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Tolay Creek Ranch Grazing Plan

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TOLAY LAKE REGIONAL PARK
Master Plan Project

Tolay Creek Ranch

Grazing Plan

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Sonoma Land Trust

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Executive Summary

The primary purpose of this plan is to provide guidelines and direction to the Sonoma Land Trust (SLT), the current owner of the Tolay Creek Ranch (the Property), and the Sonoma County Regional Park District, the Property's future owner, for the use of livestock grazing to meet rangeland and resource conservation goals.

This grazing plan was designed to address natural resource management concerns at the Preserve while supporting the existing beef cattle operation. The Property has likely been grazed by domestic livestock for over 150 years, and a recent biological resources study (LSA Associates 2009) documents abundant wildlife and native grassland biodiversity on the Property. Tolay Creek, which flows for over two miles through the Property, has been degraded by livestock impacts over many decades. Riparian protection fencing and planting on Tolay Creek and its tributaries will restore habitat values and curb stream erosion within the riparian system.

As demonstrated by research and observational studies, native grassland plant diversity can be positively affected by grazing. Non-native annual plants that now dominate most of California's grasslands, compete with natives for water and sunlight, and can prevent germination and growth of certain native plants. Grazing removal from other local conservation lands, has led to the extirpation of some native grassland plants, including special-status species. As well as helping to preserve grassland biodiversity, grazing can effectively manage some noxious weeds and fire fuels. For these reasons, and for the preservation of local agriculture, the Sonoma Land Trust (SLT) has chosen to continue livestock grazing on this site.

This plan includes general background information and recommendations for livestock species, stocking rate, grazing season and timing, livestock distribution, as well as recommendations for riparian grazing and targeted grazing for an optional weed management program. Grazing recommendations should be used as guidelines, but are intended to be flexible to accommodate natural variations in forage production and other dynamic processes. Needed infrastructure improvements, and a simple monitoring program are also described.

1.0 Introduction

In 2007, Sonoma Land Trust (SLT) acquired the Tolay Creek Ranch (the Property) to protect its ecological and cultural resources and for future incorporation into Tolay Lake Regional Park, currently slated to occur in 2012.

This Grazing Plan describes a framework and provides specific recommendations for continuing livestock grazing on the Property for management of grassland species diversity, wildlife habitat, and fire fuels. The proposed grazing program will also continue to support productive agricultural use of the land.

Like virtually all California grasslands, livestock have likely grazed on the Property for about 150 years. The Property is leased to H & L Mohring and Sons, which has run livestock here for over 30 years. Glenn Mohring, who lives nearby, typically runs a cow-calf beef operation on the Property and on other nearby properties. Sheep were also raised on the Property in the past, as evidenced by the woven wire fencing that remains along some reaches of the boundary.

Currently, H & L Mohring and Sons typically run 220 to 250 cow-calf pairs on the Property and the 330 acres leased from the Roche family (Glenn Mohring personal communication 2010). This year, a grazing lease between the Mohrings and Sonoma County Regional Parks for Tolay Lake Regional Park left the Mohrings without enough animals to fully stock the Property. For the short-term, the Mohrings have subleased most of the Property to Dean Spinelli who has stocked it with six bulls and 120 cow-calf pairs. The Mohrings are using only one field to run 180 stockers this year.

Grazing has continued at Tolay Lake Regional Park, and incorporation of the Property into this park will result in a 3,400-acre property composed almost entirely of grassland. The most practical method for managing the grassland biodiversity, including plant species composition and wildlife habitat and fire fuels for such a large tract of land is through livestock grazing.

2.0 Site Description and Inventory

2.1 Physical Description

The 1,665-acre property occupies gently rolling hills surrounding, and the valley bottom adjacent to, lower Tolay Creek. The main stem of Tolay Creek bisects the upper part of the Property, then crosses the eastern boundary between the Property and the Roche Property several times before exiting the Property at Highway 121. Elevation ranges from 660 feet in the north end of the Property to 22 feet where Tolay Creek flows under Highway 121.

A detailed description of the Property's physical characteristics, biological resources, land use history, and the regulatory context of resource management are contained in a *Biological Resource Study, Tolay Creek Ranch, Sonoma County California* (LSA Associates 2009).

2.2 Vegetation

Vegetation is primarily open grassland with scattered oak and riparian woodland along Tolay Creek and some of its tributaries. Woodlands are generally degraded, with many riparian reaches lacking woody cover. In a few areas to the south of Tolay Creek, oak woodland extends from riparian zones into uplands, but only in very few locations does oak woodland exist separate from the riparian woodland.

Native and non-native grasslands are described separately in LSA Associates (2009). Although some distinct stands rich in native grass species occur on the Property, especially on the western ridge, there are also many locations where native and non-native grassland intergrade.

Non-native Grasses. Grassland vegetation is dominated by non-native, mostly annual species. Common non-native grasses in dry upland areas include ripgut brome (*Bromus diandrus*), soft chess (*B. horeaceus*), wild oats (*Avena fatua* and *A. barbata*), foxtail (*Hordeum murinum* ssp. *leporinum*); while Mediterranean barley (*H. marinum* ssp. *gussoneanum*) and Italian ryegrass (*Lolium multiflorum*) are common in low-lying, moister areas (LSA Associates 2009). Medusahead (*Taeniatherum caput-medusae*), an invasive non-native annual grass that has very low forage quality and other characteristics that makes it a troublesome weed, also occurs throughout the Property.

Native Grasses. Small areas rich in and dense with native perennial grasses occur throughout the Property. More and larger stands of purple needlegrass (*Nassella pulchra*) occur on the hillslopes, while numerous stands of creeping wildrye (*Leymus triticoides*) and meadow barley (*Hordeum brachyantherum*) occur both on hills and in the valley bottom.

Native Forbs. Native and non-native forbs occur in both the native and non-native grasslands. Native forbs occur principally in dense stands scattered on slopes on the southwest side of Tolay Creek, while non-native forbs occur throughout the Property. Native forb species include Fremont star lily (*Zigadenus fremontii*), miniature lupine

(*Lupinus bicolor*), California buttercup (*Ranunculus californica*), narrow-leaved mules ears (*Wyethia angustifolia*), Kellogg's yampah (*Perideridia lelloggii*), hill morning glory (*Calystegia subacaulis*), yarrow (*Achillea millefolium*), blue-eyed grass (*Sisyrinchium bellum*), lotus (*Lotus wranglianus*), Ithurial's spear (*Tritelia laxa*), California poppy (*Eschscholzia californica*), soap plant (*Chorogalum pomeridianum*), California checker mallow (*Sidalcea malvaeflora*), and Johnny jump-up (*Viola pedunculata*). The Property also supports large stands of hayfield tarweed (*Hemizonia congesta* ssp. *lutescens*) (LSA Associates 2009).

Non-native Forbs. Non-native forbs include rose and subterranean clovers (*Trifolium hirtum* and *T. subterraneum*), broad-leaved and red-stemmed filarees (*Erodium botrys* and *E. cicutarium*), common vetch (*Vicia sativa*), Venus' needle (*Scandix pecten-veneris*) and other weed species listed below (LSA Associates 2009).

Invasive Weeds. Additional non-native forb species include the following invasive weeds: purple star-thistle (*Centaurea calcitrapa*), yellow star-thistle (*Centaurea solstichialis*), bristly ox-tongue (*Picris echioides*), Italian thistle (*Carduus pycnocephalus*), milk thistle (*Silybum marianum*), bull thistle (*Cirsium vulgare*), black mustard (*Brassica nigra*), and jointed charlock (*Rhapanus raphanistrum*) (LSA Associates 2009). Medusahead is also an invasive grassland weed and Himalayan blackberry (*Rubus discolor*) has become established in numerous locations along Tolay Creek and its tributaries.

2.2.1 **Forage Quality and Quantity**. Extensive grasslands at the Property provide green forage for seven to eight months each year. Overall forage quality is good, as grasslands are dominated by palatable species. The invasive weed species are generally of low palatability or unpalatable, but these constitute a relatively small proportion of the grassland vegetation. Fortunately, medusahead occurs in small, scattered stands and is not a dominant species.

In general, forage quality fluctuates with seasons and phenological stages of plant growth, and is highest in mid-spring when grasses are approaching maturity but have not yet flowered. This corresponds with the rapid spring growth period, when grassland biomass is also highest.

Forage production is very good, and most of the soil map units are classified into range sites by the *Sonoma County Soil Survey* (USDA 1972) that are among the most productive in Sonoma County, with the exception of the serpentine soils. Generally, forage production is lower on slopes where soils are thin and rocky, especially on the serpentine derived Montara cobbly clay loam soils, and production is higher in the valley bottom on deep, alluvial soils. Production can vary dramatically between years, depending on rainfall amount and distribution, and spring winds. Soil Survey values for the various map units at the Property range from 500 to 2,000 pounds per acre in an unfavorable year and 1,200 to 4,000 pounds per acre in a favorable year.

Abundant forage in Mack Field, April 2010

2.3 Wildlife

Grasslands on the Property are likely to support breeding grasshopper sparrows and horned larks. When occurring together, these species indicate high-quality, diverse grasslands, with horned larks preferring short grass and bare areas while grasshopper sparrows prefer taller grass habitats (LSA Associates 2009). This differential preference illustrates the need for some patchiness in grassland canopy height. Completely uniform grazing is undesirable, and grazing intensity should be light enough to allow a matrix of short, medium and tall patches of herbaceous vegetation, especially in the spring.

