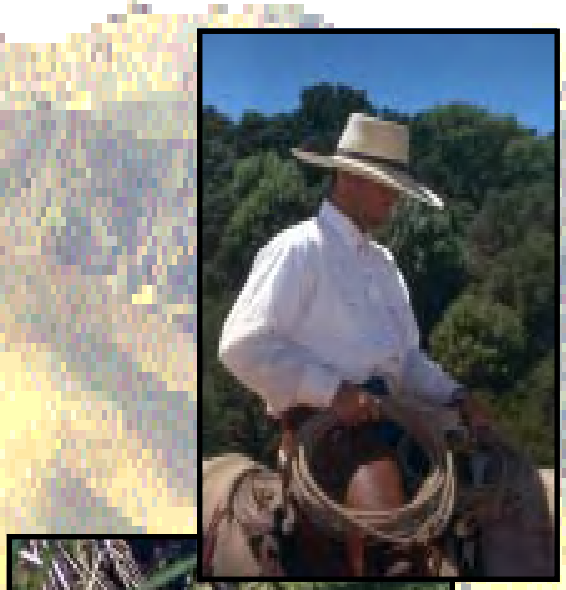

Range Resource Management Plan

Natural Resources Department

December 2001

East Bay Watershed Range Resource Management Plan

Prepared by

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APPENDICES

- The purpose of the Range Plan is to describe the East Bay livestock grazing program in accordance with the policy direction provided in the *East Bay Watershed Master Plan.*

- The objective of the grazing program is to use grazing as a tool to manage vegetation for District resource needs to support District water quality, biodiversity, fire control and other management objectives, to retain current levels of runoff, and to generate revenue. Development of this *Range Resource Management Plan* has been closely coordinated with development of the *Fire Management Plan*.

- Maintenance of adequate plant cover is essential to optimize the primary watershed functions of capture, storage and release of high quality water.

- In general, properly managed, light to moderate seasonal grazing by cattle and horses on EBMUD land supports biodiversity, including the maintenance of plant and animal species of special concern and minimizes adverse impacts on water quality.

- Of approximately 28,000 acres within EBMUD boundaries, about 10,000 are occupied by grazeable grassland and oak savanna, which provide the vast majority of livestock forage on approximately 21,000 acres of lands fenced for grazing.

- Nearly 1,000 species of biota have been identified on EBMUD land, of which twenty-nine animal and 10 plant species are listed as special status and management priority. Six special-status species can be adversely impacted by livestock and will require site-specific management for their protection.

- Riparian and oak savanna are identified by the District as sensitive habitats with particular and significant values to biodiversity; the riparian communities which occupy about 600 acres and include nearly 15 miles of perennial streams in grazing lease areas require critical evaluation relative to livestock management or exclusion.

- Differences among species and habitats will determine the optimal seasons of grazing and deferment. These factors, in combination with the seasonal impacts of livestock on water quality require

that livestock and watershed management prescriptions be made on a site-specific, field-by-field basis. These prescriptions are included herein as Allotment Management Plans.

- The presence of livestock has been positively correlated with the principal nonpoint source (physical, chemical and biological) contaminants of municipal source water.

- Dislocated soil particulates and the excrement of domestic and wild animals are the main sources of rangeland water pollution.

- Research and monitoring of municipal source waters indicate the presence of potentially hazardous protozoan pathogens, although no treated water or public health problems attributable to livestock on watersheds in California have been reported.

- Further reduction of sediment, nutrient and microbial contaminants in raw waters of EBMUD can be accomplished through source identification and site-specific livestock management practices, including adjustments in grazing season and stocking rate and minimizing access by livestock to open water.

- Site conservation thresholds for minimum levels of plant cover, maximum contaminant level goals for source water quality, and standards for desirable plant communities are recommended as District management objectives to protect and maintain water quality, biodiversity and resource productivity.

- Six management measures and twenty-nine management practices are described and recommended for implementation on EBMUD lands. For most practices, opportunities exist for cost sharing under Federal or State programs.

- Methods for monitoring range condition, forage production, forage utilization, plant biodiversity, and water quality on grazed lands are described.

- The tenant selection process, described herein, is based on an appraisal method, which prioritizes the experience, responsibility, and management practices of the livestock operator.

ACRCD	Alameda County Resource Conservation District
ADWB	Air Dry Weight Basis
AGP	Annual Grazing Plan
AMP	Allotment Management Plan
AU	Animal Unit.
AUM	Animal Unit Month.
AWWA	American Water Works Association
BMP	Best Management Practices
CDFFP	California Department of Forestry and Fire Protection
CDFG	California Department of Fish and Game
CNPS	California Native Plant Society
DBP	Disinfection by-product
DNA	Deoxyribonucleic Acid
DPC	Desired Plant Community
EAWEST	Environmental Associates West
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Park District
EBWMP	East Bay Watershed Master Plan
EIR	Environmental Impact Report
EQUIP	Environmental Quality Incentive Program (USDA)
F&W	Fish and Wildlife
FC	Fecal coliforms
FMP	Fire Management Plan
FS	Fecal streptococci
GIS	Geographic Information System
HACCP	Hazard Analysis of Critical Control Points
HCP	Habitat Conservation Plan
IPM	Integrated Pest Management
LUMP	Land Use Master Plan

MCL	Maximum Contaminant Load
MCLG	Maximum Contaminant Levels or Goals
MM	Management Measures
MMWD	Marin Municipal Water District
MWP	Metropolitan Water District (Los Angeles)
N	Nitrogen
NPS	Nonpoint Source Pollution
NRC	National Research Council
NRCD	Natural Resource Conservation District
NRCS	Natural Resource Conservation Service
P	Phosphorus
RCD	Resource Conservation District
RDM	Residual Dry Matter
RFP	Request for Proposals
RRMP	Range Resource Management Plan
RWQCB	Regional Water Quality Control Board
SCT	Site Conservation Threshold
SCS	Soil Conservation Service
SCVWD	Santa Clara Valley Water District
SSP	Special Status Species
SFWD	San Francisco Water District
T&E	Threatened and Endangered
THM	Trihalomethanes
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
UC	University of California
UCCE	University of California Cooperative Extension
UCVMRTC	University of California Veterinary Medicine Research and Teaching Center
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USL	Upper San Leandro
USLE	Universal Soil Loss Equation

1.0 Introduction

In 1996, the East Bay Municipal Utility District's (EBMUD) Board of Directors adopted the East Bay Watershed Master Plan (EBWMP) and its programmatic Environmental Impact Report. The EBWMP was a comprehensive planning effort that examined how to best manage EBMUD's 28,000 acres of open space watershed land in the East Bay area. A key component of the EBWMP was the development and implementation of a range management program that would address grazing and range management issues. This *Range Resource Management Plan* (RRMP) is the result of that effort.

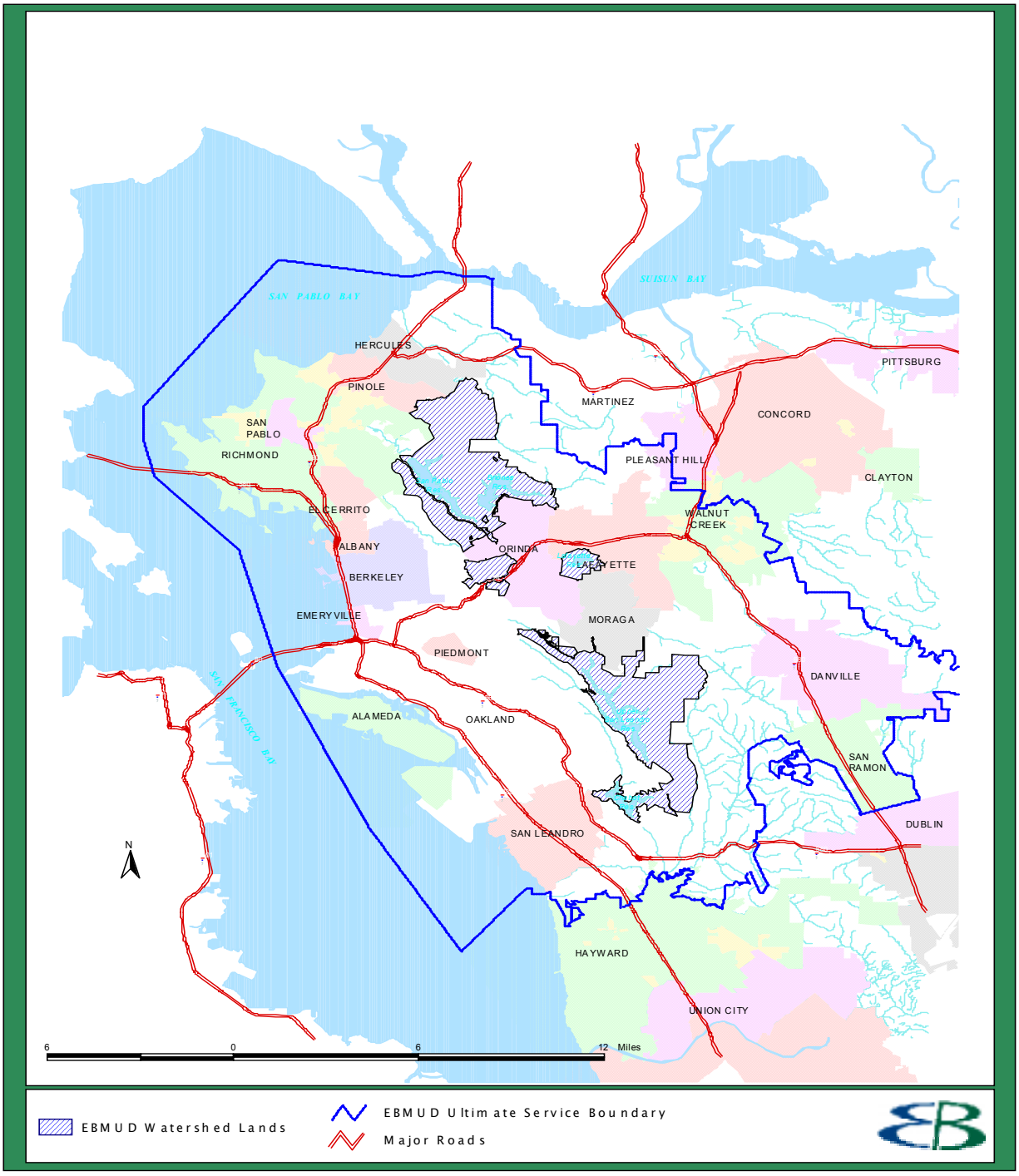
The purpose of this RRMP is to identify and implement rangeland management goals that meet the watershed management objectives outlined in the EBWMP.

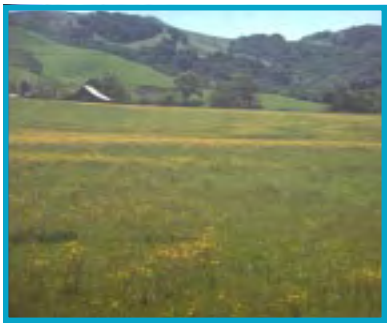
This document also provides a brief history of livestock grazing practices on EBMUD lands, describes current issues related to livestock use, and discusses plans and methods for implementing best management practices and monitoring of vegetation, wildlife, and water quality.

1.1 Location of the East Bay Municipal Utility District

EBMUD provides drinking water to approximately 1.3 million people in Alameda and Contra Costa counties. It owns and is responsible for the management of about 28,000 acres of water surface and largely undeveloped watershed land east of San Francisco Bay. Four reservoirs and their adjacent watershed basins (Briones, San Pablo, Chabot, Lafayette and Upper San Leandro),

Figure 1-1. Location Map of EBMUD Watershed Lands.





one non-reservoir watershed basin (Pinole Valley), comprise the District's East Bay Watershed. About 633 acres of non-watershed lands, such as those over ridgetops, are also included. (See Figure 1-1)

Watershed boundaries are shared with the communities of Hercules, Pinole, Richmond, Oakland, Orinda, Moraga, Lafayette, and Castro Valley, as well as the East Bay Regional Park District and private landowners within both counties.

The topography is dominated by the steep East Bay hills, which support a vegetation mosaic of annual grassland, mixed oak woodland, and shrub-dominated communities. There are approximately 10,000 grazeable acres on loamy upland range sites. The mean annual precipitation is 22 inches of rainfall, and the Mediterranean climate has cool, wet winters and warm, dry summers. Detailed descriptions of the District's natural resources can be found in the Natural Resource Inventories (EAWEST 1994). For land management purposes, District lands are divided into the North and South Watersheds. Within these watersheds, there are fourteen cattle grazing allotments and four community horse pastures.

1.2 Grazing History

Grazing has long since been a part of California's natural history and continues to be so today. Priorities, goals, and management strategies in relation to land management and the livestock industry have taken on many different directions since 1769, when Captain Fernando Rivera first introduced some 200 livestock onto California's grasslands (Burcham 1957). It was this expedition that marked the beginning of California's first industry, cattle ranching.

Grazing has also been an important part of EBMUD's history and continues to serve as an integral part in today's management strategies. In order to develop management strategies for the future, a firm understanding of the past in comparison with the present is important.

1.2.1 Early History

Prior to cattle ranching, the rangelands of California were

utilized by native wildlife. These species included pronghorn antelope, deer, and elk. Though they did not congregate into large migratory herds throughout the year, such as the bison of the Great Plains, they were numerous and had an impact upon the natural landscape. Elk were believed to be the most abundant game animal in California around 1845 (Burcham 1957). Wilkes, a visitor to California in 1841, reported that an average of about 3,000 elk and deerskins were shipped from San Francisco each year. Bryant, in 1846, saw numerous herds of elk in the Sacramento Valley east of Sutter's Fort and in the lower San Joaquin Valley. He estimated that herds in the latter area numbered between 1,000 to 2,000 animals (Burcham 1957).

The pronghorn antelope was also very abundant and known to congregate into large herds during the autumn/winter months, and scatter into small groups in the spring and summer during the time when fawns were reared. They were known to occur from the San Joaquin Delta region north to the vicinity of Klamath Lake. They were most abundant in the San Joaquin Valley, where they formed herds numbering up to two or three thousand animals (Burcham 1957).

1.2.2 The Mission Period

The Spanish missions served as the start of the cattle industry in California. Establishing a cattle herd was an important element in the founding of every mission. Even though their primary purpose was to serve as a religious agency, the raising of cattle was fostered at all 21 missions. During the mission period, livestock were not raised for monetary reasons, but as a means of subsistence. Hides were used for making harnesses, clothing, ropes, shoes, etc., while tallow went into the making of soaps, candles, and also served as a lubricant. The meat was utilized for food for the mission community, but possessed little value for sale or trade.

The Missions often extended their ranges so the boundaries of one overlapped with the boundaries of other Missions to the north and/or south. At the height of its activity,

mission-dominated land accounted for nearly one-sixth of the total area of California.

One mission, whose territory extended across the San Francisco Bay (adjacent to the current EBMUD watershed boundary), was the Mission Dolores. This Mission used the east shore of San Francisco Bay, where San Leandro, Alameda, Oakland, Berkeley and other cities now stand (Burcham 1957). The Mission Dolores used this area primarily for raising sheep before the Governor of California ceded it to Luis Maria Peralta in 1820 (Burcham 1957).

From the late 1820's to the early 1830's, the mission owned cattle herds grew and eventually they controlled large numbers of livestock. Jedediah Smith reported that in 1827, the herds of cattle had built up until they were nearly as numerous as the buffalo on the plains of Missouri (Burcham 1957). The San Gabriel Mission is estimated to have had between 80,000-100,000 head of cattle, besides horses, mules, and sheep. The five missions in the vicinity of San Francisco Bay had more than 40,000 domesticated cattle among them. By 1834 estimates of the number of mission cattle were reported to be between 142,000 and 423,000 head (Burcham 1957).

With the end of the Spanish period in 1822, laws under Mexican rule soon ordered the secularization of missions, which was completed in 1836. Soon after, the Mexican Government began granting land to private individuals for ranching, which began the "Rancho Period." Nearly anyone could obtain a grant for a square league of land (4,439 acres) with the understanding that a house would be built on it along with 100 head of cattle. By 1846, more than 500 ranchos existed in California with most of them occupying former mission controlled lands.

Given the large size of the Ranchos and with California's highly productive grasslands, cattle ranching prospered and became the dominant occupation of the Rancho period. Cattle ranchers would allow their animals to graze free-range, and except for periodic roundups and branding, the

cattle received little attention. A few vaqueros (Mexican cowboy) were needed to protect the herds from raids by Indians and to keep the cattle from straying outside the indistinct boundaries of their owner's lands.

By the 1840's, the cattle ranching trade in California was well established throughout the coastal areas from San Francisco Bay southward.

1.2.3 The Gold Rush

In 1848, gold was found in the American River, which started the infamous "California Gold Rush." As a result, a huge influx of Europeans and Americans from the Eastern United States came west to find their fortune. These events also lead to major changes in the cattle industry.

The Gold Rush created a huge demand for beef. Virtually overnight, the great "Cattle Boom" began, and with the price of cattle skyrocketing, the attention of the cattle rancher was diverted from producing tallow and hides to supplying beef to miners. Eventually, the demand for beef was so high that local ranchers could not keep up with the demand. As a result, large herds were driven into California from Texas, Mexico, and other southwestern states. In addition, thousands of livestock were brought into California from the Midwest. More than 150,000 head of cattle entered the state from that area during 1852 and 1853 alone (Burchum 1957).

This influx of cattle led to high stocking rates. As a result, free range grazing led to over-utilization of certain rangelands and degradation of the landscape. Grazing too early in the spring, improper season of use and overstocking proved to be detrimental to native perennial grassland plants. In contrast, difficult topography, insufficient water sources, and minimal herding efforts by ranchers, resulted in under utilization of other areas.

The advantage to ranchers of running large numbers of livestock was due in part to how they were sold. Even

after meat production took precedence over hides and tallow, cattle were commonly bought and sold by the head instead of by the pound. Accordingly, importance was placed on quantity rather than quality. This situation led to management strategies that promoted the production of the maximum number of livestock that the range could sustain. Consequently, during favorable and unfavorable conditions such as drought, which was common in the 1850 and 1860's, ranching practices were inflexible and did not allow for adequate range recovery periods, which resulted in heavy grazing pressures on rangelands (Burcham 1957).

