Bear Creek Watershed Assessment

FINAL

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in partnership with

Colusa County Resource Conservation District
Colusa, CA

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ABBREVIATIONS AND ACRONYMS

ACEC	Area of Critical Environmental Concern
AGR	agricultural - a beneficial use for water
APCD	Air Pollution Control District
AQMD	Air Quality Monitoring District
ARB	California Air Resource Board
ATSDR	Agency for Toxic Substances and Disease Registry
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	best management practice
CALFIRE	California Department of Forestry and Fire Protection
Cal-IPC	California Invasive Plant Council
CALTRANS	California Department of Transportation
CARB	California Air Resources Board
CAS	Climate Action Strategy
CCRCD	Colusa County Resource Conservation District
CDFA	California Department of Agriculture
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ck	Creek
CNPS	California Native Plant Society
COLD	habitat for fish requiring cold water - a beneficial use for water
CRMP	Coordinated Resource Management Plan
CVRWQCB	Central Valley Regional Water Quality Control Board
DOM	dissolved organic matter
EE/CA	engineering evaluation/cost analysis
FCAA	Federal Clean Air Act
FLPMA	Federal Land Policy and Management Act of 1976
Hg^0	elemental mercury
Hg^{2+}	mercuric mercury - an ion of mercury
ICE	Information Center for the Environment at UC-Davis
IRIS	Integrated Risk Information System
KGRA	known geothermal resource area
MAA	memorandum of agency agreement
MCL	maximum contamination limit
MeHg	methylmercury
MOU	memorandum of understanding

ms.	manuscript, not published
MUN	municipal drinking war (beneficial use)
NO_X	nitrogen oxide gases
NPDES	National Pollutant Discharge Elimination System
NRDA	Natural Resource Damage Assessment
NRDAR	Natural Resource Damage Assessment and Restoration
NTU	nephelometric turbidity units
OHV	off-highway vehicle
OMB	Office of Management and Budget
PAMP	principal areas of mine pollution
pers. comm.	personal communication
pers. obs.	personal observation
$PM_{2.5}$	fine particular matter, less than 2.5 micrometers in diameter
PM_{10}	respirable particular matter, less than 10 micrometers in diameter
ppb	parts per billion
ppm	parts per million
PRP	potentially responsible party
RAWS	remote automated weather stations
RCD	resource conservation district
REC-1	water recreation with bodily contact with water - a beneficial use for water
REC-2	water recreation without bodily contact with water - a beneficial use for water
REL	reference exposure level
RMP	resource management plan
ROG	a reactive organic gas
RWQCB	Regional Water Quality Control Board
SCAN	soil climate
SPWN	spawning habitat for fish - a beneficial use for water
TCSM	Tehama-Colusa serpentinite mélange
THg	total mercury
TMDL	total daily maximum load
UC-Davis	University of California at Davis
US EPA	United States Environmental Protection Agency
VELB	valley elderberry longhorn beetle
WARM	habitat for fish requiring warm water - a beneficial use for water

UNITS OF MEASURE

°C	degrees Centigrade
cfs	cubic feet per second
g yr^{-1}	grams per year
kg	kilograms (1000 grams)
$liter^{-1}$	per liter
liter min^{-1}	liter per minute
mg	milligrams (0.001 gram)
mg $liter^{-1}$	milligrams per liter
mg/m^3	milligrams per cubic meter
mg kg^{-1}	milligrams per kilogram
µg	micrograms (0.000001 gram)
ng $liter^{-1}$	nanograms (0.000000001 gram) per liter
yd^3	cubic yard

EXECUTIVE SUMMARY

The Watershed Assessment Process

The Bureau of Land Management (BLM) received a grant from the CALFED Watershed Program, administered by the California Department of Water Resources, to prepare the Bear Creek Watershed Assessment. Work on this project supports the partnership in Bear Creek watershed between the BLM, the Colusa County Resource Conservation District, and other watershed stakeholders.