Grasslands also provide foraging habitat for other songbirds, raptors, and small mammals that they feed on (LSA Associates 2009). A six-year study by University of California Berkeley faculty and graduate students on East Bay grassland sites under light to moderate cattle grazing and repeated rotational sheep grazing has shown the presence of horned larks to be significantly and positively associated with livestock grazing. It has also shown that grasshopper sparrows are more likely to be found where there are livestock grazing and native bunch grasses. Grasshopper sparrows are also associated with greater vegetation height variability (Dr. James Bartolome personal communication 2010).

2.4 Soils

The *Sonoma County Soil Survey* (USDA 1972) divides the Property into four soil map types: Clear Lake clay loam, Diablo series, Goulding series, and Montara loam. Clear Lake clay loam occurs primarily in the level areas along Tolay Creek. The associated

vegetation is primarily herbaceous. The Diablo series occupies the slopes. It typically has low permeability, high runoff potential, and high shrink-swell potential, and supports grasslands and scattered oaks. The Goulding series is composed of clay and rocky loam on slopes and supports primarily grassland. The Montara cobbly clay is in the southwest portion of the property, overlying the serpentine rocks.

2.5 Riparian Areas

As its name implies, Tolay Creek is a prominent feature of the Tolay Creek Ranch. Tolay Creek and its tributaries begin on Tolay Lake Regional Park to the north. Tolay Creek's origin is the outlet of Tolay Lake, from which it flows southeast into Sonoma Creek, then San Pablo Bay.

Restoration and enhancement of Tolay Creek is recommended by both the *Biological Resource Study, Tolay Creek Ranch* (LSA Associates 2009) and the *Tolay Creek Riparian Enhancement Plan* (West Coast Watershed 2009), which describes Tolay Creek's condition and recommends enhancement measures, including construction of riparian livestock exclusion fencing and revegetation. Tolay Creek's condition is described in this plan:

> "In general, the riparian zones associated with Tolay Creek and its tributaries are highly degraded, characterized by steep, eroding banks and in many places completely devoid of native perennial vegetation."

The Biological Resources Study (LSA Associates 2009) describes riparian habitats as the most important habitat for landbirds in California, with several species depending on riparian habitat for their entire breeding cycle. Structural diversity and understory volume are important components of riparian habitat for breeding birds (Marin County Resource Conservation District et al. 2001). Due to the critical importance of high quality riparian habitat for breeding birds, and the scarcity of such habitat, a primary focus of the riparian restoration effort should be to create high-quality bird breeding habitat within the Tolay Creek riparian corridor.

LSA Associates (2009) also addresses restoration of the Tolay Creek riparian woodland and recommends that the entire length of the creek be fenced, with only occasional short-term grazing recommended within the fenced corridor to maintain the habitat diversity if cattails and bulrush become so dense that pools are filled in.

2.5.1 Livestock Impacts to Riparian Areas

. Livestock have had free access to Tolay Creek for many years and are at least partially responsible for the depauperate riparian vegetation. The dramatic downcutting and resultant bank erosion that Tolay Creek is currently experiencing has been analyzed by a fluvial geomorphologist (Florsheim 2008), who has not indicated that livestock grazing is the cause of the unstable riparian system. However, bank trampling and grazing and browsing of riparian vegetation has apparently degraded some localized areas of the creek and its tributaries.

Livestock can contribute to water quality degradation by addition of pathogens, nutrients, and sediment to creeks and waterbodies. Livestock borne pathogens include *Cryptosporidium parvum* and particular strains of *E. coli*, both of which can cause illness in humans. These pathogens are of particular concern where contaminated drainages flow into water bodies that serve as drinking water sources and/or contact recreational areas, neither of which occur downstream of Tolay Creek.

Nutrients, including nitrogen and phosphorous from livestock urine and fecal material, can degrade water quality and impact aquatic life. Livestock related nutrient pollution is most serious where animals are confined, such as dairies and feedlots, which produce large quantities of concentrated animal waste. Land extensive grazing, such as occurs at the Property, is much less likely to cause significant nutrient pollution, although animal waste deposited directly into waterways, or placements of livestock attractants such as water near waterways, can degrade water quality.[1]

2.6 Existing Infrastructure

Existing livestock infrastructure consists of cross fencing, boundary fencing with associated gates, and livestock watering systems. Infrastructure improvements are shown in Figure 1.

Fencing at upper boundary between Mack Field and Tolay Lake Regional Park

[1] Fifty to 60 percent of cattle fecal loading on annual rangelands is near cattle attractants (Dr. Ken Tate personal communication)

2.6.1 **Boundary Fencing**. Livestock fencing bounds the Property except at the border with the Roche Property, and along the north and west sides of the narrow section along Highway 121, which are both unfenced. Boundary fencing is all in poor to fair condition and consists of barbed-wire and/or woven sheep fence topped with barbed-wire. Repair and replacement of boundary fencing is generally considered to be the responsibility of both landowners where livestock grazing occurs on both sides of a boundary fence, but where livestock grazing occurs on only one side, the landowner operating the livestock ranch is obligated to contain the animals. California law[2] requires livestock owners to keep animals off of public highways.

Table 1 Existing boundary fencing assessment

Fence Reach as Shown in Figure 1	Section Location	Length in Feet	Comments
BF1	Adjacent to Infineon Raceway properties, at southern boundary	8,050	Very poor condition
BF2	Adjacent to Fredericks property, at southwestern boundary	3,150	Poor condition
BF3	Adjacent to Gambonini property, at western boundary	5,400	Fair condition
BF4	Adjacent to Tolay Lake Regional Park, at northern boundary	10,420	Poor to fair condition
BF5	Adjacent to Lilly Property, at northern boundary	6,350	Poor to fair condition
BF6	Adjacent to Highway 121	2,700	Good condition, built by CalTrans in 2003
	Total	**36,070**	

[2] California Food and Agricultural Code Division 9, Part 1, Chapters 6 and 7

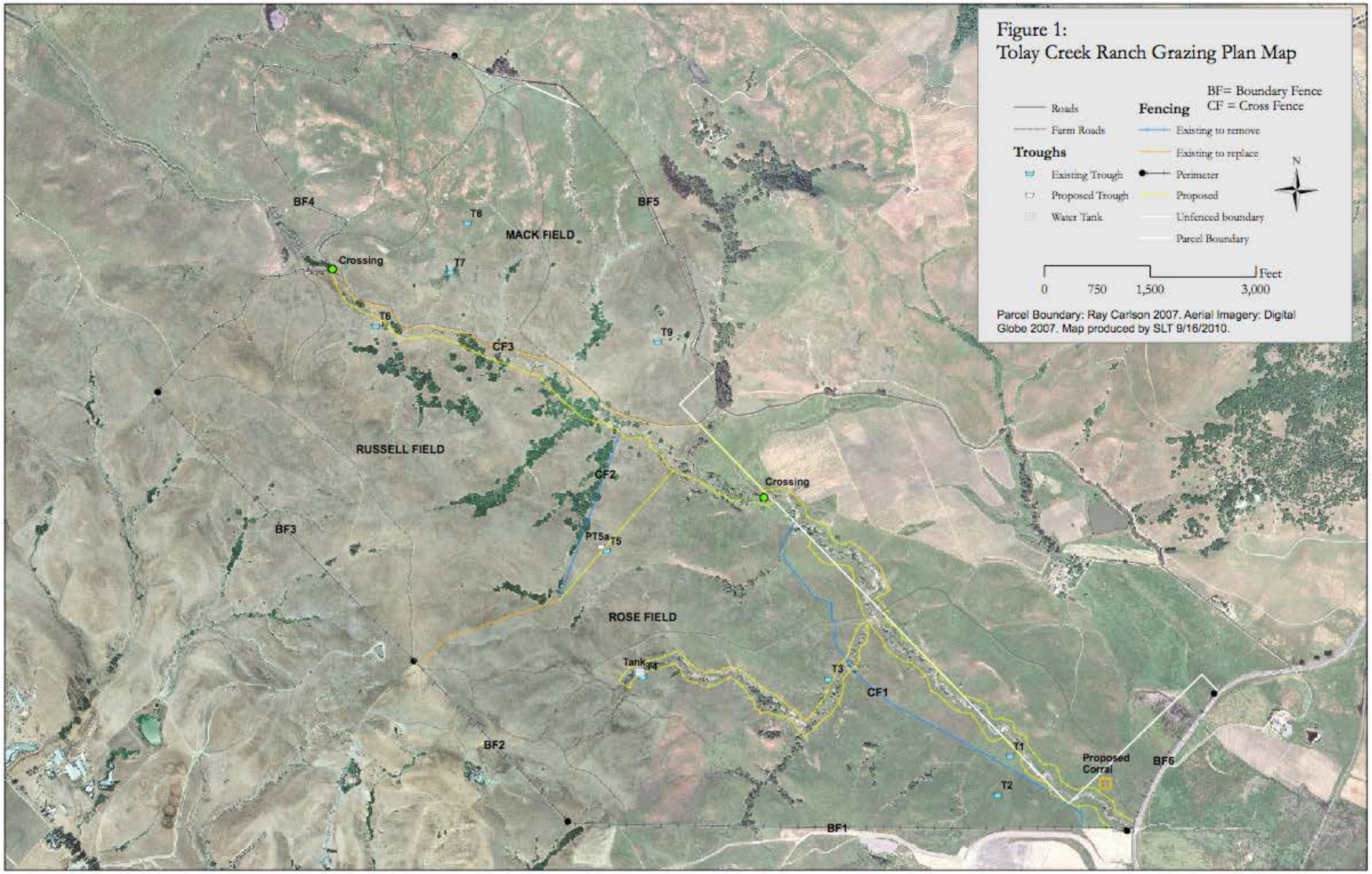
Figure 1:
Tolay Creek Ranch Grazing Plan Map
BF= Boundary Fence
CF = Cross Fence
Roads
Farm Roads
Troughs
Existing Trough
Proposed Trough
Water Tank
Fencing
Existing to remove
Existing to replace
Perimeter
Proposed
Unfenced boundary
Parcel Boundary
N
0
750
1,500
3,000
Feet
Parcel Boundary: Ray Carlson 2007. Aerial Imagery: Digital Globe 2007. Map produced by SLT 9/16/2010.
BF4
BF5
T8
MACK FIELD
Crossing
T7
T6
CF3
T9
RUSSELL FIELD
CF2
Crossing
BF3
PT5a
T5
ROSE FIELD
Tank
T4
T3
CF1
BF2
T1
Proposed Corral
BF6
T2
BF1

2.6.2 **Cross fencing**. Three existing cross fences divide the Property into the 712-acre Rose Field, the 480-acre Russell Field, and the 463-acre Mack Field, and separate a roughly 67-acre linear section of the Rose Field that is contiguous with the Roche Property from the remainder of the Rose Field. Cross fences are all in poor condition and the fence between the Rose and Russell fields is no longer effective in containing cattle.