1.2.4 Introduction of Non-Native Annuals

The introduction of nonnative annual grasses and forbes changed California's grassland communities dramatically. However, the comparative chronology of the first annuals' invasion and development of the livestock herds is not completely clear. The remains of three nonnative species have been found in the adobe bricks of the earliest missions, which suggests that the introduction of nonnative annuals into California was by 16th century explorers prior to any established livestock operations (Wagner 1989). The nonnatives apparently gained wide distribution by the 1830's. In addition, the majority of the forbes seem to have come to California after evolution as weeds from their source area (Huenneke 1989).

Operations connected with settlement during the Gold Rush (1848-1860), contributed to the conversion of the native perennial grasses to nonnative annual grasses and forbes (Burcham 1957). For example, heavy grazing of cattle and sheep put the bunchgrass at a disadvantage. During climatic fluctuations, such as drought and flooding, the introduced plants were able to replace the bunch grasses by virtue of their superior productiveness and large seed stores (Huenneke 1989). Other characteristics of these introduced plants such as aggressive growth pattern and rapid seed germination in favorable conditions, added to their advantage to out compete the native perennial species. These nonnative annual species were also highly adapted

for seed dissemination in the coats of animals, packing materials or as impurities in crop plants.

1.2.5 EBMUD: Grazing History

From EBMUD's inception in the 1920's, the primary purpose of grazing was revenue generation and fuel reduction using year-long grazing. Under the direction of the first Land Use Master Plan (LUMP, 1970), agricultural and rangeland areas were managed for maximum economic production. Livestock production requirements, therefore, guided management decisions on most of EBMUD's watershed lands.

From the 1940s to the 1980s, EBMUD determined proper (moderate) use of annual-type grassland ranges by identifying a "patchy", protective blanket of old forage that remained in the fall. This vegetation averaged two to three inches in height, which obscured most soil, small rocks, dung, and rodent mounds when viewed from a distance of 20 feet or more.

In 1984, using the EBMUD Range Resource Plan (Vonarb), the District began using rotation grazing to protect wildlife habitat and more effectively manage herbaceous fuel loads.

As the range program shifted away from maximizing the economic benefit to protecting the resource and water quality, the RDM standards were raised. By the early 1980's the District had adopted the Soil Conversation Service recommendation of 70% cover with

RDM of 400 lbs. on level, 600 lbs. on moderate, and 800 lbs. on steep slopes.

In 1984 these District standards were increased to 600/800/1000 lbs., respectively. (When the EBWMP was adopted the RDM requirements were increased by 140% to their current levels of 840/1120/1400 lbs.)

Generally, by increasing the amount of mulch (RDM), broad-leaved forbs and short grasses decrease, and are replaced by taller herbaceous vegetation.

In 1996, after a 4½-year public process, the District adopted the EBWMP as a replacement for the LUMP, 1970. With the EBWMP, the District determined that managing lands and reservoirs to protect water quality and important, high-quality biological resources could best be achieved by promoting biological diversity (biodiversity). The EBWMP clearly defines new management goals for livestock grazing directed towards protecting water quality and maintaining and enhancing biodiversity. The Range Resource Management Plan is based upon these goals.

1.3 Goals and Objectives

With the guidance of the EBWMP, the District is committed to managing its land and reservoirs to protect water quality, and maintain and enhance biological resources by promoting biodiversity. Livestock grazing will be used primarily as a tool to manage vegetation to meet goals for water quality, biodiversity, and fire protection. Through the EBWMP long-term goals listed below, the District is committed to environmentally responsible natural resource management:

- Protect and enhance water quality, biodiversity, and other natural resources by defining best management practices for livestock grazing and rest periods.
- Define the procedures for monitoring range condition, special status species, and sensitive habitats.
- Define best management practices for livestock to manage

vegetation for fire control.

- Outline the format and requirements for Allotment Management Plans that include improvements for each allotment.
- Integrate GIS capability with rangeland management in the creation of Allotment Management Plans.
- Retain current levels of runoff while protecting soils, biodiversity, and water quality.

1.3.1 Fire Management Plan

The EBWMP also envisioned that, after the EBWMP's approval in 1996, EBMUD would subsequently prepare a Fire Management Plan (FMP). The goal for the FMP is to protect human life and property, provide for public safety, and protect and enhance water quality, other natural resources, and watershed land uses. In 2001, EBMUD approved the FMP.

Grazing is used as a cost-effective tool for managing flashy fuels over large areas, especially near the urban interface, by reducing the intensity of fires in grassland areas.

Where fire protection is essential, livestock grazing as a fuel reduction tool can be implemented strategically to minimize impacts on water quality and biodiversity. Fields with urban interface, high fuel hazards, and/or other fire risks will be grazed annually to minimize risks in accordance with the goals of the Fire Management Plan. Fields not on an urban interface can be rested or banked to meet other land management goals.

The objective is to reduce the fuel loading in tall grassland fuels from 3 tons per acre (normal annual production) to ½ to ¾ ton per acre. According to the Fire Management Plan adequate fire hazard reduction is achieved when dry grassland fuels are reduced to four to six inches in height. Overall the RDM levels of 900/1200/1400 relate well to fire concerns.

Seasonal benefits of fire protection must outweigh potential longer-term negative watershed impacts on water quality and biodiversity. When grazing is deemed detrimental, the District should seek other stubble management alternatives to livestock grazing. Site-specific discussions can be found in Section 5, Allotment Management Plans and Tenant Selection. Also, See EBWMP Guidelines LG.3, LG.8, FF.7, FF.10, and FF.36 in Appendix C. The Biological Fuel Modification Treatments section of the FMP is Appendix D.

1.3.2 Cultural Resources

The District's watershed lands contain numerous archaeological and historical sites as well as the potential for others yet undiscovered. These areas are referred to collectively as cultural resources.

Impacts from livestock activities are generally minimal, since they are confined to surface disturbances. When ground-disturbing activities such as new pond construction are initiated, inspection and monitoring occurs. For reference, new stock ponds are rarely needed, and are almost always located on the site of a former pond.

1.3.3 Visual Resources

The natural features of the District's watershed lands provide a valuable visual resource to people who use these lands, as well as to people who pass through them or who reside, work, or recreate on adjacent lands.

Overall, the livestock grazing management program ensures that proposed activities do not substantially alter the open space quality of the watershed lands.

1.3.4 Recreation

Recreation on East Bay watershed lands is provided at developed recreation areas that are used extensively, and on the recreational trail system that is used at a fairly

low intensity. Grazing does not occur within any developed recreation areas, but portions of the trail system go through pastures. Those areas are monitored and mitigated as necessary.

1.4 Program Components

Specific programs and tools to implement the RRMP goals and objectives include: Spring and Fall Field Surveys, Annual Grazing Plans (AGP), Water Quality Sampling, Integrated Pest Management (IPM), Geographic Information System (GIS), the Fire Management Plan (FMP), Review by Fisheries and Wildlife staff; Management for Special Status Species (SSP), Allotment Management Plans (AMP) and current Endangered Species Act (ESA), the EBWMP and the EBWMP Programmatic Environmental Impact Report (EIR), and the RRMP.

1.4.1 The East Bay Watershed Master Plan (EBWMP)

General descriptions of the watershed lands, hydrology, water quality, soils, geology, vegetation, visual resources, cultural resources, and recreation facilities are well documented in the EBWMP. For reference, the Livestock Grazing section of the EBWMP is included as Appendix C.

1.4.2 Spring and Fall Field Surveys

Methodical and routine assessments of range condition offer a basis for evaluation of rangeland health and of changes and trends over time. Residual dry matter (RDM) analysis is included in the fall survey. A detailed discussion of range monitoring is included in Section 4, Monitoring of Grazed Rangelands.

1.4.3 Annual Grazing Plans (AGP's)

Annual grazing plans are created for each allotment based on the annual field surveys and seasonal weather conditions, plus additional factors such as vegetation abatement, which addresses fire concerns along the urban-wildland interface.

Each plan determines the number of animals that the allotment can accommodate and still maintain good rangeland health. AGPs are described in more detail in Section 5, Allotment Management Plans and Tenant Selection.

1.4.4 Water Quality Sampling

Reservoirs and tributary streams are tested for contaminants on a routine basis. Nonpoint source pollution (NPS), as well as soil particulates indicating erosion, are tracked to aid in the planning and development of land use practices to control or minimize potential adverse impacts of livestock grazing. A complete discussion may be found in Section 4.5, Water Quality Monitoring.

1.4.5 Integrated Pest Management (IPM)

Noxious weeds are removed by the safest methods available, including mechanical and spot spraying using least toxic herbicides that minimize effects to the environment. The District's IPM guidelines are included in this document as Appendix H, Integrated Pest Management Plan.

1.4.6 Geographic Information System (GIS)

Biological information, regulatory requirements, fencing, and stock water supplies are always subject to change. The rangeland management program is updated to reflect these changing watershed conditions by using the District's extensive GIS database.

1.4.7 Fire Management Plan (FMP)

Grazing is used as a cost-effective method for managing flashy fuels over large areas, especially near the wildland-urban interface. The FMP identifies these watershed interface zones where grazing is the preferred strategy to reduce fuel loads. Further discussion of this important element can be found in Section 5.5 of this document. FMP management guidelines are included as Appendix D.

1.4.8 Management for Special Status Species

Management for SSP, as set forth in federal and state regulations for threatened and endangered species, will guide the implementation of the RRMP. For example, perennial streams will be outfenced from livestock grazing and springs and seeps will be grazed seasonally, in accordance with these regulations.

1.4.9 Consultation with EBMUD Fisheries and Wildlife Staff

EBMUD has a Fisheries and Wildlife Division for the East Bay watershed lands it owns and manages. The biologists on staff are available for consultation and comment on the biological aspects of the various programs associated with the RRMP.

1.5 Organization and Use of the RRMP

1.5.1 Section 1: Introduction

The RRMP will be used in conjunction with the EBWMP and the FMP, which were developed to reduce potential management conflicts. The EBWMP requires that grazing be coordinated with these other resource management programs. Together, these plans define the implementation of management directives discussed within the EBWMP.

1.5.2 Section 2: Grazing, Livestock and Water Quality

Section 2 discusses the potential impacts of livestock grazing on water quality. The potential impacts and mitigation measures are outlined.

1.5.3 Section 3: Grazing and Biodiversity

Section 3 outlines the potential impacts to biodiversity, and the range management strategies that will be implemented to maintain and enhance these natural resources.

1.5.4 Section 4: Monitoring of Grazed Rangelands

Section 4 lists and explains the methods that will be used to monitor range condition. These activities, data collection and analysis calculations, will indicate whether the goals and objectives of the range management program are being achieved.

1.5.5 Section 5: Allotment Plans and Tenant Selection

Section 5 specifies how EBMUD's Allotment Management Plans (AMPs) are developed. These plans describe management objectives for improved water quality, enhanced biodiversity, fire control, and healthy grasslands. They are site-specific and incorporate all the elements discussed in this document, including GIS and fire and fuels management. The tenant selection process is also identified.

2.0 Introduction

More than 40 million acres of California's 101 million acres is rangeland. Classified as the most extensive land type in the state, the location of rangelands, between forested areas and major river systems, means that almost all surface water in California passes through rangeland (U.C. Davis 1998).

Livestock grazing is a significant use of rangeland in California and presents the widest array of water quality impacts (MacDonald 1991). Grazing practices can also affect the quality of public drinking water sources (Buckhouse 1999). As outlined in the East Bay Watershed Master Plan (EBWMP 1996), Guideline LG.11, these effects may include impacts to water quality and conflicts with other resources such as:

- Erosion on highly erodible sites;
- Discharge of nutrients, pathogens, sediments, and other contaminants into reservoirs and tributaries;
- Interference with vegetation recovery following prescribed fire or wildfire;
- Damage to or destruction of sensitive plant species and communities;
- Excessive removal of wildlife cover; and
- Damage to roads, trails, and recreation areas.

GRAZING AND WATER QUALITY

Throughout EBMUD's history of supplying water, the agency has been concerned with water quality issues and continually strives to provide the highest quality drinking water to its customers. Due to current water quality concerns, policies, and practices, it was determined that traditional grazing practices are not appropriate on EBMUD lands. To provide direction to the EBMUD Natural Resources Department, the EBMUD Watershed Master Plan was developed and implemented, which stipulates an aggressive approach for protection and management of source water quality in order to maintain high quality water in District reservoirs (EBWMP 1996). The EBWMP directs the District to avoid introducing pathogens, nutrients and sediment into reservoir water above baseline amounts. Consequently, a rigorous management prescription is required to meet current biodiversity, watershed hydrology, and water quality goals.

2.1 Watershed Hydrologic Functions

A watershed is defined as the area that drains water, sediment, dissolved materials, heat, biota etc., to a common outlet at some point along a stream channel (U.C. Davis 1998). To ensure effective management, a watershed must be addressed in its entirety. Each element, including flatlands, upland slopes and drainages, riparian zones and aquatic zones must be evaluated for vegetation and soil conditions. Furthermore, the relationship between land use, soil loss, and productivity, water quality, population and habitats, social factors, and economic factors are unique to watershed management.

Precipitation and the outflow of water from the watershed as evapotranspiration, ground water discharge, and stream flow is accommodated through various processes in the hydrologic cycle. These are inherent in the three primary water-related functions of a rangeland watershed.

1) *Capture* - the processes of detaining water on the surface and promoting its infiltration into the soil. Effective capture minimizes water loss by runoff. Capture is a function of vegetation cover type, amount and density, soil surface conditions, and stream drainage channel pattern and morphology.

2) *Storage* - water that is retained within the soil profile at saturation for subsequent percolation or use by plants. The amount and density of living and dead vegetation cover which influences water loss affect storage by influencing evapotranspiration. More water evaporates from bare soils than from those with good ground cover.

3) *Beneficial release* - water moving through the soil profile by percolation in order to replenish groundwater or emerge as seeps, springs and sub-surface drainage in a safe, sustained manner over time. Safe non-erosive release is promoted by maintenance of proper plant cover and concomitant soil stability.

Total yield, flow rate, and quality of runoff water are primarily functions of watershed vegetation cover characteristics and management practices. The primary objective of watershed management is to diminish the peak and extend the duration of flow in the storm water hydrograph. High peak flows associated with relatively short runoff or drainage periods in watersheds with inadequate plant cover and compacted or disturbed soils of low permeability lead to soil surface and stream bank erosion and consequent nonpoint source (NPS) pollution of water by sediment and other contaminants.

2.2 Soil Resources

Soils vary as to their inherent hydrology or watershed function and have been classified by the USDA into "hydrologic groups" A - D based upon depth, texture and infiltration rate, which is their runoff potential without protective vegetation (Table 2-1). Watershed function also varies according to "hydrologic condition", based upon the percent of total protective plant cover, including the combined density of live plants and litter and related weight of RDM.

Runoff volume, velocity, erodability and potential NPS water pollution is greatest for soils in Hydrologic Group D in poor hydrologic condition. A soil inventory in 1994 determined that 25,536 acres, or 82% of the total EBMUD watersheds is comprised of soils rated from a moderately high to a very high erosion hazard (Groups C and D). These soils occur mainly on slopes greater than 30%. Protective measures such as maintenance of higher cover density and RDM are critical for soils in this group.

Table 2-1. ***Summary of Hydrologic Characteristics of the Principal Highly Erodible Soils of East Bay Municipal Utility District.***[1]

Watershed Soil Type	Slope Percent	Hydrological Group	Erosion Hazard
Millsholm Loam	50-75	D	Very High
Gaviota Rocky Sandy Loam	40-75	D	Very High
Los Gatos/Los Osos Complex	45-75	C	High-Very High
Millsholm Silt Loam	30-75	D	High-Very High
Los Osos Silty Clay Loam	7-75	C	High-Very High
Alo Clay	30-50	D	Moderate-Very High
Los Osos Clay Loam	50-75	C	High
Los Gatos Loam	50-75	C	High
Lodo Clay Loam	50-75	D	High
Felton Loam	50-75	B	High
Sehorn Clay	30-75	D	High
Millsholm Loam	30-50	D	High
Los Osos/Millsholm Complex	30-45	C	High
Lodo Clay Loam	30-50	D	Moderate-High
Los Gatos Clay Loam	30-50	C	Moderate-High
Los Osos Clay Loam	30-50	C	Moderate-High
Diablo Clay	30-50	D	Moderate-High
Altamont/Fontana Complex	30-50	D	Moderate-High
Gilroy Clay Loam	30-50	D	Moderate-High
Tierra Loam	9-30	D	Moderate-High

[1] Source: EAWEST (1994b), USDA (1977); principal soil types each occupy >100 acres; hydrologic groups defined in Table 1; soils listed in order of decreasing % slope and erosion hazard.

2.3 Nonpoint Source Pollution

Pollution is defined as an alteration of the quality of the state waters by waste to a degree that unreasonably affects their beneficial uses or, facilities that serve their beneficial uses (U.C. Davis 1998). There are two categories of source water pollution that have been identified in the Clean Water Act; point and non-point. Point source pollution is observable, specific, and confined discharge of pollutants into a water body, such as feedlots, food processing plants, and agrochemical processing plants. A diffuse discharge of pollutants throughout the natural environment usually associated with agriculture, forestry, mining, and urban water runoff is termed nonpoint source pollution. Nonpoint source pollution occurs as water from rainfall, snowmelt, irrigation, or human activities moves over and through the ground and picks up and carries away natural and manmade pollutants, eventually depositing them into lakes, rivers, wetlands, coastal waters, and underground sources of drinking water (U.C. Davis 1998).

The potential level of water pollution is a function mainly of livestock, wildlife, and human population density as well as coincidence of animal presence with season, intensity and amount of precipitation. On rangelands, grazing, roads, construction activities, mining, recreational activities, and natural processes may cause nonpoint source pollution. The primary contaminant constituents of concern related to potential nonpoint source pollution of municipal raw water by livestock and wildlife are sediments, pathogens, nutrients, and total organic carbon. Table 2.2 lists each group, the pollutant constituents and origin, related constituents and basis for concern.

Table 2-2. ***Primary Contaminant Constituents of Concern Related to Potential Nonpoint Source Pollution of Municipal Raw Water by Livestock and Wildlife.***[1]

Contaminant Group	Pollutant Constituent	Origin, Related Constituents and Basis for Concern
Sediments (Particulates)	Turbidity (NTU) and Sediment (mg/L)	Soil erosion from animal activity can harbor microbes, nutrients and toxic chemicals; detrimental to aquatic ecosystems; increase level and cost of water treatment.
Nutrients (Organics)	Nitrates (NO_3, ppm) and Phosphates (PO_4, ppm)	Originate from animal excreta; promote algae growth, eutrophication and undesirable water flavor and odor; algae increase water treatment costs; NO_3 a health hazard.
	Total Organic Carbon (TOC, mg/L)	Originates from constituents of decomposed, dislocated/eroded plant and animal waste; a precursor of disinfection by-products(see section 2.3.2), health hazards and cause of undesirable taste and odor of water.
Pathogens (Micro-organisms)	Bacteria (MPN/100 ml)	The presence of fecal streptococci (FS) can be an indicator of water pollution by animals, esp. when related to fecal coliform (FC); both may indicate presence of other pathogens.
	Protozoa (MPN/100 ml)	*Giardia* and *Cryptosporidium*; originate from animal excreta, particularly calves under five months of age; infectious oocysts difficult to evaluate and to control by water treatment; potential health hazard.

