441 Saxony Rd. Encinitas, CA 92024

Newland Sierra Agricultural Alternative Report

Prepared for Farmer D Consulting, May 6, 2016

Project site:

Newland Sierra

33.204820, -117.142253

Twin Oaks, San Diego County, CA

Produced by:

Ecology Artisans

ecologyartisans.com

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Foreword

With more than 40 years of combined experience in gardening, farming, construction, forestry, landscaping, and business, the Ecology Artisans team is becoming expert in the regenerative agriculture industry. Our team of professionals has worked with more than 100 clients across several countries and has trained well over 1,000 people in the disciplines that make up what many now call the “Regenerative Agriculture” movement. Our team is made up of 5 owner operators and a host of experts and advisors.

Ecology Artisans is an ecological farmland and landscape design and development company headquartered out of San Diego, CA. Our mission is to design, develop, and install regenerative living systems that foster resilient, profitable outcomes for farmers, communities, and planet.

Report description

Farmer D Consulting will assist with the development of a model for the agricultural use of the 1,985 acre Newland Sierra property in San Diego County, California.

The scope of work consists of site assessment, agricultural operation suitability, and financial modeling resulting in an agricultural plan for the property.

- Comprehensive review of current maps, surveys, project plans, topography and soils maps.
- Conduct site assessment and analysis
- Assess feasibility of agriculture across the site
- Study potential agricultural uses
- Develop conceptual agricultural overlay diagram for the property
- Develop budget projection of capital and operating expenses and revenue to accompany the agricultural overlay

Project Overview: Agricultural Alternative to Mixed-use Development

The proposed Newland Sierra Development is located in North San Diego County just North West of I-15 at the Deer Springs Rd exit. It encompasses approximately 1,985 acres which is currently zoned RL-20 and consists of steep, rocky chaparral hills and a few relatively flat valley basins and plateaus. A mixed residential and commercial development is currently being proposed for this area, and this report represents an overview of the Alternative potential of agricultural development of the site to be included in the Environmental Impact Report.

We are Nature

Our team at Ecology Artisans believes that humans are an intrinsic part of nature. We do not see us as a scourge or a plague, but rather a useful tool in nature's toolbox that can deliver great benefit and regeneration when appropriately applied.

We also believe that fencing off "natural systems" cuts out a crucial and evolutionary component of our ecosystems: humanity. Indigenous wisdom and culture have much to teach (remind) us about how to balance our needs for food, medicine, shelter, and clothing with the greater whole.

We hope that you consider the possibility for increasing the capital of the land beyond just a financial perspective. With foresight, investment, and hard work, we see an opportunity for increasing the natural, social, and spiritual capital of the land by effectively managing the natural systems it contains.

Introduction

Rationale for Agricultural Alternative

Agricultural production is a historic and prevalent land use throughout San Diego County and maintaining the agricultural and open space character of the landscape is a stated goal of the County master plan. According to the Farm Bureau, San Diego County has the 12th largest agricultural economy in California producing $5.1 billion of revenue annually. The climate and market access in San Diego lead to it being ranked top 2 in the state for production of a variety of

crops including Avocados, Pomegranates, and Macadamias. (35) The price of both land and water in San Diego County encourage growing high value crops, ideally with low water needs.

This report will focus on the potential for Agricultural land use for the Newland Sierra project area. Agricultural land use has the potential to buffer the impacts of residential and commercial development on open space, maintaining the rural character and habitat value of an area, while contributing to the regional economy. However, not all sites are suitable for profitable agricultural development.

The Regrarian® Design Platform

Darren Doherty and the work of the Doherty family have greatly influenced the way that we approach broad acre and production landscapes so much so that we use their trademarked Regrarians® Platform design process as our exclusive "go to" framework when analyzing and preparing property reports. The Regrarians® Platform is based off the "Keyline Scale of Permanence" developed by the late, great Australian agricultural designer and farmer, P.A. Yeomans as outlined in his 1958 classic, *The Challenge of Landscape*.

The platform becomes our catch-all and guiding light when analyzing a landscape. The different categories trend from more permanent and hard to change to least permanent and easy to change.

1.CLIMATE - You, Enterprise, Risk, Weather

Concerns the various biomes of an enterprise, be they Human or Biospheric. Effectively these climates create "the rules of the game" in the application of the Regrarian Platform.

2.GEOGRAPHY - Landform, Components, Proximity

The "board game" in the Regrarian® platform. The Geography of your landscape places it in its catchment interacting with all other physical elements. It includes topography, demography, and geology.

3. WATER - Storage, Harvesting, Reticulation

The water an enterprise has available to it is relatively fixed. We should be concerned with how we make the best use of what's available in order to maximise the use of this critical resource. We should apply what we have learned in *Climate 1* and *Geography 2* (as well as capital) to maximize our water potential.

4. ACCESS - Roads, Tracks, Trails, Markets, Utilities, People

Roads, tracks, and lanes are long lived features in our landscapes. Their placement defines our movement and should integrate all the elements that these pathways connect.

5. FORESTRY - Blocks, Shelter, Savanna, Orchards, Natural

Perennial woody plant systems are vital, productive and overarching elements in any landscape. Their assemblies can be complex in their outcomes and their placement is critical to support and provide for other systems.

6. BUILDINGS - Homes, Sheds, Portable, Yards

The structures that we build on our landscapes are crucial to our success. The placement and design is directed by the other elements.

7. FENCING - Permanent, Electric, Cross, Living

Subdivide your landscape by following more permanent features. Use the most flexible infrastructure to take advantage of changing opportunities for yield.

8. SOIL - Planned Grazing, Minerals, Fertility, Crops

Easily destroyed and fortunately easily created, soils are the foundation of life. Management is critical to the development and management of soils. Enhance the protection of your soils by considering other elements like Water, Forestry, Fencing.

9. ECONOMY - Analysis, Strategy, Value Chain

The analysis of the market & access to it has never been easier. The difficulty remains in the terms of trade particularly with regards to compliance. We will analyze marketing strategy potentials as well as successes and failures that we have seen in the marketplace. May include direct marketing, cooperative marketing, and other strategies.

10. ENERGY - Photosynthesis, Generation, Storage

Nothing is as fleeting as a photon of light, and the primary role of humanity must be to enhance photosynthesis at every opportunity and encourage its positive side-effects, with nearly all energy systems that humans access originating from the sun.

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1. Climate

History and Setting

Agriculture in San Diego has always been a large part of the overall economy. Today it is valued at a 5.1 billion dollar industry. San Diego's Mediterranean-like climate makes it an ideal place to grow agricultural crops and livestock products.

The discussion between development vs. farming has always been an active one in the county. Real estate developers are continuing to look at how to infuse agriculture within the community. For the long term success of the county's land use strategy, we are hopeful for a future of real estate and agriculture becoming more integrated and interconnected. The General Plan for San Diego lists agricultural preservation as Guiding Principle 7. "Preserve agriculture as an integral component of the region's economy, character and open space network."

Conditions & Challenges

"San Diego's Mediterranean-like climate makes it an ideal place to grow agricultural crops and livestock products. More than 2.6 million people live in San Diego County, and more than 6,000

farmers call it home and make their living on 6,565 small family farms, 65 percent of which are nine or fewer acres in size. The high cost of water (more than $600/acre foot) and land make farming here expensive and encourage growers to raise products with a high dollar value per acre." (35)

The Newland Sierra site consists of 1,985 acres which is primarily chaparral shrublands situated on steep slopes. While San Diego County provides both prime growing conditions and close proximity to large markets, the combination of steep slopes and shallow, immature soils limits to the potential for agricultural development and production on most of the property. The current cost of water for agricultural use also limits the economic feasibility of many crops. While historically, avocados and citrus have been grown extensively throughout San Diego County the combination of increased price of water for these thirsty crops and disease pressure (Phytophthora sp.) has led to a decline in production and even removal of many orchards and groves in the region. For these reasons, this report focuses on alternative crops that show promise in the region.

Where soils and slopes permit, the opportunity for diverse and integrated cropping systems is explored. As slopes increase and soil quality decreases, these limitations force a focus on woody crop systems, animal husbandry, forestry, and open space.

The historic mining operation on the site has left a 50 acre area of steep slopes with exposed bedrock. This area has very little cropping value, but may be reclaimed as part of the overall land management plan.

Current zoning conditions allow agricultural use, but may limit the potential for grazing and livestock management on the site. For the purpose of this report, we're assuming that the zoning conditions will permit use of land for grazing livestock and poultry.

Land use Options

The parcels for which we've analyzed the agricultural use alternative are currently zoned RL - 20, and a zoning change has been requested to Village Residential and General Commercial/Office Professional for the proposed development areas with the remainder as SR4 .

For the purposes of this Agricultural analysis, we have assumed RL-20 zoning with the animal designators for the parcels in question as either G, H, I, or O. For all of these designations, poultry

and large animals are permitted. This allows us to consider agricultural systems which integrate grazing, foraging and other mixed crop-animal systems.

2. GEOGRAPHY

Land Components and Concerns

The general goal for the Agricultural Alternative assessment is to consider feasibility of ag use on the proposed development site. In order to assess feasibility and develop an agricultural land use overlay for the property, the landscape has been subdivided using a variety of parameters. These parameters include slopes, soils, watershed units, and habitat value ratings. Initially three primary subdivisions were created: Productive Land (PL), Moderate Land (ML), and Steep Land (SL) (Figure 1).

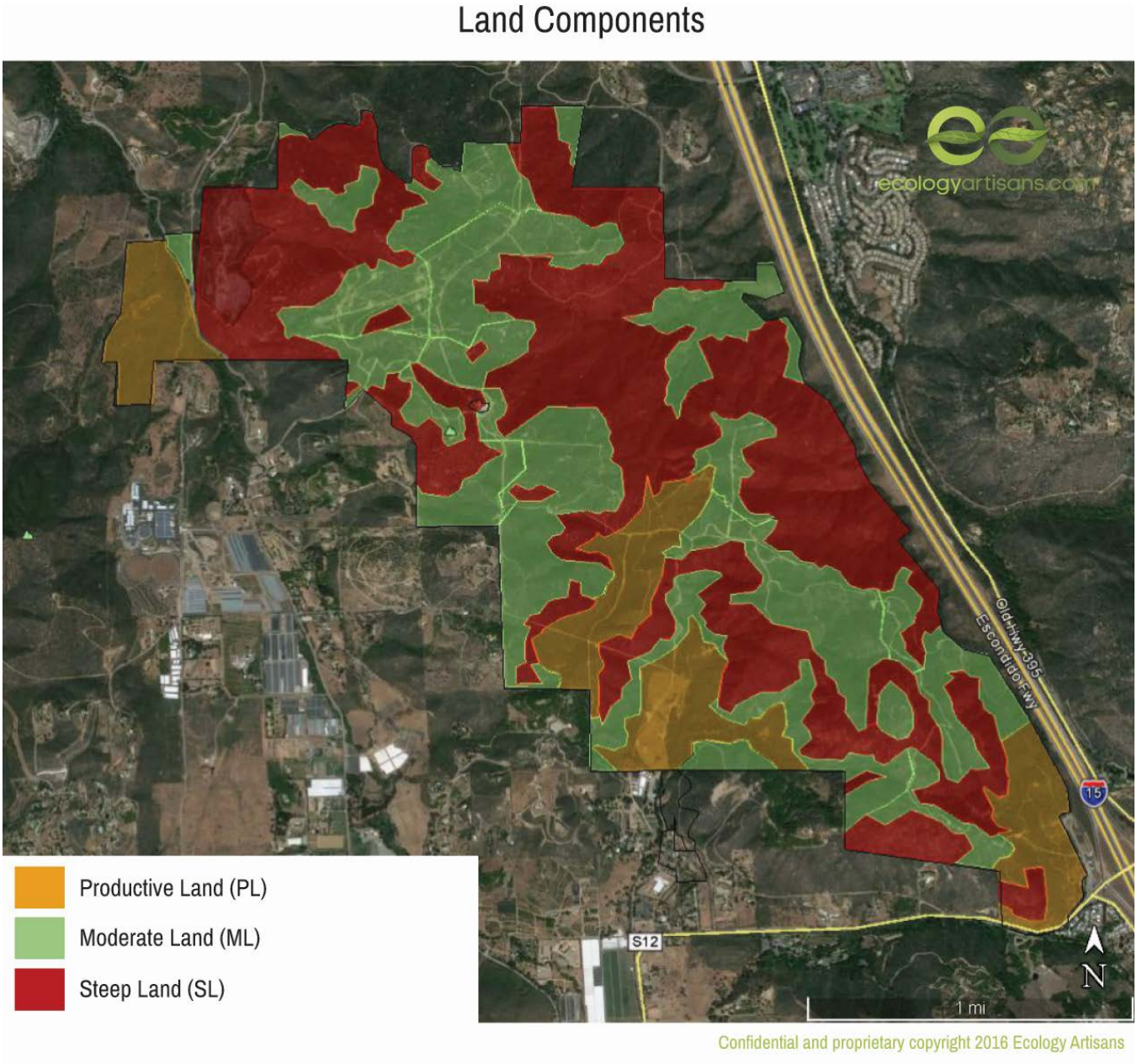

Figure 1. Land Components designated based on analysis of slope and soils.

