)	3.62 (3.27-4.10)	4.37 (3.91-4.98)	5.41 (4.68-6.38)	6.24 (5.29-7.52)	7.10 (5.87-8.77)	8.01 (6.44-10.2)	9.28 (7.15-12.3)	10.3 (7.65-14.1)
3-day	2.29 (2.07-2.58)	3.04 (2.75-3.43)	4.09 (3.69-4.62)	4.97 (4.45-5.67)	6.22 (5.38-7.34)	7.23 (6.12-8.71)	8.29 (6.85-10.2)	9.43 (7.57-12.0)	11.0 (8.50-14.6)	12.3 (9.17-16.9)
4-day	2.47 (2.24-2.78)	3.30 (2.99-3.72)	4.45 (4.02-5.04)	5.44 (4.87-6.20)	6.85 (5.93-8.08)	7.99 (6.77-9.63)	9.21 (7.61-11.4)	10.5 (8.44-13.4)	12.4 (9.53-16.4)	13.9 (10.3-19.1)
7-day	2.91 (2.63-3.28)	3.88 (3.51-4.37)	5.23 (4.72-5.92)	6.39 (5.72-7.29)	8.05 (6.97-9.50)	9.40 (7.96-11.3)	10.8 (8.95-13.4)	12.4 (9.94-15.7)	14.6 (11.2-19.3)	16.4 (12.2-22.4)
10-day	3.25 (2.95-3.66)	4.34 (3.93-4.89)	5.85 (5.28-6.62)	7.15 (6.40-8.15)	9.01 (7.80-10.6)	10.5 (8.91-12.7)	12.1 (10.0-15.0)	13.9 (11.1-17.6)	16.3 (12.6-21.6)	18.4 (13.7-25.2)
20-day	3.94 (3.57-4.44)	5.27 (4.77-5.95)	7.14 (6.44-8.07)	8.73 (7.82-9.96)	11.0 (9.55-13.0)	12.9 (10.9-15.6)	14.9 (12.3-18.4)	17.0 (13.7-21.7)	20.1 (15.5-26.6)	22.6 (16.8-31.0)
30-day	4.62 (4.19-5.21)	6.20 (5.61-6.99)	8.40 (7.58-9.50)	10.3 (9.22-11.7)	13.0 (11.3-15.4)	15.3 (12.9-18.4)	17.6 (14.5-21.7)	20.1 (16.2-25.6)	23.7 (18.3-31.4)	26.7 (19.8-36.6)
45-day	5.44 (4.93-6.13)	7.32 (6.62-8.25)	9.93 (8.96-11.2)	12.2 (10.9-13.9)	15.4 (13.3-18.2)	18.0 (15.2-21.7)	20.8 (17.2-25.6)	23.7 (19.0-30.1)	27.9 (21.5-36.9)	31.3 (23.2-42.9)
60-day	6.35 (5.75-7.15)	8.55 (7.74-9.64)	11.6 (10.5-13.1)	14.2 (12.7-16.2)	17.9 (15.5-21.1)	20.8 (17.7-25.1)	24.0 (19.8-29.6)	27.3 (21.9-34.6)	31.9 (24.6-42.3)	35.6 (26.5-48.9)

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

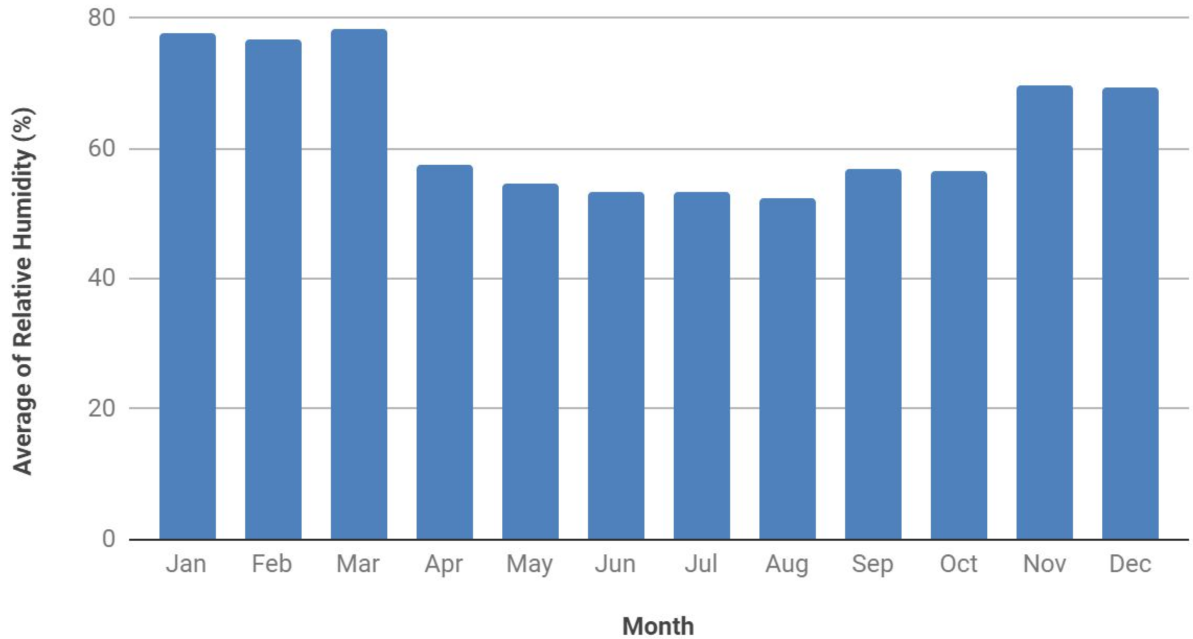
Humidity

Humidity is highest during the winter rainy season from November through March, with monthly averages ranging from 70-80%. Monthly average humidity levels during the spring and summer months ranges between 50-60%.

The average monthly relative humidity over the course of a typical meteorological year at Paso Robles Regional Airport (5.1 miles away) is shown in Figure 1-4; the hourly distribution of relative humidity in 5% ranges is provided in Appendix A, Figure A-3.

Figure 1-4

Relative humidity for a typical meteorological year at Paso Robles Regional Airport (5.1 miles away from MDR)



Fog

Offshore wind events during the fall and winter brings 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 Paso Robles area. This pattern is the inverse of the coastal pattern, where fog typically develops during onshore wind events in the spring and summer.

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). Brittleness classifications are used 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).

The climate at MDR tends is quite brittle. Long summer dry seasons and fairly short winter wet seasons predominate. There is minimal marine influence on the property (ocean 24 miles distant as the crow flies, and blocked by the Santa Lucia mountain range). Design and development of the property should utilize every possible chance to infiltrate water and retain it as long as possible on site. 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.

Solar Data

Solar aspect describes the way that the sun moves across the sky at a 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 1-2 presents the solar aspect information for each season at MDR. Detailed solar aspect charts and info are available through suncalc.org, sunearthtools.com.

Table 1-2

Solar aspect information for Morning Doe Ranch

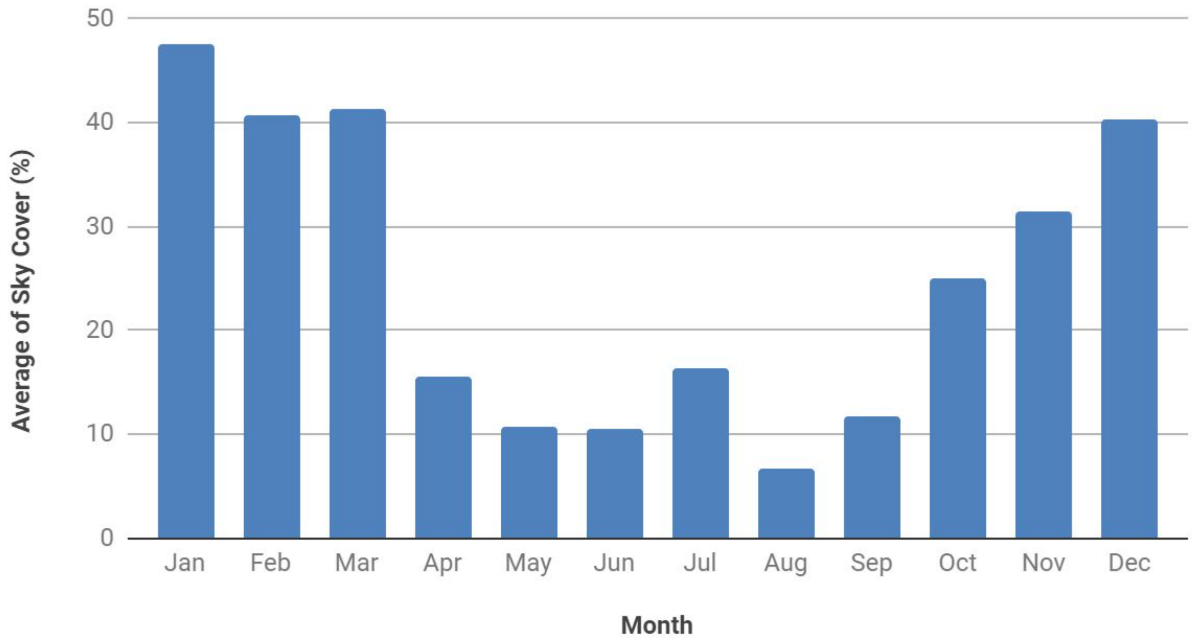
Season Change	Sun Angle*	Shadow Length**	Sunrise Location***	Sunset Location***
Winter Solstice	30.88°	1.67	118.52°	241.33°
Spring Equinox	54.27°	.72	89.46°	270.60°
Summer Solstice	79.73°	.22	59.93°	300°
Fall Equinox	54.10°	.72	89.44°	270.17°

** 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 14h35m29s on the Summer Solstice, and the shortest day length is 9h45m1s on the Winter Solstice.