[1] From the EBMUD *Watershed Sanitary Survey* (1995).

The means and pathways by which sediment and associated nutrients and microbes enter water bodies on a rangeland watershed occupied by herbivores is through plant cover reduction, soil detachment, erosion and transport by runoff of precipitation, and by animal defecation and urination directly into open water . The potential level of water pollution is, therefore, a function mainly of: (1) Domestic and wild animal population density; (2) coincidence of animal presence relative to the season, intensity and amount of precipitation; and (3) proximity and access of animals to, and time spent within, water bodies and riparian zones during drinking, feeding and loafing.

Sections 2.5 through 2.8 identify the measures taken by EBMUD to manage for and protect water quality on rangelands within EBMUD open space watershed property.

2.3.1 Sedimentation

The kinetic energy of a raindrop impacting the soil surface is the primary force responsible for initiating soil movement. Compacted and/or impermeable soils can increase the volume and velocity of runoff, and increase natural soil erosion processes.

According to the U.S. Department of Interior (1987), watershed sediment yield is most influenced or controlled by rainfall, soil type, ground cover, land use, topography, upland erosion, runoff, and characteristics of channel hydraulics and sediment grains. When these attributes are co-related with the six factors affecting soil erosion as determined by the Universal Soil Loss Equation (USLE) of the USDA -rainfall, inherent soil erodibility, length of slope, percent slope, amount of soil covered by vegetation, and erosion control practices- the managerial value of plant cover density and weight in reducing suspended sediment in runoff is readily apparent.

Suspended sediment is widely recognized and documented as the principal water nonpoint source pollutant related to agricultural grazing and forestry (Blackburn, et al. 1982, MacDonald 1991, Robbins, et al. 1991). It not only increases costs of water treatment and diminishes water quality and habitat for aquatic organisms (USEPA 1979),

but also has an affiliation and correlation with the presence or level of pathogens, particularly *Giardia, Cryptosporidium* and fecal coliform (Rose 1988). Suspended sediment has also been implicated as a means of transport for toxic chemicals (SWRCB 1994).

2.3.2 Nutrients

Although sediment is usually considered to be the largest water quality problem from livestock grazing, nutrients may also be of concern (U.C. Davis 1998). Leaching of nutrients from watersheds is a natural part of nutrient cycling, but can become pollutants near streams and lakes by direct deposit or by overland transport during the rainy season or periods of runoff. The potential for this mode of contamination depends on time, density and access. Therefore, nutrient problems are most critical where animals congregate for water, feed, salt and shade (U.C. Davis 1998). In addition, daily inputs from directly deposited feces may accumulate on the stream bottom. Any disturbance, such as peak flows, can resuspend sediment, creating high concentrations of nutrients for a short period of time.

Three principle nutrients identified as potential pollutants are nitrogen, in the form of nitrate, phosphorus, and total organic carbon (TOC). Nitrates, at high concentrations, can cause aquatic weed growth and is considered a health problem. Whereas, excess levels of phosphorus can lead to eutrophication, total organic carbons (TOC) originate from decomposed plant material and animal waste. TOC loading and aging can lead to undesirable taste, odor and color of raw water. It can also become a serious health hazard when raw water treatment by chlorination results in toxic trihalomethanes (THM) as a disinfection by-product (DBP). They can all be transported on suspended sediment into waterways.

Nitrates and phosphates (soluble orthophosphates) and a portion of TOC originate from animal excrement and its decay. Decomposition by bacterial action and mineralization of dead vegetation (litter/residue) and animal remains also contributes various forms of these potential pollutants to the soil where much of the nitrogen and

phosphorus is absorbed and utilized by plants for growth. However excess soluble organic and inorganic forms of nitrogen (N) and phosphorus (P), and organic carbon may potentially be carried overland in runoff or inflow to water bodies.

2.3.3 Pathogens

Warm-blooded animals are the primary source of fecal microbes in the watershed environment that are of human health concern (See appendix A, Table 2-3). Fecal coliform (FC) represent from 93% to 98% of total coliforms excreted by livestock and other mammalian vertebrates (Geldreich 1976). However, total FC per se is not as definitive as fecal streptococcus (FS), specifically Streptococcus bovis and Streptococcus equinus, in identifying pollution of water by livestock when humans and other animals are present in the watershed (Geldreich 1976). Although these bacteria are readily controlled by water treatment, elevated levels in raw water can act as indicators of nonpoint pollution by animals and the potential presence of other hazardous enteric microorganisms. Studies have suggested that a ratio of FC to FS of less than 0.7 is indicative of water contamination by nonhuman warm-blooded animals (Tiedemann 1987).

FC is present in watersheds whether grazed by domestic livestock or not due to the presence of wildlife (USEPA 1979). Studies have found a positive relationship between the presence of grazing livestock in a watershed and the level of FC in runoff waters (Binkley and Brown 1993). In addition, FC survived through the winter in feces and elevated FC occurs in water long after cattle are removed. Survival of bacteria in upland fecal material varies widely from at least eight months in a dry climate to as much as a year in more mesic or forested sites. FC and FS can remain viable for months in stream bottom sediments. Intensity and season of grazing can have an influence on potential bacterial contamination of water, and elevated FC occurs in water long after cattle are removed.

Both Giardia lamblia and Cryptosporidium parvum are protozoan microbes that can cause gastrointestinal illness in humans. They are shed in the feces of rangeland cattle,

and can be transmitted to water (Atwill 1996). Young calves up to four months of age have the highest probability of shedding these microbes. However, they occur in numerous host animals, including wildlife, and are transmitted via feces to water. See Table 2-3 in Appendix A.

At relatively low levels in raw water, *Giardia* cysts can be reduced by treatment to acceptable levels in drinking water. *Cryptosporidium* oocysts, on the other hand, cannot be successfully removed by treatment. However, according to State Public Health officials the risk of healthy individuals contracting cryptosporidiosis from drinking water in California is extremely low.

Feral pigs are a potential reservoir of *C. parvum* and *Giardia* and pigs under 8 months of age from high-density populations are most likely to shed *C. parvum*. Pigs' affinity for riparian areas poses a particular hazard of pollution by both protozoans. Fortunately, a large majority of cysts of *Giardia* and oocysts of *Cryptosporidium* in extensive U.S. raw water sampling in 1991 were found not to be viable.

2.4 Impacts of Grazing Livestock

The primary sources of water pollutants on grazed rangeland are soil particulates, pathogens and nutrients. The means and pathways by which sediment and associated nutrients and microbes enter water bodies on a rangeland watershed occupied by herbivores is through plant cover reduction, soil detachment, erosion and transport by runoff of precipitation, and by animal defecation and urination directly into open water. However, these pathways from livestock activity to impaired beneficial uses of water, are often complex and difficult to understand because the livestock activity that causes a water quality problem may occur over a long period of time at some distance from the point where a water quality impairment is identified (U.C. Davis 1998).

Therefore the potential level of water pollution is a function mainly of:

1. Domestic and wild animal population density;
2. Coincidence of animal presence relative to the season, intensity and amount of precipitation;
3. Proximity and access of animals to, and time spent within, water bodies and riparian zones during drinking, feeding and loafing.

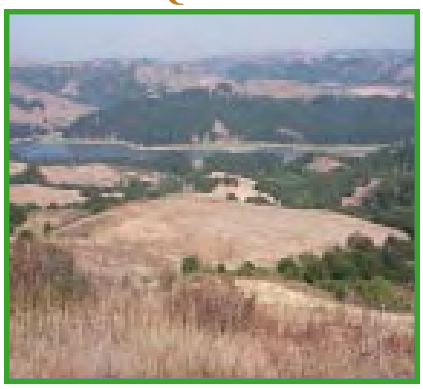
These activities fall into three categories of potential impacts: livestock waste concentration, heavy grazing, and hoof action.

Sections 2.5 through 2.8 identify the measures taken by EBMUD to manage for and protect water quality on rangelands within EBMUD open space watershed property.

2.4.1 Heavy Grazing

Vegetation protects the soil from the erosive energy of raindrops and overland flow, acts as a sediment trap and increases infiltration rates. However, heavy grazing removes vegetation that covers the soil. As a consequence, sediment is detached in the uplands by surface runoff and may eventually find its way to a stream. Research indicates that as grazing intensity is increased, the amount of herbage, litter standing crop, and cover declines (Blackburn et al 1982). In addition, soil bulk density increases and soil organic matter content and aggregate stability decreases (Heitschmidt 1990). This results in a reduction of water infiltration rates and an increase in sediment production [as a result of increased runoff]. A decrease in infiltration is accompanied by an increase in overland flow, which results in more water available for sediment transport (Branson, et al. 1972). In addition, sediment is also detached from stream banks by the erosive force of flowing water or the collapse of unstable banks (U.C. Davis 1998). Based upon research or recommendations by U.S. Department of Interior (1960), Packer (1961), USEPA (1979) and Wright, et al. (1982), a minimum plant cover of from 65% to 75% must be achieved to maintain soil stability and water quality.

Grazing season and stock density can potentially impact water quality, unless overall stocking rate is light to moderate



and adequate plant cover is retained, particularly on fine-textured soils. Sediment production under heavy, rotational grazing can average nearly twice that of moderate, continuous grazing on clay and clay loam soils (Pluhar, et al. 1987). Sediment production under heavy, continuous use of all vegetation types on silty clay can reach 180%, which is 24% greater than moderate, continuously grazed and short-duration (heavy-rotation) grazed pastures (Thurow, et al. 1986). On fine loamy soils of less than 30% slope, under heavy stocking rate, rotation of grazing showed no advantage in reducing sediment yield compared to continuous use (Gamougoun, et al. 1984).

In a two year study involving various pasture sizes and stocking densities under rotation grazing, Warren, et al. (1986a) concluded that the pasture grazed at the highest stock density produced the lowest infiltration rates and greatest sediment loss. Furthermore, implementation of cell-designed, rotational grazing systems may cause a significant increase in density and number of cattle trails, particularly near water, and under certain topographical and fencing conditions, these trails may develop on highly erodible slopes (Walker and Heitschmidt 1986).

2.4.2 Hoof Impacts

Concentrated "hoof action" by livestock causes compaction of wet soils, whether vegetated or exposed, and mechanically disrupts dry, exposed soils, causing disaggregation. In addition, hoof impacts can destroy stream bank vegetative cover, which leads to the physical breakdown of stream banks (U.C. Davis 1998). Detachment by "powdering" dry mineral and organic soils occurs on stream banks, trails and in areas of livestock concentration around watering, salting and feeding sites, and in confinement pens. When it rains these soils are transported in runoff as a "pulse" of suspended sediment.

This type of erosion is a potential impact of summer-fall grazing of livestock on California annual-type rangeland, which may lead to the impairment of water quality and the sedimentation of downstream sites during early winter rainfall. Location of concentrated livestock facilities in close

proximity to drainages and water bodies exacerbates the risk of water pollution by suspended sediment as well as by fecal nutrients and microorganisms.

2.4.3 Livestock Waste Concentration

Contributions of nutrients and pathogens to water can come from a variety of sources, including agriculture, stream bank erosion, fertilization of lawns and golf courses, septic systems, domestic and urban sewage disposal, landfills, rainfall, wildlife and livestock (USDA-NRCS 1998). Within EBMUD watersheds, these nutrients originate primarily from livestock and wild animals. This can lead to nutrient and pathogen pollution, especially if livestock concentrate in or near streams. The result is undesirable water flavor and odor. The compounds resulting from such deposition can also present a problem to human health and aquatic life.

Concern for the risk of nutrient pollution of municipal raw waters by direct deposit of excreta into open water is high, particularly since FC is an indicator of potential pathogen presence and may increase in runoff during grazing (U.C. Davis 1998).

Studies have documented that pathogens present in feces of livestock can increase fecal coliform (FC) and streptococci (FS) in streams by direct deposition (Binkley and Brown 1993). Since FC represent from 93% to 98% of total coliforms excreted by livestock and other mammalian vertebrates, the greater the number of grazing livestock in a watershed, the higher the level of FC in runoff waters. FC concentrations in water tend to be higher under deferred-rotation than continuous grazing (Skinner, et al. 1984). Furthermore, research has shown that FC is highest with heaviest grazing, intermediate under moderate grazing, and lowest with no grazing (Tiedemann 1987). However, levels of fecal coliform in stream flow appear to be more closely related to watershed characteristics that determine where livestock are likely to congregate than to stocking rates. Intensity and season of grazing can also have an influence on potential bacterial contamination of water.

A survey of 272 water supply utilities in the U.S. conducted by the American Water Works Association in 1991 found

A Best Management Practice (BMP) "is a practice or combination of practices that is determined by a state to be the most effective means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals." (Federal Clean Water Act, 1977).

that grazing occurred on 52% of the involved watersheds. However, there is very little scientific evidence linking livestock with Cryptosporidiosis in humans. Millions of municipal water customers, including those of EBMUD, have been served for decades without water supply-linked outbreaks of *Cryptosporidium* in California. Nonetheless, as outlined in Section 3 2.6 & 2.8 the District is taking an aggressive, proactive approach to preventing this type of contamination.

2.5 Water Quality Protection

The EBMUD water quality management program focuses on activities that will encourage control of contaminant sources. Accordingly, the *East Bay Watershed Master Plan* stipulates that aggressive protection and management of source water quality be implemented to maintain high quality of water in District reservoirs. The NRCS has identified a series of BMP's that support the protection of both water quality and rangeland habitats. When applied to water quality protection, a BMP is a practice or combination of practices determined by the State of California to be the most effective and practicable means of controlling point and nonpoint pollutants at levels compatible with environmental [water] quality goals.

The *East Bay Watershed Master Plan* gives specific guidance that contaminant sources *"be identified and quantified before developing management and control strategies and prioritizing implementation"*. Areas grazed by livestock and of known high soil erosion hazard and of high vulnerability as potential water contaminant sources should receive high priority for protection, particularly in the San Pablo, Briones and San Leandro reservoir watersheds.

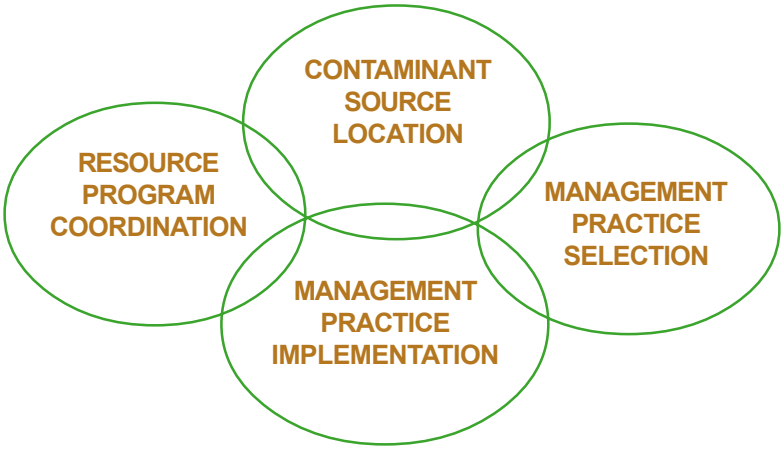


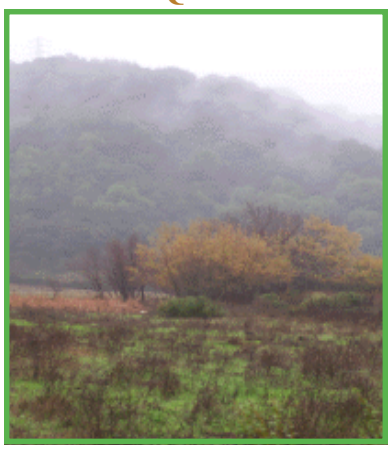
Figure 2-1: Basic Components of Livestock NPS Water Pollution Control Planning

2.5.1 Site Conservation Thresholds

A minimum vegetative cover of 65% to 75% is required to maintain soil stability and water quality. To ensure optimal protection of the raw municipal water supply in District reservoirs objective minimal standards or "site conservation thresholds" (SCTs) for watershed grazing management have been adopted. These minimum standards are based on 140% of the amended minimal residual dry-matter (RDM) standards developed by the USDA Soil Conservation Service and are as follows:

- Gentle slopes of from 0-5% should have a minimum of 840 lbs. per acre.
- Moderate slopes of 6-35% should have a minimum of 1,120 lbs. per acre.
- Steep slopes having over 35% grade should have a minimum of 1,400 lbs. per acre.

This cover is critical on the steeper slopes to maintain soil



stability, on gentle slopes to act as a filter for sediments, on flood plains to protect soil during winter storms, and on all slopes to promote effective capture, storage and release of water.

2.6 Management Measures and Best Management Practices

Management Measures (MM) identify goals for management and control of NPS pollution and protection and enhancement of rangeland biological resources for a state, watershed, or ranch. Linked to each Management Measure are a series of Best Management Practices. The BMP's support the protection of both water quality and rangeland habitat biodiversity goals and objectives.

BMP's are practices applied alone or in combinations to address specific Management Measures. All BMP's have been determined by the State of California to be the most effective and practicable means of controlling point and nonpoint pollutants at levels compatible with environmental [water] quality goals. The Natural Resource Conservation Service (NRCS) Best Management Practices are described in Table 3-1 in Appendix A. Specific descriptions of each BMP can be accessed through the USDA web sites at http://www.ftw.nrcs.usda.gov/nhcp_2.html for federal standards, and at http://www.ca.nrcs.usda.gov/rts/sec4.htm for California-specific practices.

Management Measures 1, 2, and 3 (listed below) relate to NPS pollution management, measures 4, 5, and 6 relate to habitat management for animal and plant species of concern, including domestic livestock and forage plants as components of the ecosystem, and 7 and 8 refer to the protection and preservation of sensitive cultural and visual resources.