2.6.3 **Livestock Water System**. The Property is endowed with abundant and well-distributed springs that fill nine livestock drinking troughs. The livestock water system consists of these troughs, a 5,000-gallon water storage tank, a pond, and distribution pipes. Livestock presently also drink out of Tolay Creek and its tributaries, to which they have had free access. Surface water from the pond fills trough T4 via a 2 inch pipe, and overflow from this trough fills the 5,000-gallon storage tank, which in turn fills trough T5. If the water level in the stock pond gets low enough, the storage tank and both of these troughs would dry up (Brad Stevens personal communication 2010).

Table 2. Existing livestock water locations

Rose Field	Comments
T1	Rectangular concrete trough installed in 2009, fed by 4 inch pipe, source unknown, has been in place less than one year
T2	Rectangular concrete trough installed in 2009, fed by 4 inch pipe, source unknown, has been in place less than one year
T3	Rectangular concrete trough installed in 2009, fed by 4 inch pipe, source unknown, has been in place less than one year
T4	Round metal trough, fed by stock pond surface water, runs year-round
T5	Rectangular concrete trough installed in 2009, fed by 4 inch pipe, from stock pond surface water, has been in place less than one year
Russell Field	
T6	Rubbermaid trough, fed by very good spring that needs to be redeveloped, runs year-round except in drought years
Mack Field	
T7	Old metal trough, spring fed, runs year-round; this trough is located very close to a seep which is heavily impacted by cattle who visit this trough to drink
T8	Round concrete trough, spring fed, runs year-round
T9	Rectangular metal trough, spring fed, runs year-round

3.0 Management Goals and Objectives

SLT's overall goal for the Property is to protect its ecological, cultural, and scenic resources and to provide for future public recreation. More specific goals and objectives related to grazing include the following ecological goals (Neale 2009):

Goal 1. Enhance riparian habitat on Tolay Creek.

Objective 1a. Increase extent of native riparian vegetation on Tolay Creek and its tributaries.

Objective 1b. Reduce bank erosion on Tolay Creek and its tributaries.

Goal 2. Manage grazing to promote native plant species and discourage non-native species.

Objective 2a. Maintain native cover in serpentine and native-dominated grasslands through well-managed grazing.

Objective 2b. Prevent expansion of yellow star-thistle and purple star-thistle.

Goal 1 and its associated objectives will be achieved by excluding livestock from Tolay Creek and select tributaries. Occasional grazing may occur within the riparian exclusion area if needed for weed or fire fuel management, but, if so, grazing episodes will be only occasional and for short durations (see section 4.5).

Goal 2 and its objectives will be achieved through continued moderate grazing that will help to manage non-native, primarily annual biomass, and by using carefully timed short-duration, high-intensity grazing for yellow star-thistle management (see section 4.6). Purple star-thistle cannot be effectively managed with grazing.

The serpentine area on the west ridge supports extensive native forb cover, including Marin western flax (*Hesperolinon congestum*), cream cups (*Platystegon californicus*), California goldfields (*Lasthenia californica*) tidy-tips (*Layia* spp.), California plantain (*Plantago erecta*), and many other species. These small-statured plants thrive on the low fertility serpentine soils, due in part to the limited competition from non-native annual grasses that grow better on more fertile sites. In some areas of California, including San Jose, non-native annual grasses have recently invaded serpentine grasslands due to deposition of atmospheric nitrogen, which increases soil fertility and can drastically alter the native flora. Atmospheric nitrogen deposition has also been detected on non-serpentine sites in Sonoma County along Highway 12 and on Todd Road between Santa Rosa and Sebastopol (Daniel Gluesenkamp personal communication).

Continued grazing on the serpentine area and throughout the Property, should help maintain native cover by creating open areas in the grassland canopy, and exposing small areas of soil within which small-statured forbs can germinate and grow.

4.0 Proposed Grazing Program and Recommendations

Continuing the moderate level of grazing at the Property, combined with riparian fencing, and an increased level of weed management should preserve and enhance native plant species diversity and wildlife habitat while providing on-going management of fine fire fuels. Infrastructure improvements and placement of salt licks will be used to improve animal distribution to avoid under- or over-utilization of specific areas within the Property. The current cow-calf beef operation is compatible with management goals and objectives for the Property, and no significant changes to the overall livestock operation are proposed.

4.1 Livestock Species

Foraging habits, behaviors, and other characteristics differ between livestock species and classes that may make one type of livestock preferable over another for meeting site-specific management goals. Predator problems, site topography and local availability of livestock types are also important considerations.

Different species of animals prefer different topographic positions. Steepness of slope significantly influences distribution of cattle (Heady and Child 1994), while smaller animals, such as sheep and goats, are more able to traverse steep hillsides. Larger animals including cattle and horses prefer to graze level-to-gently rolling land. In areas with steep terrain, cattle generally congregate on more level areas, which can lead to heavy use of flat land unless infrastructure or attractants are used to improve distribution. The gentle topography of the Property is well suited to cattle grazing.

Small-scale targeted grazing by goats and/or sheep may be useful for managing weed species (see section 4.6), or for grazing within the riparian fence (see section 4.5), but extensive grazing by either of these species is not recommend because of their potential to negatively impact the native forbs and because predation by coyotes would likely cause significant livestock losses. If a future grazing tenant or Sonoma County Regional Parks utilizes goats or sheep for targeted grazing of weeds or riparian grazing, both of these smaller livestock species would require protection with webbed electric fencing and possibly guard dogs, or would need to be brought in to a secure enclosure at night.

Grazing animals are divided into groups based on their vegetation preferences and primary foraging methods. These groups include the grazers (cattle and horses), which have a diet dominated by grasses and grasslike plants, the browsers (goats), which consume primarily forbs and shrubs, and the intermediate feeders (sheep), which have no particular preference for grasses, forbs, or shrubs (Holechek, Pieper and Herbel 1998). Browsers commonly consume large amounts of green grass during rapid growth stages but avoid dry, mature grass and often experience digestive upsets if forced to consume too much mature grass (Vallentine 1990).

Body size and reticulo-rumen capacity, anatomical differences in teeth, lips, and mouth structure, grazing ability, and differences in digestive systems account for some of the differences in foraging behavior. Mouth size directly affects the degree of selectivity that

is physically possible; ruminants with small mouth parts such as sheep and goats, in contrast to cattle and horses, can more effectively utilize shrubs while selecting against woody material. Dietary preferences of different livestock species are shown in Table 3.

Table 3. Generalized dietary preferences by domestic livestock species

Species	Dietary Preferences
Cattle	Grazer: mostly grasses, some seasonal use of forbs and browse
Horses	Grazer: mostly grasses, minor forbs and browse
Sheep	Intermediate feeder: high use of forbs, but also use high volumes of grass and browse
Goats	Browser to intermediate feeder: high forb use, but can utilize large amounts of browse and grass; highly versatile

(Adapted from Vallentine 1990)

In addition to physiological influences on diet selection, animal behavior can strongly affect what livestock choose to eat. Young animals learn foraging behaviors from their mothers and peers and can be taught to eat or avoid certain plants.

Although many other factors can influence forage consumption, animal unit equivalents (AUEs) are useful in estimating stocking rates and comparing forage demand of different ages and species of animals. Animal unit equivalents vary by source, actual weight of animal, and individual animal (USDA 2003). Table 4 provides AUEs for common domestic livestock and can be used as follows:

7 mature sheep or goats = 1.4 animal units (7 x .2)
48 two year old cattle=38 animal units (48 x .8)

Table 4. Animal unit equivalents

Animal kind and class	Animal Unit Equivalent	Monthly Forage Consumption
Cow, dry	.92	727
Cow, with calf	1.00	790
Bull, mature	1.35	1,067
Cattle, 1 year old	.60	474
Cattle, 2 year old	.80	632
Horse, mature	1.25	988
Sheep, mature	.20	158
Lamb, 1 year old	.15	118
Goat, mature	.15	118
Kid, 1 year old	.10	.79

(Adapted from Vallentine 1990)

Livestock Species Recommendations:

- Continue the cattle grazing as described in this plan
- Utilize the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant or a third party, for riparian area grazing as described in section 4.5 and weed management as described in section 4.6

4.2 Stocking Rate and Grazing Capacity Estimates

Stocking rate is the actual number of animals on a site for a given period of time. Annual fluctuations in forage production mean that setting and adjusting stocking rates should be viewed as a process rather than an exercise in determining a precise number of animals that a site can carry.

The Property has supported about 220 cow-calf pairs for 30 years (Glenn Mohring, personal communication 2010). Animal numbers have varied within 10 to 15 percent between drought years when forage production has been very poor, and good forage years. The current condition of Property resources, including the considerable grassland species diversity, is in part due to livestock management at this stocking rate.