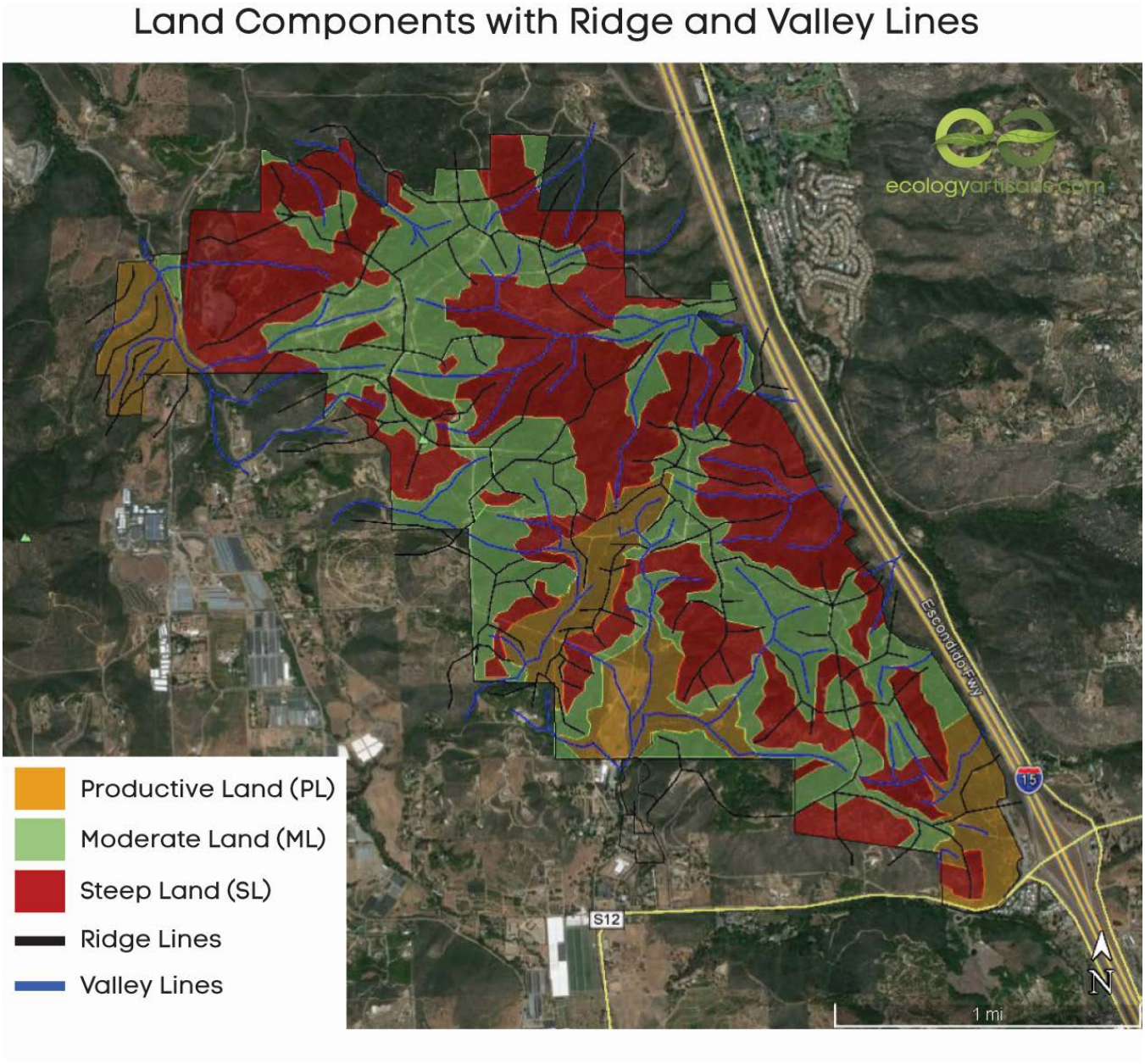

Figure 2. Land components with ridge and valley centerlines marked for ease of subwatershed visualization.

Steep Lands comprise most of the landscape, ~920 acres (46%), while Moderate Land and Productive Land comprise smaller percentages, ~765 acres (39%) and ~300 acres (15%). Productive Lands were designated such due to a combination of relatively lower slopes (generally <10 percent) and deeper soils, many of which are classified as Farmland of Statewide Importance (see Soils Chapter). Moderate Lands were designated due to lower slopes than steep lands, but less productive soils or steeper slopes than Productive Land.

Five areas on site have been designated High Habitat Value according to the Multiple Species Conservation Program, North County Plan, Habitat Evaluation Model (36, Figure 3). Of these areas the NE Section comprises ~100 acres of mostly steep land next to I-15, which has been designated as habitat reserve in this plan. A nearby ridgetop with rocky outcroppings (~10 acres) is also designated as reserve. The other three High Habitat Value areas overlap with Productive Land and/or soils of Statewide Importance so agricultural land uses are proposed for these areas and habitat values are considered as system parameters. The SE most High Habitat Value section (~6 acres) is near Deer Springs Rd. The current motocross area accessed on the S by Gist Rd. is also designated as a High Habitat Value section (~18 acres), but has significant disturbance do to tracks and use of motorized vehicles. The NW area to the W of N Twin Oaks Valley Road (~62 acres) has a few valleys with riparian corridor character (Figure 2) which are recommended to be left as wildlife corridors connecting this area to the unnamed creek which flows N along N Twin Oaks Valley Rd.

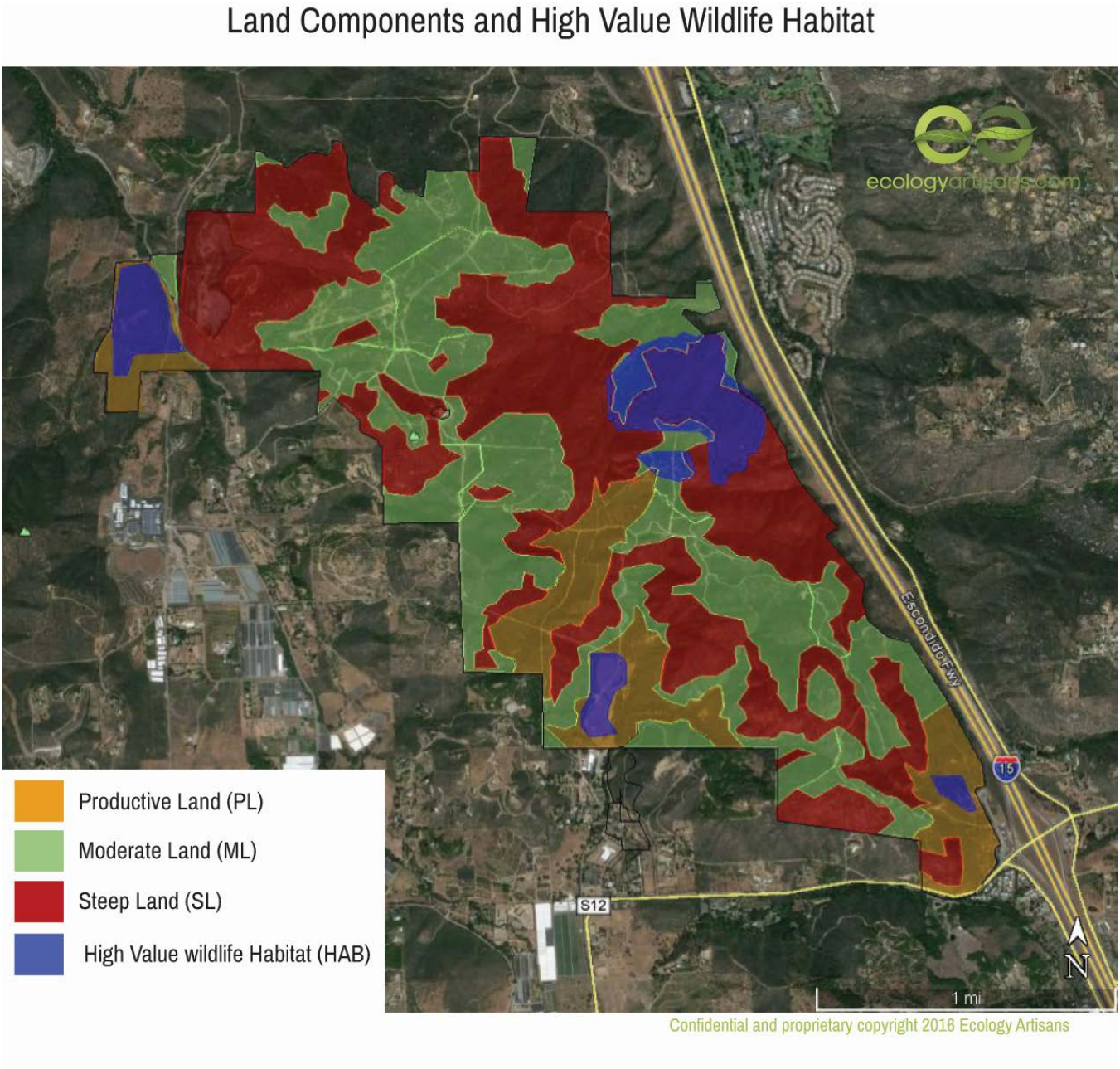

Figure 3. Areas specified as High Wildlife Habitat overlaid on Land Components.

Landform

- **Topography and Geology**:
    - The area consists of Granite and Granodiorite geologic formations with shallow, relatively young soils derived from these parent materials
    - A large proportion of the site is on steep slopes (>25 percent). Smaller relatively flat areas have deeper soils. These areas are primarily S and W facing. Small sections

on the NW corner have N aspects. The land contains all aspects and many peaks and ridgelines.

- **Land Size**: Total size is 1,985 acres
    - The land consists of 35 parcels of various size
- **Features**:
    - Quarry or mine
        - The potential for reclamation of this site exists and one goal would be to return it to slope stabilizing grassland through the use of Holistic Planned Grazing. This technique has been successfully used in mine reclamation in Southern Nevada by the Tipton Ranch (10). Another option would be to use the flat, clear areas to develop any buildings associated with proposed ag operations for storage, processing, and other needed functions.
    - Landing strip
        - The large relatively flat area has potential for intensive silvopasture and rotational grazing with minimal irrigation. Increased irrigation can lead to increased pasture and animal production but may not be economic.
    - Large Rock Outcroppings
        - These areas are likely best left as open space and wildlife habitat, connected through a series of wildlife corridors integrated into the agricultural system.
- **Erosion**: most soils on the site are shallow (less than 30" to bedrock) and situated on steep slopes. They are listed as highly erodible, particularly if cleared of vegetation.
- **Adjacent Land Uses**: Along the S and W of the site, there are many large residences with orchards and groves of tree crops and large areas of farms and nursery greenhouses as the land flattens to the W along N Twin Oaks Valley Road.

3. WATER

Types

Municipal water supply pipes are located on property and available for Agricultural use.

The price of Municipal water in 2016 ranges from $594-780 per AF according to the San Diego County Water Authority website (37).

Currently a large water tank exists (1.3 million Gal) as part of the storage and distribution system positioned at ~1610 ft amsl. This tank has potential to supply pressurized water to most of the site.

Other Supply options that may be available are

1. Onsite groundwater wells,
2. Small farm ponds (<10 AF) where physical and legal characteristics permit), and
3. Roofwater catchment off any developed Ag buildings.

Rainfall

According to the NOAA Coop weather station at Escondido, average annual precipitation for Escondido is ~16" with a 24 hr max of 6.47" and most rain falling between December and March (>75%) (45). During the recent drought 9" precipitation per year is more common. According to the NRCS Soil Survey, most of the steep slopes and shallow soils on the site have a high to very high rates of runoff. A primary goal of any agricultural operation on site is to promote perennial living groundcover and 100% litter cover to facilitate water infiltration and minimize erosion.

Uses

Primary uses of agricultural water on-site include livestock water and irrigation water. Secondary uses include fire suppression and washwater.

For irrigation of crops and nurseries, reasonable sources of water include

- Municipal potable and untreated Ag water available via San Diego County Water Authority
- Onsite Groundwater Wells
- Ponds and surface water storage from Runoff catchment (water rights and soil dependent)
- Tank storage on hilltops to pressurize and distribute water

For Stock water, reasonable sources include

- All listed for crops plus
- Roofwater tanks from large buildings like hay barns, stock facilities, processing structures, etc.