There are an average of 286 days of sun per year in Paso Robles. The monthly average percent of sky cover is shown in Figure 1-5. A chart of the hourly distribution of cloud cover for a typical meteorological year at Paso Robles Regional Airport (5.1 miles away) is provided in Appendix A, Figure A-2.

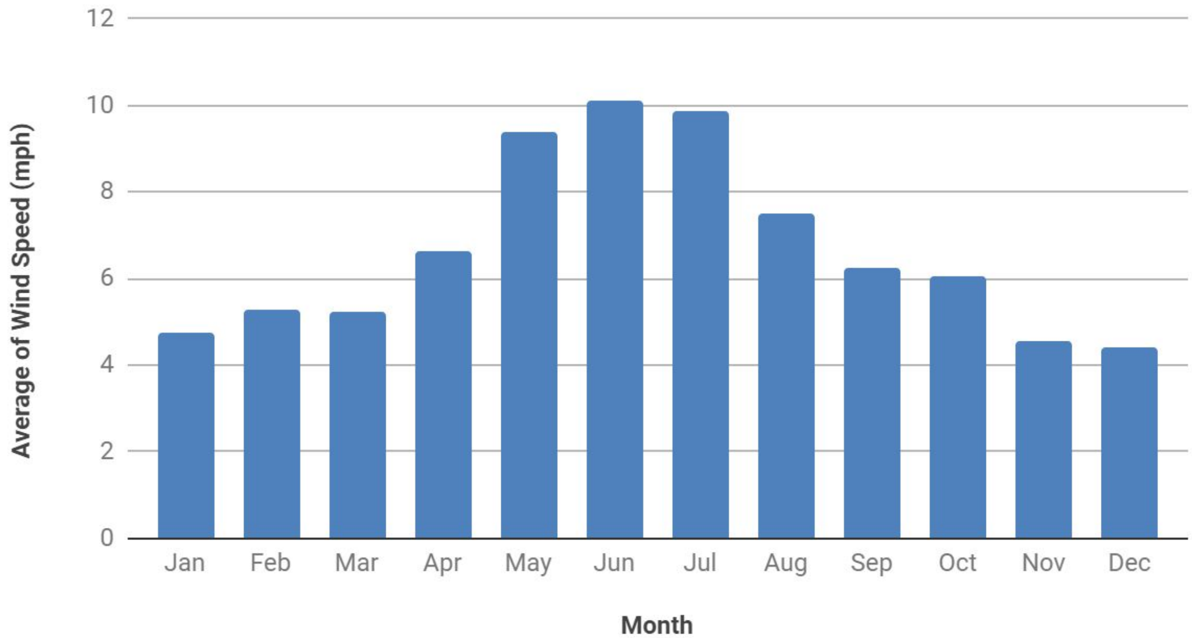
Figure 1-5
Daily average wind speed and wind direction, plotted over a typical meteorological year at Paso Robles Regional Airport (5.1 miles away)



Wind Data

The monthly average wind speed over the course of a typical meteorological year at Paso Robles Regional Airport is shown in Figure 1-6. Average wind speeds are highest during the late spring and summer months, the highest being 10.1 mph during the month of June. The lowest monthly average wind speed of 4.4 mph occurs during December.

Figure 1-6
Daily average wind speed and wind direction, plotted over a typical meteorological year at Paso Robles Regional Airport (5.1 miles away)



The prevailing wind blows onshore from Northwest to Southeast, over the Santa Lucia range. These prevailing winds are most present during the spring and summer months. Fall days see frequent warmer offshore wind events from Northeast to Southwest. Winter sees a mix of onshore and offshore winds during clear days and winds from South to North during the passage of storms.

The hourly distributions for wind direction and wind speed for a typical meteorological year at Paso Robles Regional Airport are available in Appendix A, Figures A-4 and A-5, respectively.

Climate Zones

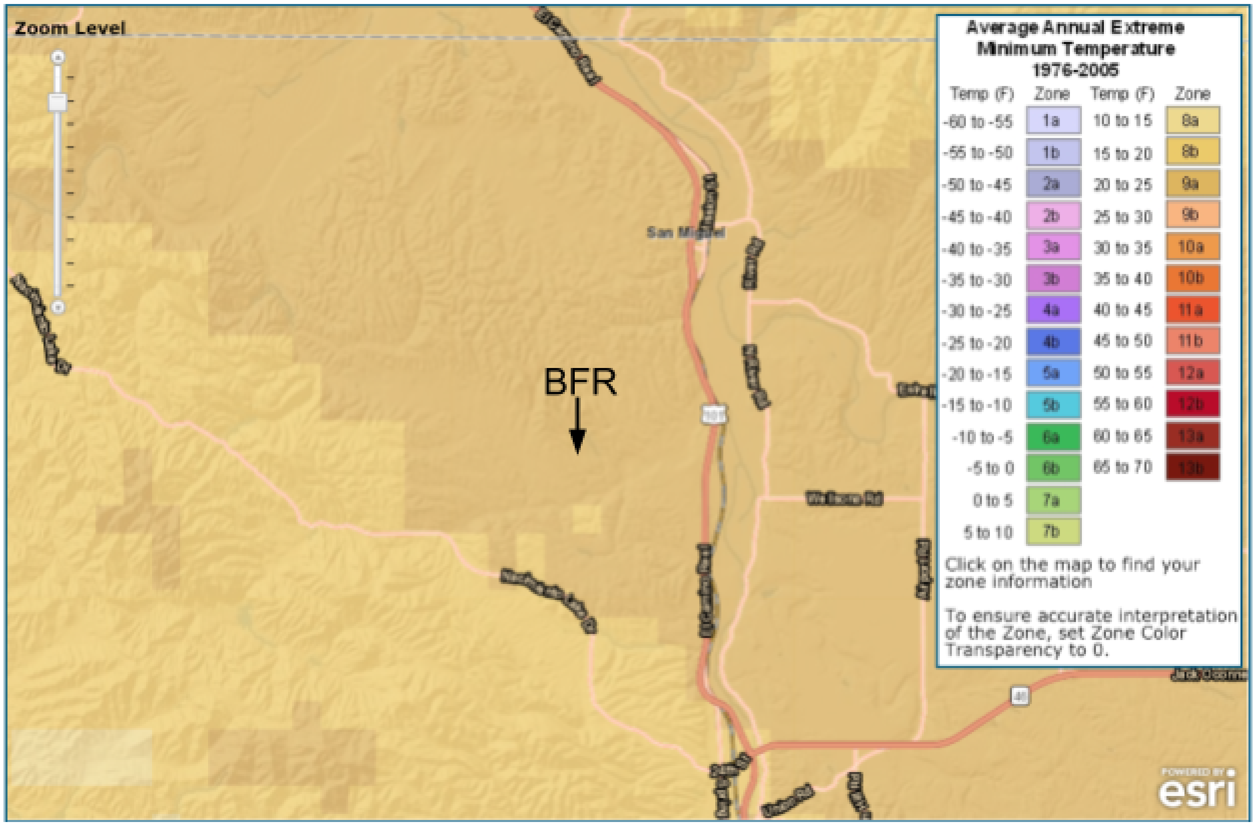
USDA Hardiness Zone

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 http://planthardiness.ars.usda.gov/PHZMWeb/. Microclimates and site specific characteristics will vary.

The USDA Hardiness Zone for 0107 Razor Ridge Road, Paso Robles 93446 is **8b/9a**. This zone is characterized by cold-season low temperatures that do not generally fall lower than 20-25ºF, and extremes that rarely fall below 15ºF. Frost tender perennial plants are likely to suffer damage and/or not thrive in this climate. Potted frost-tender plants should be moved indoors or somehow protected.

Figure 1-7 below presents a map of USDA hardiness zones for the general area.

Figure 1-7
USDA Hardiness Zones for Paso Robles and surrounding areas



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.

The Sunset Climate Zone(s) for Morning Doe Ranch is Zone 7. This climate zone 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— one could get away with growing borderline plants such as citrus, oleanders, and almonds if a spot with good air drainage is chosen to take the edge off winter chill. At weather-recording stations in Zone 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).

Figure 1-7

Sunset Climate Zones for California's Central Coast

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. 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 Kopper Geiger Climate Classification System map, viewable by county, is available at http://koeppen-geiger.vu-wien.ac.at/.

The Koppen Geiger Climate Classification for San Luis Obispo County is **Csb/BSk.**

- **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.
- **BSk:** The B stands for Arid, the s stands for Steppe, and the k stands for 'cold arid'. This is generally considered a semi-arid, dry-steppe type environment.

Growing Season

The 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 (Early June), 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 an average of 286 sunny days in a typical meteorological year at Paso Robles Regional Airport.

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 1-8 presents the high level topographical map for MDR and the surrounding properties of Razor Ridge Court.

Figure 1-8
High-level topographical map of Morning Doe Ranch and surrounding properties

The MDR property spans the intersections of two primary valleys. The proposed future home site sits atop the toe of a primary ridge with west and east-facing aspects. Grades are as steep as 35-40%, and the proposed access road to the future home site current traverses a grade of ~22% at its steepest. From the highest point atop the primary ridge where the future home site is proposed there is a 2% drop to the current siting of the water tank that supplies the main residence on property. The grade measurements taken at MDR are shown in Figure 1-9.