LSA Associates (2009) recommends maintaining the vegetation in roughly its current state, until more is known about the Property's ecology, although enhancement and weed control are recommended. The serpentine areas in particular is valuable due to high plant and insect diversity, and as noted by LSA (2009) this area has withstood the trampling of cattle since the arrival of the Spanish.

Riparian exclusion fencing will remove approximately 50 acres,[3] or three percent of the Property from grazing. If the stocking rate is reduced to reflect this, it would mean a reduction by seven to eight AUs.

4.2.1 Residual Dry Matter

. Residual dry matter (RDM) is the dry, herbaceous biomass remaining on the ground at the end of the grazing season, usually measured in October, and before fall rains begin. Retaining an appropriate level of RDM serves several purposes. Adequate RDM minimizes early season erosion from rain splash, provides favorable conditions for seed germination, and has been shown to affect future years forage production and species composition on annual rangelands.

A moderate level of grazing should be maintained unless specific resources call for more or less intensive use. Rangeland researchers have defined and quantified "moderate grazing:" Clawson and McDougald (1982) found that too much RDM results in a thatch, which inhibits early response of new forage growth, and that maintenance of seeded annual legumes and filaree (*Erodium* spp.) abundance[4] requires adequate but lower amounts of RDM than grass forages and linked the idea of using broad categories to describe grazing impact on landscape appearance and stubble height: light grazing leaves three or more inches; moderate grazing leaves two inches; and heavy grazing leaves less than two inches with areas of bare soil visible from 20 feet away.

Early RDM research related RDM levels—which can be related to low, moderate, or heavy grazing—to subsequent years forage production and species composition (Heady 1956). Over the four years of an experiment that involved manually manipulating RDM levels within plots by hand clipping to various levels, Heady found that:

[3] It will also remove roughly nine acres of the Roche Property from grazing
[4] This indicates that excessive RDM can have a negative effect on some forb species

- increasing amounts of RDM on the soil immediately before the fall rains led to an increase in herbage production the following spring
- biomass production increased with increased weight of RDM between 1,200 and 2,400 pounds per acre
- some species responded to RDM treatments and some didn't
- RDM had a direct effect on composition and some species were favored when all mulch was removed, others were favored when none was removed, and a third group reached maximum composition with intermediate RDM levels; for example, California goldfields (then *Baeria chrysostoma*, now *Lasthenia californica*) was very abundant with no RDM and was absent where RDM was heaviest; conversely, soft chess (then *Bromus mollis*, now *B. hordeaceus*) was the only plant that increased significantly in percent composition with the heaviest RDM treatments; legumes were most abundant at intermediate RDM levels

In conclusion, RDM levels can dramatically effect forage production and species composition. A moderate level of grazing should be maintained to ensure continued high forage production and forage species diversity. For practical purposes, this means that significant bare or heavily grazed areas should not occur as this level of disturbance encourages invasion by thistles and other unpalatable noxious weeds, and that excessive lightly grazed areas should also be avoided to prevent thatch buildup, which is detrimental to early forage production and maintenance of important forbs such as clovers.

University of California researchers have established minimum RDM standards for different grassland types and climatic regions based on these attributes. Published standards (Bartolome et al. 2002) and professional judgment were used to determine a target minimum RDM level of 1,000 pounds per acre for the Property, except in the serpentine area and areas where high-intensity grazing is used for weed management. The serpentine area, which may have annual production of less then 1,000 pounds per acre, and which supports the most native forbs can have very low RDM.[5] Weed management areas may have RDM as low as several hundred pounds per acre in treatment years.

Low RDM in a single year is not apt to cause significant, lasting negative effects on forage resources, plant species composition, or other features. However, RDM below the recommended minimum level in two or more consecutive years should be avoided by destocking or supplemental feeding. RDM monitoring is discussed in more detail in section 6.2.

4.2.2 **Soil Survey Forage Production Estimate**. The *Sonoma County Soil Survey* (USDA 1972) provides estimates of forage production for range sites and/or soil map units for years of "favorable" and "unfavorable" moisture. Although these estimates are very general, and do not reflect site specific conditions such as past land uses and forage species composition, range site estimates provide rough guidelines for comparison with other methods.

[5] RDM levels of 500 pounds per acre for the serpentine area were used in stocking rate calculations, but slightly lower levels may be acceptable or even desirable.

Table 4 provides range site estimates for "unfavorable" and "favorable" moisture years for total AUMs, where one AUM is equal to 1,000 pounds of forage.

Subtracting 1,000 pounds per acre of RDM, results in an "unfavorable" year total of 1,169 available AUMs and a "favorable" year total of 3,948 available AUMs. Divided by 12 months, these values can be converted into stocking rates in AUs per year for a year-round grazing operation. The "unfavorable" year stocking rate would be 97 AUs/year, and the "favorable" year stocking rate would be 329 AUs/year. These values represent extremes in predicted forage production, so using the average should reflect what can be expected in most years.

Table 5. Tolay Creek Ranch soil survey range site forage estimates

	Soil Unit	Acres	AUMs/acre "Unfavorabe" Year	AUMs/acre "Favorable" Year	Total AUMs "Unfavorable" Year	Total AUMs "Favorable" Year
CcA	Clear Lake clay loam 0-20% slopes	176	2.0[6]	4.0	352	704
DbC	Diablo clay 2-9% slopes	58	2.0[7]	4.0	116	232
DbD	Diablo clay 9-15% slopes	240	1.8	3.6	432	864
DbE	Diablo clay 15-30% slopes	145	1.8	3.6	261	522
DbE2	Diablo clay 15-30% slopes, eroded	756	1.8	3.6	1,361	2,722
GoF	Goulding – Toomes complex, 9–50% slopes	101	1.6	3.2	162	324
GuF	Gullied land	31	NA	NA	0	0
MoE	Montara cobbly clay loam 2–30% slopes	158	.5	1.2	79	190
	Total	**1,657**			**2,747**	**5,526**
Less RDM of 1,000 lbs./acre (1.0 AUMs) for Clear Lake, Diablo and Goulding Soils and 500 lbs./acre (.5 AUMs) for Montara soils					-1,578	-1,578
Total available forage in AUMs (Total AUMs – RDM)					**1,169**	**3,948**
Average available forage for unfavorable and favorable years in AUMs					**2,558**	
Stocking rate in AUs for a year-round (12 month) operation (Total available forage in AUMs/12 months)					**97**	**329**
Average stocking rate for unfavorable and favorable years in AUs for a year-round (12 month) operation					**213**	

[6] The Sonoma County Soil Survey does not provide range site production estimates for Clear Lake clay loam 0-20% slopes; instead, the forage production estimate for dryland pasture production under a high level of management (Table 2, Soil Survey, Sonoma County) was used to represent production in a favorable year, with the assumption that production in an unfavorable year would be reduced by 50%

[7] The Sonoma County Soil Survey does not provide range site production estimates for Diablo clay 2-9% slopes; instead, the forage production estimate for dryland pasture production under a high level of management (Table 2, Soil Survey, Sonoma County) was used to represent production in a favorable year, with the assumption that production in an unfavorable year would be reduced by 50%

4.2.3 **Scorecard Grazing Capacity Estimate**. University of California researchers developed a simple "scorecard" that can be used to estimate grazing capacity on annual-dominated rangelands based on desired RDM levels and general site characteristics. This method provides rough estimates based on rainfall, canopy cover, and slope (McDougald et al. 1991). The scorecard method of estimating grazing capacity accounts for animal behavior by recognizing that grazing use decreases on steeper slopes.

Table 6. Scorecard for Central Coast and Central Valley Foothills Zone (10 inch to 40 inch precipitation), with RDM adjusted upwards to 1,000 pounds per acre

	Slope Classes			
Canopy Cover (percent)	<10%	10%-25 %	25% - 40%	>40%
	AUM/acre			
0% to 25%	1.4	.4	.3	.1
25% to 50%	.9	.2	.2	0
50% to 75%	.4	0	.1	0
75% to 100%	0	0	0	0
	RDM lb/acre			
	1,000	1,000	1,000	1,000

(Adapted from McDougald et al. 1991)

A digital elevation model generated by Gold Ridge Resource Conservation District, shows that 1,567 acres of the Property is on slopes of zero to 10 percent, and 90 acres is on slopes of 10 to 25 percent. According to this scorecard, the lower gradient slopes should provide 1.4 AUMs/acre of available forage, while slopes in the steeper slope class should provide .4 AUMs/acre of available forage, resulting in a total of 2,320 AUMs of available forage, or a stocking rate of 193 AUs on a year-round basis.[8]

4.2.4 **Current and Historic Stocking Rates**. Glenn Mohring, the current grazing tenant, has run cattle at the Property for over 30 years. Currently, Glenn has 180 stockers on the approximately 464-acre Mack Field. He brought them on-site in mid-December when they weighed about 500 pounds each, and they will be sold in mid-June when they weigh about 860 pounds each.

Glenn says that he is pretty conservative with his stocking rate, as he doesn't want to have to feed a lot of hay. In some years, if there is excess feed on the Mack Field after the stockers come off, he may graze this field with some of his cow/calf pairs (Glenn Mohring personal communication 2010).