Stock/Animal Water

Stock water can be provided onsite through municipal supply and other developed sources of water. Stock water needs vary base on temperature, animal species and class. A rough average

stock water need per day is 15-20 gal/animal/day for cattle and 1-2 gal/animal/day for sheep. For poultry, needs are 2 gal/100 birds/day for laying hens, 2 gal/100 birds/day for broilers, and 30 gal/100 birds/day for turkeys (20).

Based on rangeland production numbers from the NRCS Soil Survey, we've estimated a stocking rate for the ~1065 acres designated as Moderate and Productive Lands at ~67 AU per year (804 AUM or 24000 Animal Days). Based on this calculation combined with a 90 day grazing period, we estimate daily water use at 5320 gal/day for 266 cattle or 2660 gal/day for 1330 sheep. Total water for the 90 day grazing period would be 478,000 gal (1.5 acre ft) for cattle or 240,000 gal (0.74 acre ft) for sheep.

To supply water to livestock, permanent watering troughs can be developed, however, we recommend using portable troughs to facilitate rotational grazing and locating watering stations at a different point each time the herd is moved. This can be facilitated by integrating the water distribution pipes (2" HDPE MWS pipe) for stockwater with the network of road access through the site.

Irrigation

- Due to the recent drought and continuing increase in the cost of water, this report focuses on crops with low water use requirements. Specifically, selection criteria have been set at irrigation needs of ≤2 acre ft / yr except for small scale intensive vegetable crops (<10 acres).
- Options for clean water **sources** are:
    - **On site ponds** of <10 Ac ft that can be utilized during dry periods:
        - Pros: Ponds double as wildlife habitat and fire protection. Once built, they cost much less per acre ft to maintain that municipal supplies cost. Ponds must be a minimum depth of 12-15' and have a low surface area to volume ratio to minimize evaporation in San Diego's arid climate.
        - Cons: Appropriate water rights may not exist. Appropriate soils may not exist on site. All potential pond sites are relatively low in elevation on site, so pumping to a tank would be necessary for distribution. Ponds are expensive to build. A significant amount of water is lost to evaporation. Pond water must be filtered and filters maintained to use in a drip irrigation system.
    - **Municipal water**:
        - Pros: Clean and consistent water is available.

        - Cons: The cost of municipal water limits economic feasibility of most crop production options.
- Options for **reticulation and distribution** are:
    - Due to steep slopes and high cost of water, precision drip irrigation systems are recommended for all crops
    - Once groundcover and litter are established, either by bale feeding or plant grown and trampling, small areas of overhead irrigation can be possible on pasture areas. Depending on forage availability, hay prices, and stock prices, it may make sense to irrigate some areas of pasture using a mobile overhead sprinkler system such as K-Line (16).

4. ACCESS

Roads

- **Primary Access**:
    - This report assumes use of existing roads as the primary access options for the site. If water rights and appropriate soils exist at potential pond sites, a few low-gradient catchment roads may be economic to develop.
- **Secondary Access**:
    - Intensive cropping systems such as olive orchards, olive silvopasture, vineyards, and SPIN vegetable farm plots will require some additional vehicle access to supply materials such as compost and to allow for efficient harvest. This is one reason these cropping areas are situated close to Primary access roads on the site and on relatively flat land. Ideally to minimize erosion and maintenance costs, secondary roads should be constructed down the centerlines of ridges or at low gradients (<4%) across slope. Drainage features such as rolling dips and surface cross-drains need to be incorporated to allow water to move off of the roads and onto vegetated surfaces where water can infiltrate (49). Preferred locations for diversion of runoff include ridgelines, convex areas of the landscape, and low gradient slopes. Drainage features should be considered every 25-200' with increasing frequency as road gradient increases. Figures 4-6 demonstrating idealized drainage features follow.

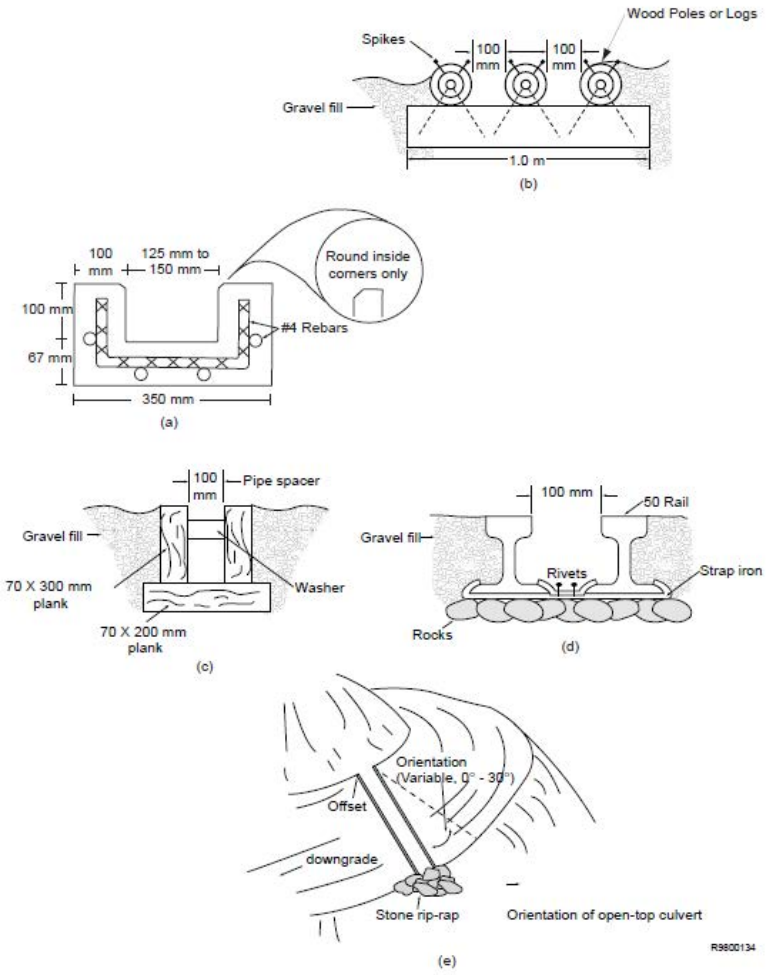

Figure 2—Various open top culvert surface cross drain designs: (a) concrete, (b) pole, (c) wood box; (d) rail culvert, (e) orientation is typically up to 30 degrees from perpendicular to the direction of travel.

FIgure 4. Surface Cross Drain examples from Water/Road Interaction: Introduction to Surface Cross Drains (8).

Figure V-1: *Rolling dip schematic.*

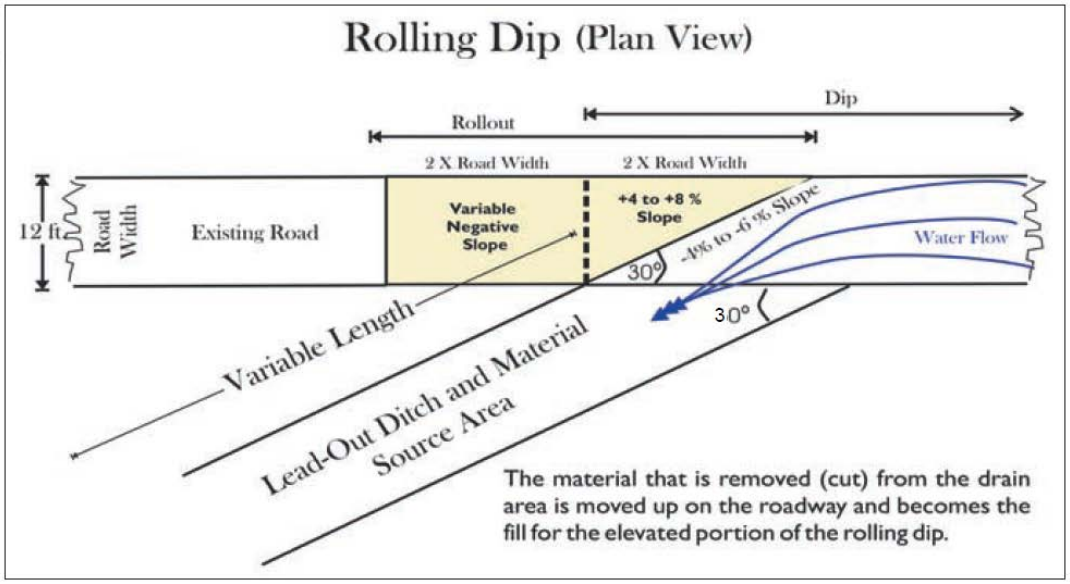

Figure 5. Rolling Dip Plan View from A Good Road Lies Easy on the Land (49).

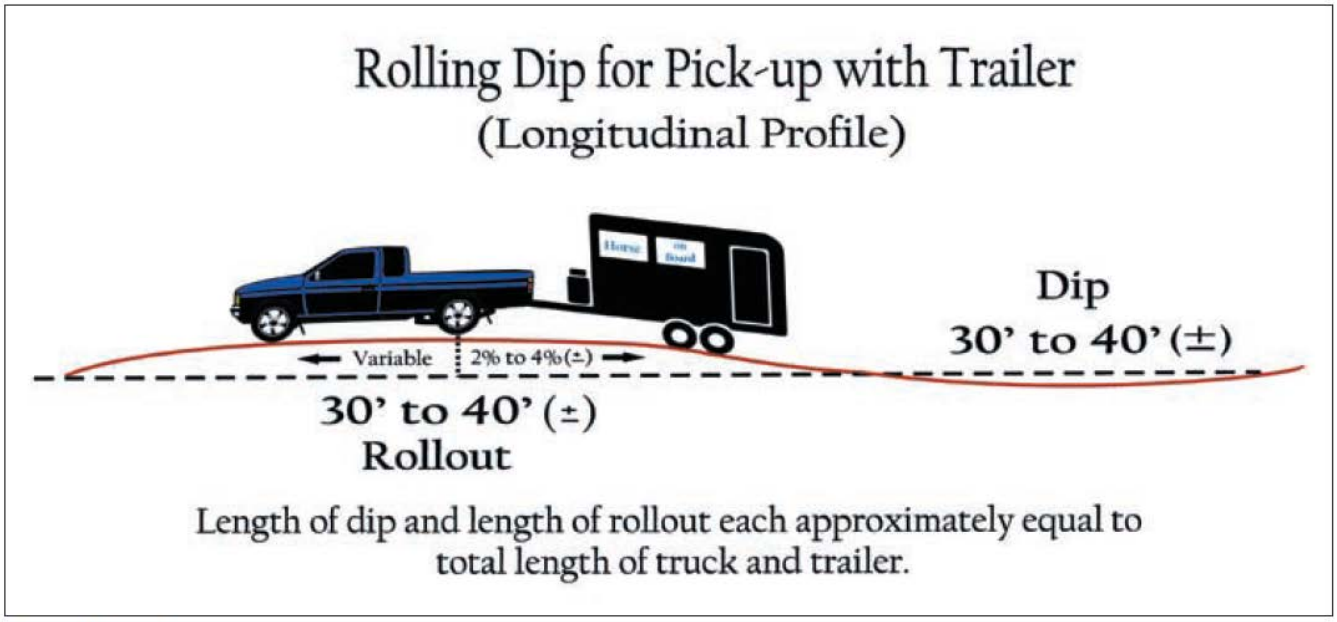

Figure V-2: *A rolling dip must be sized according to the dimensions and clearance for the type of vehicle with the strictest requirements.*

Figure 6. Rolling Dip Cross Section. For areas where vehicle length is shorter (i.e. 15'), rolling dips can be shorter. For steeper slopes use surface cross drains (49).

Table 1. Example of costs for Road Improvement and Modification from Handbook for Forest, Ranch, and Rural Roads (44).