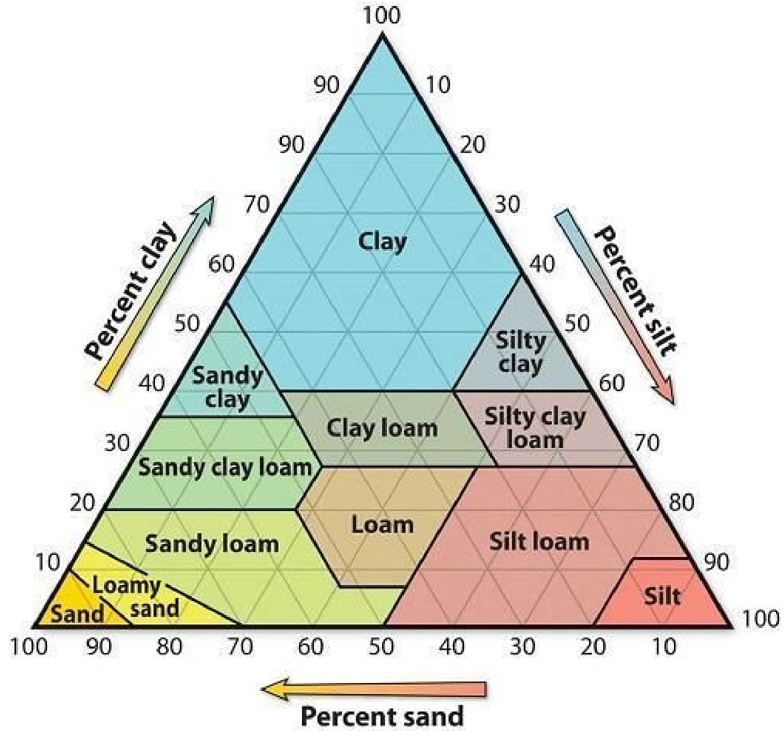
Figure 1-9
Slope Aspects at MDR

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 1-10, 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 1-10
Soil Classification Triangle



Soil Condition Summary

All of the predominant soil types present on-property and up-watershed are predominantly of shale and/or sandstone origin. Soil pH is notably alkaline in these soil strata, with Natural Resources Conservation Service (NRCS) data suggesting an average pH of 8.2.

All NRCS soil layer data indicates that all soil types on the property and up-watershed are either fragile or moderately fragile, with high run-off potentials and low soil-moisture holding capacity, meaning they are quite susceptible to erosion. There was some evidence of the down-valley sediment migration from the up-valley vineyards and properties. Potential for high inbound sediment loads in the event of heavy rain events falling on pre-saturated soils should be taken into account and designed for to mitigate future issues with sediment deposition.

The fragility and general high-erodibility of the soil types present, along with low water holding capacities indicate that plant and tree roots will be among the most effective ways to infiltrate and store water. Care will need to be taken during wet periods with grazing animals to time their presence to allow the land to dry somewhat (and to dry significantly on the steeper slopes), so as to avoid physical damage on steeper slopes (>20%).

Soil organic matter content is quite low in its present state. Establishment of perennial plants and tree cover throughout the property is recommended to increase soil organic matter, particularly with drought hardy pioneer tree species that can be managed by coppicing, pollarding and/or chop-and-drop to rapidly increase soil carbon levels and consequent moisture holding capacity.

Highly targeted and well-managed animal grazing at certain times of the year will also help to increase soil fertility and process perennial biomass into milk, meat and manure.

The Natural Resources Conservation Service (NRCS) map for MDR is provided in Figure 1-11. Detailed descriptions of the soil classifications shown on the map follow.

Figure 1-11
NRCS Web Soil Survey Data for Morning Doe Ranch and surrounding areas

On-Property

- **181—Nacimiento-Los Osos complex, 50 to 75 percent slopes**
    - 50-75% slopes, very high run-off, low infiltration rate.
    - Soil pH is generally quite alkaline, averaging ~8.2 for MDR's native soil complex.
    - **Map Unit Composition**
        - *Nacimiento and similar soils:* 35 percent
        - *Los osos and similar soils:* 20 percent
        - *Minor components:* 30 percent
- **Nacimiento:** Composed of residuum weathered from calcareous shale, typically 20-40" to paralithic bedrock, moderate capacity for infiltration (0.2 - 0.57" /hr) in most limiting layer, run-off is very high, not considered prime agricultural soil, has low ability to store water in the soil profile (~ 5").
    - Hydrologic Soil Group: C
        - **Group C** soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes

downward movement of water and soils with moderately fine to fine structure.

- Landscape Capability Classification: **7e**
  - **Class 7** soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
  - **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.

- **Osos:** Composed of residuum weathered from shale and/or sandstone, typically 20-40" to paralithic bedrock, low-moderately high capacity for infiltration (0.06 - 0.2" /hr) in most limiting layer, run-off is very high, not considered prime agricultural soil, has low ability to store water in the soil profile (~ 3.9").
  - Hydrologic Soil Group: D
    - **Group D** soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This Hydrologic Soil Group has the highest runoff potential. They have *very low infiltration rates when thoroughly wetted* and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and *shallow soils over nearly impervious material*.
  - Landscape Capability Classification: **7e**
    - **Class 7** soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
    - **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.

Infiltration Tests

Infiltration tests were performed at several locations on property. 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 in summarized in Table 1-3, and is available in full detail in the MDR Water Catchment Calculator Google Spreadsheet.

Table 1-3
Infiltration test results for various locations at MDR

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
East Valley Bottom	195	0.55	0.88	23,976	1,438,560
West Valley Bottom	12000	0.01	0.01	390	23,400
Ridge Toe Slope	270	0.40	0.64	17,316	1,038,960
West Facing Slope	90	1.19	1.91	51,947	3,116,820

Land History

The Salinan people inhabited the area in which Paso Robles is located for thousands of years prior to the arrival of the Spanish. The area where Paso Robles is used to known to the Salinan as The Springs due to the large number of natural hot springs in the area. The Salinan tribal council is still active in Northern San Luis Obispo county and the Morro Bay area. The Salinan are an officially recognized tribe by the state of California and are petitioning for federal recognition. Their traditional language of Hokan is the oldest known spoken language in California. Archaeological evidence indicates that the Salinan have inhabited this region for over 10,000 years. For more information, visit the Salinan Tribal Council website.

The Salinan were quickly and brutally incorporated into the mission system following the arrival of the Spanish. General History of Mission System from the Native American Heritage Commission of California.

In August of 1857 the Paso de Robles Land Grant of 25,933 acres was purchased by brothers Daniel and James Blackburn and Lazarus Godchaux from Petronilo Rios. Daniel became the owner of the land west of the Salinas River that eventually became the town of Paso Robles. At the time of purchase there was no town, only a small wooden log shack built around the spring that was located on the northeast corner of what ultimately become 10th and Spring Streets. The spring went dry in 1906 but later became active again in 2003 following an earthquake.

The first post office was established in 1867, and the first train reached the town in 1886, which opened up the original land grant to additional prospective buyers. Paso Robles became a health resort, and many people came to enjoy the hot mineral springs and mud baths.

Paso Robles once had the highest concentration of almond orchards in the world, and some of these orchards still exist, though many have been replaced by vineyards.

Water

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 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 owners are coming to find their flow rate dropping or even disappearing altogether as underground aquifers are depleted.

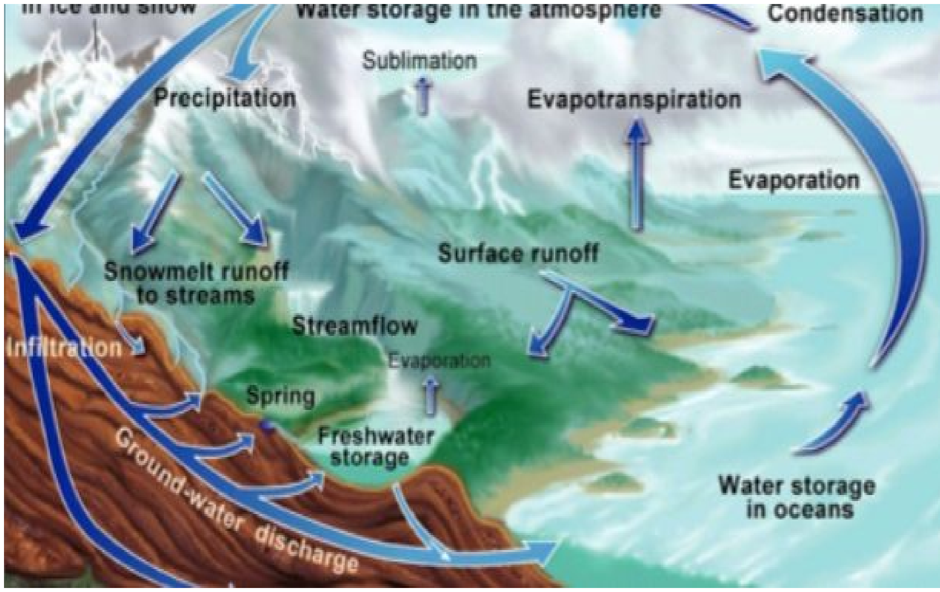
Additionally, conventional property development in the past century was geared towards moving rainwater away from structures and off-property as quickly as possible in an effort to prevent damage. While this seemed to work at first, unfortunately in the long-term this has resulted in major erosion issues (exacerbated by the clearcutting of land and overgrazing with cattle), landscape dehydration, and aquifer depletion.

These issues speak to the critical need for landowners to work with water and embrace its presence on-site rather than fight it by designing for and implementing rainwater harvesting strategies - to work towards regenerating the hydrological cycle on the landscape.