In addition to the stockers, there are 120 cow-calf pairs plus six bulls on the remaining 1,201 acres. This year's total forage demand for both the stockers (see Table 7) and the cow-calf pairs is in 2,270 AUMs. This is equivalent to a stocking rate of 189 AUs/year.[9]

[8] 2,320 AUMs ÷ 12 months = 193 AUs; this scorecard slightly overestimates AUMs, because the 158 acres of Montara soils will have RDM of roughly 500 pounds per acre

[9] 734 AUMs for the stockers (see Table 7), + 120 Cow-calf pairs x 1 AUM/pair/month + 6 bulls x 1.35 AUM/bull/month x 12 months = 2,270 AUMs/year ÷ 12 months = 189

Glenn has typically run 220 to 250 cow-calf pairs on the Property plus the 330 acres leased from the Roche family, in past years when he did not buy stockers. This works out to almost eight acres per pair, or an average of 196 pairs for the Property.

Table 7. Current stocking rate for 464-acre Mack Field with 180 500-pound stockers at an average of two pounds gain per day

Month	Stocker Weight in Pounds	Forage Demand for 180 Animals in AUMs
December (.5 months)	500	45
January	560	101
February	620	112
March	680	122
April	740	133
May	800	144
June (.5 months)	860	77
Total	**NA**	**734**
Average per month	**680 (.68 AUs)**	**122**

4.2.5 **Summary and Recommended Stocking Rate**. Due to the interannual fluctuations in forage production, and the fact that recommended RDM levels are not absolute, stocking rates should be somewhat flexible. The seven to eight AUs that will be displaced due to the riparian fencing will slightly lower the historic stocking rate, as the fenced area will be grazed only occasionally and grazing may be by a small separate herd of sheep or goats.

An average of the favorable year and unfavorable year Soil Survey forage production estimates, the scorecard estimate, and current and the historic stocking rates, all indicate that a stocking rate ranging from 190 to 200 pairs, is appropriate for the Property. Although the Soil Survey favorable and unfavorable year estimates vary by over 300 percent, the unfavorable year value could occur in an extreme drought year, while the favorable year value probably reflects an extremely productive year similar to 2010. Stocking rates for other classes of livestock can be calculated using Table 4.

Table 8. Comparison of results from grazing capacity estimation methods

Method of forage production estimation	Available forage in AUMs/acre	Stocking Rate in AUs for 12 Months
Soil Survey	2,558[10]	213[11]
Scorecard	2,320	193
Current stocking rate	2,270	189
Historic stocking rate	2,820	196
Recommended range of stocking rates		**190 -200**

4.2.6 **Stocking Rate Adjustments**. In severe drought years or in years of above-average forage production, stocking rates may need to be adjusted downward or upward during the grazing season to achieve management objectives. This process can be tricky, as it requires the livestock operator to be flexible and to respond quickly to unpredictable weather conditions that affect forage production. A livestock producer who must decrease

[10] Average of for unfavorable and favorable years
[11] Ibid

stocking rates in response to a spring drought may suffer financially. In a good forage year, adding animals may be difficult unless the operator has a large herd with the ability to move animals from other sites.

The stocking rate should be adjusted downward in poor feed years by weaning calves early, or culling more heavily than usual. In good forage years, culling animals lightly or retaining more replacement animals can be used to increase stocking rates. A process for adjusting stocking rates should be identified in the grazing contract.

Stocking Rate Recommendations:

- Maintain a stocking rate of 190 to 200
- In years of extreme drought, cattle should be culled more heavily than usual to decrease stocking by 10 to 15 percent
- In years of unusually high forage production, lighter culling or retaining more replacement heifers should be used to manage excess forage
- Maintain a minimum of 1,000 pounds per acre of RDM on Clear Lake, Diablo and Goulding Soils and 500 pounds per acre of RDM on Montara (serpentine) soils

4.3 Grazing Season and Timing

Except as described in section 4.6, the year-round grazing regime that has been practiced at the Property for many decades should continue. This low input, land extensive management system has preserved significant native forb populations, including the federally threatened Marin western flax and significant native grass stands, as well as diverse wildlife species including borrowing owls, ground nesting birds, and the federally threatened California red-legged frog (*Rana aurora draytonii*).

Although Tolay Creek and its tributaries have been degraded by long-term, year-round grazing impacts, the proposed riparian fencing and restoration program will improve riparian conditions.

Additional reasons for continuing land extensive, year-round grazing are:

- Year-round grazing is required to sustain cow-calf beef operations, which are the basis for California's beef industry; mother cows must have pasture throughout the year.
- Cattle that are spread out on the landscape at moderate stocking levels create grasslands with diverse structure, which provides suitable habitat for grassland birds and other wildlife species.
- More intensive grazing pressure, other than on a very small scale, may not be supported by some of the springs. For example, the water trough in the Russell Field has run dry in some drought years, and cattle have had to be removed from this field (Glenn Mohring, personal communication).

Grazing Season and Timing Recommendations:

- Continue the year-round grazing system that is currently in place throughout the Property
- Use carefully, short-term, targeted grazing for weed management as described in section 4.6
- Use occasional short-term grazing to manage fire fuels and weeds within the riparian fencing as described in section 4.5

4.4 Livestock Distribution

Livestock should be distributed throughout a site to avoid areas of overuse or underuse that can lead to rangeland degradation, but completely uniform grazing is undesirable as it decreases the variability in grassland structure. Replacement of the cross fence on the west ridge (CF2, as shown in Figure 1), and cross fencing that bounds the Mack Field, creates three fields that provide the framework for animal distribution on the Property. Within each field, water is the main attractant and livestock tend to use areas near water sources more heavily than distal locations. Shade and patches of particularly palatable forage are also livestock attractants that help distribute animals across the landscape.

Five water troughs in the Rose Field and three troughs in the Mack Field aid animal distribution in these fields, but with only one trough in the Russell Field, it has been underutilized in some years. Glenn Mohring has had to take animals out of the Russell Field late in the year in dry years when the one water trough could not provide enough water for cattle (Glenn Mohring personal communication 2010). Development of a second water trough on the north side of CF2 (PT5a), will improve animal distribution in this field (see Figure 1).

Other attractants such as salt licks or other nutritional supplements can also be used to improve livestock distribution. They should be placed in underutilized areas, as far from water as possible.

Livestock Distribution Recommendations:

- Install water trough PT5a in the Russell Field as shown in Figure 1
- Place salt licks and/or other mineral supplements in under utilized areas as needed

4.5 Riparian Grazing

The *Tolay Creek Riparian Enhancement Plan* (West Coast Watershed 2009) recommends extensive riparian revegetation for habitat enhancement and stabilization of Tolay Creek and its tributaries. This work will require livestock to be excluded from enhancement areas for the short-term, and possibly indefinitely from some areas; the plan suggests that fencing should be in place for a minimum of 10 years to allow riparian vegetation establishment and minimize bank erosion caused by cattle access to riparian areas. Barbed wire fencing will be installed to create an approximately 150 foot wide fenced corridor, which will result in exclusion of approximately 60 acres from the Property and the adjacent Roche Property. The riparian enhancement plan further recommends limited duration, seasonal livestock access during the dry season.

Since habitat enhancement is one of the main purposes of the fence construction, maximizing habitat values within the corridor should take precedence over utilizing the area for livestock forage. Livestock may be useful for limited and occasional grazing within the corridor, but maintaining a diverse habitat structure including a dense shrubby understory, a mid-level tree story, then an emergent, tall tree canopy layer should be the main objective of the riparian enhancement program.

The woody understory is important for birds that nest at or just above the ground level including Wilson's warbler, Swainson's thrush and/or spotted towhee and quail (Clinton Kellner personal communication 2010).

Since livestock grazing and browsing mostly affects vegetation within this lower zone, grazing should only occur when and if woody plants become well established, or if livestock can be excluded from woody riparian vegetation within the riparian corridors with electric or other portable fencing. Because Tolay Creek is sinuous in its lower reaches, and constructing corners in livestock fencing is expensive, straight reaches of riparian fencing will fence out some relatively large patches of grassland. These areas could be grazed if woody plants can be protected from browsing with temporary fencing, provided that water is also provided in portable troughs. Grazing should occur in these areas if undesirable weed species proliferate.

Fuel loading within the approximately 60-acre riparian corridor should not pose a significant danger to nearby homes or other properties, as grasslands surrounding the corridor will be grazed. Although the corridor will extend all the way down to Highway 121, the most likely ignition source for a wildland fire, fires in this area tend to burn toward the mouth of Tolay Creek due to north winds (Glenn Mohring personal communication 2010).

If and when riparian grazing is deemed necessary for weed management, it should take place for short periods after birds have fledged and in the dry season to prevent stream bank erosion, ideally from August through October (Marin County Resource Conservation District et al. 2001). During these months, while woody riparian vegetation is green and herbaceous vegetation is mostly dry, woody riparian vegetation will be particularly susceptible to livestock browsing. Very mature plants should be able to withstand some browsing pressure, but when riparian vegetation is young, grazing periods should be short and/or woody plants should be protected with portable fencing.

Riparian Grazing Recommendations:

- Annually evaluate the need for grazing within excluded riparian area, although leaving the riparian area ungrazed may be the best long-term option for riparian habitat protection
- Within the first five years after fencing, graze excluded grassland patches if weeds become prolific, using the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant, utilizing portable infrastructure

- In five to 10 years, determine if woody plants are well enough established to withstand some browsing by livestock and evaluate the possibility of allowing occasional cattle grazing within riparian exclusion area
- If riparian grazing is warranted, graze between August through October, when streambanks are dry and birds have fledged

4.6 Optional Grazing-based Weed Management Program

Targeted grazing has been used with some success to help manage populations of select weed species. Grazing trials led by Dr. Emilio Laca of the University of California at Davis have successfully reduced cover and seed output of medusahead in experimental settings. Similarly, yellow star-thistle management through grazing has shown some success in California (Thomsen et al. 1996).

The most critical aspects of targeted grazing for weed management are timing, stocking density, repetition of treatment, use of appropriate infrastructure, and use of appropriate livestock species. These factors should be applied to targeted grazing of any weed species at the Property.