1) *Minimize delivery of sediment from grazed rangeland, pastureland and cropland to surface waters.*

2) *Collect solids and reduce contaminant concentrations and runoff from confined animal facilities.*

3) *Protect sensitive areas on grazing lands to reduce physical disturbance and direct loading into water of animal waste and sediment caused by livestock.*

4) *Protect and enhance riparian and aquatic habitat for native plants, animals and fisheries, including resident and anadromous species.*

5) *Protect and enhance upland habitat for management priority plant and animal species.*

6) *Manage livestock and grazable rangeland in a manner that will protect biodiversity and maintain soil and vegetation productivity.*

7) *Protect and preserve sensitive cultural resources.*

8) *Ensure that valuable and rare visual resources are protected from degradation.*

These measures apply to all EBMUD rangelands and can be achieved by identifying and implementing the appropriate management practices individually or in combination that apply to specific potential impacts on individual allotments. The EBWMP stipulates that aggressive protection and management of source water quality be implemented to maintain high water quality in District reservoirs. Grazing to accomplish multiple resource management objectives must therefore be prescribed on a site-specific, field-by-field, allotment basis. Section 5, Allotment Management Plans and Tenant Selection, describes the details required to manage each allotment.

2.7 Water Quality Control Measures

When developing watershed management plans to control nonpoint source pollution, it is critical to ascertain if existing raw water is meeting water quality standards by establishing an initial set of water quality measurements. These baseline conditions allow subsequent evaluation of the effectiveness of best management practices (BMPs) through monitoring of implementation activities. Baseline pollutant levels are established by examining all existing water analysis records for the tributaries and reservoirs, as well as available water quality information outside of the water utility itself.

For reference, please see Appendix A, Table 3-2 Background Surface Water Quality of Comparable Grazed Rangeland

Watersheds of Coastal California presents a summary of data for background surface water quality of grazed rangeland. Also in App. A, see Table 3-3 Preliminary Baseline and Proposed Maximum Contaminant Level Goals for Seven Water Quality Parameters, EBMUD Grazed Watersheds.

Total maximum daily load (TMDL) protocols are currently being developed by the EPA. When available, they will be used as minimum operating parameters for the protection of aquatic organisms, especially fish and listed plant and animal species. See EBWMP Guidelines WQ.4, WQ.17, WQ.19, and WQ.20 in Appendix C.

Data for Cryptosporidium and Giardia are not widely available, since raw water assessments have been conducted only in recent years. In an effort to gather data from an uncontrolled source, EBMUD (1998) conducted monitoring of 60 feral pigs and found no Cryptosporidium and little Giardia in the samples.

2.8 Protection of Water Quality on EBMUD Lands

Livestock grazing, using traditional methods and grazing levels, can often negatively impact water quality for municipal water supplies. However, under reasonable management, detrimental effects may be controlled within acceptable levels to improve downstream beneficial uses of water.

2.8.1 Control of NPS

On EBMUD rangelands designated for grazing under a multiple-use resources management plan, control of nonpoint source pollution of water by sediment, nutrients and fecal contaminants will be accomplished by implementing a light to moderate grazing program. Avoiding high stock density for longer periods of time and localized concentration of livestock will be a primary component of the grazing program. Both the Grazing Leases and Allotment Management Plans specify in detail grazing standards, water quality pollution control measures, and resource protection measures.

The impact of livestock on watershed is a controllable factor influencing NPS pollution of municipal source waters. Inflow waters from livestock range on EBMUD watersheds have not negatively

impacted reservoir waters. Prior to this RRMP, sampling intensity of rangeland tributaries and both baseline and maximum contaminant levels, or goals (MCLG), had not been established as per Appendix A, Table 3-3. The American Water Works Association reported that 61% of State drinking water agencies use ambient water quality criteria for effective watershed control.

- **Residual Dry Matter (RDM)**

  RDM refers to the amount of forage plant material remaining on the range in the fall following spring and summer grazing. RDM is composed of the mulch residue, litter or dried plant material that is left standing or on the ground, from the season's current growth. It does not include unpalatable forbs or weeds, woody plants, new green growth or dung (Point Reyes 1990). RDM is an important constituent in protecting soil form erosion, improving soil fertility, structure and infiltration rate, and in providing beneficial surface conditions for plant growth (U.C. Davis 1998).

  Assessments of EBMUD's rangelands have been made over the past several decades through evaluations that measure the capability of the land's current abundance, diversity, and vigor of the plant community it supports. The results are then compared to the theoretical potential for a given site or habitat. Range condition is rated as excellent, good, fair or poor, and trends or change in condition is subjectively and objectively estimated. Some factors that determine range condition include types and numbers of different plant species, plant vigor, reproduction, age class, soil erosion, litter cover and other site factors. Estimations of ground cover (%), residual dry matter (RDM, lb.) and species composition are useful and reliable techniques for evaluating range health that are used routinely on EBMUD rangelands.

- **RDM Standards: Heavy, Moderate and Light**

  In the EBWMP EIR, The University of California Cooperative Extension provided reccomendations for RDM levels for EBMUD lands. However, EBMUD developed RDM standards that exceed (2x) the U.C. standards. These standards are listed in table 2.3 for

comparison.

EBMUD determined that the upper threshold for moderate grazing has been reached when RDM levels measure 900-1,400 lbs./ac, adjusted for slope. Light grazing is defined as rangelands with RDM levels greater than District standards, and heavy grazing as rangelands with RDM's below these standards. Particular consideration must be given to controlling access by livestock, especially females with nursing young, to open water and associated riparian zones. Late spring and early summer grazing may present the least risk to water contamination. See EBWMP Guidelines WQ.7, WQ.35, LG.7, and LG.11 in Appendix C.

Table 2-3. ***Heavy, Moderate and Light Grazing RDM's. EBMUD standards and University of California Cooperative Extensive Standards.***

SLOPE	Heavy Grazing	Moderate Grazing	Light Grazing	U.C.C.E.
Level	0-840	840-1180	1180+	400
Moderate	0-1120	1120-1570	1570+	600
Steep	0-1400	1400-1950	1950+	800

2.8.2 Control of Pathogens and Livestock Waste Concentration

Livestock will be managed to minimize the discharge of protozoan pathogens into the water supply above the natural background level on EBMUD lands. This will be achieved by controlling access of livestock to water bodies. The time livestock spend in or very near water has a direct influence on both the deposition and re-suspension of microbes and thus the occurrence and extent of downstream pollution of water. Development of alternate water supplies for cattle can reduce the time animals spent in the stream from 80% to 90% (Miner 1992 and Swanson 1994). Controlling access of livestock to water bodies can mitigate this activity. Unless feces are deposited in or immediately adjacent to a streambed, there is little

danger of significant bacterial contamination from overland flow. For example, under simulated rainfall conditions on grass sod bacterial loads are reduced 95% only seven feet from a feces deposit (Swanson 1994). In soil, FC and FS survival varies with environmental conditions, from two or three days in the summer to more than 20 days in winter. Doyle, et al. (1975) found no significant movement of FC and FS populations or N and P further than 3.8 meters (12.3 ft.) from source manure. Buckhouse and Gifford (1976) found that only the fecal patch and surrounding one-meter radius were subject to bacterial pollution and suggested that "unless feces are deposited in or adjacent to a streambed, there is little danger of significant bacterial contamination" [of water].

2.8.3 Riparian Buffers

Use of riparian buffers, or strips of relatively undisturbed vegetation along watercourses is one of the most effective practices used to protect water supplies. Overall they are rated as 65% to 70% effective in protecting water quality. They act as pollutant filter strips on slopes up to about 20% and can filter from 50% to 90% of the sediment, nitrogen and phosphorus and bacterial concentrations in surface runoff except in flood years. To insure protection of terminal reservoir water quality, fenced buffer strips of approximately 100 feet width are being implemented in a phased priority program as a District standard.

The criteria used to develop creek protection priorities are:

1. Water quality;
2. Habitat protection for endangered species; and
3. Habitat protection for other listed species.

Following these guidelines, over the past several years, EBMUD has fenced out all the major tributary creeks that faced potenial impacts from grazing. Thus the creek riparian resources have been protected through this measure.

See EBWMP Guidelines WQ.20, WQ.25, LG.1 and LG.7 in Appendix C.

3.0 Introduction

There are many interpretations of biodiversity. In a general sense, biodiversity refers to the assortment of life on earth and includes plants, animals and insects. It is the blanket term for the natural biological wealth and foundation of human life that promotes well-being. According to The Keystone Center (1991), "Biodiversity is the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting" (Noss and Cooperrider 1994).

However, it is not necessarily the sheer number of elements (species and natural community types) found within a given area (often referred to as "species richness" and "community richness"), but rather the quality of those elements relative to the natural ecological processes of a region (Knopf and Samson 1993). Therefore, it is essential to identify those elements that are intricately tied to the processes of an ecoregion and for which the ecoregion offers a significant or perhaps only chance for long-term survival (i.e., those elements that are endemic or mostly endemic to the region).

Preservation of biological diversity, which is desired, is dependent upon a systematic approach to management of natural resources. This approach is a concept wherein land management and use activities are considered within the context

of economic, ecological and social interactions and in which the ecosystem maintains its composition, function, structure, productivity and community diversity over time (Flick and King 1995). In addition to scientific facts, community values and shared visions are separate yet important components in determining feasible, adaptable management options in ecosystem management (Burnside and Rasmussen 1997). Implementation of ecosystem management is specifically directed by the EBWMP as an objective to maintain and enhance biodiversity on District Lands (EBMUD 1996).

3.1 Biodiversity

Most commonly, discussions of biodiversity consider all the organisms that interact with each other in an extended geographical region. In addition, biodiversity must also address the ecological patterns and processes that maintain that diversity. Any discussion of biodiversity must be related to the degree that disturbance regimes remain intact, the functional intactness of remaining habitat, the presence of the full suite of native species, and the representation of elements across their natural range of variability (Grumbine 1994).

The EBWMP (1996) defines biodiversity as *"the variety and variability among living organisms and the ecological complexes in which they occur*". An important objective of the EBWMP is to maintain and enhance biodiversity on District lands. Successful preservation of biological diversity is dependent upon an ecosystem-based management strategy that will maintain the composition, function, structure, productivity, and community diversity of natural resources over time. In general, in depauperate areas, light to moderate grazing may produce an increase in species composition, and/or diversity, while heavy grazing may decrease this richness.

Maintenance and enhancement of species diversity should consider the substantial number of well-adapted and valuable exotic species that are permanent residents in addition to, and often at the expense of, native species of flora and fauna. According to the EBWMP (1996), the ecological value and likely permanence of certain nonnative species and habitats must be recognized and their management incorporated into biodiversity

planning efforts.

3.1.1 Areas of Significant Biodiversity

Three locally rare habitat types, riparian with associated water (ponds, streams,) oak savanna, and native grasslands, occur within grazeable areas and are not protected by topographic isolation. These habitats are potentially sensitive to grazing.

Table 3-1. ***Areas of Significant Biodiversity and Sensitive Habitats Within Fenced, Grazeable Lands of EBMUD.***

FEATURES	WATERSHEDS NORTH	SOUTH	TOTAL
Area of Significant Biodiversity	1,782	1,890	3,672
Riparian Types (acres):			
Herbaceous/Bare	101	31	132
Mixed Woodland	185	236	421
Willow	25	14	39
Oak Savanna (acres)	267	72	339
Streams (miles)			
Intermittent	79.4	61.1	140.5
Perennial	7.6	7.2	14.8
Ponds (number)	77	37	114

Source: EBMUD (1997); unknown portions of features given are included in the area of significant biodiversity. Fresh water marsh (36 acres) is associated with reservoirs or otherwise excluded; an insignificant area occurs within grazeable land.

3.1.2 Riparian

Riparian woodlands occur in ribbon-like bands along perennial and seasonal streams and rivers. Although this community is comprised primarily of wetland species and accounts for less than one percent of California's total forest acreage, it supports one of the most diverse ecological communities of plants and animals.

The relative significance of riparian zones to animal biodiversity is widely recognized and documented. Almost 80% of the wildlife in the West depends on healthy riparian systems for at least part of their life cycle. Proportionately high populations and species diversity of birds, small mammals and herpetofauna live in riparian zones as compared to uplands.

The primary determinants of stable and healthy riparian ecosystems are the presence of water and maintenance of an adequate vegetation corridor, which includes both the herbaceous and woody canopy. The latter functions to stabilize soil against erosion, filter sediment, and dissipate stream flow energy. The canopy also provides shade to stabilize water temperature, and supplies the bulk of living and detritus organic matter, which supports aquatic life.

3.1.3 Oak Woodlands and Savanna

Oak woodlands and savannas are essential habitat to a wealth of organisms. The California coastal oak woodland community (20-80% canopy) is rich in biodiversity with more than 262 species of amphibians, birds, mammals and reptiles and hundreds of plant species, including forty of special-status.

Savanna communities (0-20%) are similar to woodlands except that the trees are more widely spaced and the under story is almost entirely dominated by various species of grasses and forbs. Basically, savanna is grassland with scattered individual trees. Climate is the most important factor in creating savanna. Savannas are always found in warm or hot climate where annual rainfall is from about 50.8 to 127 cm (20-50 inches) per year.

The survival of live oak (*Quercus agrifolia*) and valley oak (*Q. lobata*) communities on EBMUD lands is critical to diversity of plants and animals at both the species and community levels. The factors than can influence oak regeneration includes insects, disease, overgrazing (see section 3.3.4) and wildlife (eating the acorns and seedlings). Also, competition for moisture is a primary influence on seedling mortality.

3.1.4 Native Grassland

A third area of significant biodiversity is native grassland, which is characterized as lands dominated by grasses rather than large shrubs and trees. Native perennial grasses are important to biodiversity for many reasons. Their deeper root structure cycles more nutrients, stabilizes more soil, and contributes more organic matter to soil than annual plants. Green forage is provided for wildlife and livestock in the summer and fall seasons, and the shorter dormant period for perennial grasses shortens the fire season. Native plants also add diversity and essential habitat structure to the local flora and dependent fauna. Overgrazing, drought, and introduction of European annual grasses are considered the primary factors that led to the conversion of native grasslands to annual exotic grasslands in the 1800's.

Remnants of native grasslands with accompanying native forbs exist on the EBMUD north and south watersheds. The presence (or non-presence) of these grasses is dependent upon many factors, including grazing.

Native grasslands exist in ungrazed as well as grazed areas, which demonstrate some tolerance for livestock grazing. However, native perennial grasses are potentially susceptible to impacts from intensive grazing regimes.

3.1.5 Special Status Species

Endangered species means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant, which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (Fish and Game Code Section 2050-2068).

Twenty-nine animal species and ten plant species are of special-status or concern on EBMUD lands (EBWMP 1996, FWS 2001). Since the development of the EBWMP, Steelehead have been added to the special status species list and the Canada Goose has been removed. However, the goose is still of special concern and will be monitored as required by law.

Of the animal species, only six are potentially impacted by livestock, primarily through the deleterious effects of moderate to heavy grazing on their habitats (see tables 3.4 and 3.5).

The remaining twenty-three species are mostly carnivorous, insectivorous or raptorial birds. They are primarily winter migrants that enjoy adequate ungrazed habitat, or grazed habitat where managed livestock most likely exert either insignificant or possibly benign impacts on their livelihood.

3.2 Grazing and Biodiversity

A vast majority of rangeland forages produced by EBMUD watersheds for commercial cattle and recreational horses are provided primarily by portions of the open grassland communities that occur within fenced grazing leases of the District (EBMUD 1997a). These grasslands provide significant

yields of water and lease revenue, wildlife habitat and aesthetic values, as well as feed for wild and domestic animals. Additional herbaceous livestock forages and limited browse are available from oak savanna, cultivated field crop residue and the herbaceous, willow and woodland riparian communities that occur within lease areas. Goats utilize grassland and specific portions of chaparral and coastal scrub communities under a prescribed fire hazard reduction program. In addition to domestic livestock, black-tailed mule deer, feral pigs and a variety of small herbivorous mammals, including ground squirrels, mice, rats, and rabbits, reptiles and amphibians, cohabitate EBMUD grasslands (Stebbins 1996).

Of 28,124 total acres in the District, approximately 21,100 acres are fenced for grazing lease and have the capacity to provide approximately 10,000 AUM's of livestock forage in an average rainfall year (EBMUD 1997a). Average AUM's and Low AUM's are calculated by using a GIS program developed specifically for EBMUD's range resource management program. The average AUM calculation refers to the number of AUM's available in average rainfall years and the low AUM calculation refers to the number of AUM's available in low rainfall years. Management AUM's are the amount actually contracted to the lessee. Management AUM's take into account actual field conditions, GIS calculations, and current and future weather conditions.

Table 3-2. ***Summary of Total and Grazeable Acreages for Principal Grazeable Plant Communities of EBMUD Watersheds.***

Plant Communities	Acreages Total Watershed	Acreages Total Grazeable
Grassland	9,836	9,126
Oak Savanna	419	339
Cultivated	266	266
Riparian	817	592
Others	16,786	0
Total	**28,124**	**10,323**

[1] Excludes fresh water marsh (36 acres), but makes no account of existing, excluded riparian areas.
[2] Includes all other plant communities, open water and developed areas; grazed/grazeable area within these accessible acres (10,777) is unknown.

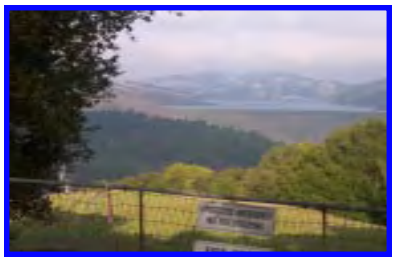


Table 3.3 presents a comparison of rangeland animals typically found on the EBMUD watersheds. Evaluation of past, present, and potential grazing impacts and stocking rates may use these kinds of information.

Table 3.3. ***Approximate or Median Values for Characteristics of Typical Mature Ungulate Rangeland Animals on a Year-Round Basis.***

	Dietary Preference %			Body	Head	Daily Requirement	
Animal	Grass	Forbs	Browse	Wt. lb.	Per AU	Forage, lb.	Water, Gal
Horse	90	1	9	1,100	0.8	15.5	10-14
Beef Cow	82	9	9	1,000	1	25	10-18
Beef Steer	82	9	9	600	1.7	14	6-10
Feral Pig	30	43	27	150	4.5	6.5	1-2
Mule Deer	6	7	87	150	4.5	3.8	1-2
Sheep	60	17	23	130	5	3.5	1-2
Goat	39	13	48	100	6	4.2	1-2

Source: Leach and Hiehle (1957), Malecheck and Leinweber (1972), Heady (1975), Stoddart, et al. (1975), Hubbard and Hansen (1976), Olsen and Hansen (1977), Hansen, et al. (1977), Ensminger and Olentine (1978), Barrett (1978), Bryant, et al. (1979), Kasworm, et al. (1984).