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 2-1
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.

To increase recharge, a landowner can:

- Limit impervious surfaces and the wholesale conversion of native vegetation.
- Implement stormwater pacification techniques designed to slow, spread, and sink water into earthen storage.
- Protect open space in known groundwater recharge areas. If site conditions are not conducive to recharge, then the landowner is wise to ensure proper bio-filtration of all

surface waters prior to their discharge and deposit into rivers, wetlands, lakes, estuaries, and oceans.

- Most Importantly - Landowners can plant trees and establish perennial vegetation wherever bare soil exists. Trees are far and away the best producers of future rainfall, in addition to being the best protectors of soil *from* the impacts of rainfall as well as the most effective means by which to infiltrate precipitation into the soil and increase soil moisture to the benefit of all lifeforms. Trees and perennial vegetation are *critical* to increasing the recharge capacity of the landscape.

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 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 practices (creating impervious surfaces, channelizing stormwater, 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.

Water Patterning Strategies for Regenerative Hydrology

Slow, Spread, Sink, Grow

1. **Slow The Water Down -** By slowing the movement of water over a landscape, its erosive potential is reduced and infiltration is allowed to occur. Common methods for achieving this are increasing vegetative cover (grasses, trees, plants), installing earthworks (swales, catchment basins, net-and-pan, boomerangs, keyline plowing etc.) and limiting/reducing the use of hardscape and consequent concentrated run-off flows, and when possible using permeable surfaces.
2. **Spread The Water Out -** Part of slowing water down is to spread it over as much surface area as possible, and reduce any peaks in concentration. The more surface area the water can touch the greater the opportunity for it to sink in and be put to work in the landscape. Common methods for spreading water include those mentioned above as well as geological and biological flow spreaders (plants and/or rocks arranged to pacify and spread overland flows).
3. **Sink The Water Into Soil -** If Steps 1 and 2 have been designed well, this part will take care of itself. For this, an emphasis is placed on permeable surfaces where hardscape is necessary and encouraging vegetation where it is not (plant and tree roots are the best infiltration mechanisms we have).
4. **Grow Biomass -** Slowing water down, spreading it out, and encouraging infiltration into living soil creates the greatest amount of living edge possible for water to interact with. It is here that the landscape and its stewards reap the greatest rewards, as evaporation is reduced, solar energy conversion to biomass is maximized and life expression is steered towards abundance.

Rainwater harvesting falls into two major categories—passive water harvesting and active water harvesting. Very simply, 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. Active water harvesting, in contrast, uses rain barrels, cisterns, and other types of containers 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 appropriate filtration) uses. Both passive and active water harvesting systems can "extend" the rainfall season and maximize the use of water that falls on property. Passive systems are more cost effective than active systems per gallon harvested, but yield fewer options for water use.

Most landowners opt for a combination of active and passive water harvesting. Below is a summary of the rainwater calculations for the MDR property, existing passive and active water harvesting systems in place, as well as recommendations of strategies to increase water harvesting capacity.

Context

Rainwater Harvesting Potential

A watershed, also known as a drainage basin or catchment, is an area bounded by hills, ridges, and valleys where any rainfall and runoff leads to a single outlet. Watersheds can be as small as a footprint, the roof of a house, a small urban residential property, a broad-acre farm, or large enough to encompass all of the land that drains water into rivers that drain into the ocean (such as the portion of the San Luis Obispo watershed draining into San Luis Obispo Creek, ultimately draining into Avila Bay). 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.

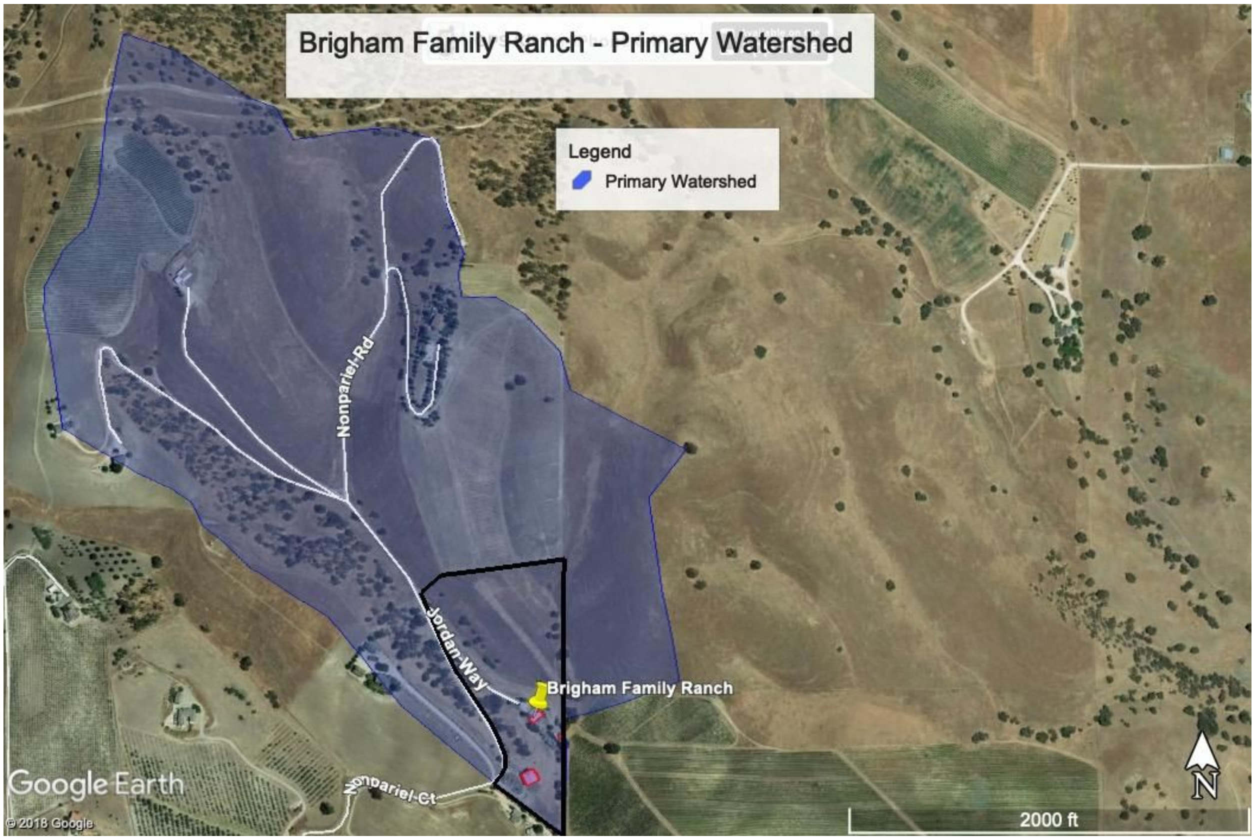
Morning Doe Ranch is located at the intersection of two primary valleys. The property has 12.57 acres of catchment area comprised of structures, hardscape, and softscape - summarized in Table 2-1. An additional ~123 acres of up-canyon catchment is located above the MDR property.

Table 2-1
Summary of catchment areas within MDR boundaries

Catchment Name	Area (sq. ft.)	Surface Type
Structures - House Roof	1,780	Roofs
Structures - Shop Roof	3,700	Roofs
Structures - Shed Roof	380	Roofs
Access - Main Driveway	10,100	Drives and Walks
Access - Shop Driveway	4,600	Drives and Walks
Access - Seasonal Shop	7,900	Drives and Walks
Access - Seasonal Shed	2,700	Drives and Walks
Access - Seasonal East Valley	6,000	Drives and Walks
Access - Seasonal North Hilltop	9,100	Drives and Walks
East Valley East Aspect	103,000	Ag - Bare Packed Soil/Rough
East Valley West Aspect	28,000	Ag - Bare Packed Soil/Rough
West Valley East Aspect	146,000	Ag - Bare Packed Soil/Rough
West Valley West Aspect	155,000	Ag - Bare Packed Soil/Rough
West Valley Bottom	55,000	Ag - Bare Packed Soil/Smooth
East Valley Bottom	14,000	Ag - Bare Packed Soil/Smooth