Table 3. Costs to modify and improve existing roads

Activity	Ideal equipment	Cost rate*	Production rates†	Costs
out-sloping road and filling ditch	motor grader with rippers	$140/hr	500 ft/hr for a 20 ft wide road	$280/1,000 ft
installing rolling dip	small dozer with rippers (John Deere 450)	$130/hr	1 hr each (30 to 40 ft long on flat roads) 2 hr each (50 to 100 ft long on steep roads)	$130 to $260 each
removing berm or cleaning ditch	motor grader	$140/hr	1,000 ft/hr	$140/1,000 ft
rock-surfacing road (1.5 in. minus crushed)	dump truck spread	$25 to $50/ yd³ delivered‡	4 in. deep × 20 ft wide = 250 yd³/1,000 ft road	$6,250 to $12,500/1,000 ft
installing ditch relief culvert (40 ft of 18 in. culvert)	backhoe or tractor, laborer	$120/hr or $95/hr $55/hr	3 hr each + culvert ($35/ft + $25 coupler + $165 labor)	$1,950 each
installing stream crossing (36 in. × 40 ft culvert with 200 yd³ fill)	excavator, small dozer, water truck, laborer	$175/hr $130/hr $95/hr $55/hr	$2,350 culvert (w/coupler) + $1,225 excavator +$910 dozer + $190 water truck + $165 labor + $125 tamper	$4,965 each
installing culvert downspout	hand labor, equipment (>24 in. culvert)	$55/hr $125/hr	2 hr labor for 20 ft × 24 in. 3 hr labor for 40ft × 36 in.	$110 + materials $375 + materials
straw mulching of bare soils areas	labor	$55/hr $7.50/straw bale incl. tax/delivery	1 bale/600 ft² to 700 ft² + spreading at 4 bales/hr	$36 to $40/1,000 ft²
upgrading road completely	motor grader, skip loader, dump truck water truck riding compactor	$140/hr $110/hr $85/hr $95/hr $95/hr	Average mid-slope road requiring stream crossing upgrades	$45,000 to $77,000 per mi

Source: Adapted from CDFG 2004 by Joe Carri Jr.
Notes: *Additional equipment mobilization costs apply (4-hour minimum for small equipment and an 8-hour minimum for large equipment).
†Production rates do not account for rocky soil or soft soil conditions.
‡Trucking and material costs for bulk rock or sand assume a round trip time from 1 to 2½ hours. Longer hauls require additional trucking costs.

5. FORESTRY: CROP PRODUCTION

Overview

Based on the prime growing conditions of the San Diego County region, a large range of crop options were considered. The primary selection criteria which informed the chosen crop options were:

- Low water use
- High value crop
- Low cost of setup
- Potential to improve ecosystem services and wildlife habitat
- Adapted to local soil conditions: primarily shallow, low fertility soils

In particular, we decided to limit tree and woody crops to those which require ≤2 acre ft of water per acre. Higher water use crops were limited to intensive vegetable production systems on limited acreage.

Initially a large range of crop options were considered. Several of those initially considered are listed below in case it is determined they warrant further analysis.

Plants

- Crops
    - **Cane Berries (Raspberries and Blackberries: *Rubus sp.*)**: were considered due to their high production per acre and price per ton. However they were not included due to high water use. (Production: ~7-9 Tons/Acre; Price: $12K/ton; Water use: 4-6 acre ft) (33, 34)
    - **Fig: *Ficus carica*:** were considered due to lower water use but were not included due to lower harvest quantities, low price per ton, and high potential for crop loss to pests. (Production: 1.05 ton/acre; Price: $585/ton; Water use: ~2 acre ft /yr) (30)
    - **Macadamia Nuts:*Macadamia integrifolia and M. tetraphylla***: were considered due to high price per ton. They were not included due to high water use. (Production: 1 ton/acre; Price: $4,057/ton: Water use: 4-5 acre ft) (2, 34)
    - **Persimmons: *Diospyros kaki***: were considered due to high price per ton. They were not included due to high water use. (Production: 3-4 tons/acre; Price: $1,700/ton; Water use: 2-3 acre ft) (34)
    - **Pomegranate: *Punica granatum***: were considered due to high price per ton. They were not included due to high water use. (Production: 4 ton/acre; Price: $1,200 $/ton; Water use: 3 acre ft) (31, 34)
    - **English Walnuts: *Juglans regia***: were considered due to high price per ton. They were not included due to high water use. (Production: 1-2 tons/acre; Price: $2,400-3,600/ton; Water use: 3-3.5 acre ft) (32)

Of note. This report is not recommending Avocados (4-5 acre ft) or Citrus (3 ac ft) due to the Cost of water and their water needs and the prevalence of disease Phytophthora sp. which is leading to removal of many established orchards in the region.

Selected Crops

The crops which were selected for more detailed analysis and proposed on the site plan include

- **Oil Olives: *Olea europea***: Oil olives produce higher quality oil when irrigated at a water defecit and provide access to both artisan and larger markets. They are low water use and high value. (Production: ~2-3 tons/acre, 80-120 gallons oil/acre; Price: $900/ton olives, $50-75/gallon oil; Water use: 1-1.67 acre ft) (27)

- **Wine Grapes: *Vitis sp.*:** Wine grapes are currently produced throughout San Diego County, are high value and low water use. (Production: 5-6 tons/acre; Price: $1,547/ton; Water use: 0-1 acre ft) (34, 46)
- **SPIN Vegetable Farming:** Small Plot INtensive: small scale high intensity vegetable farming.

In addition several other woody crops are recommended for consideration in an more diversified agro-ecosystem. These species are detailed in the Silvopasture section.

Animals

Animals are an essential part of any regenerative agriculture. They provide opportunities for short term cash flow and are a useful tool for managing larger areas of less productive land because the cost of needed infrastructure and site development are often lower.

Animals are often purchased and sold at the sale barn with prices set at $/CWT (per 100 lbs.). Animals worth considering integrating into the agricultural operations include (34):

- Chickens: Broilers and Layers/Eggs: Chx $60/CWT, Eggs $1/doz
- Turkeys $70/CWT
- Cattle: $168/CWT
- Goats: $150/CWT
- Sheep: $132/CWT
- Pigs: $61/CWT
- Bees/Apiary: Honey: $2.50/lb, $5,000/ton (Wax, Bees/Queens, pollen as minor products):

Existing Conditions

Most of the site is undeveloped Southern California Chaparral mixed shrubland. The dense chaparral vegetation on steep slopes makes this site a highly fire prone area where wildfires burn hot, fast, and are difficult to manage. The few areas which are not chapparal are the mine, the landing strip, and a motocross track.

The areas where existing chaparral is less steep (<30%) have the potential to support perennial grassland and savannah types of vegetative community, particularly when managed with holistic grazing planning. Much of San Diego County was historically Oak Savannah and many areas have

transitioned to chaparral due to conditions which favored a low fire frequency and minimal to no large herbivore animal impact.

Production Systems Opportunities

Based on the characteristics and limitations of the site, this report proposes 2 production options for Steep Land, 3 production options for Moderate Land, and a suite of production options for Productive Land (Figure 7).

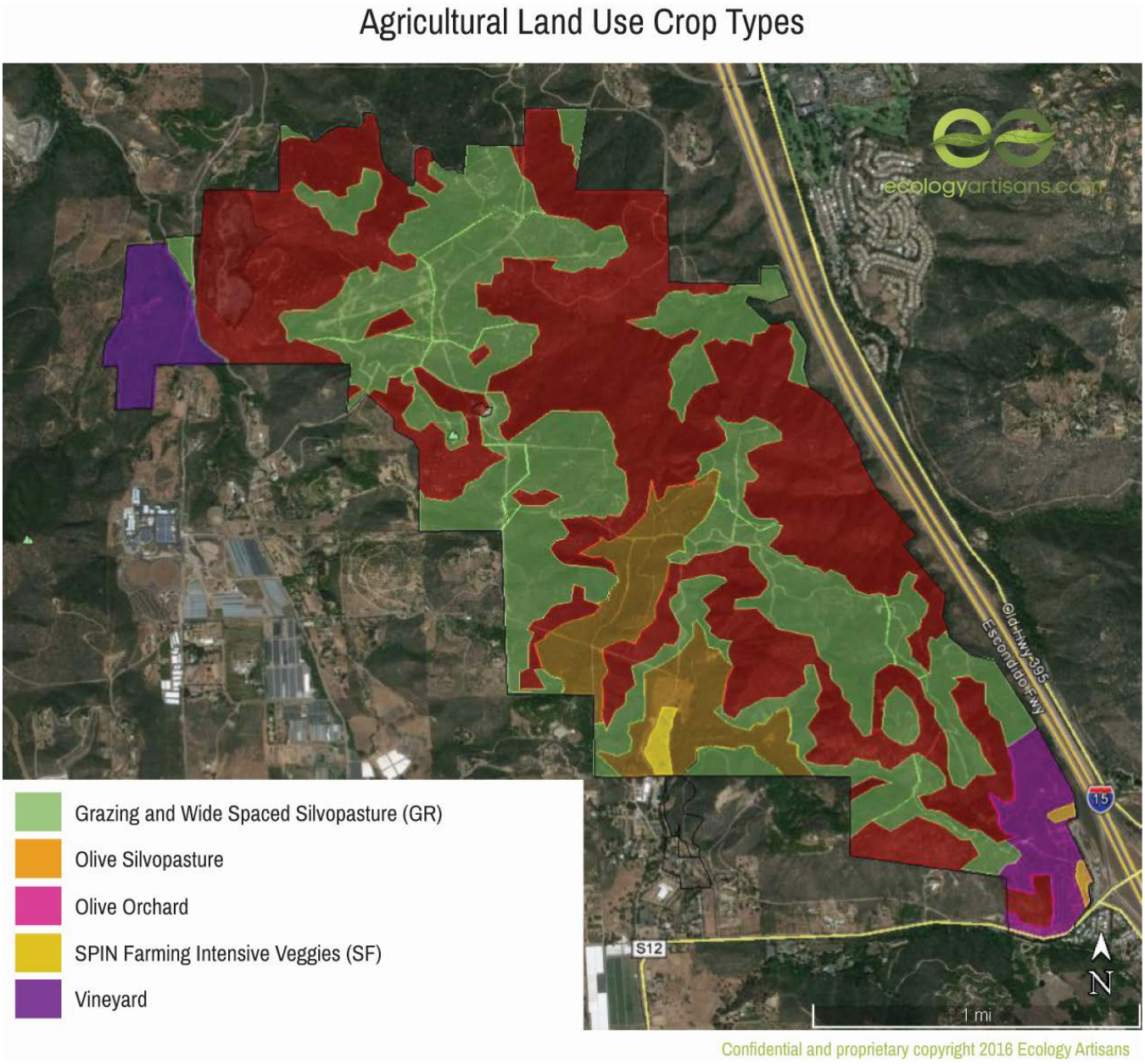

Figure 7. Crop options Proposed for Land Components.

Steep Land

For Steep Land areas, 2 main land use options are proposed:

- Maintain as wildland Chaparral Woodlands
- Convert to livestock grazing

The cheapest and simplest option is to allow them to remain chaparral woodland. In particular, this is recommended for the 100 acres of high value habitat area along I-15 in the NE portion of the site.

A second option that can be considered once fencing and water infrastructure have been developed is to integrate these areas into the livestock grazing plan. They are relatively low production areas and have high erosion potential, so careful attention should be paid to the effects of grazing disturbance and grazing should only commence after grazing skills and results have been demonstrated on less sensitive areas of the site. If this land component is used for grazing, ~750 additional acres could be added to grazing systems. This acreage does not include the mine area or the high value habitat area. We want to emphasize the need for high quality grazing management on these sites. No continuous stocking should be allowed, but rather moderate to high density, short duration rotational grazing is recommended as best practice.

Moderate Land

For Moderate Land areas, 3 production options are proposed:

- Convert to Holistic planned grazing with livestock
- Convert to olive silvopasture
- Convert to high diversity Dehesa Silvopasture

In all scenarios, begin with Holistic planned grazing to develop improved effectiveness of the water and nutrient cycles and improved grassland conditions for the first year or two while preparing the site for tree planting. Holistic planned grazing requires improved water infrastructure for rotational grazing and multiple stock tank watering points. Fencing infrastructure will also be needed to facilitate planned grazing. We recommend either a Cattle stocker operation to begin on this site because it allows the site to be grazed during the ~90 day growing season between December and April when the forage quality and quantity are at maximum, then the cattle can be

sold and the land can be rested for the rest of the year. Well managed grazing will convert the chaparral to grassland which has a much lower fire risk.

Our grazing estimates utilize the avg. annual production of the onsite soil types from the NRCS Web soil survey and estimate an initial stocking rate for 90 days on the Moderate lands of 216 AU. This estimate is based on a 'take half, leave half' practice which grazed 50% of forage production and leaves 50% ideally trampled as litter and for wildlife forage. As part of the grassland development process, some bale feeding and sprayed molasses may be useful to engage the cattle in trampling of chaparral shrubs and conversion of the site to a more grass dominated vegetation community.

Silvopasture

Two Silvopasture models are proposed for Moderate Lands. For both models the following apply.

- Most trees/shrubs will need to be protected by a combination of:
    - Proper rotational grazing management and oversight to ensure paddock rotation happens before bark stripping/pruning occurs
    - Tree tubes or wire cages to allow trees to grow without damage and emerge above browse height of livestock (~5') and some native wildlife
    - Electric fencing to protect tree rows. Need not always be armed, only when browse pressure might occur.\

Olive - Silvopasture Model

Conversion of these grazing lands to silvopasture could be done by integrating wide spaced olive trees (40'x40') at a rate of ~25 trees per acre. Over the ~743 acres this adds ~18,575 trees, which provide multiple benefits for wildlife habitat, soil stabilization, shelter for livestock and additional tree crops of oil olives. Olives require approximate 1.67 acre ft of irrigation at medium density (269 trees/acre). At this low intensity, a water use of 0.2 acre ft of water per acre is estimated. Because this option is more complex than grazing and maintains an overall simplicity of silvopasture, we have included it in our financial analysis.