When high-intensity grazing is used for weed management, treatment locations should be carefully selected as severe grazing episodes could detrimentally affect sensitive resources. Livestock numbers, location and size of treatment areas, and exact timing should be arranged annually with the livestock operator based on site conditions.

Timing. Target weed species must be grazed when they are palatable to the grazing or browsing livestock species, otherwise the grazing treatment will not be effective. Weeds should also be grazed when they are most susceptible to damage by defoliation and when flowering and/or seed set can be intercepted.

Stocking Density. Stocking density should be heavy enough to reduce target plant species to one to two inches in height. Stocking densities of about 2.5 to 6 AUs per acre are typically used.

Repetition of Treatment. Most weed species require repeated defoliation to either weaken plants or to intercept flowering and seed set. Plants will resprout after being grazed, but repeated, and/or heavy grazing may be effective at preventing or reducing flower heads.

Appropriate Infrastructure. Typically, weed species have lower palatability than other pasture plants, so livestock must be forced to graze or browse them. This is accomplished by confining livestock in the weed-infested area so they are forced to consume the target species. This is best accomplished with small enclosures made of electric fencing that is charged by a solar charger. Portable water troughs must also be provided.

Appropriate Livestock Species. As discussed in section 4.1, generally, goats and/or sheep more readily consume forbs and browse than do cattle. This means that these species are naturally more inclined to eat thistles, blackberries, black mustard, and other weeds that

occur on the Property. However, cattle will graze yellow star-thistle in the rosette to bolting stage (Launchbaugh and Walker 2006).

4.6.1 **Targeted Grazing of Yellow Star-thistle**. Following is a prescription for yellow star-thistle management. Timing of grazing is the most important factor in reducing this species through grazing, as it becomes less palatable once spines develop.

The following information was derived from Thomsen et al. (1996), Davison et al. (2007), and Doran (2009):

- Three to five years is likely needed to reduce populations and deplete the seed bank.
- Grazing does not eradicate yellow star-thistle, and long term management requires continued use of livestock or other weed-control practices appropriate for the site; by grazing after the earlier-maturing annuals have completed their life cycle and produced seed, plant diversity can be maintained.
- Grazing can be effective if implemented often enough to prevent flowering for several years to reduce populations. Grazing levels must be carefully controlled to avoid damage to desirable species.
- Like mowing, grazing can either decrease or increase yellow star-thistle, depending on the frequency of defoliation and stage of plant growth.

Timing. Yellow star-thistle should be grazed before spines and flowers start developing, but after the plants have bolted. At the bolting stage, yellow star-thistle can have about 14 percent protein and will be highly palatable to livestock. A complicating factor can be high soil moisture conditions resulting from heavy or late spring rains. If there is sufficient soil moisture, the plant will simply re-grow after defoliation. Adjustments to the density and duration of grazing episodes may be necessary as conditions change.

Stocking Density. Stocking density should be in the order of 6 AUs per acre for 10 to 14 days.

Repetition of Treatment. Grazing treatment should be repeated as needed if high soil moisture results in regrowth of yellow star-thistle. After initial grazing, depending on the rate of regrowth, one to three follow-up grazings at two-week intervals are required to adequately suppress yellow star-thistle growth.

Appropriate Livestock Species. By most accounts, sheep and goats consume yellow-star-thistle more readily than cattle do and are the species of choice for yellow star-thistle management. Horses should not graze yellow star-thistle as prolonged ingestion can lead to the fatal nervous disorder equine nigropallidal incephalomalacia, or "chewing disease" (Thomsen et al. 1996).

4.6.2 **Targeted Grazing of Medusahead**. Research conducted by the University of California at Davis (UCD) under the direction of Dr. Emilio Laca, Associate Professor of Plant Sciences, has shown short duration, high-intensity grazing by sheep to be effective

in greatly reducing medusahead. Precision grazing for medusahead management requires careful planning and timing because medusahead phenology is not always consistent; some plants may be at stage for grazing while some may not.

UCD experiments have shown that:

- High utilization levels (i.e. severe grazing) were more successful in reducing medusahead with less post-grazing regrowth than were lower utilization plots; best results occurred when plots were grazed to a height of one to two inches.
- Stocking densities of 2.6 to 2.8 AUs, which is equivalent to 13 to 14 mature sheep, per acre for 14 to 17 days were most effective; higher stocking densities, of about 5 AUs per acre for a shorter period were also effective.
- Late vegetative stage is the best time for defoliation; this phenological stage is reached before awns from the flowerhead appear above the flag leaf, when bumps can be felt within the leaf sheath, and growing points are elevated; if grazing occurs too early (before elongation of the internodes and elevation of growing points), plants will keep growing and flower heads will develop.
- Follow-up seeding with species that have quickly-developing, deep roots like medusahead provides competition with future years' medusahead seedlings.

Medusahead plant at the proper stage for grazing

The following information, which provides a framework for implementing a medusahead management program, is based on personal communications with Morgan Doran (2004 and 2008) and Sheila Barry (2008) and attendance at a medusahead field day at UCD in July 2007.

Pre-planning. Treatment areas should be identified a year in advance of grazing as medusahead plants are difficult to identify in their vegetative state. A global positioning system (GPS) should be used to define infested areas. In addition, treatment areas should be evaluated to ensure that they don't contain other resources that would be damaged by the intensive grazing treatment.

Timing. Timing of medusahead grazing is critical because the window of opportunity for late-spring grazing is very small. Careful monitoring and the ability to move an adequate number of livestock into the fenced treatment areas in a timely fashion are essential. If grazing occurs too early, the plants will re-sprout and if it occurs too late, the livestock will not graze the flower heads. The timing of this optimal phenological stage will vary depending on weather conditions but should usually occur in late April.

Stocking Density. Grazing intensity for late-spring grazing should be heavy, which may result in a higher proportion of bare ground than would normally be considered acceptable. Stocking density for late-spring grazing should be on the order of 2.5 to 5 AUs per acre,[12] or as needed to graze herbage down to a height of one to two inches. Because grazing will be somewhat patchy, areas of bare ground will be interspersed with one- to two-inch-tall biomass.

Repetition of Treatment. Grazing treatment should be repeated as needed.

Appropriate Livestock Species. Sheep have been used in most of the UCD trials, primarily because they were present on the main research site; cattle may be just as effective.

Optional Grazing Based Weed Management Recommendations:

- Prioritize weed species for grazing treatment and focus resources on highest priority species
- For annual species, identify treatment areas the year prior to treatment, preferably with a GPS
- Utilize portable fencing and water to confine livestock in treatment areas
- Utilize high-intensity grazing, with stocking densities of 2.5 to 6 AUs per acre
- Utilize the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant.

[12] Mr. Doran's research plots have been grazed at a rate of about 162 AUdays/acre, which equals 5.4 AUs/acre; these values were converted from 10 sheep/10m^2 plot for two days

4.7 Protection of Cultural Resources

The Property supports numerous important cultural resource sites that should be protected from damage by grazing related activities. Cultural resource records should be consulted before installation of any grazing infrastructure, implementation of high-intensity targeted grazing, or any other activities that could desecrate or damage cultural resources. In addition, an archaeologist should review the Cultural Resources Study for the Property prepared by LSA Associates and categorize archaeological sites according to their sensitivity to grazing. Highly sensitive sites should be protected from potential livestock damage by exclusion of grazing or avoidance of grazing when soils are wet and most susceptible to compaction. The Federated Indians of Graton Rancheria should be consulted as appropriate.

Cultural Resource Protection Recommendations:

- Consult an archaeologist to determine which archaeological sites are most sensitivity to livestock damage.
- Protect highly sensitive sites from potential livestock damage by exclusion of grazing or avoidance of grazing when soils are wet and most susceptible to compaction.
- Consult an archaeologist and/or cultural resource records as appropriate before any infrastructure improvements, high-intensity grazing, or other high impact activities are implemented
- Consult the Federated Indians of Graton Rancheria as appropriate

5.0 Infrastructure Recommendations

Existing infrastructure includes fencing, a water system, and a ruderal system of unsurfaced ranch roads, but is incomplete, as there is no on-site corral for working and loading cattle. Fence replacement, construction of a corral, addition of a water trough and redevelopment of some of the springs are all needed. Additionally, some of the dirt roads are gullying and are in need of water diversions or re-routing.

5.1 Fencing Recommendations

Boundary fences, are required by California law to "…prevent the ingress and egress of livestock…" and to "…have a minimum of three tightly stretched barbed wires securely fastened to posts of reasonable strength, firmly set in the ground not more than one rod apart, one of which wires shall be at least four feet above the surface of the ground."[13] Four to five strands of wire make stronger, longer lasting fences because of the tensile strength added by additional wires and because the closer spacing between wires discourages cattle from pushing their heads through the wires and loosening them.

The concept of "wildlife friendly fencing", which often has a bottom smooth wire that may be higher off the ground to allow animal movement underneath, has become popular in recent years. This type of fencing is fine for interior fencing, but should not be used on boundaries, as young calves may also be able to move under the high, smooth bottom wires.

5.1.1 **Boundary and Cross Fencing Recommendations**. Existing cross fences are in poor condition and should be realigned and replaced. Cross fence CF1, that runs northwest/southeast in the southern part of the Property should be removed. The proposed riparian fencing will function as a boundary fence on the eastern side of the Property, and CF1 will no longer serve a purpose.

Cross fence CF2, which bisects the West ridge from the eastern boundary to Tolay Creek should be replaced, with the northern portion realigned as shown in Figure 1. This realignment will allow installation of an additional trough adjacent to but north of trough T5 in the Russell Field, which will allow for improved livestock distribution and serve as a backup water source should trough T6 malfunction.