Forage: Air dry weight basis; average, all sexes, activities.

NOTE: Forbs include roots, bulbs; browse includes acorns.

3.3 Impacts on Rangeland Biodiversity

It is commonly believed that heavy livestock grazing has a negative impact on rangeland biodiversity, while light to moderate grazing may increase species composition, and/or diversity. These potential negative impacts are primarily the result of "excessive" or "over" grazing. Commercial and recreational domestic livestock impact rangeland vegetation cover and soil surface. The extent of the impacts is a function of the type of animal, the stocking rate, and period of grazing. Conversely, there is documentation of proper grazing practices actually promoting species diversity in certain applications. When annual grasses and other tall-growing plants are grazed back, sunlight can reach the lower-growing ones that would have otherwise been shaded out. In other situations, grazing benefits some special-status plants, which reduces competition by associated, palatable plants.

The EBWMP specifically states that continuous, year-round grazing has the potential to degrade biological resource values by damaging wetland, riparian and other sensitive habitats, eliminating sensitive plant species, and encouraging the spread of noxious weeds. The EBWMP directs that the grazing program be refocused to reduce impacts on biodiversity, and that overall livestock numbers be reduced from historical levels to enhance biodiversity on watershed lands.

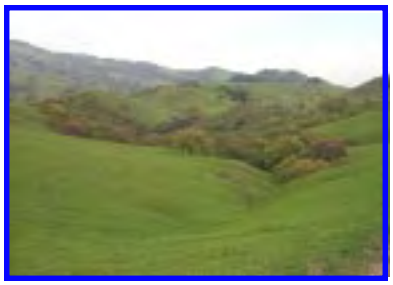
A number of biologically diverse and sensitive habitats occur outside grazeable areas and will not be subjected to livestock impacts. Topographic isolation provides some essential refuge from impacts for those areas of significant biodiversity that occur within grazing allotments. In addition, under direction of the EBWMP, sensitive riparian habitat has been outfenced from grazing, and continues to improve in condition and function.

3.3.1 Grazing Impacts and Special Status Species

To date, field surveys have accounted for 10 plant species and 29 animal species listed as Federal, State or CNPS-listed, and therefore are classified as special-status species on EBMUD lands (Stebbins 1996, EBMUD 1996, FWS 2001).

No research is available which documents the extirpation of either a plant or an animal species by grazing impacts, although anecdotal evidence exists that certain special-status species are negatively affected by grazing. Examples are provided by the highly palatable and trampling-sensitive *Trifolium longipes* ssp. *neurophyllum* of Arizona (Ladyman 1995) and *Trientalis arctica* of California (CNPS 1994). And, heavy livestock grazing and browsing of riparian vegetation nesting habitat has been implicated in the decline of two listed birds, the yellow-billed cuckoo (*Coccyzus Americanus occidentalis)* and the least Bell's vireo (V*ireo bellii pusillus)* (Thelander 1994).

Section 3.4 describes the measures EBMUD has taken to protect special status species and sensitive habitats.



3.3.2 Special Status Plant Species

Table 3-4 presents the special-status plant species currently listed as inhabitants of EBMUD lands, with an evaluation of the potential impacts of livestock on each. This evaluation is made based upon best professional judgment and pertinent information from Dayton (1937), Hormay (1940), Hermann (1966), Hickman (1993), CNPS (1994), EAEST (1994), EBMUD (1996), and Stebbins (1996).

Only three of the ten plants listed present concern relative to potential grazing impacts: *Calochortus pulchellus, C. umbellatus and Helianthella castanea*. All three are perennials of considerable, recognized palatability.

Of particular note of the species in Table 3-4 is *Holocarpha macradenia*. This tarplant is very closely related (morphologically and cytogenetically) to, and may be a coastal ecotype of *Holocarpha virgata* (Palmer 1986), a prolific rangeland weed (Winans and McKell 1963). Plants such as the Santa Cruz tarplant benefit from grazing through the removal of cool-season competitors, which results in an increase in sunlight. The Mt. Diablo fairy lantern (*Calochortus pulchellus),* the Oakland star tulip (*C. umbellatus),* and the Diablo sunflower *(Helianthella castanea)* are special status plants that can be damaged by livestock. Grazing in areas where these plants are found will generally be deferred in winter and spring.

Table 3-4. ***Special-Status Plant Species of EBMUD Lands and Potential Impacts of Livestock Grazing.***

SPECIES	POTENTIAL FOR IMPACTS
Amsinckia lunaris (Bent-flowered fiddleneck)	LOW: Annual herb, bristly-hairy; habitat: grassland; genus of limited palatability[1] to cattle and goats (10%) only in seedling stage; negligible impact by horses; Briones and Lafayette watersheds; no grazing threat given by CNPS.
Arctostaphylos pallida	NONE: Evergreen shrub, rigid foliage; habitat: chaparral or wooded areas; genus (Pallid manzanita) unpalatable (0%) to cattle and horses, sparingly used by goats; communities generally in areas unsuitable or inaccessible to livestock; one population, USL watershed; no grazing threat given by CNPS.
Calochortus pulchellus (Mt. Diablo fairy lantern) and *Calochortus umbellatus* (Oakland star-tulip)	MODERATE: Bulbous, glabrous herb; habitat: grassland, chaparral, woodland; genus of 20-30% palatability, early foliage; highest use by goats, least by horses; both species occur on rocky ridge, USL watershed; *C. pulchellus* and other species threatened by grazing(CNPS); monitoring of grazing impact and management or protection justified.
Circium andrewsii (Franciscan thistle)	LOW: Biennial herb, cobwebby, spiny; habitat: upland wooded riparian; genus 0-10% palatable, primarily to horses, cattle; one population in San Pablo watershed; grazing impact uncertain, may be benign; no grazing threat given by CNPS.
Dirca occidentalis (Western leatherwood)	NONE: Deciduous shrub; habitat: shaded upland forest and riparian; palatability unknown but unlikely; occurs in San Pablo watershed in localized areas unsuitable for livestock use; no grazing threat given by CNPS.
Helianthella castanea (Diablo sunflower)	MODERATE: Perennial herb from a tap root; habitat: grassland and associated woodland, chaparral; genus of low (10%) to fair (30%) palatability for cattle and horses to good (40%) for goats, flowers relished; widely found in Pinole, San Pablo, USL watersheds; threatened by grazing (CNPS); monitoring of grazing and management or protection justified.

Table 3-4. ***Special-Status Plant Species of EBMUD Lands and Potential Impacts of Livestock Grazing. (Continued)***

SPECIES	POTENTIAL FOR IMPACTS
Holocarpha macradenia (Santa Cruz tarplant)	NONE: Annual herb, glandular, scented; habitat: grassland; genus of very low palatability (<10%) only as a seedling; one population in Sather Canyon, San Pablo watershed; could be favored by grazing of competition; no grazing threat given by CNPS.
Juglans californica var. *Hindsii* (California black walnut)	NONE: Deciduous tree; habitat: riparian woodland; no documented palatability of genus to livestock; habitats; one population in Kaiser Creek, USL watershed; no grazing threat cited by CNPS.
Monardella antonina ssp. antonina (San Antonio monardella)	NONE: Perennial herb; hairy, odoriferous; habitat: woodland, chaparral; very lowpalatability except to goats; woodland, occurs outside of grazing lease area; no grazing threat to *Monardella* spp. given by CNPS.

[1] The relative degree to which a plant is selectively eaten under moderate stocking rate as % by weight of current foliage.

3.3.3 Riparian Habitat

Improper livestock grazing and browsing of riparian vegetation, with the associated trampling of stream banks, can affect stream channel morphology, shape and quality of the water column, and structure of the soil portion of the stream bank. Heavy grazing decreases riparian vegetation and can impair water quality, but increases water temperature and stream bottom fine sediments. This in turn decreases desirable, native aquatic organisms, particularly salmonid fishes, as well as terrestrial wildlife dependent on riparian habitat.

Any amount of grazing, particularly at high intensity (stocking rate) for short periods when riparian soils are wet, will result in serious damage. Furthermore, exposure

of riparian zones to summer and fall grazing during the dry, warm season will invariably result in livestock concentration and damage where water, shade and green forage are available. The traditional practice of creating "riparian pastures" is not applicable to District watersheds in which protection of municipal reservoir source waters are of concern.

Section 3.4.3 describes the measures EBMUD has taken to protect riparian habitat. Specific management measures are identified in the AMP's (appendix K) for each allotment.

3.3.4 Oak Woodland and Savanna

Although palatability of live oak and valley white oak is rated as "poor to useless" for cattle and horses, livestock eat acorns, oak foliage and seedlings, and can trample young trees. Overgrazing by livestock can affect oak reproduction and can cause rapid breakdown of fallen branches and leaf litter. Important to native fauna, these potential negative impacts can provide a sensitive measure for biodiversity goals in oak woodlands and savanna.

Section 3.4.7 describes the measures EBMUD has taken to protect oak woodland and savannah habitats.

3.3.5 Special Status Animal Species

Table 3-5 presents a summary of the potential impacts of livestock on habitat alteration and management of the six animal species of concern. This evaluation is made based upon information from Reiser and Bjornn (1979), Platts (1981), Jones & Stokes (1989, 1991), Kie and Loft (1990), USFWS (1990, 1991, 1994, 1996, 1997), Thelander (1994), Jennings and Hayes (1994), Stebbins (1996), EBMUD (1996, 1997), CDFG (1997).

Section 3.4.8 describes the measures EBMUD has taken to protect special status animal species.

Table 3.5. ***Summary of the Potential Impacts of Livestock on Habitats of Six Special-Status Animal Species that occur within EBMUD Watershed Lands.***

SPECIES	POTENTIAL IMPACTS
Branta canadensis ssp. leucopareia (Aleutian Canada goose)	NONE: Significant beneficial effect on feeding/ pasturing winter habitat November-February. No apparent adverse impacts on roosting/ resting wintering habitat of open water, shoreline and open, green fields since geese are benefited by short cover while avoiding raptorial and terrestrial predators. Livestock not a disturbance factor; moderate grazing by cattle to promote young, palatable green herbaceous foliage for migrating adult geese is desirable on grasslands. Found and monitored by USFWS and EBMUD Fisheries and Wildlife Dept. in Pinole and San Pablo watersheds.
Clemmys marmorata (Western Pond Turtle)	HIGH: Potentially significant adverse impact on nesting (burrowing) habitat within one-quarter mile of feeding habitats in perennial, slow or quiet water. Frequent livestock grazing or trampling activity on southerly slopes with heavy soils is detrimental to nesting and incubation April-September. All ages dependent on shallow water with submergent plants and insect prey; tolerant of dense and sparse riparian plant cover. Complete exclusion or deferment of grazing of critical habitat April-November may provide optimal protection for aquatic and nesting habitats. Present in all District watersheds.
Masticophis lateralis ssp. *euryxanthus* (Alameda whipsnake)	LOW: Insignificant effects of grazing since primary whipsnake habitats of steeper (>30% slope) chaparral, coastal scrub and rock outcrops are unsuitable or little used by cattle and horses. Minor potential and possibly benign impact on marginal upland savanna and riparian habitats of cohabitation. No documented negative impact of livestock on the species or its habitat, although brushland browsing and trampling activities of goats suggest potential harm during period of whipsnake activity April-November. Found in both north and south watersheds.

Table 3.5. ***Summary of the Potential Impacts of Livestock on Continued.***

SPECIES	POTENTIAL IMPACTS
Oncorhynchus mykiss	HIGH: Significant negative effects of heavy grazing(steelhead/rainbow trout) and browsing on stream morphology, riparian habitat and water quality potentially resulting in inadequate stream bank herbaceous and woody canopy cover, and excessively high water temperature (>58°F), turbidity (>25NTU), stream bottom fine sediments, and possibly low dissolved oxygen content (<6.5 mg/l) for migration, spawning and rearing of young. Deteriorated habitat should be protected from livestock; light grazing in the late spring (only) may be possible with minimal impacts on healthy stream riparian habitat under optimal and controlled conditions. Species found in Pinole and USL watersheds.
Phrynosoma coronatum (California horned lizard)	LOW: Most likely insignificant adverse impacts; No negative impacts of livestock are suggested by authorities.[1] Inhabits primarily dry sites of loose, sandy soils, thin or open herbaceous and shrubby plant cover less likely to be grazed. Active April-July.
Rana aurora ssp. *Draytonii* (California red-legged frog)	MODERATE: Negetive cumulative impacts of trampling, heavy grazing and browsing on essential breeding and sheltering habitat, including emergent aquatic plants and dense riparian herbaceous and willow cover of stock ponds and pools of slow-moving streams. Partial permanent protection from livestock or extended deferment of use from fall through mid-spring is desirable for recovery of depleted stream habitat and optimal protection during the breeding period. Species is tolerant of light to moderate grazing which will maintain habitat for the frog and its prey base up to a mile from permanent open water. Found in Pinole Creek watershed and San Pablo, USL, and Chabot watersheds.

[1] State CSC, but no information available from E. Loft, J. Brode of CDFG, Sacramento.

3.4 Managing for Biodiversity

Livestock grazing and rangeland practices that pertain to water quality protection also apply to habitat protection, maintenance and enhancement of biological resources. This relationship is particularly true for riparian and aquatic habitats when livestock access is excluded by establishing buffer zones, and by the development of alternate upland stock water supplies. Prescribed grazing, exclusion of livestock use, and fencing provide control of location and timing of livestock impacts, and are commonly used to protect and enhance plant and animal diversity. In addition to these practices, the establishment of proper stocking rates and judicious monitoring form the basis for biological resource management on grazed watershed lands.

The EBWMP identifies high-priority sites for habitat restoration based primarily on water quality protection and the value of restored habitats as important wildlife use areas and corridors. It also directs that habitat for threatened and endangered species be enhanced as financially feasible. Prior to implementation of specific protection measures the life history, habitat requirements, potential impact of livestock, and specific location of a management priority species must be thoroughly investigated. See EBWMP Guidelines BIO.8, BIO.9, BIO.21, Bio.22, LG.1, LG.6, and Tables 2-5 and 2-6 in Section 2.

3.4.1 Management Measures and Best Management Practices

Management measures identify goals to control NPS pollution and protect rangeland biological resources. Linked to each Management Measure are a series of Best Management Practices (BMP). The BMP's support the protection of both water quality and rangeland habitat biodiversity goals. A complete list of BMP's are in Appedix A.

BMP's are practices applied alone or in combinations to address specific Management Measures. All BMP's have been determined by the State of California to be the most effective and feasible means of controlling point and nonpoint

pollutants at levels compatible with environmental water quality goals.

Measures 1, 2, and 3 (listed in section 2.5) relate to NPS pollution management, measures 4, 5, and 6 relate to habitat management for animal and plant species of concern, including domestic livestock and forage plants as components of the ecosystem, and 7 and 8 refer to the protection and preservation of sensitive cultural and visual resources.

The measures apply to all EBMUD rangelands and can be achieved by identifying and implementing the appropriate BMP's individually or in combination that apply to specific potential impacts on individual allotments.

3.4.2 Biological Monitoring

A biological survey program has been established to monitor and track both flora and fauna on EBMUD lands. The program's main goal is to provide a scientific basis for arriving at land management decisions including grazing levels that may affect the District's plant communities and wildlife.

Nearly 300 species of vertebrate animals and 684 species of flora have been identified as present or expected on EBMUD watersheds. Ten plant species and twenty-nine animal species are Federal, State or CNPS-listed and are thereby stipulated as special-status species. These and numerous locally rare, indicator and keystone species are referred to as "management priority species". In some situations, light to moderate grazing of terrestrial grassland habitats can favor plant diversity and may not have significant negative impacts on diversity of associated vertebrate wildlife.

Identification of areas of significant biodiversity is directed in the EBWMP. These areas are surveyed and mapped and the data is stored in a GIS. The GIS includes key

habitats of high biological value, special-status plants and animals and is used as an aid in the protection and management of these areas.

3.4.3 Protection of Sensitive Habitats

In general, light to moderate grazing of grassland, oak woodland and savanna habitats can potentially promote plant and associated vertebrate wildlife diversity. Preservation of good vegetative cover is achieved by using light to moderate grazing or by resting pastures. In certain situations, water quality goals rather than promotion of species diversity dictate the grazing regime. For example, if a higher vegetation coverage is required on slopes to prevent increased erosion, but reduced vegetation on the same site would promote perenial grasses, water quality goals will prevail.