Figure 8. Sheep and Olive Wide spaced silvopasture in Spain (42).

Diversified Dehesa Silvopasture

The Diversified Dehesa Silvopasture model includes a much higher quantity of species adapted to the San Diego regional climate and provides a wider range of potential products. We consider this to be the preferred model of regenerative agriculture due to it's high level of diveristy, high wildlife value, wide range of products (high value timber, cork, nuts, pods for flour, low water use, and increased shelter for livestock). While this model is our preferred option, many of these products are specialty crops and are difficult to project accurate yields and financial returns.

One potential layout of this system has been drafted in a conceptual cross section (Figures 9-10) which demonstrates the boundaries and transitions from Steep Land to Moderate Land to Productive Land and back. It includes contour shelterbelts (which double as timber production systems) on the boundaries between each land use type and wide spaced silvopasture throughout the Moderate lands with a diversity of tree crops on 60'x60' spacing (~12 trees/acre).

Contour tree belts are generally composed of 3-4 rows of timber trees with one row of low growing fodder tree on each side. Trees are spaced 15'x15' for timber production giving 6.67 trees/100' of row in each row. Low growing fodder rows are 6' spacing within row and 6-8' spacing between fodder and timber row. Contour tree belts are often associated with gradient access roads. For timber belts, we recommend pruning all side limbs situated at a trunk diameter of 4" or above to a height of 12-18'. This provides the highest quality of saw log capable of becoming veneer, slab, and furniture logs. Many trees, such as *Eucalyptus camoldulensis*, regrow rapidly from coppice which avoids replanting costs and allows shorter rotations (6-10 years) following first cutting. To provide the most effective shelterbelts, contour tree belts integrate 1-2 rows of evergreen trees such as Deodar Cedar.

Ideal trees for Dehesa Silvopasture are adapted to local rainfall conditions, provide an edible mast crop to livestock, provide shelter and windbreak for the pasture, and can be harvested for a saleable yield such as cork, firewood, truffles, pods, flour, or nuts.

We recommend a combination of native trees such as Oaks and trees which have higher potential for economic yields, specifically Cork Oak, Carob, Honey Mesquite, and Olive.

Nut Trees

A suggested list of nut trees for Dehesa Silvopasture.

- **Oaks**
    - **Black Oak: *Quercus kelloggii***
    - **Coast Live Oak: *Quercus agrifolia***
    - **Cork Oak: *Quercus suber***
    - **Interior Live Oak: *Quercus wislizenii***
- **Stone Pines**
    - **Digger Pine: *Pinus sabiniana***
    - **Italian Stone Pine: *Pinus pinea***
- **Walnuts**
    - **California Black Walnut: *Juglans californica***
    - **English Walnut: *Juglans regia***: not ideal due to water requirements
- **Others**
    - **Bunya Bunya Pine: *Araucaria bidwillii***
    - **Macadamia Nut: *Macadamia integrifolia and M. tetraphylla***: not ideal due to water requirements.

Forage/Nitrogen Fixing Trees

- **Honey Mesquite: *Prosopis glandulosa***: pods used as fodder and converted to flour for specialty crop production
- ***Leucaena leucocephala*:** Fast growing fodder tree.
- **Shoestring Acacia: *Acacia stenophylla:*** Fast growing fodder and shelter tree
- **Carob: *Ceratonia siliqua***: Carob studies in California list production at 3-4 tons/acre or 200lbs/tree. Carob can be dry farmed on 14” of rain, but ideally 22” is required for high production. This suggests ~1acre ft irrigation is needed for cropping, however, as a mast

tree, it will likely only require irrigation for establishment (1). A price/ton was not found. Retail Organic Carob Powder sells for $16/lb on amazon.com

Fruit Trees

- **Mulberry, Black*: Morus nigra*:** fast growing high fodder value (leaves up to 28% protein similar to alfalfa), also produces high value berries for use as specialty crop and value add such as jellies, jams, and wines. Can be mast crop as well.
- **Jujube/Chinese Date: *Ziziphus jujuba***: slow growing very drought hardy fruit tree. Primarily mast production. Can be sold as specialty crop particularly to asian markets
- **Olive: *Olea europea*:** See above
- **Persimmon: *Diospyros kaki.***: unlikely due to water use, but may be practical in certain locations; American persimmon (*Diospyros virginiana*) is more drought tolerant for use as mast rather than commercial fruit.

Hardwoods

These species have potential as timber trees. A focus on high value timber such as furniture and veneer is recommended. Other high value options include trim, paneling, flooring and sills. Lower end uses are standard building dimensional lumber, fence posts, and firewood. Milling can be done onsite with a Lucas Mill or contracted to a sawmill. Kiln drying can take place onsite or be contracted.

- *General Uses:* lumber, carpentry wood, cork, acorns (white oaks), firewood, mushroom farming
- **Black Acacia: *Acacia melanoxylon***: Timber
- **California Black Walnut: *Juglans californica***: Timber
- **Deodor Cedar: *Cedrus deodora***: Timber
- **Monterey Cypress: *Cupressus macrocarpa***: Timber
- **Oaks**
    - **Interior Live Oak: *Quercus wislizenii*:** Primarily for firewood or mushroom logs
    - **Black Oak: *Quercus kelloggii*:** Primarily for firewood or mushroom logs
    - **Cork Oak: *Quercus suber***: Primarily for cork
-
- **River Red Gum: *Eucalyptus camoldulensis***: Timber
- **River She-Oak: *Casuarina cunninghamiana:*** Timber

Herbaceous Layer

- **Mixed Pasture:** primarily native grasses, forbs, and legumes

Additional Research

- The Center for Agroforestry at the University of Missouri has extensive research and test plots on silvopasture and other agroforestry practices
- Mark Shepard, 15+ year silvopasture and agroforestry system in Wisconsin

Windbreak/Shelterbelts

Contour tree belts double as windbreak/shelterbelts. A focus on hardwoods edged by Honey Mesquite, Leucaena sp., Mulberry or Carob is recommended.

Due to the high fire risk of the site, a succulent hedgerow may be considered in areas where fire is more likely. All succulents suggested can be considered for development into specialty crop products. Prickly Pear can also provide supplemental forage value in times of need.

- Succulents for Fire break:
  - Prickly Pear: Opuntia sp.
  - Agave, Blue: Agave sp.
  - Aloe: Aloe sp.

Riparian Buffer Strips

As part of the combined goals of improved wildlife habitat and ecosystem function, Riparian buffer strips are recommended along creek lines. Generally ~100' wide from creek center, these can be fenced off and left wild, or managed for production of hardwood and specialty forest products. In particular, California Walnut and American Sycamore (*Plantanus occidentalis)* can be managed for timber.

Silvopasture Nursery

- Two options exist for nursery establishment to produce trees for silvopasture work:
  - Contract with a local nursery to grow plants
    - Pros: experienced, have infrastructure/labor
    - Cons: may lack experience with certain species, direct cost, distance/transportation
  - Build one on site to grow plants
    - Pros: direct control/oversight, potentially lower cost

- Cons: at scale needed it takes up a good bit of space, infrastructure/water needed, labor for management can be costly

- Contract growing is good from a cost-savings perspective, but only if you can get a nursery to grow them that shares your climate and weather conditions. If not, you may shock the plants with extreme differences in climate once introduced to your area.

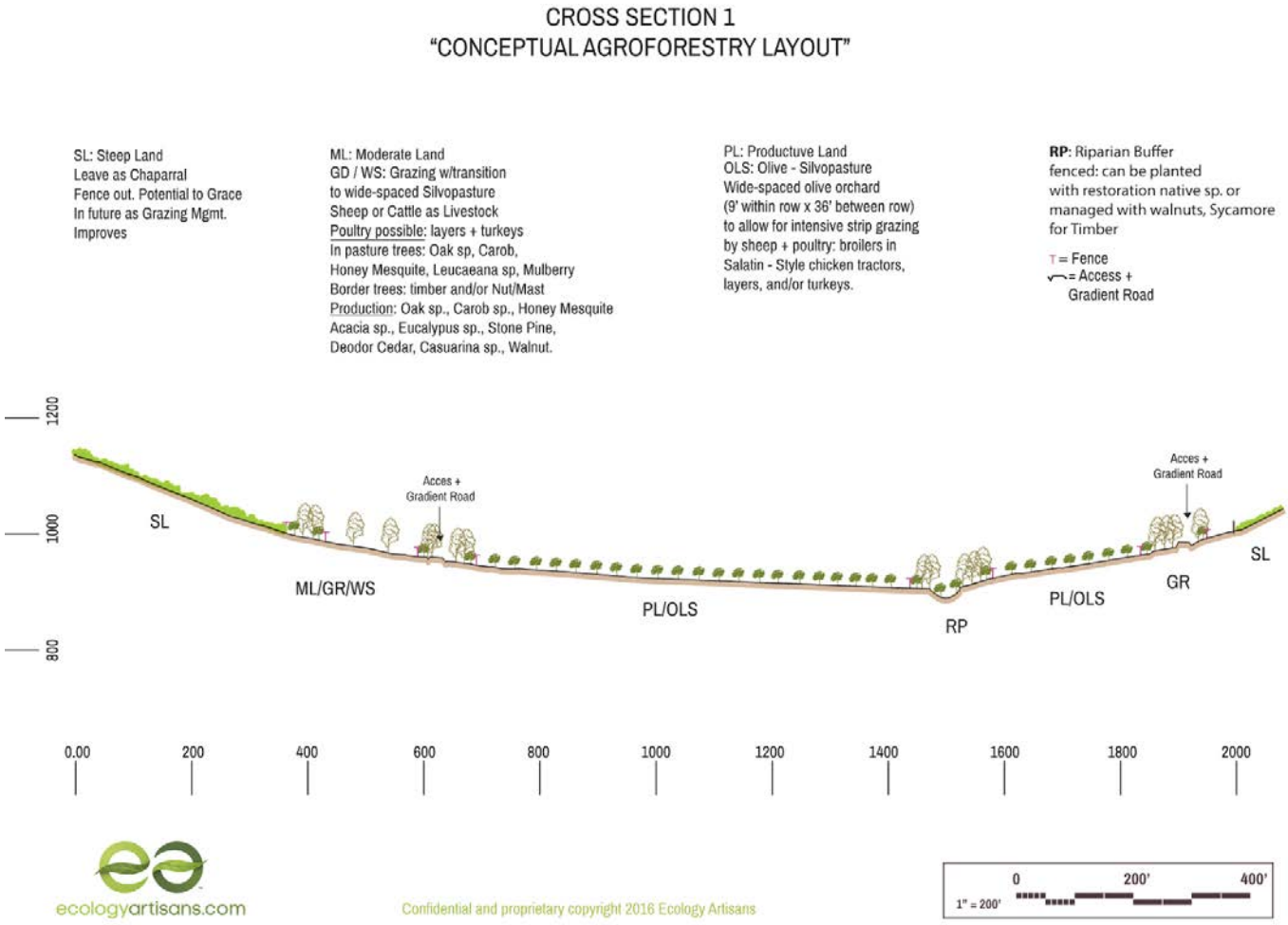

Figure 9. Conceptual cross-section through Steep, Moderate, and Productive Lands which demonstrates the subdivision of the land use type, access roads and fencing.

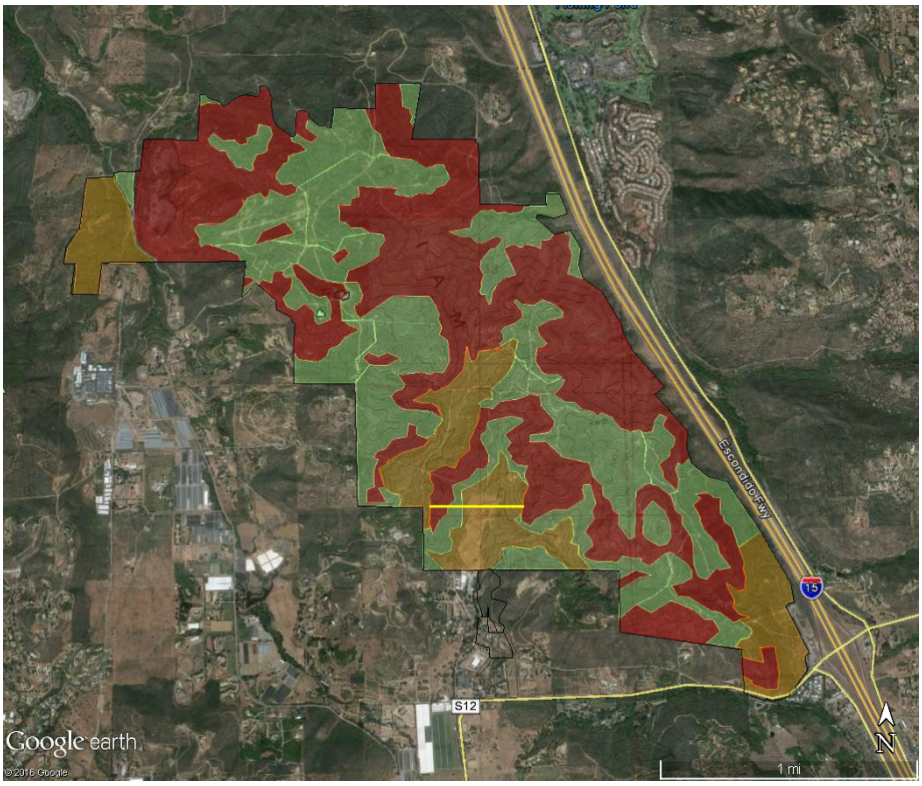

Figure 10. Location of conceptual cross section on Newland Sierra site.