Cross fence CF3, which runs along the base of the Mack Field, just south of Mangel Ranch Road, should be replaced with new fencing to function as part of the riparian exclusion fencing.

Boundary fencing is in fair to poor condition, and should all be replaced within the next five to 10 years. Table 9 shows the various reaches that border adjacent properties, and their priority for replacement.

[13] California Code Section 17121

Fencing at lower boundary between Mack Field and Tolay Lake Regional Park

Fencing at boundary between Mack Field and Lilly property

Table 9. Boundary fencing replacement priorities

Boundary Reach	Section Location	Length in feet	Replacement Priority
BF1	Adjacent to Infineon Raceway properties, at southern boundary	8,050	1
BF2	Adjacent to Fredericks property, at southwestern boundary	3,150	5
BF3	Adjacent to Gambonini property, at western boundary	5,400	2
BF4	Adjacent to Tolay Lake Regional Park, at northern boundary	10,420	3
BF5	Adjacent to Lilly Property, at northern boundary	6,350	4
BF6	Adjacent to Highway 121	2,700	6
	Total	**36,070**	

5.1.2 **Riparian Fencing Recommendations**. Riparian exclusion fencing should be installed as generally shown in Figure 1. Three pairs of gates should be installed in the riparian fencing to allow cattle to cross between the Rose Field and the Roche Property (two locations), and between the Russell Field and the Mack Field. These crossings can be constructed by installing pairs of 4- to 6-foot wide in-line gates on opposite sides of Tolay Creek in the two locations where only livestock will cross and a pair of 12- to 14-foot gates at the vehicle crossing. The paired gates can both be opened at the same time to allow occasional herding of cattle across the creek and to allow vehicles to cross where the ranch road crosses the creek.

5.1.3 **Seep Fencing Recommendations**. LSA Associates (2009) recommended fencing selected wet seeps to see if protection from grazing will improve wildlife cover in these important wildlife watering locations. One or two seeps could be fenced out entirely, or several seeps could be partially fenced to evaluate changes in wildlife cover in grazed and ungrazed seep areas. If results are positive, remaining seeps can be fenced.

5.1.4 **Livestock Corral Recommendations**. In order to function as an independent ranch unit, a corral for working and loading animals should be constructed in an area that is easily accessible to vehicles year-round from Highway 121. The corral should be of adequate size to handle 200 cow-calf pairs.

Fencing Recommendations:

- Construct boundary fencing of 4- to 5-strand barbed wire, with a top wire at 48 inches
- Construct "wildlife friendly" interior fencing with a smooth bottom wire
- Continue to maintain, and within five to 10 years, replace boundary fencing as prioritized in Table 9
- Construct riparian exclusion fencing that will also serve as a partial boundary fence between the Property and the Roche Property, leaving three gated crossings for livestock and/or vehicles movement
- Install two pairs of 4- to 6-foot wide in-line gates on opposite sides of Tolay Creek in the two locations where only livestock will cross and a pair of 12- to 14-foot gates at the vehicle crossing

- Replace cross fence CF2, moving the northern end to the east as shown in Figure 1
- Replace Cross fence CF3 with riparian exclusion fencing
- Remove cross fence CF1
- Install fencing around seeps and evaluate changes in wildlife cover; expand to other seeps if results are positive
- Construct a corral sufficient in size to handle at least 200 pairs, to the south of the main driveway from Highway 121 as shown in Figure 1

5.2 Livestock Watering System Recommendations

A sufficient, properly functioning and reliable water system is of utmost importance. The springs that serve the nine livestock water troughs are variable in terms of production, and flow rates are unknown. Most of them provide sufficient water for the livestock and to provide at least some of the water for the abundant wildlife on the Property.

Livestock water needs vary seasonally, with low amounts of drinking water required during winter and spring when green forage has a high water content, and higher amounts needed during summer. Generally, beef cattle on pasture need 15 to 20 gallons per day during dry periods. For a 200 head herd, the summer water demand would be 3,000 to 4,000 gallons per day. Springs should have sufficient flow to refill troughs quickly.

Because many wildlife species rely on livestock troughs for at least part of their water needs, troughs should be designed to accommodate their access and to prevent drowning of small animals by inclusion of wildlife escape structures in troughs.

Trough T7 is located just above a large seep, which is heavily impacted by cattle grazing and trampling. This trough should be moved as faraway as possible from the seep, with overflow piped back into the seep. This may allow the wetland vegetation, including Pacific rush, to recover enough to provide cover for birds, mammals, and reptiles that frequent seeps for drinking water (LSA Associates 2009).

Trough 7 should be moved away from seep

Table 10. Recommended livestock water system improvements

Water Trough	Comments
Rose Field	
T1	New trough, no improvements needed
T2	New trough, no improvements needed
T3	New trough, no improvements needed
T4	Round metal trough, no improvements needed
T5	New trough, no improvements needed
Russell Field	
PT5a	Proposed second trough in Russell Field would be fed by the same pipe that fills T5
T6	Rubbermaid trough, fed by very good spring, runs year-round except in drought years, spring needs to be redeveloped
Mack Field	
T7	Old metal trough, spring fed, runs year-round, should be moved as far away as possible from the adjacent seep, with overflow piped back into the seep
T8	Round concrete trough, spring fed, runs year-round, no improvements needed
T9	Rectangular metal trough, spring fed, runs year-round, no improvements needed

Water System Recommendations:

- Securely install wildlife escape ramps in all water troughs
- Redevelop the spring that feeds T6 and any other springs that decline in water production
- Install a new rectangular concrete trough in location PT5a as shown in Figure 1
- If the pond that feeds T4 is drained in late summer for bullfrog control, run a temporary pipe from the spring in the pond bottom to the storage tank to keep troughs T4 and T5 functioning; it is unknown how this will affect troughs T1 through T3

6.0 Adaptive Management

Adaptive management is the process whereby management is initiated, evaluated, and refined (Holling 1978). The formal adaptive management process, as shown in Figure 2, consists of a six-step cycle that is a useful framework for vegetation management. Monitoring plays an important role in the adaptive management process by providing

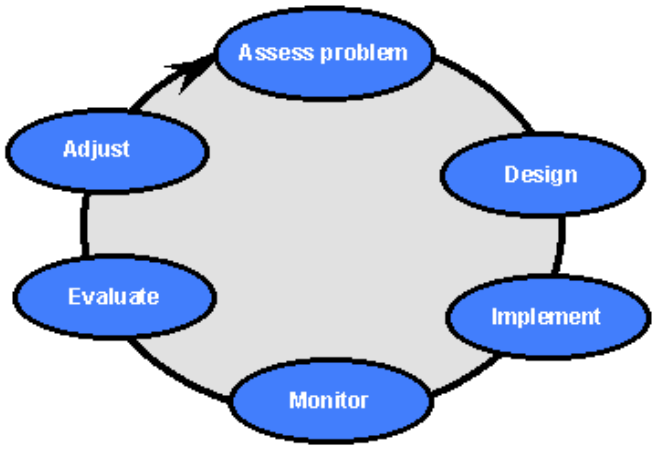

Figure 2. Adaptive Management Cycle

Figure 2 illustrates the six steps of adaptive management that should be applied to grazing management at the Property.

1. **Assess Problem**. This is an ongoing process that was begun by evaluation of management issues in the *Biological Resource Study, Tolay Creek Ranch* (LSA Associates 2009), the *Tolay Creek Riparian Enhancement Plan* (West Coast Watershed 2009), and in this grazing plan.

2. **Design**. This step represents the planning that has been accomplished by SLT staff, and as recommended in the *Tolay Creek Riparian Enhancement Plan* (West Coast Watershed 2009) and in this grazing plan.

3. **Implement**. Implementation of recommendations in the *Tolay Creek Riparian Enhancement Plan* (West Coast Watershed 2009) and in this grazing plan will begin this phase.

4. **Monitor**. On-going monitoring should be conducted to help determine if management actions are effectively achieving overall management goals and objectives and purposes of individual management actions. Compliance monitoring should also be performed to ensure that the grazing lessee is in compliance with lease requirements.

5. **Evaluate**. SLT, and in the future Sonoma County Regional Parks, should use information gathered through monitoring to determine if management recommendations are effectively meeting goals and objectives.

6. **Adjust**. Information gained in steps 4 and 5 should be used to evaluate and update, as necessary, this grazing plan and management recommendations included in other plans to improve management methods and results.

***Adaptive Management Recommendation*:**

- Follow the six steps of adaptive management as shown in Figure 2 and described above

7.0 Monitoring

Various types and techniques of monitoring are appropriate for helping to evaluate the effectiveness of management practices at the Property. In addition, the grazing tenants obligations as described in the grazing agreement should be monitored for compliance with the agreement.

General Monitoring. Various property conditions, not all of which are related to grazing, should be monitored on a regular basis. Erosion sites should be watched, with changes documented, and weed infestations should be monitored. Monitoring can be accomplished by recording observations, with photographs, and, in the case of new or spreading weed infestations, with a GPS.

Effectiveness Monitoring. Monitoring and evaluation of the riparian enhancement goal and objectives can be done fairly easily by comparing aerial photographs over time. Increased woody riparian cover will be evident in aerial photos, and ground truthing will confirm that woody plants are native.

To effectively evaluate Goal 2 and its related objectives, which focus on promoting native plant species and discouraging non-native species, long-term plant species composition monitoring would need to be conducted. Because SLT and Sonoma County Regional Parks do not have the institutional capability to conduct such monitoring, having local educational institutions and/or the Milo Baker Chapter of the California Native Plant Society develop an appropriate monitoring program should be explored.