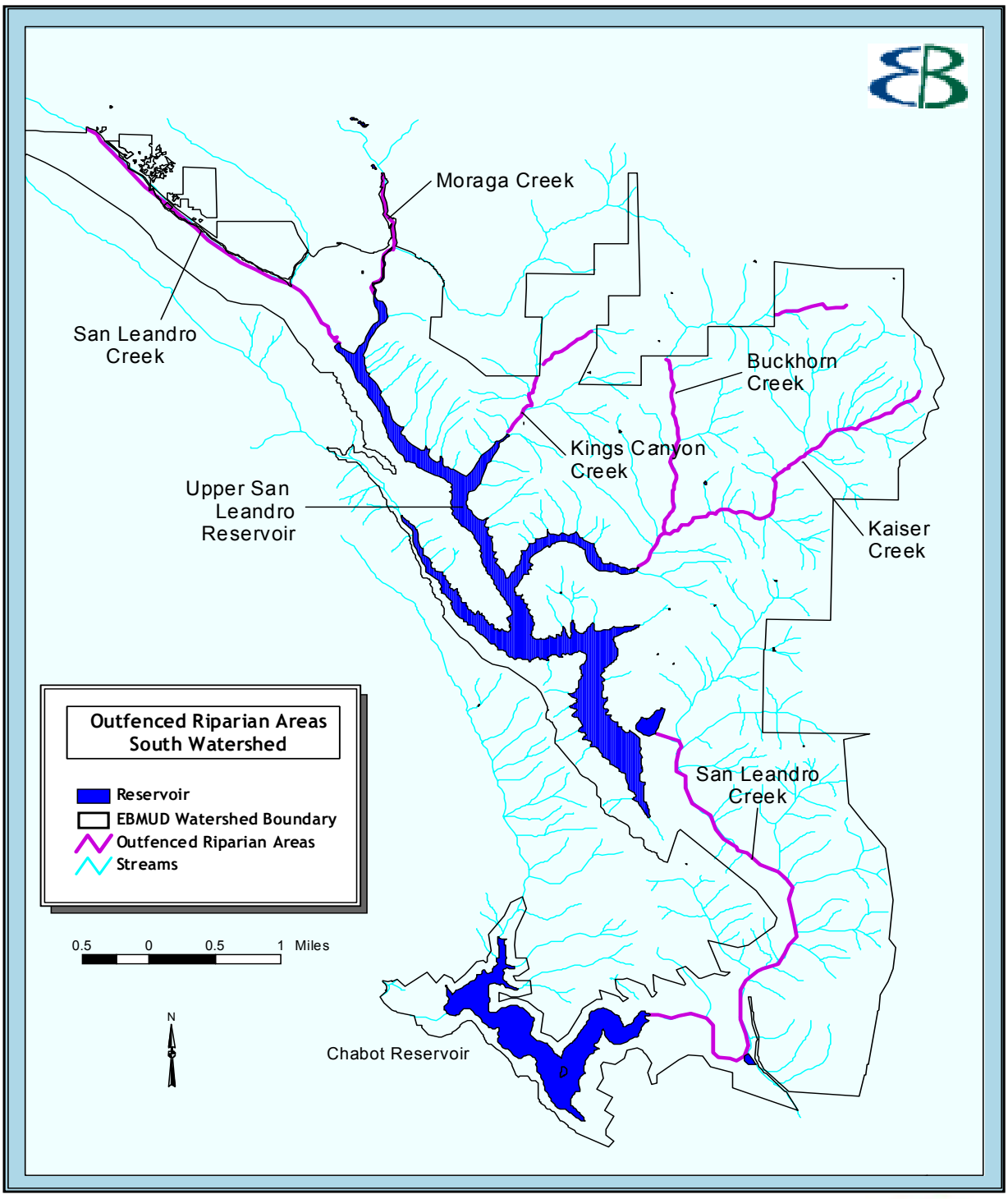
Direction for the Identification, protection and management of these areas is contained in the EBWMP water quality goals section. See EBWMP Guidelines LG.1, LG.6, and LG.11.

3.4.4 Protection of Riparian Habitat

For high quality aquatic habitat and productivity, livestock management must provide for maintenance of streamside (or pond) canopy and bank vegetation to avoid an unacceptable increase of water temperature and to provide food and cover for wildlife.

Complete protection of riparian/aquatic habitat is most compatible with fisheries habitat maintenance and enhancement. To protect stream reaches, EBMUD out-fences the riparian habitat along streams and creeks. Fencing from 80 to 100 feet from the centerline of a creek, creates a "buffer zone" to moderate temperatures, provides food for aquatic invertebrates and reduces siltation and elevated nutrient loads. In the fall, vegetation will be adequate to provide for sediment filtering.

Fencing is complete along Oursan Creek, which flows into


Moraga Creek
San Leandro Creek
Buckhorn Creek
Kings Canyon Creek
Upper San Leandro Reservoir
Kaiser Creek
San Leandro Creek
Chabot Reservoir
Outfenced Riparian Areas South Watershed
Reservoir
EBMUD Watershed Boundary
Outfenced Riparian Areas
Streams
0.5 0 0.5 1 Miles
N

San Pablo Reservoir, and Kaiser and Buckhorn Creeks that are tributary to USL Reservoir. To protect red-legged frog, western pond turtle, and steelhead trout habitat, the lower reaches of Pinole and Simas Creek, with their associated ponds and wetlands, have also been outfenced.

See Outfenced Riparian Area Map on page 3-19.
See EBWMP Guideline LG.1 in Appendix C.

3.4.5 Protection of Stock Ponds

Stock ponds, which were created in the early 20th century by ranchers, promote better distribution of foraging cattle, takes "pressure" off natural riparian water sources, and with grazing, have created valuable supplemental and replacement habitat for special status species and other wildlife. Efforts toward environmental protection must be planned and implemented in accordance with water quality and biodiversity goals. The management measures will be applied to native habitats as well as artificial enhancements such as stock ponds.

3.4.6 Implementation of Creek Restoration Projects

Since 1993 the District has integrated its restoration efforts with an interpretive education program that involves students from local schools. Classes grow plants from seed and then plant their seedlings or cuttings in restoration sites on the watershed previously identified by EBMUD staff as creeks with disturbed and/or impacted riparian areas. Participants who volunteer in the late spring or summer, mulch and weed around plantingS along the creeks.

Creeks within the terminal reservoir basins take priority for restoration over those outside these basins. Restoration is achieved by using low-impact, bio-engineered methods. Willows, alders and cottonwoods are planted in the creek beds, and valley oaks, live oaks and buckeyes are planted on the creek banks. To control erosion, the banks are stabilized using willow wattles, mulching, and willow bundles. Electric fencing is installed around restored sites

that are within planned grazing areas. Follow-up monitoring is conducted to determine restoration success and replanting needs.

Through these hands-on classes, students gain direct experience restoring the environment and have opportunities to view and learn about wildlife. Their teachers incorporate the visits with their curricula, so students can relate their classroom learning to problem solving in the real world. Through this program, the District builds relationships with local schools and teachers who have made the creek restoration project an integral part of their annual course work. Many return with their students year after year.

See EBWMP Guidelines EE.1, EE.2, and VR.5 in Appendix C.

3.4.7 Protection of Oak Savanna

Due to the important habitat that oak savannas provide, the District has implemented a program for monitoring the density and growth of oaks within these communities (see Section 4.4 for description of monitoring program).

Oak Savanna communities provide significant herbaceous forage on some grazing leases of EBMUD. Where riparian communities are not a constraint, consideration will be given to grazing with cattle or horses at light to moderate rates from late fall until middle March, followed by deferment thereafter to promote oak recruitment.

Under properly timed grazing management, damage to oak seedlings by cattle and horses that prevent seedling establishment can be minimized.

Limiting grazing to the early season discourages rodent populations, leaves higher soil moisture for oak seedling

growth, and avoids potential selective browsing of seedlings after forages are mature in late spring (U.C. Davis 1996).

Total exclusion of livestock from savanna is generally not warranted unless there is insufficient recruitment of oak seedlings to maintain the habitat. In order to evaluate the progress of seedling recruitment a long-term monitoring program has been established. See Section 4, Monitoring of Grazed Rangelands.

With light to moderate stocking, little or no feeding by cattle occurs under canopies of evergreen (live oak) trees where the herbs are of low palatability to livestock.

See EBWMP Guidelines EE.1, EE.2, and VR.5 in Appendix C.

See EBWMP Guidelines BIO.5 and BIO.8 in Appendix C.

3.4.8 Protection of Native Grasslands

The goal of this plan is to maintain or enhance the current native grasslands for their ecological value. Grazing rotation systems and burning may provide some promise for enhancing native populations, and experiments with management practices will be encouraged and closely monitored for success or failure. In light of the current knowledge, heavy grazing of native grasslands should be avoided, and closely monitored light to moderate grazing with periodic rest is recommended because it may enhance native perennial grass vigor.

Grazing will also be used to retain current levels of runoff by maintaining grassland communities, which provide greater runoff than scrublands or forests. Site Conservation Threshold RDM Levels of 900 lbs./acres, 1,200 lbs./acre, and 1,400 lbs./acre RDM and 70% total cover density will be followed to ensure adequate protection of watersheds and water quality on grazed lands.

A second important objective of the RRMP is the

maintenance and enhancement of the grassland habitat mosaic. Studies indicate that light to moderate grazing of terrestrial grassland habitats favors plant diversity and may not have significant negative impacts on diversity of associated vertebrate wildlife. In addition, managed livestock grazing can be an effective tool for maintaining grasslands in addition to inhibiting brush encroachment, particularly coyote brush. This management strategy supports biodiversity and fire hazard mitigation.

See EBWMP Guidelines LG.1, LG.6, and LG.7 in Appendix C.

3.4.9 Protection of Special Status Species

For protection and enhancement of riparian and aquatic habitats of the red-legged frog, steelhead trout and western pond turtle, EBMUD identifies critical stream reaches and outfences them from grazing.

Vernal pool fairy shrimp (*Branchinecta lynchi*i) and the red-legged frog (*Rana aurora draytonii*), both listed species, continue to thrive in ponded waters of historically grazed grasslands of Central California (Jones & Stokes 1989; USFWS 1994, 1996).

High winter migratory populations of Canada geese, including the Aleutian, occur on moderately grazed ponds within the EBMUD watershed (USFWS 1997). The

4.0 Introduction

The management goals and objectives for EBMUD rangelands are to promote and ensure healthy and sustainable ecosystems through the enhancement and maintenance of biodiversity and water quality. The EBWMP (Guideline LG. 6 in Section 3) requires year round monitoring efforts conducted to assess the success of the RRMP. This continuous program improvement, or "adaptive management" ensures the continued success of the RRMP.

Data collected from these monitoring efforts serve as estimates of the conditions at the time the data was collected. It is from this data that recommendations and management strategies are developed and adopted to accomplish program goals. As conditions change, so do management strategies regarding efforts to minimize potential grazing impacts on EBMUD watersheds.

4.1 Range Monitoring Program Components

The District has been monitoring many of the grazing allotments for several decades. Presently there are twenty locations at which measurements of forage productivity, utilization, and range condition are recorded annually. Each monitoring location consists of a grazing exclosure and a 100-foot line transect permanently marked with steel posts or concrete monuments.

The sites were selected to represent the typical range site and utilization for a specific area or allotment. As part of the RRMP, existing site locations are periodically reviewed to confirm that they

accurately represent the allotment. Sites are relocated as necessary.

4.1.1 Spring Field Survey

Transects are sampled for range condition and forage production, in late April or early May, to determine the peak standing spring crop. In addition, plant biodiversity has been sampled since 1998, and is described in further detail in Section 5.4. Photo plots of each transect and exclosure are taken, and an equipment list is included in Appendix F.

- ***Range Condition***

The Range Condition procedure is one of several used to determine the general condition of rangelands and livestock carrying capacity for each allotment. Each allotment is sampled and ranked based upon forage quality as it relates to livestock consumption.

Using the Spring Field Survey Sheet (Appendix F), plant species are recorded at one-foot intervals on the line transect according to the line-point range monitoring technique. At each point, the rod descends perpendicular to the land surface, and the first plant it touches is recorded as the "hit" for that point. If no plant is touched, the hit is recorded as "soil".

Plant species are ranked for palatability to livestock according to forage class as desirable, less desirable and undesirable. The data are tallied and a range condition rating is calculated on the basis of the following formula (modified from USDA Soil Conservation Service 1962):

$$\textit{Range Condition} = \frac{(\%\ \text{Desirable species}) + [100 - (1/2)(\%\ \text{Less Desirable Species})] + [100 - (2)(\%\ \text{Undesirable Species})] + (\text{Total}\ \%\ \text{Cover})}{4}$$

This calculation incorporates both the total plant cover and the relative plant cover of the different species by

forage class. The results are categorized and recorded according to the following Range Condition Classes (modified from USDA Soil Conservation Service 1962):

Excellent	90-100%
Good	80-89%
Fair	60-79%
Poor	40-59%

- ***Forage Production***

Forage production is measured in the late spring to determine how much feed is available. In addition to the Range Condition ranking procedure, the results of this monitoring procedure help determine the annual carrying capacity for each allotment.

At peak standing crop, forage production is measured inside the grazing exclosure. Three representative samples are located and collected, using the 0.96 square foot circular quadrant. Unpalatable forage is not included in the sample, and disturbed areas such as gopher mounds are avoided. The sample should include all forage that is rooted inside the quadrant, and forage that is not rooted inside the quadrant should be separated out from the sample. Forage is clipped to the 1cm level and stored in a paper bag for several days or oven dried until the moisture has evaporated to achieve air-dry weight basis (ADWB). Then the samples are weighed and the measurements in grams are converted to lb./acre using the following conversion factor: **1 g/0.96 sq. ft = 100 lb./acre.** Measurements are recorded on the Spring Field Survey Sheet and notes of grazing utilization, erosion, and water improvements for the allotment are made.

Grazing exclosures are relocated in the fall to grazed areas in preparation for new Spring Field Survey sampling. Moving the exclosures provides production data that is representitive of a grazed rangeland.

MONITORING OF GRAZED RANGELANDS

- ***Plant Biodiversity Monitoring***

Of the many tools that measure biodiversity, EBMUD uses the Shannon-Weaver index, which combines information on both the number of taxa present in a collection and the abundance distribution among those taxonomic groups. This index number is calculated using the Belt Transect Method.

The Belt Transect is an estimate of relative cover taken over a 3-foot wide strip along the length of the 100-foot line transect (approximately 300 sq. ft. area). A list of all plant species within the belt transect are recorded. A trained botanist or range manager then estimates absolute cover of each species present. (Note: The sum of the absolute cover estimates for all species can exceed 100%, which allows for overlap of species.) Relative cover is calculated by dividing the absolute cover for each species by the sum total of the absolute cover of all species.

The Belt Transect Method is a comprehensive method that provides data for species and their approximate representation in the plant community at the transect site. It includes species that have been missed by the line-point method. Field survey sheets are included in Appendix F.

The formula for the Shannon-Weaver Index (H') is as follows:

$$H' = -\sum_{i-1}^{S} p_i \log p_i$$

Where:

H' = Index value used to serve as a measure for biodiversity.

- = Inverse function of Σ (sum), H' needs to be a positive value so value is changed from (-) to (+) value.

Σ = Sum of components occurring to the right of the symbol.

S = The number of categories.
pí = Relative abundance of individual species or the proportion of hits for an individual species out of the total hits for the transect.
Log pí = natural logarithm for each species

A summary of the equation is as follows:

pi is the relative abundance of individual species, or the proportion of hits for an individual species out of the total hits for the transect. The index value is calculated by taking the product of (pi) and it's natural logarithm (log pi) for each species, and then adding (å) the products together to arrive at the sum, H'. The sign of H' must be changed in order to make it a positive value. A sample calculation of H' is included in Appendix F. According to this index, the greater the value of H', the greater the biodiversity of plants present. For example, the values from nearby Briones Park reported in a 1997 study range from 2-3 for annual grasslands.

- ***Oak Woodland and Savanna Monitoring***

The monitoring program for oak woodlands is conducted through aerial photos and vegetative mapping which is converted to a GIS coverage. This information is then compared to previous mapping to determine the trend of hardwood communities. This process serves as a means for measuring the overall health and diversity of the hardwood community.

NORTH WATERSHED
SIMAS VALLEY

Prior to Outfencing 1992

After Outfencing 2001

4.1.2 Fall Field Survey

Range utilization is measured in the fall of each year prior to the onset of the rainy season to determine vegetative cover, hydrologic condition, and general range condition. The method used employs a combination of visual estimation, and clipping and weighing the RDM. Photos are also taken of each transect and exclosure. Problems such as distribution, accelerated erosion, and mass wasting (landslides) are noted. RDM mapping is conducted to record the forage utilization over each allotment. (See RDM Map page 7.) Grazing exclosures are relocated to unsampled areas during this time in preparation for the spring survey

samples. Survey sheets and an equipment list are included in Appendix F.

- ***Range Utilization***

  Measuring and estimating range utilization provides an overview of the range health of each allotment. It is also plays an important role in the development of each Annual Grazing Plan (AGP) by providing valuable data and information to allow for modification, change and adjustments if necessary. If problem areas are identified, corrective measures are incorporated into the next plan.

  The procedures for range utilization monitoring are as follows:

  1. To measure specific forage use, a circular 0.96 sq. ft. quadrant is randomly thrown ten times within 50 feet of the transect. Any forage the quadrant lands on, whether rooted inside the quadrant or not, is included in the sample. Mustards and thistles are excluded from the clippings, and do not count as RDM.

  2. The field crew estimates the weights of the first two samples before they are clipped to the 1 cm height and weighed on-site using a Pesola scale. The next eight samples are measured using visual estimation. The information is recorded on the Fall Field Survey Sheet and an average RDM level is calculated for each site. The measurements are taken when the forage is not wet since the ADWB is used. If new growth has started, green forage is not included in the sample.

  3. A visual survey of each allotment is completed and notes of grazing distribution, erosion, water conditions, and degraded areas are made.

  4. If the transect results are below site conservation thresholds as outlined in Section 2.1.2, RDM mapping of the entire allotment will be conducted. Otherwise mapping will occur every other year as described in the following section.