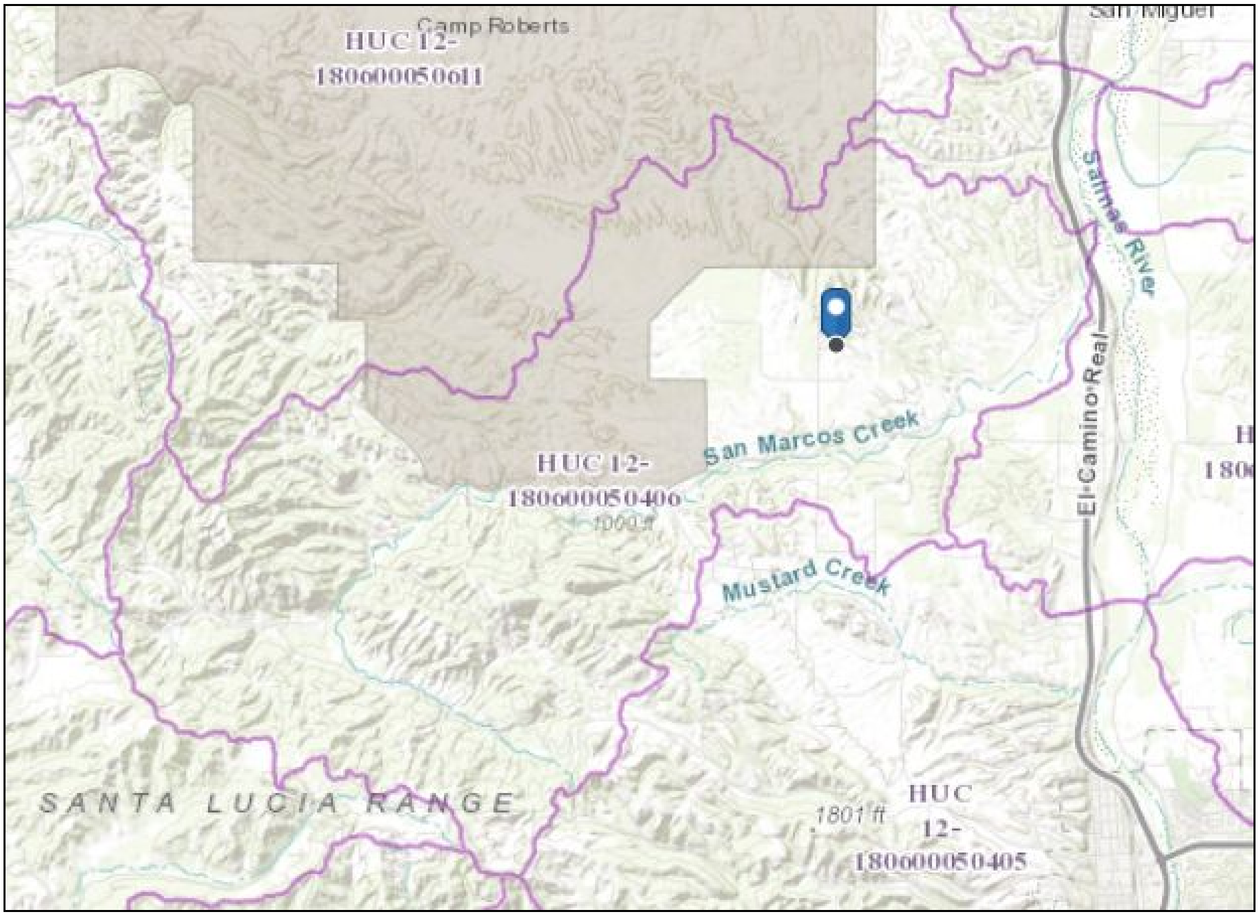
During an mean rain year of 14.77 inches, the total volume of rainfall that lands within MDR property lines is 5.04 million gallons; the total volume that lands on structure roofs is 53,960 gallons. Based on runoff estimates for the terrain, an estimated 1.3 - 2.7 million gallons of this water is lost to runoff during an average rain year. Detailed calculations are available on the Catchment and Runoff Calculation spreadsheet.

Figure 2-2
Primary watershed feeding into MDR property



In a mean rainfall year of 14.77 inches, over 49.3 million gallons of rain falls on the 123 acres up-canyon from MDR. Based on runoff estimates for the terrain, an estimated 9.8 - 24.7 million gallons of this water is lost to runoff during an average rain year, which ultimately passes through MDR. This watershed ultimately feeds into the Salinas Valley watershed and the Salinas River via the San Marcos Creek watershed. Macro scale views of this watershed can be viewed at the San Luis Obispo County Interactive Data Viewer.

Figure 2-3
MDR location within the San Marcos Creek Watershed



Aquifer

Information about the aquifer underneath Morning Doe Ranch can be gathered from the following websites:

- Principal Aquifer Map of U.S.
- California Groundwater Basin Boundary Assessment Tool
- California Water Management Planning Tool

Figure 2-4
MDR's location within larger Salinas Valley Groundwater Basin

The Salinas Valley Groundwater Basin is currently classified as Critically Overdrafted. Groundwater overdraft occurs when groundwater use exceeds the amount of recharge into an aquifer, which leads to a decline in groundwater level.

Wells

The MDR shares a well with other nearby landowners. The well location was not determined during the site visit. The well is configured with a storage tank of estimated 5,000 gallon capacity located near the shop on the ridge in the southern corner of the property. The storage tank is dedicated to MDR.

Municipal Water

The property is not currently tied to any municipal water systems.

Passive Water Harvesting

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, French drains, and more. They are typically less expensive, simpler to build, lower maintenance, and longer lasting than active water harvesting systems.

Existing Conditions

While over 5 million gallons of water falls within property boundaries during an average rain year, most of it exits the property via runoff or evaporates before being able to be utilized by living systems due to the predominance of fast-growing, short-lived annual grasses and the lack of tree cover. The infiltration rate of the soil is fairly high, but once saturation is reached, which occurs fairly quickly due to the thin nature of the soil and thus low total water holding capacity, no additional water can infiltrate. Additionally, organic matter content is very low, further reducing the soil's capacity to retain water for productive use later into the growing season. Wind exposure and bare soil without cover or shade currently create high evaporation conditions.

Recommendations

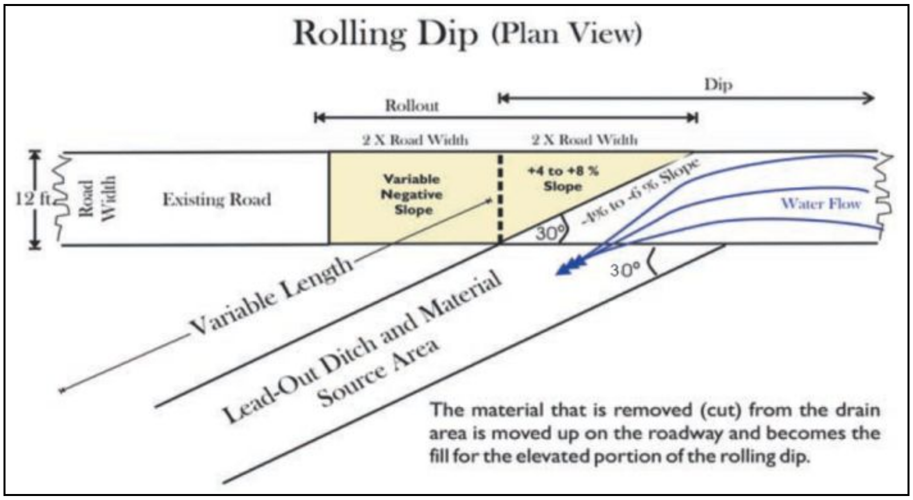
In order to improve water infiltration and retention on-site, the following elements and steps are recommended:

- Re-grading of the section of Razor Ridge Road just uphill of the turn onto Turner Way (driveway) to keep water on the west side of the road until it reaches the culvert at the northwest corner of the property. This may entail raising the roadway level slightly in order to ensure water transits through the culvert and not across Razor Ridge Road.
- A rolling dip should be installed on Razor Ridge Road, just before the intersection of Razor Ridge Road and Turner Road (driveway). A rolling dip is a long, shallow depression in a road with a very slight elevation drop that crosses the road at a diagonal towards a desired lead-out point where water can be safely discharged from the road surface. This rolling dip should direct any water flow down Razor Ridge Road into the culvert entrance, rather than down the driveway.

Figure 2-5
Location of drainage issues and recommended rolling dip

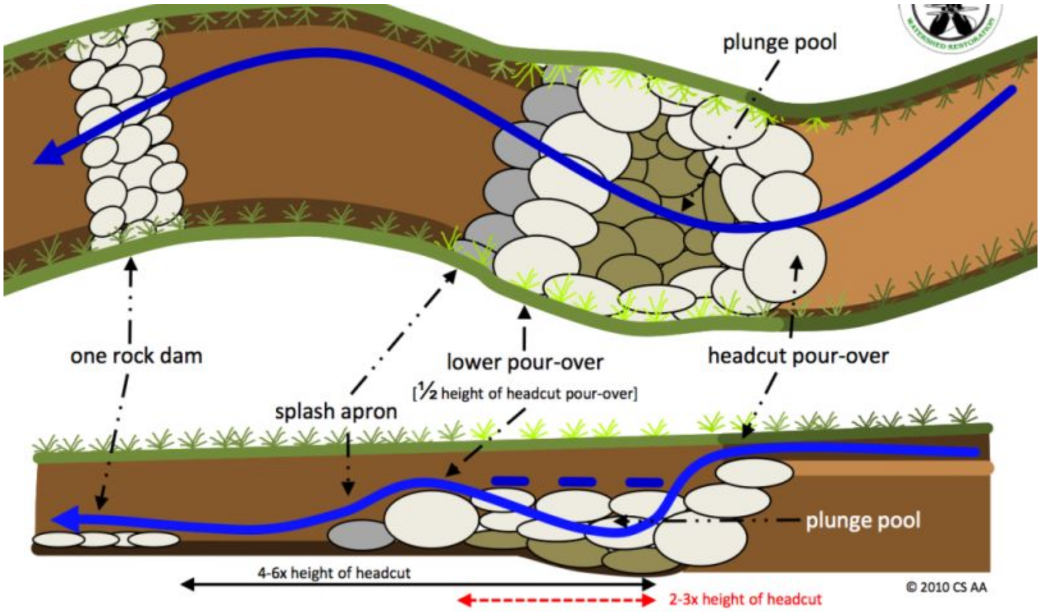
Figure 2-6
Erosion at driveway entrance due to improper road grading and drainage

Figure 2-7
Rolling dip design



- Maintenance of the culvert ditch at the entrance to the culvert to ensure water transits through the culvert without delay. Currently the ditch bottom is lower than the culvert, leading to pooling on the west side of Razor Ridge Road. Either the ditch bottom should be raised (along with a concomitant increase in road height) to meet the lower lip of the culvert pipe to alleviate pooling, or the culvert should be re-dug lower so it is even with the bottom of the culvert ditch.
- At the exit of the culvert crossing under Razor Ridge Road, there is evidence of significant downcutting, which if not remedied will eventually become a headcut, undercutting the road and necessitating repair. An armored plunge pool, known in the regenerative hydrology world as a Zuni Bowl, should be installed at the exit of the culvert crossing under Razor Ridge Road in the northwestern corner of the property to pacify the water's exit from the culvert and allow it to be discharged over a broader area of the landscape than it is currently. The flow dispersal area should be planted with perennial vegetation to protect the soils and further improve infiltration.