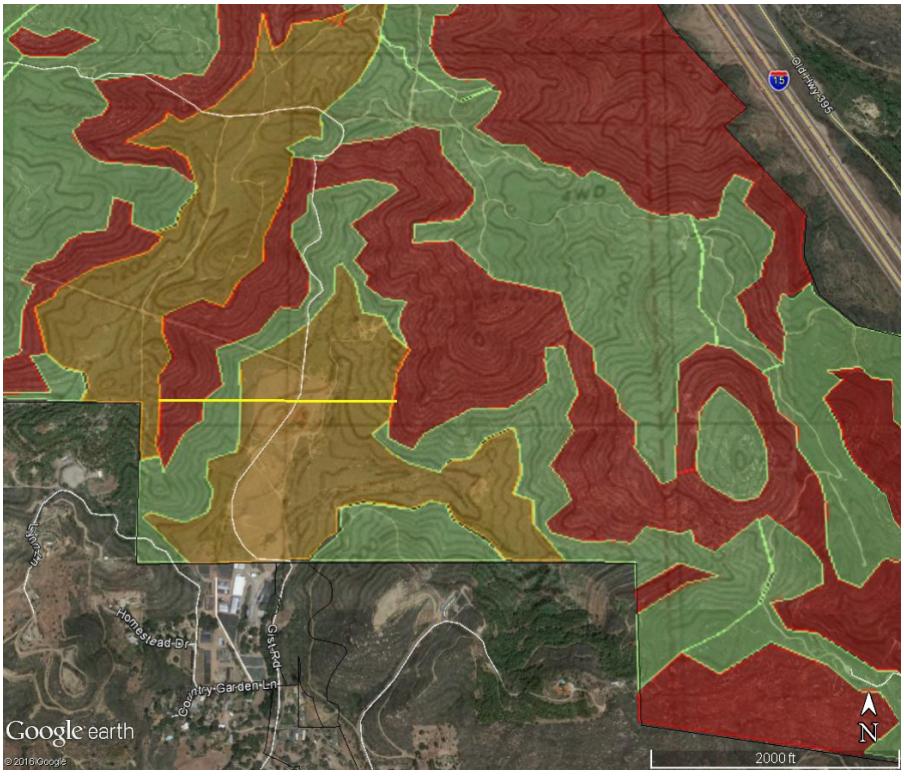

Figure 10.a Location of conceptual cross section on Newland Sierra site.

Productive Land

For the ~290 acres designated Productive Land, a variety of high value crop uses is recommended. In particular, the areas can focus on 4 production systems:

- Wine Vineyard: ~55 acres
- Olive Oil Orchard: ~62 acres
- Olive Oil Silvopasture: ~134 acres
- SPIN Farming: ~10 acres

Wine Vineyard

San Diego County provides great growing conditions for wine grapes which use a minimal amount of water (dry farmed to 1 acre ft) and demand high prices. We propose a the NW section to the W of N Twin Oaks Rd (~62 acre) be developed as an intensive vineyard. This area is separated from the rest of the property by the mine area and N Twin Oaks Road and already has relatively good access. Within this area, we recommend leaving strips of Riparian buffer 40-50' wide to allow for wildlife habitat and corridors that connect the the unnamed stream that flows alongside N Twin Oaks Rd. Along the creek, we recommend 100-120' buffer. These buffers decrease the total acreage to ~55 acres. We analyzed a medium density vineyard with plants spaced 6'x8' for ~908 vines per acre. This provides a total of ~50,000 vines.

Olive Oil Orchard

Two land uses are proposed for the relatively flat area on the SE edge of the property just N of Deer Springs Road. On the flattest areas closest to the road, SPIN Farming is recommended. On the steeper areas just uphill to the W of the SPIN Farming plots, a Medium Density Olive Oil Orchard is proposed. While many Olive Oil Orchards are moving towards Super High Density, a Medium Density orchard (9'x18' spacing for 269 trees/acre) is proposed to balance low water use with the potential to integrate other production systems into the orchard. Optimally either pastured poultry broilers in chicken tractors or layer hens and turkeys managed with electronet mobile electric fencing. Broilers and Turkeys provide the option to integrate and maintain short term cash flow (8-16 weeks per cycle) into the longer term economics of orchard development and management while providing a nitrogen and phosphorous fertilizer supplement.

The proposed area is ~62 acres which would include ~16,678 trees at medium density spacing. Harvestable yields are expected to begin in year 4 at 1 ton/acre (40 gallons oil/acre) and increase to maximum at year 9. After 7-9 years, production rates of 2-3 tons/acre of olives yielding ~80-120

gallons oil/acre are projected. At this scale, projected yields are 2,480 gal, 4,960 gal, and 7,440 gal per year in years 4,7, and 9+ respectively. At year 9 yields are expected to stabilize but can vary from year to year with heavy cropping usually followed by light years (27).

Olive Oil Silvopasture

Two areas designated as Productive Land are proposed for Low Density Olive Oil Silvopasture (9'x36' spacing) with ~134 trees per acre in an alley crop layout. This layout allows for integrated rotational grazing using electronet fencing for sheep and layer hens, or temporary single wire electric fencing for strip grazing cattle between rows.

The proposed area is ~153 acres which would include ~20,500 trees. Using the same yield projections per tree as for the Medium Density Orchard, total production for this area is expected to be 3,060 gal, 6,120 gal, and 9,180 gal per year in years 4,7, and 9+ respectively. (27)

Total Olive Oil yields from the site are expected to be 5,540 gal, 11,080 gal, and 16,620 gal per year in years 4,7, and 9+ respectively.

SPIN Farming is proposed for the flattest area with Ramona Soils in the SE Olive Oil Silvopasture land use area. This area totals ~7.3 acres.

SPIN Farming

SPIN Farming stands for Small Plot INtensive Farming. It is a recently developed urban agricultural method adapted from French bio-intensive farming and has been demonstrated profitable in a range of agricultural settings from Quebec, Canada to Sebastopol, CA. The method consists of high intensity, short rotation cropping of valuable crops such as leafy greens, basil, carrots, and microgreens. High value per square foot crops like tomatoes are also included. The three best examples of Small Plot Intensive Farming all selling six figures (~$100-150K) of crops on 2 acres or less are:

- Curtis Stone: Green City Acres: http://www.greencityacres.com/
- Paul Kaiser: Singing Frogs Farm: http://www.singingfrogsfarm.com/
- Jean-Martin Fortier: Les Jardins de la Grelinette: http://lagrelinette.com/

Figure 11. Photo of Singing Frogs Farm in Sebastopol, California. (41)

This method is recommended for 3 areas of relatively flat land on the deepest soils on the site that total ~10 acres. Ideally these areas can be subdivided into plots 2 acres or smaller to facilitate a similar management and marketing style to the model farms mentioned above.

Animals

Based on rangeland production numbers from the NRCS Soil Survey, a stocking rate for the ~1065 acres designated as Moderate and Productive Lands at ~67 AU per year (804 AUM or 24000 Animal Days) is estimated. Based on this calculation combined with a 90 day grazing period, a stocking rate of 266 cattle or 1330 sheep is estimated. Cattle were used in initial budget projections due to less intensive fencing needs. However, sheep may be a better overall fit for the site and merit further investigation.

Well managed livestock grazing systems can both improve ecosystem health and biodiversity while maintaining the open space character of the landscape. Holistically planned grazing systems

such as those used at Deseret Ranch, Brown's Ranch, and Markegard Family Farm have demonstrated this in a variety of dryland climates.

- Deseret Ranch, Utah: http://quiviracoalition.org/images/pdfs/5992-Journal40web9-14.pdf
- Brown's Ranch, North Dakota: http://brownsranch.us/
- Markegard Family Grass Fed, California: http://www.markegardfamily.com/

The primary limitation for developing these types of agricultural production systems at the Newland Sierra site is development of water and fencing infrastructure to allow intensive management of grazing timing, density, and location.

Figure 12. Ultra-high density Silvopasture Grazing at Brown's Ranch in N. Dakota. A 16" rainfall environment.(4)

Additional Livestock

The primary animal system analyzed for this property is cattle grazing as discussed in the silvopasture section. Additionally, it is recommended to highly consider sheep due to their disposition for browsing shrubs such as native chaparral, and based on precedence of sheep integration into olive oil systems.

It may be possible to create a Leader-Follower system where cows are followed by chickens, pigs, sheep, and or turkeys. The variations available are numerous based on ability for that specific species/variety to handle the high relative humidity and heat. These Leader-Follower systems are

more complex and compound management, but they benefit by breaking pest and disease cycles, cycle nutrients more efficiently, consume a greater diversity of the available biomass compared to cows alone.

Poultry, particularly broilers and turkeys, are recommended due to the fast turnover of these animals. These birds can follow sheep or cattle through rotations in the Olive Oil silvopasture systems and potentially be integrated into the medium density Olive Oil orchard as described above.

Livestock Guardian Dogs

Critical to Animal systems with any animals smaller than cattle are Livestock Guardian Dogs. These dogs stay with the animals at all times and combine with fencing to enable predator protection. Common breeds include Maremma, Pyrenees, Anatolian Shepherd, and Akbash (18).

6. BUILDINGS

Currently no buildings exist on site. Depending on selection of agricultural, processing and marketing systems a variety of buildings may be practical and desired.

Future Structures/Building

A list of optional buildings and functions for the proposed operations includes:

- **Olive Oil Processing Facility:** Based on the estimated quantity of olives and oil to be produced as well as the added value of marketing locally produced and processed oils to the local foods market, it may be worthwhile to invest in an oil processing facility and to develop a brand. This would also allow aggregation of olives from other local orchards to provide additional opportunities for revenue. Small Commercial Olive Mills can process 350-500 lbs/hr and cost ~$60K plus $30K-50K for peripheral equipment. Medium Commercial Olive Mills can process 2 tons/hr and cost ~$220K-300K plus $80K-100K for peripheral equipment (24)
- **Hoophouses**: For SPIN Farming production of starts and microgreens, hoophouses are an essential component of the production system. Hoophouses, also known as polytunnels or high tunnels, come in a wide range of sizes and shapes. They are usually purchased as

pre-fabricated kits. A 30'x96' hoophouse which covers 2,880 sq. ft. costs $7K-9K (13). At least one hoophouse per acre of operation is recommended, 2-3 per acre are ideal.

- **Lumber Processing and Drying:** If lumber is processed on site using a Lucas Mill or other portable sawmill, it is likely that a kiln and/or other lumber drying building will be a practical addition to the site. In lieu of a permanent building, drying kits are now available to retrofit Shipping Containers for lumber drying (23).

7. FENCING

Fencing is a critical component of any operating that includes animals, both to keep the animals on the property and to facilitate planned rotational grazing and protect establishing trees.

Existing Fencing

Currently no significant fencing exists on the property.

Recommended Fencing

Two main categories of fencing are recommended: Perimeter fencing and Interior fencing. For both categories, electric fencing is recommended because it is very effective to train the animals and allows minimal, lightweight temporary fencing to be used for large portions of the interior fencing (15).

Perimeter Fencing:

Perimeter fencing can either be installed around the entire perimeter of the property, or just the perimeters of the planned grazing areas. This fencing is the 'last line of defense' which keeps animals on the property. Exclusion of large livestock is recommended for both the wine vineyard and intensive Olive Orchard. The Vineyard is separated from the majority of the property by a road and does not need protective fencing from livestock. The Olive Orchard area would benefit from a fence on the W perimeter to exclude any large livestock.

An electrified perimeter fence in dry territory needs to be positive-negative so that the animal does not function as a ground/earth-return (26).

Perimeter fencing can be 3-5 wire for cattle and sheep.

Interior Fencing:

Interior fencing has fewer structural needs and just needs to support the wires carrying electric current. For cattle, a one wire system is sufficient. Sheep often require 2-3 wires. Interior fencing can be subdivided into two main types: Permanent and Temporary.