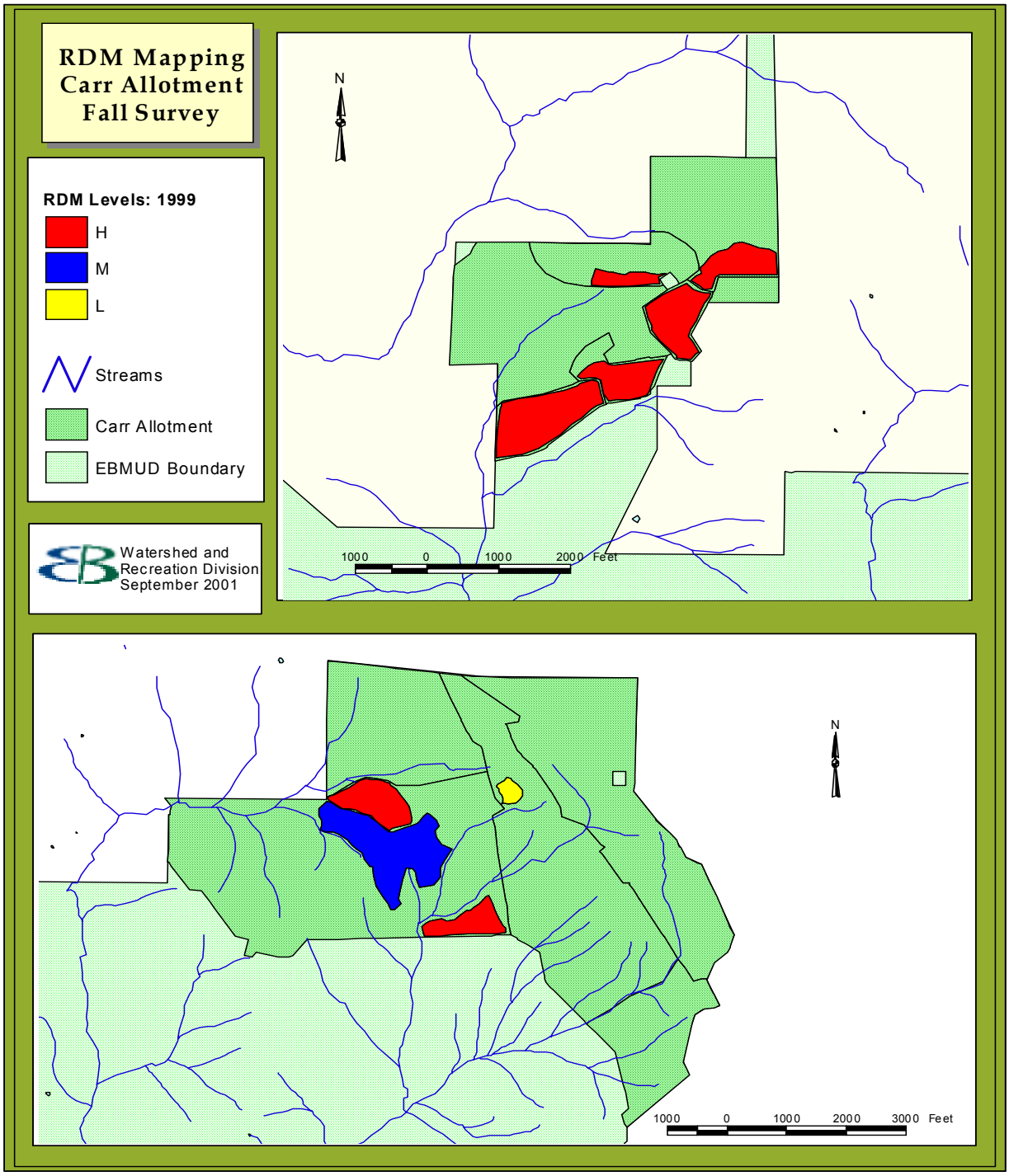
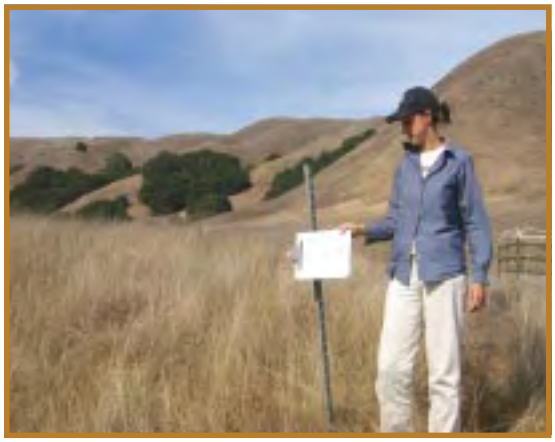

RDM Mapping
Carr Allotment
Fall Survey
RDM Levels: 1999
H
M
L
Streams
Carr Allotment
EBMUD Boundary
Watershed and
Recreation Division
September 2001
N
1000 0 1000 2000 Feet
N
1000 0 1000 2000 3000 Feet

Table 4-1: ***RDM Utilization Ratings***

RDM Levels			Utilization Rating
< 5 % slope	5 – 35 % slope	> 35 % slope	
< 840 RDM	< 1120 slope	<1400 slope	Heavy
840 – 1200 RDM	1120 - 1600 slope	1400 – 2000 slope	Moderate
> 1200 RDM	> 1600 slope	>2000 slope	Light

- ***RDM Mapping and Analysis***



Bi-annually, RDM mapping will be conducted to record the survey of heavy forage utilization over each allotment. This process requires visual estimation of RDM levels and delineating the area on a field map. The maps are then converted into GIS layers. Utilization is determined relative to the District's RDM standards for the three slope classes: 0-5% slope (flat), 6-35% slope (moderate), and > 35 % slope (steep). Each slope class has a range of RDM Levels corresponding to Light, Moderate, and Heavy Grazing (see Table 4.1). Light utilization applies to areas where RDM is above the standards, Moderate utilization applies to areas that meet the standards, and Heavy utilization applies to areas that are below the standards.

4.2 Survey Monitoring Results: 1990-1997

Table 4.2 presents a summary of monitoring results from 1990-1997. The sample is comprised of a range of grazing years from the drought period of the early 1990's to heavier rainfall years later in the decade. Two sets of data are shown for Productivity, RDM, and Range Condition; the median (top number) represents a normal grazing year on an allotment; and, the bottom number represents the range of the sample for each allotment. Although the median value for each allotment meets EBMUD's RDM standards for that time period, the low values of the range indicate years when overgrazing occurred on the allotment. As a consequence, on allotments such as Rifle Range, the allotment was vacated for several years until the new grazing guidelines were established in the EBWMP.

Table 4-2: *Summary of Historical Records for Grazing Allotments. Figures give the median and the range for the years 1990-1997. Complete data was not collected for all years at all sites. Range condition ratings are: Excellent = 90–100, Good = 80-89, Fair = 60-79, Poor = 40-59.*

Allotment	Soil Type	Range Site	Productivity median (lb./acre)	Productivity range (lb./acre)	RDM median (lb./acre)	RDM range (lb./acre)	Range Condition	
Airstrip	Millsholm Silt Loam	Loamy	3700	1700-6000	1800	400-4000	Good	67-87
Baden	Gilroy Clay Loam	Loamy	4900	3000-6700	1200	460-2400	Fair	63-82
Bar X	Sandy Loam	Loamy	4100	3200-6300	1000	300-4300	Fair	67-77
Boy Scout	Millsholm Loam	Shallow Fine Loamy	5300	2200-5700	1800	1800	Excellent	92-98
Carr Home Ranch	Los Osos Clay Loam	Fine Loamy	3500	2700-4900	590	30-960	Fair	58-78
Carr: Rocky Ridge	Clay Loam	Fine Loamy	4900	2900-9400	1200	1000-2400	Fair	61-86
Gateway	Diablo Clay	Clayey	3600	3000-4400	1800	1100-2800	Fair	70-85
Hoover	Millsholm Silt Loam	Loamy	3700	3200-5200	1100	270-3400	Good	72-81
Mike Ranch	Millsholm Loam	Shallow Fine Loamy	2700	1700-3600	1600	500-2500	Fair	69-77
Moraga Horse	Clay Loam	Fine Loamy	3200	2900-4100	2200	1100-3200	Excellent	82-90
Nunes: Wife Ranch	Clay Loam	Fine Loamy	3400	2700-3900	2200	1350-2750	Good	59-95
Orinda Horse	Gilroy Clay Loam	Loamy	4300	3300-5200	900	320-3600	Excellent	88-93
Oursan	Los Osos Clay Loam	Clayey	3400	3000-4700	1800	1300-2800	Excellent	81-97
Pindle Y	Millsholm Loam	Shallow Fine Loamy	3800	2200-7100	1500	950-2000	Good	76-98
Redwood Rangers	Los Osos Silt Loam	Loamy	2800	2800-3500	1000	400-2200	Fair	61-78
Rifle Range	Los Osos Silt Loam	Loamy	3100	1000-6000	800	400-1470	Fair	65-84
Sanders Rocky Ridge	Los Gatos Complex	Fine Loamy	3900	3100-9500	2600	700-3300	Fair	71-77
Sather	Los Osos Clay Loam	Clayey	3600	2500-4400	900	700-2800	Good	75-86
Siesta Valley	Diablo Clay	Clayey	3000	2600-4300	1100	700-2400	Good	74-86
Tri- Cities	Sehorn Clay	Clayey	3200	2100-4200	1400	750-3200	Good	74-95

Furthermore, each transect represents a sample of the range utilization of a typical area within the allotment. Some areas will be more heavily grazed relative to the transect site and other areas more lightly grazed. Annual monitoring includes a visual inspection of the allotment during the spring and fall field surveys, and RDM mapping is conducted in alternate years to delineate areas of heavy, moderate and light utilization.

4.3 Special Status Species and Sensitive Habitats

Special status species and sensitive habitats are identified for each allotment in the Annual Grazing Plan (AGP). Protection for and management of federally threatened and endangered (T&E) species and sensitive habitats will be reflected in each AGP. The Fisheries and Wildlife (F&W) Division of EBMUD will monitor all T&E species and sensitive habitats (see section 1.4.9). Prior to "ground-disturbing" and/or construction activities taking place, EBMUD F &W will assess the area for the presence of special status species and/or sensitive habitat. If special status species or sensitive habitats exist in the surrounding area, an on-site survey will be conducted to assess whether or not the activity will have any potential adverse effects.

Special status species and sensitive habitats that are not listed as rare, threatened, or endangered will also be monitored by EBMUD. For example, oak savannas and riparian zones are important centers of biodiversity and will therefore be monitored using rapid bioassessment (see sections 4.1 and 4.5.2). Relative changes in oak savanna habitat will be monitored by tracking changes in the vegetation coverages. Regular monitoring of ponds and streams for habitat quality, species composition, and wildlife presence will occur on a sample of the grazing allotments. Included in Appendix F are samples of field survey sheets for Watershed Ponds and Pools, Pool Quality Index, and Woody Species Regeneration.

4.3.1 Photo Points

Photo points are a complementary monitoring technique for recording change in vegetation and other habitat features. Recording photos at permanently established markers at regular intervals is a highly descriptive method of documenting the effects of changes in management for wildlife protection (see Appendix H: Using Photopoints as a Monitoring Tool.)

4.4 Vulnerable and Degraded Areas

Vulnerable and degraded areas include concentrated animal use areas, noxious weed populations, prescribed burn or wildfire burn areas, and highly erodible sites due to unstable soils or other conditions. These areas are identified for each allotment in the Annual Grazing Plan (AGP) and are addressed using the BMPs listed in the Biodiversity and Water Quality sections of this document.

4.4.1 Photo Points

Photo points will be established and recorded annually for eroding areas that potentially impact water quality and rangeland health. Such areas include large headcuts, gullies with eroding banks, and unstable slopes. Once the progress of erosion is documented, livestock management practices can be altered to improve the quality and health of the site. For example, if grazing is considered to be contributing to the progress of a headcut into a pasture, that area can be excluded from grazing and monitored to see if the rate of erosion decreases.

4.4.2 Control of Noxious Weed Populations

Control of noxious weed populations is addressed in the

Integrated Pest Management Plan (Appendix I). The process for controlling a noxious weed involves the following steps:

1. Identify the extent of the problem through field mapping,
2. Develop a plan of action to address the spread of the population that is consistent with management objectives for the impacted area,
3. Implement the plan,
4. Monitor for effectiveness of control actions, and
5. Modify plan as necessary to achieve maximum effectiveness.

An example of noxious weed control is Goat Grass (*Aegilops triuncialis*) on the Nunes allotment. Goat grass is an invasive and unpalatable European annual grass that is listed on the California State Noxious Weed – B List, which requires landowners to control its spread.

EBMUD identified the problem in the early 1990's and mapped the population extent in 1993. Permanent line transects were established at the site to monitor changes in population, and a burning program was implemented to limit the spread and to eradicate the population. Burns were conducted in the summers of 1993, 1996, and 1997, and effective reduction in the population was indicated through annual spring monitoring of the transects (Bartolome 1999). A fall burn in 1997 was also conducted in addition to the summer burn to experiment with the effects of seasonal differences in burning. Although the percent cover of goat grass has been reduced, the geographical extent of the population has spread despite an increase in the burning area each year.

4.5 Water Quality Monitoring

The Water Systems Inspection Division routinely monitors reservoirs in compliance with all regulatory requirements. Drinking water reservoirs are tested biweekly and/or monthly for an extensive range of physical, chemical, and biological contaminants, including the microorganisms Giardia and Cryptosporidium.

Rapid bioassessment is conducted on perennial streams to determine

ecosystem health. Upper San Leandro and San Pablo reservoirs were sampled extensively in a non-point source study of urban, residential, and wildland runoff water quality in 1992. Other studies on Upper San Leandro reservoir have examined nutrients, total organic carbon, and macrophytes.

4.5.1 Cryptosporidium and Giardia

The District began monitoring for Cryptosporidium and Giardia on grazed watersheds in the winter of 1998. The initial sampling was a collaborative effort between Dr. Atwill of the U.C. Veterinary Medicine Research and Teaching Center (VMTRC) and Dr. Rochelle of the Metropolitan Water District (MWD).

- ***Sampling***

Sampling is conducted in the rainy season when there is the highest probability of microorganisms contaminating water sources via runoff. The sampling design is comprehensive and includes three points of potential contamination in terminal reservoir watersheds: livestock herds, feral pigs, and the watering ponds and streams they use. A University of California veterinarian samples livestock feces when cattle are gathered for branding in late winter. Various ages within the herds are sampled in order to test across the population. Calves fewer than four months of age have the highest probability of shedding Cryptosporidium and Giardia, and at this time of year many are within this age range.

Ponds and streams frequented by calves are targeted as water sampling points because they have the highest probability of contamination by livestock. Pig wallows will be sampled when they are accessible.

A contractor, under the direction of EBMUD, conducts a feral pig eradication program on the Upper San Leandro Reservoir. A random (by age of pig) sample of pig feces are taken by the contractor and analyzed by the UC VMTRC.

- ***Methods***

Due to high turbidity and pathogen concentration in these water bodies, grab samples of one to five liters are obtained and tested. Two samples from each location are taken and processed to a small pellet by the Laboratory Services Division. The sample is then sent to MWD for pathogen analysis. The MWD lab uses DNA sequencing technology to identify different strains of Cryptosporidium and Giardia that are associated with specific hosts. For example, if Cryptosporidium is identified in water samples, it is then possible to identify the pathogen source from a livestock herd or pig population on the watershed.

Livestock herds, ponds and streams on terminal reservoir watershed lands will be sampled for Cryptosporidium and Giardia on an annual basis as time and funds allow. At a minimum, samples will be collected every third year.

4.5.2 Rapid Bioassessment

In accordance with the EBWMP, managing for water quality means managing for biodiversity. A technique supported by the Regional Water Quality Control Board (RWQCB), the EPA, and the CDFG, for monitoring the health of a creek is known as rapid bioassessment, which provides a direct assessment of ecosystem health. The EPA and the RWQCB, to prioritize water quality problems and to document recovery following rehabilitation, currently use this monitoring technique. Biological communities of organisms such as fish and insects are identified and quantified, from which the condition or health of the creek can be extrapolated. This technique is conducted on creeks by the EBMUD Fisheries and Wildlife staff when overall health of these areas are in question due to impacts made by surrounding activities (i.e. land improvements, grazing). Rapid Bioassessment is often used prior to man-induced activities to provide baseline data so that overall health and the corresponding biodiversity can be monitored over time.

5.0 Introduction

An Allotment Management Plan (AMP) is a five-year detailed document covering EBMUD's policies for grazing, all range management components, and future projects for each grazing allotment. See map 5.1 and 5.2 for specific allotments on EBMUD watershed property.

The Annual Grazing Plan (AGP) is a specific annual plan that establishes working goals derived from the 5-year AMP. The AGP identifies specific projects that will be accomplished for the coming year for each grazing lease and addresses how different sections within each allotment will be grazed. AGP's are normally completed by January 1 for the following grazing year.

EBMUD uses an appraisal method for selecting new grazing tenants most qualified to maintain and enhance range and watershed resources according to District standards.

The appraisal method considers a variety of relevant criteria to determine the best applicant.

The grazing lease is a comprehensive document covering all aspects of livestock management on EBMUD's Watershed lands. These leases are offered in one and five year terms.