Compliance Monitoring. Compliance monitoring should focus on provisions included in the grazing agreement, such as the grazing tenant's obligation to maintain fences, maintenance of the recommended stocking rate, and achieving target minimum RDM levels. Several methods that vary in accuracy and required time and effort can be used to estimate RDM, but simple and quick estimation should generally be used unless RDM estimates are disputed by the grazing tenant, in which case more intensive sampling should be conducted.

RDM monitoring methods can include direct measurement and visual estimation. The dry-weight-rank method combines direct measurement and visual estimation. With direct measurement, small plots are clipped and RDM is weighed to determine pounds per acre, while visual estimation methods focus on estimating RDM weight based on stubble height and appearance of the landscape. Some clipping and weighing should be done with visual estimation to check and calibrate the monitor's visual estimations. The following methodology is recommended for RDM monitoring at the Property.

- ***Timing***. Conduct RDM monitoring in early to mid-October before the rainy season begins.
- ***Visual Estimation***. After clipping and weighing as many quadrats as needed to calibrate the monitor's eye, he or she should estimate the RDM throughout the

Property, continuing to clip and weigh the occasional quadrat as needed to maintain fairly accurate estimates.

- ***Clipping Plots***. RDM should be clipped within one-square-foot quadrats, placed in small paper bags, and weighed with a hand held gram scale. Weight in grams can be converted to pounds per acre by multiplying grams per square foot by 96.
- ***Photographic Documentation***. Photographs of target RDM levels (minimum 1,000 pounds per acre),[14] patches of RDM below 1,000 pounds per acre, and significantly higher weights should be taken to help future monitors visualize RDM levels.

More information on RDM monitoring can be found in the *RDM Monitoring Photo-Guide* available from Wildland Solutions http://www.wildlandsolutions.com[15] and *California Guidelines for Residual Dry Matter (RDM) Management on Coastal and Foothill Annual Ranges* (Bartolome et al. 2002) ucanr.org/freepubs/docs/8092.pd.

Monitoring Recommendations:

- Explore relationships with local educational institutions and/or the Milo Baker Chapter of the California Native Plant Society for developing a monitoring program to evaluate native plant species populations
- Monitor the presence, distribution and population size of weeds within the riparian fencing and in uplands; adjust grazing and weed management activities accordingly.
- Perform RDM monitoring in the fall to ensure that minimum RDM standards are being met
- Require grazer to record how many animals are in each pasture each month.
- Meet at least annually with grazing tenant to review RDM monitoring, and other grazing lease provisions

[14] RDM levels may be significantly lower in the serpentine area, which is acceptable, due to lower biomass production,

[15] One drawback to this guide is that most of the photographs depict RDM levels that are inappropriately low for most of Sonoma County

8.0 Summary of Recommendations

Livestock Species Recommendations:

- Continue the cattle grazing as described in this plan
- Utilize the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant or a third party, for riparian area grazing as described in section 4.5 and weed management as described in section 4.6

Stocking Rate Recommendations:

- Maintain a stocking rate of 190 to 200
- In years of extreme drought, cattle should be culled more heavily than usual to decrease stocking by 10 to 15 percent
- In years of unusually high forage production, lighter culling or retaining more replacement heifers should be used to manage excess forage
- Maintain a minimum of 1,000 pounds per acre of RDM on Clear Lake, Diablo and Goulding Soils and 500 pounds per acre of RDM on Montara (serpentine) soils

Grazing Season and Timing Recommendations:

- Continue the year-round grazing system that is currently in place throughout the Property
- Use carefully, short-term, targeted grazing for weed management as described in section 4.6
- Use occasional short-term grazing to manage fire fuels and weeds within the riparian fencing as described in section 4.5

Livestock Distribution Recommendations:

- Install water trough PT5a in the Russell Field as shown in Figure 1
- Place salt licks and/or other mineral supplements in under utilized areas as needed

Riparian Grazing Recommendations:

- Annually evaluate the need for grazing within excluded riparian area, although leaving the riparian area ungrazed may be the best long-term option for riparian habitat protection
- Within the first five years after fencing, graze excluded grassland patches if weeds become prolific, using the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant, utilizing portable infrastructure
- In five to 10 years, determine if woody plants are well enough established to withstand some browsing by livestock and evaluate the possibility of allowing occasional cattle grazing within riparian exclusion area
- If riparian grazing is warranted, graze between August through October, when streambanks are dry and birds have fledged

Optional Grazing Based Weed Management Recommendations:

- Prioritize weed species for grazing treatment and focus resources on highest priority species
- For annual species, identify treatment areas the year prior to treatment, preferably with a GPS
- Utilize portable fencing and water to confine livestock in treatment areas
- Utilize high-intensity grazing, with stocking densities of 2.5 to 6 AUs per acre
- Utilize the small goat herd managed by Sonoma County Regional Parks at Tolay Lake Regional Park, or a small herd of sheep or goats provided by the grazing tenant

Cultural Resource Protection Recommendations:

- Consult an archaeologist to determine which archaeological sites are most sensitivity to livestock damage.
- Protect highly sensitive sites from potential livestock damage by exclusion of grazing or avoidance of grazing when soils are wet and most susceptible to compaction.
- Consult an archaeologist and/or cultural resource records as appropriate before any infrastructure improvements, high-intensity grazing, or other high impact activities are implemented
- Consult the Federated Indians of Graton Rancheria as appropriate

Fencing Recommendations:

- Construct boundary fencing of 4- to 5-strand barbed wire, with a top wire at 48 inches
- Construct "wildlife friendly" interior fencing with a smooth bottom wire
- Continue to maintain, and within five to 10 years, replace boundary fencing as prioritized in Table 9
- Construct riparian exclusion fencing that will also serve as a partial boundary fence between the Property and the Roche Property, leaving three gated crossings for livestock and/or vehicles movement
- Install two pairs of 4- to 6-foot wide in-line gates on opposite sides of Tolay Creek in the two locations where only livestock will cross and a pair of 12- to 14-foot gates at the vehicle crossing
- Replace cross fence CF2, moving the northern end to the east as shown in Figure 1
- Replace Cross fence CF3 with riparian exclusion fencing
- Remove cross fence CF1
- Install fencing around seeps and evaluate changes in wildlife cover; expand to other seeps if results are positive
- Construct a corral sufficient in size to handle at least 200 pairs, to the south of the main driveway from Highway 121 as shown in Figure 1

Water System Recommendations:

- Securely install wildlife escape ramps in all water troughs
- Redevelop the spring that feeds T6 and any other springs that decline in water

production
- Install a new rectangular concrete trough in location PT5a as shown in Figure 1
- If the pond that feeds T4 is drained in late summer for bullfrog control, run a temporary pipe from the spring in the pond bottom to the storage tank to keep troughs T4 and T5 functioning; it is unknown how this will affect troughs T1 through T3

***Adaptive Management Recommendation*:**
- Follow the six steps of adaptive management as shown in Figure 2 and described above

Monitoring Recommendations:
- Explore relationships with local educational institutions and/or the Milo Baker Chapter of the California Native Plant Society for developing a monitoring program to evaluate native plant species frequency
- Perform RDM monitoring in the fall to ensure that minimum RDM standards are being met
- Periodically evaluate other grazing lease provisions

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Doran, Morgan. 2004. Telephone conversations, September 17, 21, 22, and October 6. Mr. Doran is the University of California Cooperative Extension Advisor for Livestock and Natural Resources for Yolo, Napa, and Solano Counties; Mr. Doran has participated in UC research trials related to managing medusahead with high-intensity grazing.

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Mohring, Glenn. 2010. Telephone conversations, March 31, and May 14; meeting April 28. Mr. Mohring is the grazing tenant at the Tolay Creek Ranch.

Stevens, Brad. 2010. Telephone conversation, March 30. Mr. Stevens installed the new water troughs at the Tolay Ceek Ranch.

Appendix 1

Grazing Management Terms

Animal Unit (AU). An adult cow or an adult cow and her calf, or the equivalent. A cow and her calf can be referred to as a "cow-calf pair", or simply a "pair" or the equivalent

Animal Unit Month (AUM). The amount of forage that is needed to support one AU for one month. One AUM is equal to 1,000 lbs. of forage16

Animal Unit Equivalent (AEU). A number relating the forage consumption of a kind or class of animal to one AU. For example, the AUE for a 1 year old kid is .1.

Browser. An animal that feeds primarily on woody vegetation.

Cow-calf pair. A mother cow and her calf, considered to be one AU.

Forage. Biomass, including herbaceous and woody (also called browse), that provides feed for grazing and/or bowsing animals.

Grazer. An animal that feeds primarily on herbaceous vegetation.

Grazing Capacity. The maximum number of livestock that can graze on a given site without adversely affecting range productivity, causing a decline in range condition, or resulting in other adverse impacts. Grazing capacity is expressed in pounds or tons of forage produced, often described in AUMs.

Intermediate Feeder. An animal that feeds by browsing and grazing.

Residual Dry Matter (RDM). The amount of herbaceous biomass that should be left at the end of the grazing season to provide suitable conditions for germination of the following year's forage crop and for soil protection. RDM should be subtracted from forage production estimates to determine available forage. Professional opinions as to appropriate RDM levels vary to some degree and are dependent on site objectives. An economic objective aimed at producing the maximum amount of high-quality forage might differ from one aimed at providing specific habitat conditions.

Stocking Density. The number of AUs present on a given area at one point in time.

Stocking Rate. The number of AUs present on a given area over a designated time period.

[16] Forage weights used for this definition are variable. Some range managers use 1,000 pounds of forage for one AUM, which accounts for wasted forage. Others use a lower rate based on actual consumption (26 pounds per day per AU) and apply a "grazing efficiency rate" to account for wasted forage.