Figure 2-8
Zuni Bowl construction



- Planting of drought-hardy, flood-tolerant species in flow-spreading arcs just downslope of the culvert exit onto the property to help spread, slow and immediately infiltrate incoming flow from the culvert.
- Planting of drought hardy, leguminous pioneer trees along both the West and East Valley Bottoms to shade soil, improve infiltration during rain events, improve water retention and banking throughout the dry season, improve soil fertility for future long-term productive overstory plantings. Below is a short list of trees that have these qualities:
    - Honey Mesquite - *Prosopis juliflora*
    - Chilean Mesquite - *Prosopis chilensis*
    - Velvet Mesquite - *Prosopis velutina*
    - Mimosa/Persian Silk Tree - *Albizia julibrissin* (already present on property)
    - Woman's Tongue - *Albizia lebbek*
    - Rosewood - *Tipuana tipu*
    - Black Locust - *Robinia pseudoacacia*
    - Acacias - *Acacia spp.*
- Cover the soil, especially on steep slopes, both with mulch and living cover.
- Establishment of drought hardy, leguminous pioneer trees on steep slopes for shade, wind buffer, soil fertility, erosion mitigation, and potential forage for future livestock. Healthy and well-adapted trees that will have a long and productive life need to be established well (i.e. have a properly structured root system) or they will languish and never grow to their potential, but establishing trees is challenging in brittle climates with long dry seasons, and setting up irrigation for dense agroforestry plantings across broad acreage is not only expensive but also a huge maintenance issue. A new technology known as the Groasis Waterboxx, shown in Figure 2-7, provides a good solution to these problems. The Waterboxx is essentially a water battery that is pre-charged with several gallons of water.

The water reservoir sits inside a covered container placed around the tree seedling or tree seed. A wick from the internal reservoir leaches out some 50mL per day of water - not enough to make the tree lazy and meet all of its needs, just enough to create a water column of moisture directly beneath the soil upon which the Waterboxx sits. There is not enough water in this column for the tree to thrive, but there is enough to continually stimulate the taproot to continue growing deeper into the soil (a very desirable trait in drought-prone climates). The water reservoir also serves as a thermal mass that condenses warmer, moisture laden air on the Waterboxx's surface, which refills the reservoir. These devices are meant to filled once and left for a year or longer, and they will continue to self-fill and maintain the water column training the young tree to develop a strong, deep root system.

Figure 2-9
Groasis Waterboxx

An animated walkthrough of how the Groasis Waterboxx works is available here.

Active Water Harvesting

Active water harvesting uses rain barrels, cisterns, and other types of containers 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 extensive 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

The only water storage on-site is fed from the well - no rainwater storage systems exist. The house has a gutter system that currently empties into the West Valley. The shop does not have a gutter system.

Recommendations

In order to improve water harvesting on-site, the following elements and steps are recommended:

- A gutter system should be installed on the shop roof. Gutters could be patterned into the current water tank supplying the main house, or into an additional tank to create additional storage buffer.

Access

Access patterning is a critical design component for creating low-maintenance, low-input properties. It can often be a limiting factor when selecting appropriate management strategies. Additionally, access routes present huge opportunities for passive water harvesting on-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 large amounts of unnecessary energy expenditure over the lifespan of the access route (in fuel and human/animal calories burned).

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 (areas immediately before and after stretches where drainage is not feasible. Erosive runoff water should be diverted from the access roads as shallow, non-erosive flow using rolling dips, crowning, cut-off drains, and water bars into passive water harvesting systems such as swales, infiltration basins, biological flow spreaders and multi-level perennial vegetation.
- 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.

Roads

Roads refer to any access routes that are designed and built to accommodate vehicle use. Roads typically have a specially prepared surface to designed to sustain vehicle traffic during four-seasons- in urban and suburban areas with heavy vehicle traffic this surface is usually asphalt or concrete laid on a compacted base course, but most ranch and farm roads still utilize dirt and gravel road surfaces.

Existing Conditions

Razor Ridge Road delineates the Western property line at MDR. It is composed of gravel road base and runs at ~6.5% grade down to the intersection with the MDR driveway (Turner Way), which is also composed of gravel road base and runs at ~2.7% grade to the main house. The driveway continues to the lower garage. A loop composed of gravel road base runs in front of the shop, connecting to Razor Ridge road at two locations allowing for bidirectional access to the shop and larger shop area. All other access routes on the MDR property are currently dirt roads and require a 4-wheel drive vehicle to access. The two vehicle paths leading directly up the East-facing slope from the main house to the shop reach ~35% grade at their steepest. The path heading from the garage across the West Valley Bottom and leading up to the future proposed home site has a maximum grade of ~22%. At the base of the toe slope upon which the proposed future home site is located an access track branches to the east and runs along the East Valley Bottom once permitted by the property fence line.

Figure 3-1
Existing access routes for Morning Doe Ranch

Recommendations

The following is recommended to improve road access on the property:

- The two 4WD tracks leading up to the shop from the main house should be used as sparingly as possible. Due to the fragility of the soil and the steepness of the grade, consistent use will ultimately lead to downcutting, which dramatically increases the erosion risk (and erosion mitigation cost) of this east-facing slope. Use should be minimal or non-existent when soils are wet or during precipitation events.

- Vehicle access to the future housing site by vehicle should be limited to the access track traversing the spine of the ridge, where the grade only reaches 22% as compared to the 40%+ grades experienced on the west and east facing sides of the ridge, for the same reasons already mentioned.

Human/Animal Walking Paths

The paths described in this section are only built or recommended for human and animal walking access. They may be large enough to accomodate a wheelbarrow or handcart, though in many cases may only be suitable for foot traffic due to steepness.

Existing Conditions

There are few existing foot paths on property. Evidence of animal access paths on the hillsides is evident (dogs, rogue cow, deer?).

Recommendations

The following new walking paths, or modifications to existing walking paths, are recommended:

- A switchback footpath can be constructed leading from the house to the shop to create a walkable “commute” and take pressure off of the fragile vehicle tracks on this hillside.

Structures

In a good design, homes, sheds, animal shelters, greenhouses, and other buildings are placed in relation to on-site water patterning and desired/necessary frequency of access. This interconnected, efficient approach to element placement saves large amounts of energy over the lifetime of the site. Siting a home for a view (for example, at the highest point on the property) is often costly from an energy efficiency standpoint, as inefficiencies increase due to the reliance on mechanical sources to bring pressurized water to the site, comfort levels decrease 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 structures were already present in less than ideal locations when the land was purchased, any future structures can be placed with these principles in mind.

Context

The structures at MDR are shown in Figure 4-1. A summary of any applicable county/city building codes and restrictions, as well as an analysis of environmental and human sectors at the main residential sites on the property, is provided below.

Figure 4-1
Existing structures at Morning Doe Ranch

Restrictions - Building Codes / Permits / Legal Barriers

Building Code Restrictions and Permits

SLO County has especially stringent regulations on building. These codes should be thoroughly researched and taken into account when planning for the placement of additional structures on-property. The codes are available at the SLO County Planning and Building website.

Building permits information, forms, and submissions can be accessed at the SLO County Planning & Building website.

Septic Codes

Septic systems/hookups are required at this site.

Zoning ordinances

Morning Doe Ranch is zoned for agriculture**.**

Utility easements

The following utility easements exist at MDR:

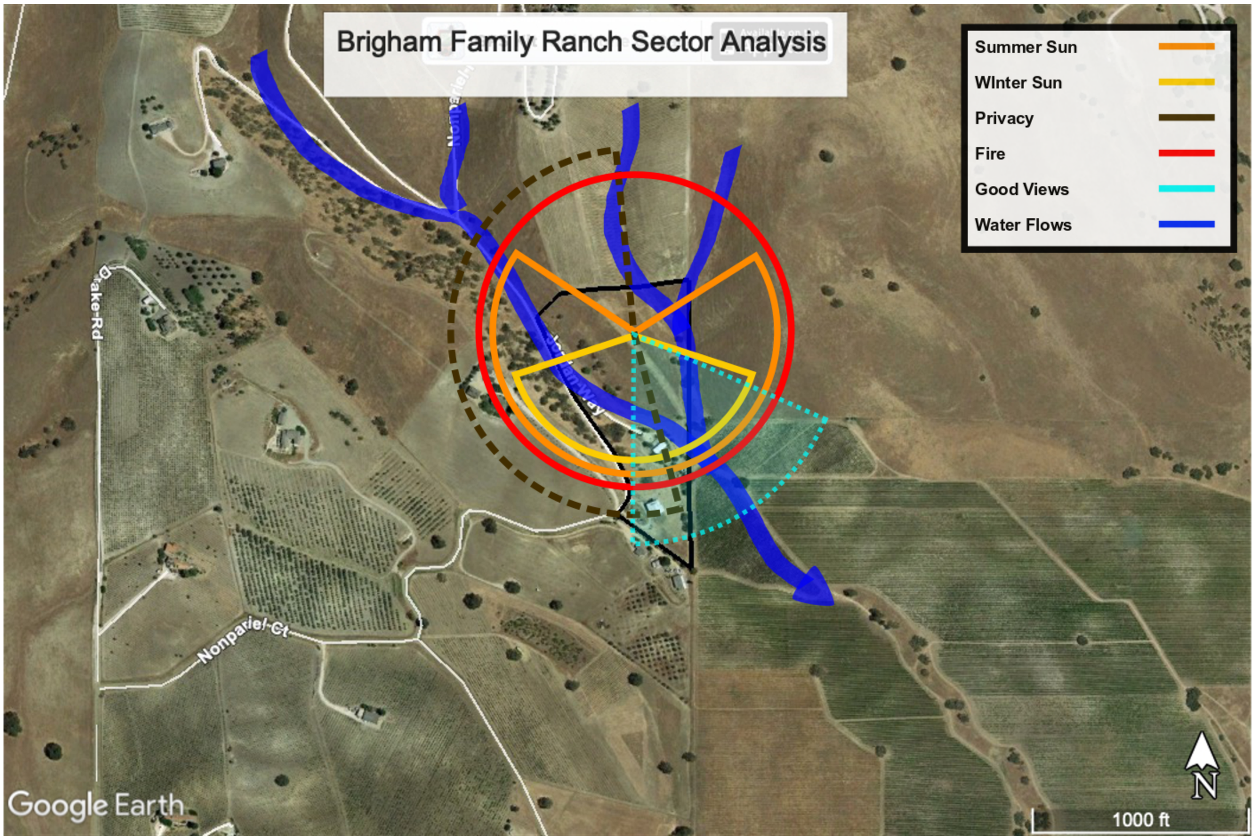
Home-Owners Associations

The property is not associated with any home-owners associations.

Sector Analysis

A sector analysis examines the natural environmental factors that affect a site. The sector analysis and a brief written summary of the sectors affecting Morning Doe Ranch is provided below.

Figure 4-2
Sector analysis of Morning Doe Ranch



- Solar Aspect & Access
  - Sun's relationship to structure siting, orientation, construction, materials
  - Main house is oriented Northeast by Southwest lengthwise, good opportunities for roof top solar PV and/or solar thermal.
- Physical Access
  - Razor Ridge Road approaches the property from the West.
- Visual Privacy / Exposure
  - Neighbors with direct lines of sight onto the property to the North, Northwest, West and South.
- Wind
  - See Wind Data section.
- Fire

   - Fire could approach the property from all directions. However, due to the barren condition of the neighboring properties and the surrounding vineyards, risk of catastrophic fire is quite low. Fast moving grass fires are the most likely fire vector, though do not pose a great danger to existing structures.
   - As additional vegetation is established on the property, careful attention should be paid to spacing, composition and species selection to ensure that fire danger is not increased. More information on this topic is available in Living With Fire - Part 2: Regenerative Firescaping - Protecting Your Home With Good Design on the 7th Generation Design website.
- Security
   - Access to the property via Razor Ridge Road and Turner Way (driveway to main house). The property is fenced, though the fence is fallen and has large gaps in numerous locations, permitting access by large animals (cow) and people. The driveway not gated at its intersection with Razor Ridge Road.
   - The entire property is visible upon from the point where Razor Ridge Road meets with the shop driveway loop. Visibility is also nearly complete from neighboring properties and dwellings to the North, Northwest, and West.

Homes

Homes for the purposes of this report are permanent structures intended to provide shelter and comfort for humans.

Existing Conditions

There is a single-story home (1,500 interior/1,780 roof sq-ft) on the west side of the West Valley Bottom. The rear of the home has a deck and gravel entertainment area. The house has rain gutters. The home is ideally positioned on the property to take advantage of favorable microclimate - its location at a higher elevation than the valley bottom makes the area warmer during the wintertime than it would be if located at the valley bottom. Additionally, it sees lower intensity hot and cold winds than it would if located at the top of a ridge.

Figure 4-3
Main Homesite Area of Morning Doe Ranch

The Doe family conveyed a 5-year plan to build an additional home on the crest of the southeast-facing ridge on the north end of the property. This site takes advantage of the beautiful view sector, but is completely exposed to the elements. Full sun exposure on a south-facing slope during the warmest months with no shade from trees will result in extreme heat (and thus energy-intensive cooling demands). During the winter, the sun exposure will be a benefit, but the cold south winds from storm systems will be funneled up-canyon, passing through the homesite with higher speed. Additionally, the top of the crest of the ridge is located at a higher elevation than the water tank, meaning that additional energy-intensive pumping equipment will be required to supply water to the area.

Recommendations

Moving the proposed future homesite partway down the ridge should be considered. This will slightly alleviate its exposure to winds, and depending on location, will either reduce or altogether eliminate water pumping needs. Regardless of which homesite is selected, fast-growing deciduous shade trees (which will will block summer sun but allow for winter sun) should be planted around the area as soon as possible, and fast-growing windbreak trees (evergreen, to diffuse winter winds) should be planted on contour downslope of the home on the south-east facing ridge. Even if the exact size, design, and orientation of the home is not yet known, planting in the general area and giving these trees a head start will result in much more comfort when the home is built. Any trees that end up interfering with the house location can be removed at that time.

Figure 4-4
Proposed and Recommended Second Homesites at Morning Doe Ranch

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

There is a shop on the west side of the property (3,700 sq-ft roof area). There is a detached garage/shed at the bottom of the property (380 sq-ft roof area). Neither the shop or shed has rain gutters.

Figure 4-5
Shop at Morning Doe Ranch

Recommendations

Rain gutters are recommended for the shop, possibly for storage of rainwater in the existing storage tanks or in an additional tank in the same location. Roof catchment totals can be found in the [Water chapter.](#)

Animal Enclosures

Animal enclosures are designed to provide shelter for animals, and may potentially also provide storage for feed. They can be either permanent, portable or temporary.

Existing Conditions

There is an enclosed chicken yard and raised bed garden zone to the southeast of the main house.

Recommendations

Mobile chicken tractors, which are essentially chicken coops on wheels, should be considered to allow the chickens seasonal access to fresh pasture and other areas outside of the fenced garden zone. During the winter and spring, the chickens can be brought out to pasture and relocated every few days so the flock has a consistent supply of fresh vegetation to forage in. Chickens like to eat the tender tips of grass and weeds, and they especially relish bugs, slugs, and snails – which helps make a dent in the pest population on a property. As the tractor is moved around, they leave their nitrogen- and phosphorus-rich manure behind them.

The chicken tractor is not recommended for use in the extreme heat and dry terrain of summer, at least until more trees are established in the valley bottoms, providing shade and additional moisture to the areas. There are many plans for chicken tractor construction available - an example of one is shown in Figure 4-3.

Figure 4-3
Chicken tractor example

Portable Structures

Portable structures are designed to be somewhat easily relocated. They can be used temporarily or semi-permanently in a location.

Existing Conditions

There is currently a tiny house located at the low point of the West Valley Bottom. The Doe Family has expressed the desire for additional portable/temporary housing on-site to facilitate multi-day workshops hosted on-site as part of the woodworking business. Tent cabins are currently under consideration.

Recommendations

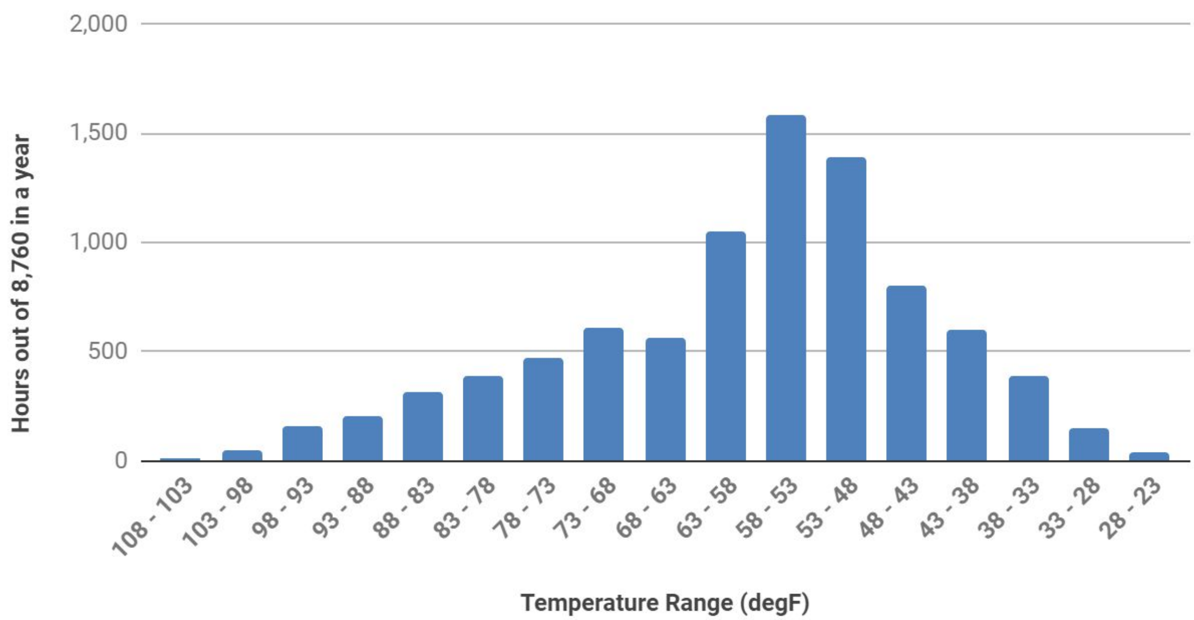
Tent cabin (or other semi-permanent housing) locations are suggested for areas outside of the valley bottom low points, which are prone to boggy conditions and possible runoff events during the winter and spring, and away from ridge tops, where they are exposed to summer heat and neighbor view sectors. Potentially suitable cabin area locations include the area currently used for the burn pile, the area just upslope from the shop along the east fence, and the area where the existing garden is (The raised beds can be moved closer to the house for kitchen gardening, and fruit trees planted throughout the property, especially once nurse trees are planted in the valley bottoms to moderate the climate and enrich the soil).