Figure 5.1 - South Watershed Grazing Allotments

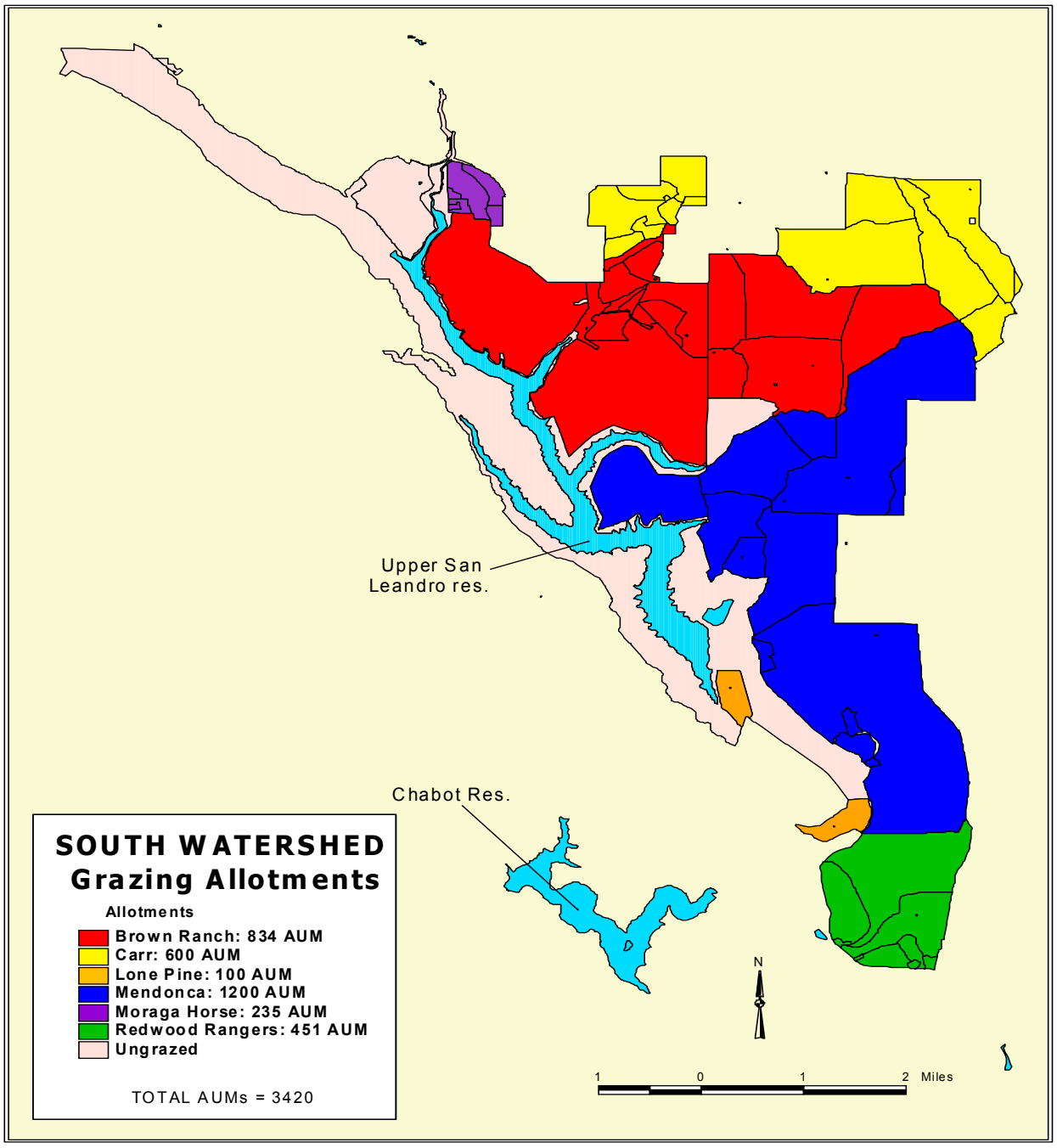
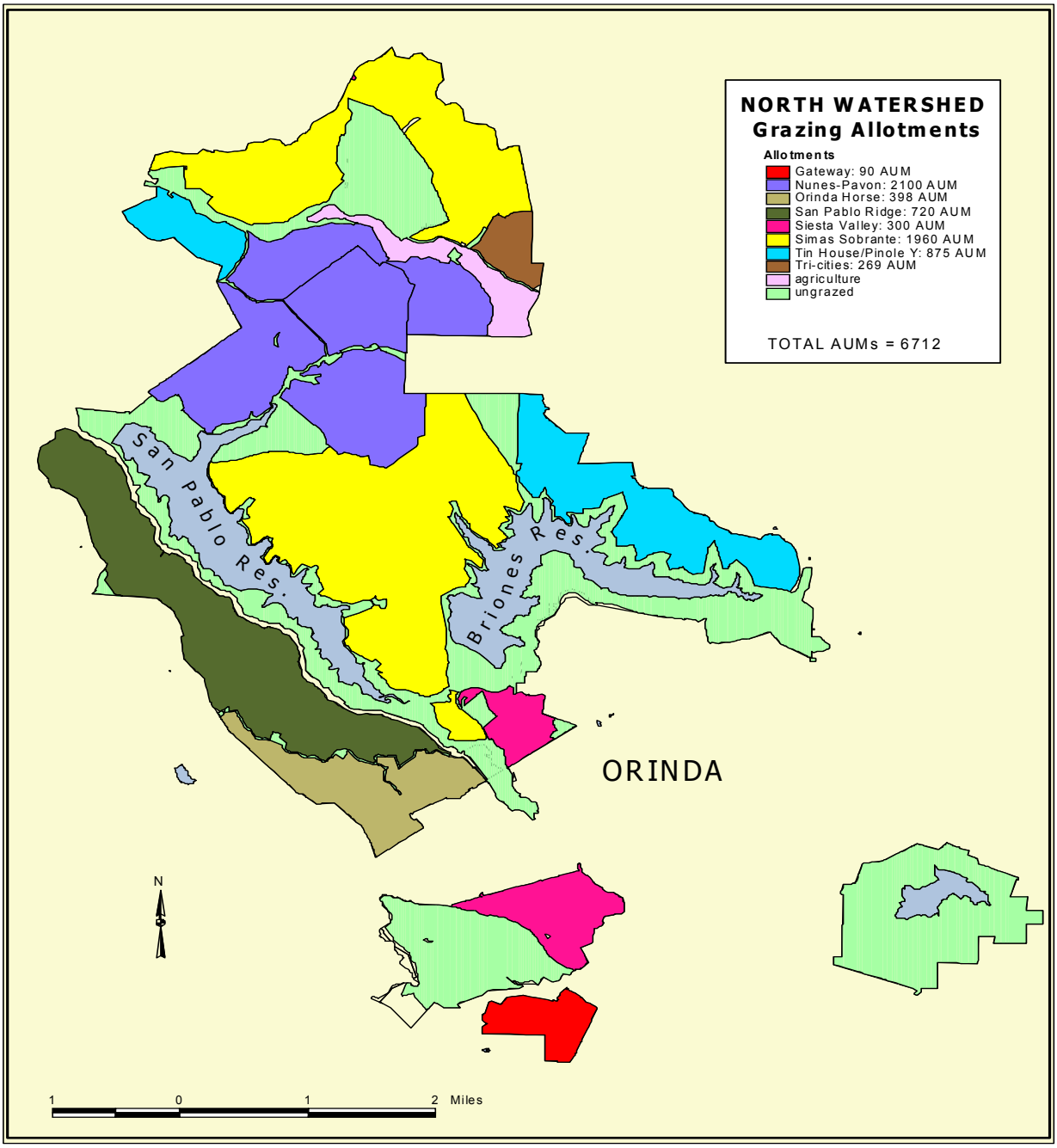


Figure 5.2 - North Watershed Grazing Allotments



5.1 Allotment Management Plans

Key components of each AMP include: (1) Introduction, including the District's 8 management measures, (2) Site Description, (3) Water Quality Concerns, (4) Biodiversity Concerns, (5) Fire and Fuels Management, and (6) Improvements (7) Cultural Resources, (8) NRCS Best Management Practices, (9) Maps of the Allotment.

Locations of the allotments are shown in Figures 5-1 and 5-2. A summary and copy of each AMP may be found in Appendix K.

5.1.1 Introduction

The Introduction of each AMP describes the functionality of the AMP under the direction of EBMUD's Watershed Master Plan (WMP) and the Range Resource Master Plan (RRMP). Outlined within this section of the document are EBMUD's Management Measures as they appear in the RRMP. These management measures act as goals that direct management decisions for the control of Non-point source (NPS) pollution and protection of District rangelands and biological resources.

5.1.2 Site Description

Each allotment is unique in the biotic (living) and abiotic (non-living) resources that it contains. Consideration of these unique resources, as they pertain to each allotment, will be made in order to make accurate and sound management decisions. A listing of site characteristics is included within each AMP for this purpose. Listed below is a description as they appear in the AMP.

Location:	Watershed, boundaries, and landmarks for allotment.
Topography and Acreage	Terrain, aspect, slope and area.
Vegetation Types:	Primary vegetation communities.
Soil Types:	Primary soil series and erosion hazard ratings.
Forage	Estimated productivity by range site

Productivity: and total AUMs.
Table 1: GIS Summary of acreage and AUMs.

Further discussion of the five key elements follows.

5.1.3 Water Quality Concerns

- *Drainage Basin*

  San Pablo, Briones, and Upper San Leandro basins are terminal reservoir watersheds. Extra attention will be given to water quality on allotments draining into these reservoirs.

  Chabot Reservoir is used for non-potable irrigation for golf courses and as an emergency supply. The Pinole basin is not used for drinking water. Therefore, water quality restrictions for terminal reservoir watersheds do not apply to Chabot Reservoir and Pinole Creek basins.

- *Season of Use*

  Season of Use is defined as the season that the allotment will be grazed after considering water quality and biological concerns. Due to current knowledge of pathogen contamination, grazing on terminal reservoir watersheds will be avoided during the rainy season. Chabot and Pinole watersheds, however, may be grazed in the winter.

  Calves less than four months of age will be prohibited on terminal reservoir watersheds during the winter months due to the high potential for shedding *Cryptosporidium* and *Giardia*.

- *Erosion*

  Most upland range sites have moderate to high erosion ratings. In most cases EBMUD RDM standards are sufficient to provide protection from erosion. Problem areas, such as head cuts or gullies, will be addressed in the Annual Grazing Plan (AGP) for each allotment.

Schools in Creeks Restoration Program

North Watershed
Three Corner Flat
1995

North Watershed
Three Corner Flat
2001

- *Pasture Rotation*

Pasture rotations are developed based on water quality concerns, biodiversity issues, fuel reductions, and operational needs. Potential conflicts are identified and restrictions described for each field..

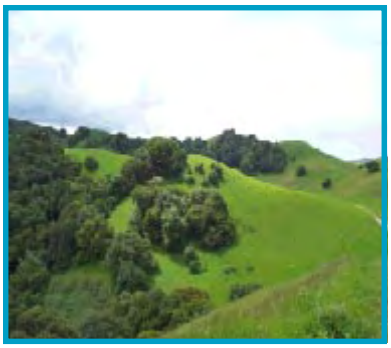
In general, each field receives a minimum thirty day rest during the growing season and ninety day rest during the dormant season to promote plant vigor. Detailed descriptions of each year's moves are outlined in the AGP for each allotment.

As discussed in Section 3.5, grazing to minimize fire risks along the urban interface occurs annually. All other fields are managed toward a rotation-grazing scheme that will provide unused feed for use during years of low forage production.

During spring and summer the animals are moved into fields within terminal reservoir basins. These fields will have a light carrying capacity to provide "banked" feed. This feed is utilized during drought situations and may be subject to include winter grazing. These "Early-Use Fields" are included in the AMP's as they occur on each allotment. These fields will have riparian areas and free water excluded from livestock and, where possible, positioned at the upper reaches of the basin.

- *Riparian Areas*

Riparian areas are described and any special management practices necessary to protect water quality will be defined. In terminal reservoir watersheds, perennial streams are out-fenced with a 100 foot buffer, and late-running intermittent streams will be deferred from livestock grazing until summer when practical. Numerous small springs and seeps are grazed according to the pasture rotation system due to negligible impact on water quality.



Protection measures for pond maintenance and construction include biological surveys by EBMUD F&W staff and erosion control, plus seeding and mulching the site with native grasses.

- *Water Sources*

Table 2 within the AMP in Section 5 lists the number and types of water developments by field. Water distribution problems are noted.

5.1.4 Biodiversity Concerns

- *Special Status Species and Sensitive Habitat*

The identification of special status species has been recorded on EBMUD watershed property. To preserve and protect these species, necessary precautions will be taken and EBMUD F&W Biologists consulted when developing management strategies in the Annual Grazing Plans (AGP's). Within each AGP, management measures and Best Management Practices (BMP's) will be listed for the protection of these sensitive plant and animal species and their habitats.

- *Areas of Significant Biodiversity*

Potential impacts to biodiversity will be addressed in each AGP. If monitoring data indicates that grazing is having an impact on biodiversity, management practices will be amended accordingly.

Riparian areas will not be grazed as specified in the EBWMP, Guidelines WQ 20, WQ.35, and LG 1. Oak savannas will be deferred from grazing during the summer and early fall months to encourage seedling recruitment. Native grasslands will be grazed according to water quality and special status species restrictions provided there are sufficient rest periods to enhance perennial plant vigor.

- *Noxious Weed Management*

  Significant noxious weed populations are identified, and management plans are included in the AGP in accordance with EBMUD's IPM plan. Responsibility for monitoring and control are defined in the AGP.

5.1.5 Fire Management

The goal of the Fire Management Plan (FMP) is to maintain the current vegetation mosaic through periodic grazing. The FMP, approved by EBMUD in 2001, recommends maintaining the vegetation mosaic that has existed since 1997, which is adequate to provide sufficient fire protection on District lands. The vegetation mosaic is partially the result of historic grazing levels and stocking rates.

Areas of priority grazing in each allotment are identified to meet the goals of the FMP as well as the RRMP. These areas of distinct recommendations represent priorities with respect to fuel reduction.

There are five classifications of priorities for fuel reduction:

(1) Essential - Grassland fuels in interface areas that require grazing or an alternative treatment such as disking, mowing, or strategically located road treatments.

(2) Preferred - Grasslands adjacent to interface areas, which are designed to support fire protection benefits of essential areas.

(3) Current - Current represents a "neutral" fire recommendation in terms of grazing or not grazing. If fuel loading is significant, however, increased grazing will be necessary to maintain reasonable loads.

(4) Agricultural - tilled or grazed late in the season.

(5) Non-Grazing – Areas identified by the EBMUD

Fisheries and Wildlife staff to be protected due to the existence of special status species and sensitive habitat.

5.1.6 Improvements

Range improvements such as water developments, fencing, or erosion control are identified and prioritized according to water quality and biodiversity goals. A schedule for completion is included.

5.1.7 Cultural Resources

Culturally sensitive sites will be identified prior to the commencement of any new ground-disturbing activities. These activities may include new pond construction or spring development, or the rare instance where heavy equipment is used to clear vegetation prior to new fence construction. Records and site searches will be conducted before ground disturbance, and monitoring will take place for the duration of the project.

5.1.8 Best Management Practices (BMP's)

Best Management Practices are approved for the state of California by the Natural Resources Conservation Service (NRCS) and are recommended as standards for the design of measures used to treat impacts that affect our natural resources. Standards that are applicable to each allotment are listed in this section. A complete listing of all standards recommended for California by the NRCS can be obtained at the following website: http://www.ca.usda.gov/rts/sec4.htm

5.1.9 GIS and Map of Allotment

The EBMUD GIS has been designed to store, analyze and update the data used in an AMP. ArcInfo (GIS Software) coverage's are used to map and catalogue the physical, ecological, and biological characteristics of the land.

Included with each AMP is a map of the allotment. The

maps serve as a visual tool for communicating important information about the allotment to the public, ranchers and District personnel. These site maps describe physical characteristics such as fences, roads, culturally sensitive areas, water developments, pastures and their corresponding numbers, streams, lakes, and project areas.

- *AUM Calculation*

  The GIS is used to calculate forage production for each pasture in AUM's. Acreages for two plant communities only, grassland and oak savanna, are used for the calculation. Forage production of grasses for range sites (see Table 5-1) are based on the soil type mapped by the Contra Costa County Soil Survey. The RDM requirements for the three slope classes are subtracted from the forage production figures, and the available AUMs are calculated for each pasture. Favorable, normal, and unfavorable rainfall amounts are used to give a range of estimates for AUMs. An AUM is equal to 800 lb. of forage. The AUMs leased for management purposes are less than the available GIS AUMs to allow for inefficiencies in livestock distribution.

Table 5-1. ***Grassland Range Sites, Normal Productivity, and Estimated Proper Stocking Rate for EBMUD Lands***

Range Site	Total Yield[1] (lb./acre)	Available Forage (lb./acre)	Stocking Rate (AUM/acre)[2]
Clayey	4500	3300	4.1
Fine Loamy	3000	1800	2.25
Loamy	2000	800	1
Shallow Fine Loamy	1800	600	0.75
Shallow Loamy	1800	600	0.75
Gravelly Loam	1500	600	0.75
Shallow Coarse Loamy	1400	200	0.25
Sandy	700	0	0

[1] Figures in use by the NRCS in Alameda and Contra Costa Counties (USDA Soil Conservation Service 1981)
[2] An AUM = 800 lb. forage, air-dry weight basis (ADWB).

5.2 Annual Grazing Plan (AGP)

The AGP is an annual plan that is developed from the 5-year AMP. The AGP establishes working goals for both EBMUD and the lessee. EBMUD works with the lessee to discuss the prior year's outcome and set priorities and expectations for the coming year. AGP's are normally completed by January 1 for the following grazing year. Some key elements of the AGP are as follows:

- Endangered species
- Fire and fuels
- Noxious weeds
- Pasture rotation
- Restoration projects
- Grazing schedule
- Long-term maintenance
- Projects and improvements

5.3 Grazing Tenant Selection Procedures

Grazing parcels may become available when an old lease is terminated and reopened or when new property is acquired and deemed suitable for grazing.

EBMUD uses an appraisal method for selecting new grazing tenants. The appraisal method considers a variety of relevant criteria to determine the best applicant. This allows EBMUD to lease to tenants most qualified to maintain and enhance range and watershed resources according to EBMUD standards.

The common alternative to the appraisal method is the economic bid system. Although bidding systems are financially beneficial, they may not promote proper range management. A bidding system can force potential lessees to bid beyond their economic means, causing the awarded lessee to overcome the financial loss by taking economic short cuts and using improper range practices, including overstocking. For existing tenants, the insecurity of a system that opens the lease for bid every five years results in uncertainty and deferred maintenance. There is little incentive for tenant participation in long-term range management programs or improvements.

The following procedure will be used in the selection of tenants for new or vacant grazing parcels:

5.3.1 List of Interested Parties

The Watershed and Recreation Division will maintain an ongoing list of all people interested in acquiring an EBMUD grazing lease.

5.3.2 Advertisement of Available Parcel

When a grazing parcel becomes available it will be advertised in local newspapers and trade journals. The advertisement will also be posted conspicuously on the available property and on the nearest public road.

5.3.3 Application Packet

The Watershed and Recreation Division will send an application packet to all interested parties. The packet will consist of:

- The Request for Proposal (RFP)
- A copy of the master-grazing lease.
- A description of the parcel(s) to be leased including the gross acres and AUMs.
- Dates when the vacant parcel(s) will be shown.

5.3.4 Qualifications Appraisal Panel

The Watershed and Recreation Division will convene a qualification appraisal panel. This panel will consist of two representatives from EBMUD and two representatives from outside agencies. All panel members will have recent experience in development or administration of a range management program.

5.3.5 Selection of Finalists

The panel will review and rate each completed RFP. Each question will be evaluated on a point scale. Each vacant parcel will be considered independently. The applicants with the three highest scores will be selected as finalists (see "Guidelines for Review of Prospective Tenant Questionnaires," Section 5.5, and "Applicant Questionnaire," Appendix F).

5.3.6 Interview of Finalists

Finalists will be interviewed at their current cattle operation. The operation will be evaluated on the basis of best range management practices. This will give the panel an opportunity to ask additional questions if necessary (see Section 5.6 "Guidelines for Review of Grazing Lease Finalists," and Appendix J, Applicant Questionnaire).

5.3.7 Final Decision

Each panel member will independently rank each candidate and a composite list will be compiled from these rankings. In the event of a tie, the Manager of Watershed and Recreation, after consultation with the panel members, will cast the deciding vote.

5.3.8 Award of Lease

After approval by EBMUD Board of Directors, the number one ranked candidate will be awarded the lease. All unsuccessful candidates will be notified in writing. An explanation of the Panel's decision will be provided upon request.

Lease award will be based on the following criteria:

a. Completeness and accuracy of the RFP (falsification on any accounts will be ground for disqualification).

b. Financial stability.

c. Adjacency of other range parcels.

d. Experience with integrated pest management techniques.

e. Ability to respond quickly to problems and emergencies.

f. Any other related experience that will guarantee the conservation of the range resource.

5.3.9 Appeal Process

In the event that an applicant feels the selection was unfair or the selection process was improperly carried out, the following procedure will apply:

a. Applicant will appeal to the Manager of Natural Resources in writing.

b. The Manager of Natural Resources will arrange a meeting of EBMUD Council, Manager of Watershed and Recreation and the complainant.

c. At this meeting, the complainant will have the opportunity to explain why he/she feels that the award process was unfair or improper.

5.4 Leases

The grazing lease is a comprehensive document covering all aspects of livestock management on EBMUD's Watershed lands. These leases are offered in one and five year terms. Some key elements are as follows:

- Rent, including how AUM's are calculated.
- Grazing capacity
- Livestock distribution
- RDM
- AGP format