Permanent Interior fencing is recommended surrounding contour tree belts, roads, and on the boundary between Productive Land systems and Moderate Land systems. In addition to permanent electric fencing, more structural long term fencing is important for stockyards where animals are loaded, unloaded, and processed. The flat area at the end of Gist Rd provides one potential location for a stock yard.

Temporary fencing facilitates rotation of animals and can be either polywire on a roll stretched between two sections of permanent interior fencing (or Perimeter Fencing) or electronet poly wire powered by portable solar chargers. Polywire rolls often come in ¼ mile lengths and can be as long as ¾ mile. They allow large areas to be subdivided for grazing. Electronet comes in 160' and 120' lengths and are ideal for subdividing grazing areas within the Olive Oil plantings on PL designated areas. This type of electronet fencing also functions well for poultry systems.

As an alternative, tree tubes can be used for establishment and sheep can be trained not to browse on certain foliage using Lithium chloride treatments (5, 38). If a standing herd is maintained, then behavior is often passed on to new members, both additions and lambs. Once a herd is trained, any non-trained sheep should be retrained or culled immediately.

8. SOILS

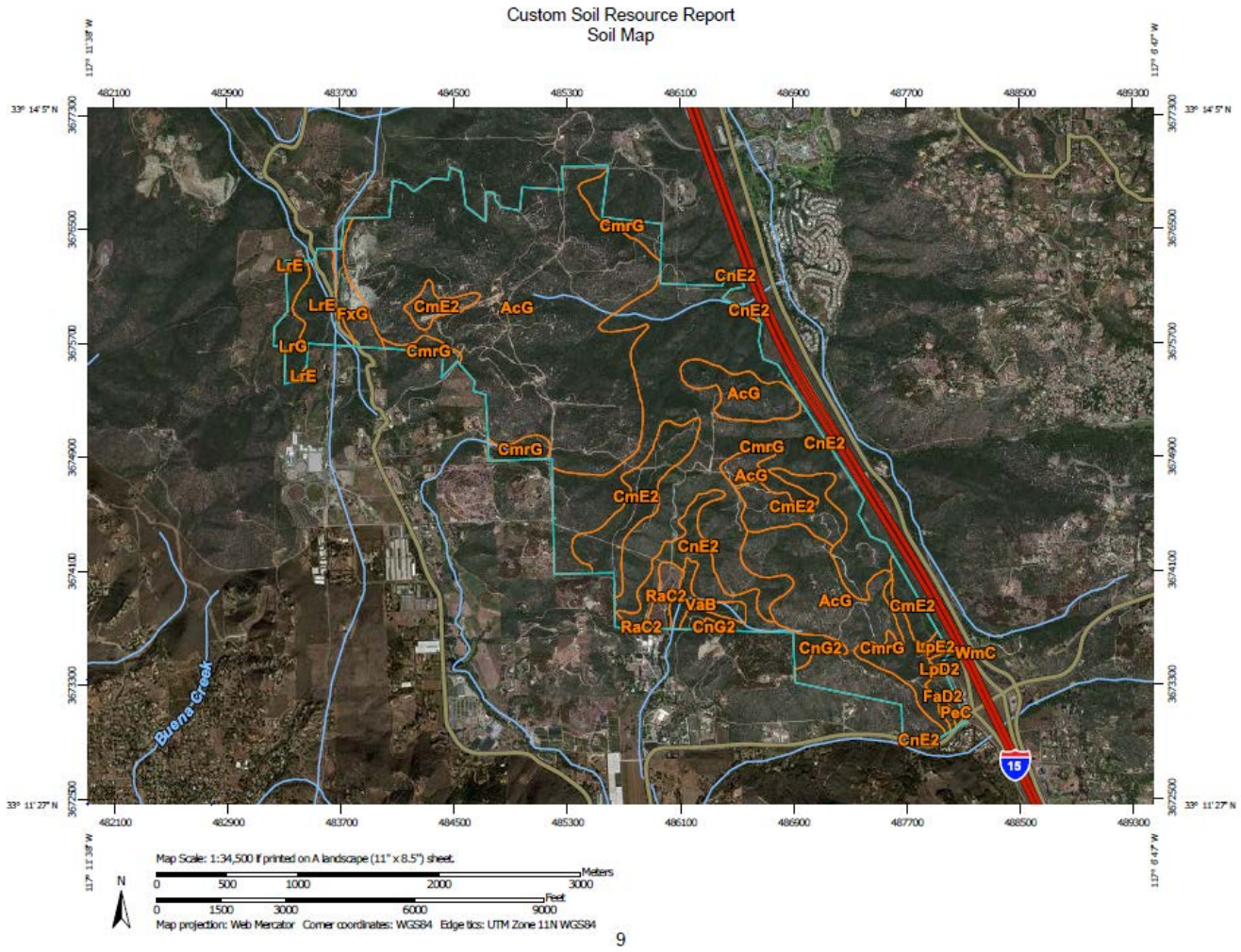

Figure 13. Soil Map (Source: NRCS Web Soil Survey)

Soil types on site and associated land uses

Soils have been assessed based on the NRCS Web Soil Survey information available for the site. The Site is primarily Acid igneous rock land (49%) which has shallow soils, low productivity and bedrock at 0-4". These rocky soils currently support chaparral vegetation, which is the primary recommendation for much of the site. Where the slope is less than ~30%, these soils may support a savannah of mixed grassland and hardy trees such as Olive, Carob, Honey Mesquite, and Live

Oaks. Soils and slopes which have been identified as having higher production potential have been grouped into Moderate Land and Productive Land categories.

Table 2. Soil Map Units and Acreages in Area of Interest.(Source: NRCS Web Soil Survey)

Map Unit Legend

San Diego County Area, California (CA638)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AcG	Acid igneous rock land	978.7	49.1%
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes , eroded	169.2	8.5%
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	594.9	29.8%
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent sl opes, eroded	76.9	3.9%
CnG2	Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent s lopes, eroded	15.5	0.8%
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	9.5	0.5%
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	27.4	1.4%
LpD2	Las Posas fine sandy loam, 9 to 15 percent slopes, erod ed	0.8	0.0%
LpE2	Las Posas fine sandy loam, 15 to 30 percent slopes, ero ded	4.9	0.2%
LrE	Las Posas stony fine sandy loam, 9 to 30 percent slopes	45.2	2.3%
LrG	Las Posas stony fine sandy loam, 30 to 65 percent slope s	27.5	1.4%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	3.4	0.2%
PeC2	Placentia sandy loam, 5 to 9 percent slopes, eroded	0.4	0.0%
RaC2	Ramona sandy loam, 5 to 9 percent slopes, eroded	16.2	0.8%
VaB	Visalia sandy loam, 2 to 5 percent slopes	21.5	1.1%
WmC	Wyman loam, 5 to 9 percent slopes	1.8	0.1%
Totals for Area of Interest		**1,993.9**	**100.0%**

Steep Land

Steep Land is dominated by Acid igneous rock land and includes several other soil types, most of which are rocky and sandy with shallow bedrock layers (<20”), high to very high rates of runoff, and low water holding capacities.

Table 3. Soils found in Steep Land Designation

Soil Map Unit Symbol	Map Unit Name	Land Capability Classification	Farmland Classification	Water Holding Capacity	Depth to Bedrock
AcG	Acid igneous rock land	8	Not prime farmland	N/a	0-4”
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded	7e	Not prime farmland	0.8” VL	4-20”
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	7e	Not prime farmland	0.8” VL	4-20”
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded	4e-6e	Not prime farmland	1.0-6.5” M	6-40”
CnG2	Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded	6e-7e	Not prime farmland	1.0-6.5” M	4-40”
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	4e	Not prime farmland	13.2” VH	40-60”
FxG	Friant rocky fine sandy loam, 30 to 70 percent slopes	7e	Not prime farmland	2.9” VL	6-20”

Moderate Land

The Moderate Land designation is also dominated by AcG soils, but with lower slopes. The other primary soil types in Moderate Lands is CmE2 and CmrG. These Cieneba soils are also shallow sandy soils with very low water holding capacities. For this reason proposed uses are grazing and silvopasture with hardy trees that tolerate rocky and shallow soils.

Table 4. Soils Found in Moderate Land Designation

Soil Map Unit Symbol	Map Unit Name	Land Capability Classifi-cation	Farmland Classifi-cation	Water Holding Capacity	Depth to Bedrock
AcG	Acid igneous rock land	8	Not prime farmland	N/a	0-4”
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded	7e	Not prime farmland	0.8” VL	4-20”
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	7e	Not prime farmland	0.8” VL	4-20”
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded	4e-6e	Not prime farmland	1.0-6.5” M	6-40”
CnG2	Cieneba-Fallbrook rocky sandy loams, 30 to 65 percent slopes, eroded	6e-7e	Not prime farmland	1.0-6.5” M	4-40”
RaC2	Ramona sandy loam, 5 to 9 percent slopes, eroded	3e-4e	Farmland of statewide importance	16.2” VH	>80”
VaB	Visalia sandy loam, 2 to 5 percent slopes	2e	Prime farmland if irrigated	11.9” H	>80”

Productive Land

The Productive Land designation has been given to areas of the site with low slopes. It has been focused on areas with soils that are Farmlands of statewide importance, and also includes some shallower soils which have lower slopes and better access. These shallower soils (i.e. CmE2) have been designated for Olive Oil Silvopasture with grazing and shallow rocky soil tolerant woody crops as the primary production systems.

The higher density Olive Oil Orchard includes some areas with CmrG shallow soils and may be considered for lower density Olive Oil Silvopasture if grazing is selected as the primary enterprise for the site.

The site proposed for Vineyard is located on Las Posas soils which are deeper and have a higher water holding capacity.

The sites proposed for SPIN Farming are the deeper soils listed as Farmland of Statewide Importance with low slopes and good access.

Table 5. Soils Found in Productive Land Designation

Soil Map Unit Symbol	Map Unit Name	Land Capability Classification	Farmland Classification	Water Holding Capacity	Depth to Bed rock
AcG	Acid igneous rock land	8	Not prime farmland	N/a	0-4”
CmE2	Cieneba rocky coarse sandy loam, 9 to 30 percent slopes, eroded	7e	Not prime farmland	0.8” VL	4-20”
CmrG	Cieneba very rocky coarse sandy loam, 30 to 75 percent slopes	7e	Not prime farmland	0.8” VL	4-20”
CnE2	Cieneba-Fallbrook rocky sandy loams, 9 to 30 percent slopes, eroded	4e-6e	Not prime farmland	1.0-6.5” M	6-40”
FaD2	Fallbrook sandy loam, 9 to 15 percent slopes, eroded	4e	Not prime farmland	13.2” VH	40-60”
LpD2	Las Posas fine sandy loam, 9 to 15 percent slopes, eroded	4e	Not prime farmland	9.8” H	20-40”
LpE2	Las Posas fine sandy loam, 15 to 30 percent slopes, eroded	6e	Not prime farmland	9.8” H	20-40”
LrE	Las Posas fine sandy loam, 9-30 percent slopes	6e	Not prime farmland	9.2” H	20-40”
LrG	Las Posas stony fine sandy loam, 30 to 65 percent slopes	7e	Not prime farmland	9.2” H	20-40”
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	4e	Farmland of statewide importance	9.2” H	>80”
PeC2	Placentia sandy loam, 5 to 9 percent slopes, eroded	4e	Farmland of statewide importance	7.4” M	>80”
RaC2	Ramona sandy loam, 5 to 9 percent slopes, eroded	3e-4e	Farmland of statewide importance	16.2” VH	>80”

VaB	Visalia sandy loam, 2 to 5 percent slopes	2e	Prime farmland if irrigated	11.9" H	>80"
WmC	Wyman loam, 5 to 9 percent slopes	2e-4e	Farmland of statewide importance	10.0" H	>80"

Salinity Concerns

Placentia soils may have soil salinity concentrations and Sodium Adsorption Ratios that limit growth of certain crops. Salinity and SAR increases at depth, which is likely due ot leaching and concentration at finer clay loam soil textures which occur at lower horizons in the soil profile. Prior to any cropping, these soils and irrigation water should be tested for chemistry at a lab (i.e. A&L Western Labs). SPIN Farming has been proposed in these areas, and initial crops should be selected which can tolerate moderate levels of salinity. There are several reasons for selecting SPIN Farming for these areas.

- The capacity to change crop types specific to soil conditions and the effects of soil renovation.
- The generally shallow rooted nature of annual vegetable crops.
- The practice of amending the soil with significant amounts of compost (~1-2" per year) which increases the soil organic matter content which has potential to adsorb and moderate salt issues.
- The higher irrigation rates associated with SPIN Farming assist in leaching salts.