Appendix A - Additional Climate Information

The hourly distribution of temperature for a typical meteorological year at Paso Robles Regional Airport (5.1 miles away from MDR) is provided in Table A-1. This chart shows how many hours of a typical meteorological year fall within certain temperatures ranges, which is helpful in determining which plant species are most suitable for the climate in a given area, or in designing for the heating/cooling needs of a home.

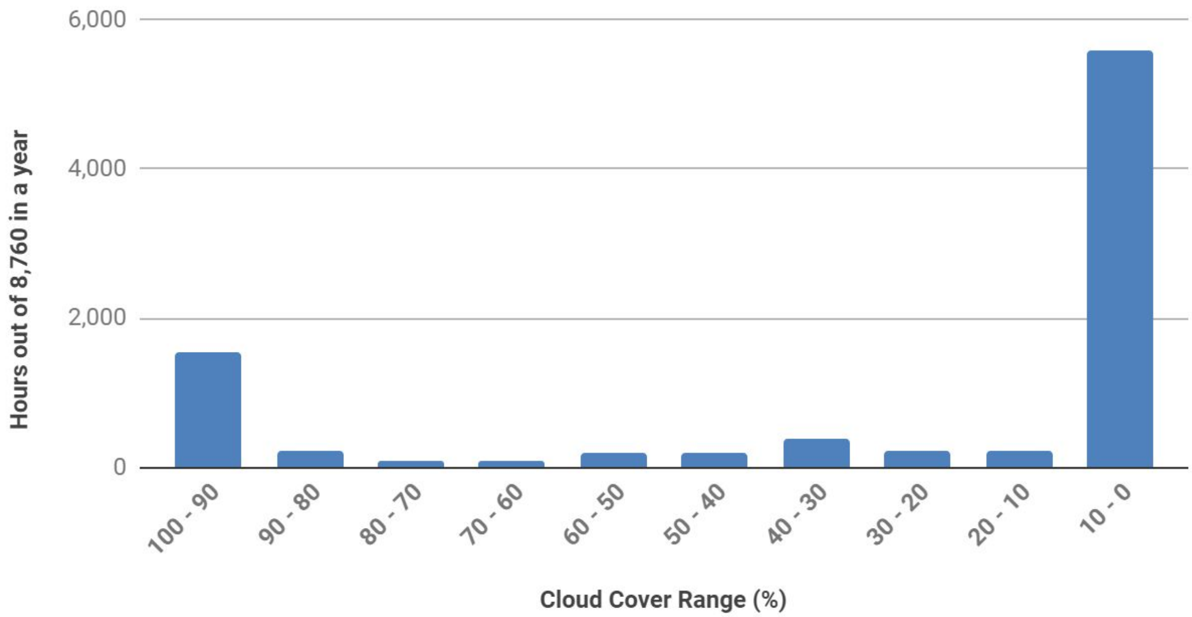
Figure A-1

Hourly temperature distribution for typical meteorological year at Paso Robles Regional Airport (5.1 miles away from MDR)



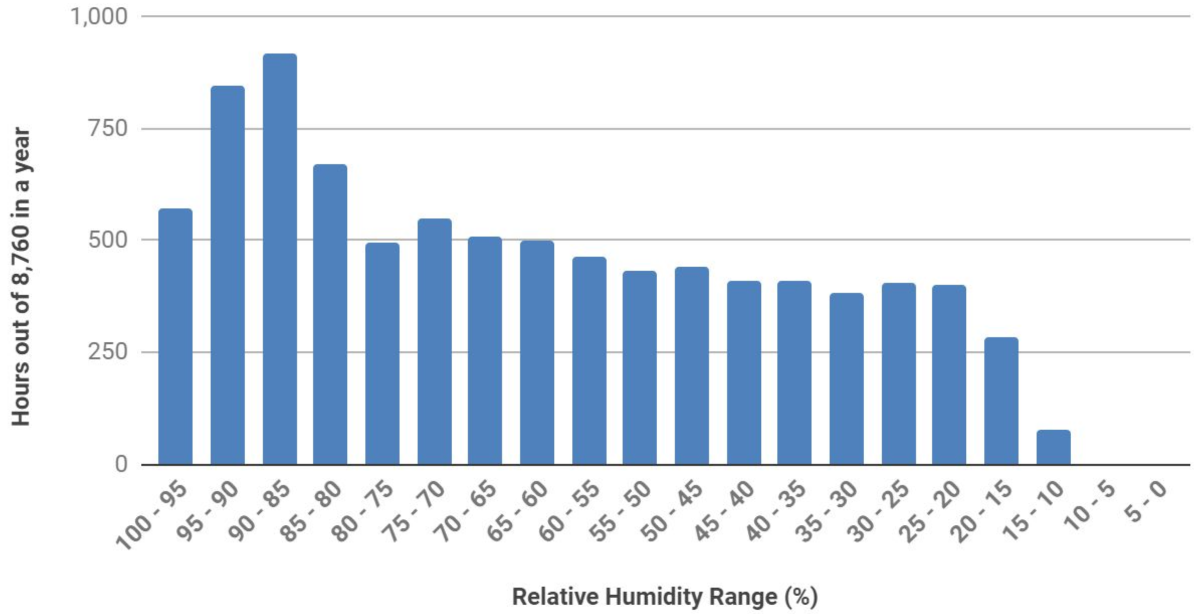
A chart of the hourly distribution of cloud cover for a typical meteorological year at Paso Robles Regional Airport is provided in Figure A-2. This chart shows how many hours of a typical meteorological year fall within certain a certain percentage range of cloud cover (for example, how many hours of the year the sky is 40-50% covered with clouds), which is helpful in determining the number of sunny days an area sees each year and thus which plant species are most suitable.

Figure A-2
Hourly cloud cover distribution at a percentage of sky covered for typical meteorological year at Paso Robles Regional Airport (5.1 miles away)



The hourly distribution of relative humidity in 5% ranges is provided in Figure A-3. This information is helpful in selecting plant species that are well adapted for the climate at MDR, as well as home and structure design for indoor climate control.

Figure A-3
Hourly relative humidity distribution (5% ranges) for typical meteorological year at Paso Robles Regional Airport (5.1 miles away)



The hourly distributions for wind direction and wind speed for a typical meteorological year at Paso Robles Regional Airport is provided in Figures A-4 and A-5, respectively.

Figure A-4
Hourly wind direction distribution for typical meteorological year at Paso Robles Regional Airport (5.1 miles away)

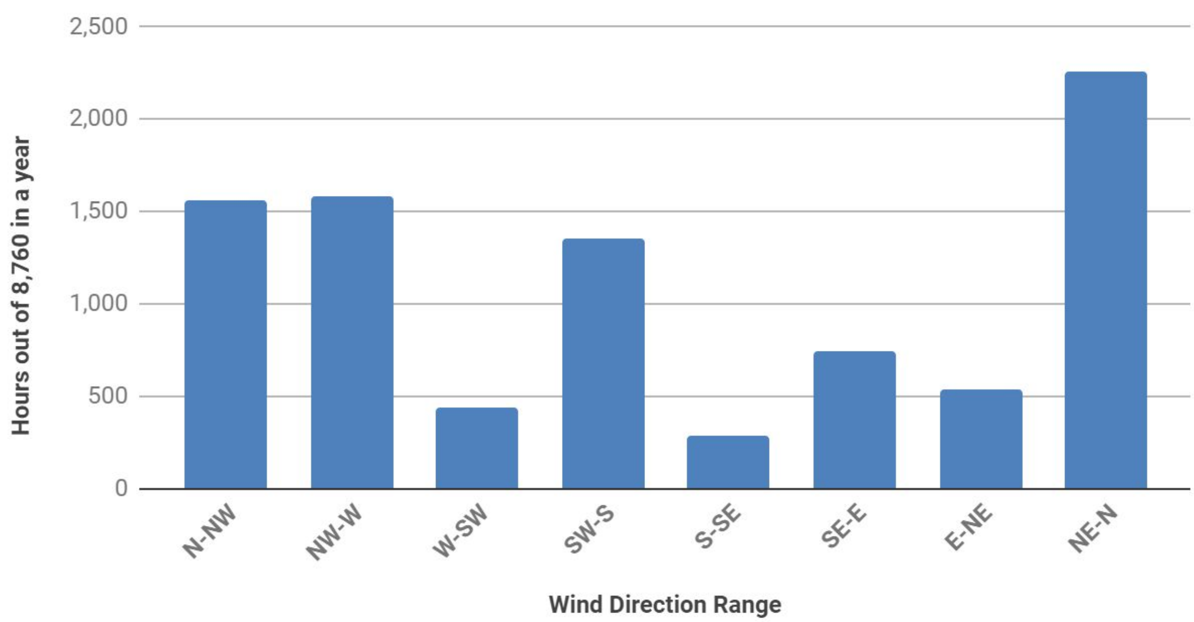


Figure A-5
Hourly wind speed distribution (5% ranges) for typical meteorological year at Paso Robles Regional Airport (5.1 miles away)