A list of Salt Tolerant Vegetable crops worth considering as part of the initial SPIN Farming crop list include Beet, Arugula, Swiss Chard, Lettuce, Kale, Spring Onions, Spring Garlic. In addition, Tomatoes are moderately tolerant and worth considering due to their high value.

Table 6. Salintiy tolerance of vegetable crops (43).

Vegetable Crops		
$EC_e \times 10^3 = 12$	$EC_e \times 10^3 = 10$	$EC_e \times 10^3 = 4$
Garden beets	Tomato	Radish
Kale	Broccoli	Celery
Asparagus	Cabbage	Green beans
Spinach	Bell pepper	
	Cauliflower	
	Lettuce	
	Sweet corn	
	Potatoes (White Rose)	
	Carrot	
	Onion	
	Peas	
	Squash	
	Cucumber	
$EC_e \times 10^3 = 10$	$EC_e \times 10^3 = 4$	$EC_e \times 10^3 = 3$

Olives, Grapes, Figs, Pomegranates also have moderate soil salinity tolerances which is one reason for investigating these crops and selection of Olive Oil Orchard for the portions of the property containing Placentia soil types.

Soil Renovation Strategies

A primary goal of any regenerative agricultural system is soil surface management to develop and improve topsoil through increases in cover, litter, and soil organic matter. Increased soil organic matter improves infiltration rates, water holding capacity, and nutrient holding capacity of soils.

Several soil renovation strategies may be practical on this site. For Moderate Lands, soil renovation will likely focus on grazing based methods. These include:

- **Holistic Planned Grazing:** This planned rotational grazing system is the core of soil improvement grazing strategies and informs the selection of the other grazing strategies for specific areas and to target specific resource concerns. Holistic Planned grazing is a dynamic grazing planning method which integrates grazing the allotted forage resource while leaving appropriate litter and trampled forage with proper timing and rotation for rest and recovery of the vegetation.

    - **Rest and Recovery:** Proper rest and recovery periods are critical mitigate overgrazing and to improving soils and forage quality and quantity through grazing. This is one reason why we have recommended a 90-100 day grazing period for the whole site which allows more than 300 days of rest for any individual paddock.
    - **Groundcover and Litter**: increasing groundcover and litter on the soil surface is critical to improving soil quality. Groundcover and litter protect the soil from erosion, compaction, baking, and evaporation. These features also increase infiltration and over time soil organic matter and water holding capacity. When combined this allows the water that falls on the site to be more effective and available for growing forage.
- **Bale grazing**: where large bales of hay are places on the site to concentrate animals, induce trampling and add litter to a specific area, while supplementing feed and forage resources. This is particularly useful to prepare areas for tree planting in the following year or two.
- **Molasses Sprays**: where vegetation is sprayed with molasses to concentrate animals and induce trampling and add litter to a specific area. This technique is useful to create strips of trampled areas which can serve as firebreaks.
- **Free Choice Minerals**: where a mineral 'buffet' with individual minerals available in troughs is moved throughout the grazing area and animals are allows to self-select the minerals they are not getting from the forage resource. This method is used to remineralize soils in a balanced way that directly improves forage value to the grazing animals over the course of one to several years (14).
- **Poultry Feeds**: most pastured poultry operations provide grain based feed as the primary food source for the poultry. While much of this feed nourishes the animal, a valuable portion of it is left on the pastured areas as manure containing N, P, K and micronutrients. This additional fertility is readily bioavailable and supports both soil microbes and vegetation.

For Productive Lands, these grazing based strategies will also apply. In addition, soil renovation on Productive Land can include several physical, plant, and amendment based soil renovation strategies.

- **Physical:** Keyline pattern subsoiling, mounding/raised beds
    - **Keyline pattern subsoiling:** This technique applies a non-inversion subsoiler (like a Yeomans Plow (48)) which is dragged through the soil across the slope on a near

contour patterning 8-10" deep and increasing depths in subsequent years for 1-3 years. This treatment alleviates compaction and increases pore space to improve infiltration and root penetration. Primarily it's recommended in areas which are compacted due to vehicle activity (ie.the motocross area N of Gist Rd.) or which have subsoil hardpans such as those which may exist in the Placentia soils near Deer Springs Rd.

- **Mounding/Raised Beds**: this technique is recommended as part of the development of the SPIN Farming plots to improve soil aeration, tilth, and drainage while being integrated with initial applications of minerals and compost amendments. It may also be considered in areas where Olives are planted if soil drainage characteristics are poor.

- **Plant based:**
  - **No-Till Cover Cropping**: No-till management of soils is recommended following any initial site preparation tillage done to mitigate weed pressure for tree establishment. In areas where supplemental irrigation is available to silvopasture, no-till drill seeding of cover crops can both dramatically increase forage resources and improve soils. This can also be done without use of supplemental irrigation if timed with seasonal rains. At Brown's Ranch, Gabe Brown has achieved amazing results using this technique (4)
- **Amendments**:
  - **Compost**: Addition of high quality compost the SPIN Farming plots is an important part of feeding the soil biology and increasing soil water and nutrient holding capacity. Compost can either be purchased locally or produced on site. One example of high quality compost produced on site is Fortunate Farms which uses spent grain from a local brewery (North Coast Brewing) to create both compost as a salable product and as a soil amendment. (22)

9. ECONOMY

The proposed crop options support four primary enterprises onto which several others could be integrated. The most appropriate enterprises are:

- **Primary Enterprises**
    - Livestock: Stocker Cattle
    - Olive Oil
    - Wine Grapes
    - Market Garden Vegetables
- **Potential Secondary Enterprises:**
    - Livestock: sheep, poultry
    - Honey
    - Timber
    - Carob and Mesquite Pods and Powders
    - Non-Timber Forest Products: Mushrooms, Firewood

A general analysis of the Economics for the primary enterprises is provided in our attached economic model, which can be expanded to be more thorough and complete with more time. Rough revenue numbers for each enterprise are as follows:

Vineyard

The vineyard has potential to produce 5-6 tons of grapes per year after 3-4 years for a total of ~275-330 tons of grapes per year for a revenue of $425K-510K per year. Startup costs for vineyards in San Diego average $30K/acre and maintenance averages 5K/acre/year. For 55 acres, projected revenue - (maintenance costs ($275K) + water cost ($38.5K)) are $112K-197K per year for 5-6 tons/acre. If vines start producing harvestable quantities in year 3 and land prices are estimated at $10K/acre, Then ROI occurs at 30 years at 5 tons/acre and 19 years at 6 tons/acre.

Olive Oil

The Oil Olives have potential to produce 5,540 gal, 11,080 gal, and 16,620 gal Olive oil per year in years 4,7, and 9+ respectively. If organic and sold by the gallon at $20.50 per gallon, projected revenues for years 4, 7, and 9+ are $113K, 227K, and 340K respectively. While bottling has a higher

cost associated, if bottled and sold retail, projected revenues are increased 5 fold to $0.5M, 1.1M, and 1.66M respectively.

Cattle

Grazing stocker Cattle requires that cattle are bought and sold each year and revenue is generated based on weight gain of the cattle during the time between purchase and sale. Assuming 1.7 lbs per day of gain (which is common on moderate quality forage) purchase weight of yearling cattle at 500 lbs with sale 90 days later would put cattle at 650 lbs. Price of cattle varies, so assuming 100 $/CWT, this provides $150/head revenue. At 266 head, sale price ($172.9K) - purchase price ($133K) is $39.9K.

SPIN Farming

SPIN Farming practitioners are consistently grossing $150K/acre with non-labor operating costs of less than ~$75K/acre and labor costs of ~$50K/acre. This provides a return of ~$25K per acre if labor is fast and efficient. Costs of setup vary based on soil amendments and hoophouse installation however a cost of $20K-30K is expected for 2 hoophouses, 1" of purchased compost, and irrigation. At 10 acres, an annual return of $250K is possible after 2-3 years. SPIN Farming success relies upon this fast, efficient labor and marketing to high end retail purchasers such as restaurants.

10. ENERGY

Photosynthetic Efficiency:

San Diego County receives 266 sunny days per year and photosynthesis is primarily limited by water availability. The focus on this landscape toward renovating the soil to increase organic matter and litter increases water infiltration and water holding capacity which will support increased vegetation growth, particularly grasses. Grasslands in Southern California are dominated by cool season (C3) grasses, but can support perennial warm season (C4) grasses with proper grazing management and improved soil conditions. As the population of perennial warm season grasses increases, the overall duration of active photosynthesis on the site increases which provides increased forage availability and duration as well as increased soil organic matter and habitat value.

Conclusion

The Newland Sierra site has significant limitations for agricultural productivity. However, a few enterprises are reasonable and compatible with multiple landscape scale goals. The cost of water is a significant limitation for agriculture on the site, so we have limited enterprises to those which use <2 acre ft / acre, with the exception being a small area (~10 acres) of deepest soils allotted towards Intensive Vegetable Farming.

About half the site (>1000 acres) has potential to be managed through Holistic Planned Grazing to both improve ecosystem functions, such as water retention and effectiveness, and mitigate some fire risk while providing a potentially profitable enterprise. Due to the scale of the site and lack of current water and fencing infrastructure, a phased approach to develop grazing paddocks and systems is reasonable starting with the Productive Land areas as a way to renovate the soils prior to planting Olive Oil silvopasture systems. If planned grazing is the only use of the area, total water use to support the estimated 266 AU is less than 2 acre ft per year. Many additional opportunities exist for the Moderate Land designation such as Dehesa-style Silvopasture and contour tree belts for timber production and specialty forest products; however, since no models of this type of system exist currently in Southern California, economics are difficult to predict.

Less than 18% of the site (~300 acres) has been designated as Productive Lands with a higher agricultural potential. These are the flatter lands (primarily <15% slopes) with deeper soils. Selection of high value crops with low water use has led to two primary enterprise recommendations: ~55 acres of Wine Vineyard and ~192 acres of Oil Olives. The vineyard has a potential ROI of 19-30 years with $112K-197K return per year after. The Oil Olives ROI and returns will vary dramatically based on enterprise selection and costs of pressing, bottling and marketing for local artisan olive oil.

Cattle can provide short term cash flow of ~$39.9K each year to support development of site infrastructure such as fencing and water, as well as soil and site preparation for Olive Oil silvopasture areas.

SPIN Farming can drive the development and speed up the ROI on the project as a whole. At 10 acres, an annual return of $250K is possible after 2-3 years.

Combined, this suite of enterprises has the potential to make the site profitable as a source of local, artisanal food products, which would allow for some experimentation into Dehesa-style

agroforestry with it's various products in addition to the environmental benefits of regenerative agriculture.

Although the site has potential to be profitable, this potential has significant limitations and risk associated with it. Only a small portion of the whole site (15%) has potential for intensive agricultural production. The majority of the site (46%) is either inaccessible and not productive or limited to grazing as the primary enterprise (39%) . Even with improvement (but not irrigation) the carrying capacity of the land is estimated at ~266 AU. The enterprise examined with the highest returns is SPIN Farming, however, this enterprise needs both good soils and has a high water demand, so it is limited to a small portion of the site and has minimal opportunities for expansion over time. While both wine grapes and oil olives can be profitable enterprises on this site, ROIs are much longer (20-30 years) which make the capital expense investment needed to get these operations established a high risk and sensitive to market and weather fluctuations over a long time span. When considered in aggregate, these limitations suggest that one would need to be passionate about local agriculture to develop this site with these enterprises in mind. There are many sites in San Diego County with higher agricultural potential as evidenced by the existing agricultural operations along Deer Springs Rd and N Twin Oaks Rd. While this site has the potential to be a profitable operation, to someone searching for a site suitable for agricultural enterprises, it is unlikely to be a prime choice.

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Appendices

Bio-physical Climate Summary

Weather

- **Clear Days**: 266 days
- **Cloud Days**: 99 days
- **Climate Classification**:
    - Köppen–Geiger: Csa: dry summer mediterranean
    - USDA Zone: 9b (25-30°F / -3.9 - -1.1°C)
- **Peak Heat**: 113°F (08-29-1909)
- **Peak Cold**: 13°F (01-02-1901)
- **January Avgs (High/Low/Precip)**: 64.9°F / 37.1°F / 3.24”
- **July Avgs (High/Low/Precip)**: 88.2°F / 58.0°F / 0.03”
- **Heat Index** (No. days @ heat index temp in avg. year):

    - 90°F+: 44 days
- **Growing Degree Days (GDD)**:
    - e.g. Rice: 3355 GDD (April 15th through August 15th)
        - Annual GDD Base 50F: 4400
- **Chilling Hours**: ~750 hrs
- **Evapotranspiration (ETo)**: 49-55”
- **Rainfall**:
    - **Annual Avg**: 12-16 inches/yr
    - **Rain Days/Year**: 70-80
    - **Rain Seasonality**: December - March
    - **25-Year, 24-Hour Storm Rainfall Avg**: 6.47”