The assessment has assembled existing information about the watershed from different sources on multiple, often interconnected topics that speak to stakeholders' watershed goals and issues in watershed management. To produce the assessment, the authors took the following steps:

1. Gather and organize information from stakeholders, technical literature, agency documents, and data sets that describe past and current conditions in the watershed
2. Describe stakeholders' goals and stewardship issues for the watershed based on stakeholder input
3. Conduct resource inventories as feasible and identify gaps in needed information
4. Prepare a written solicitation to the public for additional goals and issues and for additional information about Bear Creek watershed
5. Assess water quality, hydrologic function, soil and site stability, and biological resources
6. Identify locations, stewardship practices, and opportunities appropriate for addressing stakeholders' issues in the watershed through analysis of individual subwatersheds
7. Present a draft version of the assessment for public review and comment on the website of the Colusa County Resource Conservation District
8. Incorporate public comments and any new information into the final draft of the Bear Creek watershed assessment.

Special Features of the Watershed

Bear Creek watershed encompasses 103 square miles (266 km^2) at the interface of the North Coast Range on the west side of the Sacramento River Valley in Colusa County. The watershed has varied terrain, from the nearly flat Bear Valley floor to steep, highly dissected canyons at the northwest, west, and southeast edges of the watershed. A series of rolling hills of blue oak woodland form the east boundary. Although the watershed is sparsely populated today, people over the past 150 years have transformed large portions of the landscape, particularly in Bear Valley and in Sulphur Creek subwatershed. Mercury mining, cattle ranching, and hot springs resorts have been the mainstays of the economic life of the watershed.

The watershed is rural in character, with 55 percent private lands and 45 percent public lands. Existing county and federal land management plans aim to maintain the rural environment and natural character of the watershed, while sustaining traditional economic livelihoods. Public lands emphasize recreation opportunities and conservation of biological diversity as well. Several ranches in the watershed have conservation easements which further protect the natural landscape.

The watershed owes its strong visual contrasts to the interface of the Great Valley Geomorphic Province and the Coast Range Geomorphic Province and resulting geology and plate tectonic shifts along the east side of the Inner Coast Range. Rocks from the Great Valley are sedimentary, having formed from sediments deposited in the Sacramento Valley when it was an ocean floor. Rocks from the Coast Range are mostly ultramafic, formed volcanically on the Pacific Ocean floor and subsequently thrust up to the ground surface over eons.

From the complex geological history, the soils developing from the underlying parent rock are highly diverse. More than 35 soil series are found within the watershed. In upland areas on the east side of the watershed, sedimentary soils such as the Millsholm and Contra Costa soil series predominate. In the southwest quarter, soils consist of Millsholm, Contra Costa, and Sleeper series. Soils in the northwest quarter of the watershed are primarily ultramafic Henneke, Okiota, and Montara soils. Ultramafic soils and their parent rocks have unusually high concentrations of magnesium and iron and are habitat for plants especially adapted to the unusual soil chemistry. Some ultramafic soils west of lower Bear Creek and in Mill Creek subwatershed are extensive barrens, sites largely devoid of vegetation because of extreme soil chemistry.

Ultramafic sediment moving in drainages originating on Walker Ridge has created several alluvial fans on the west side of Bear Valley. Shorter, less steep drainages on sedimentary soils create swales along the east side of the valley. Mixing of both sediment sources has led to creation of ultramafic alluvial soils, the youngest soils in the watershed, on the Bear Valley floor. Three series of these mixed soils (Bear Valley, Leesville, and Venado) are known only from Bear Valley.

Bear Creek flows north to south through the watershed into Cache Creek. Where Bear Creek meets Mill Creek, Mill Creek usually supplies the greater volume of water. Streams from both sides of Bear Valley and from Long Valley east of Leesville add more water to Bear Creek as the creek traverses Bear Valley. The other major contribution of water to Bear Creek comes from Sulphur Creek subwatershed south of Bear Valley. Sulphur Creek water and sediments are important for their contribution of high concentrations of iron, sulfur, dissolved salts, and heavy metals. Very little information exists about groundwater anywhere in the watershed.

Hydric soils and flooding are not common in the watershed except along portions of Mill Creek and Bear Creek in Bear Valley and along Sulphur Creek. Bear Valley once had more extensive wetlands, and Bear Creek meandered slowly through the valley plain. Riparian woodland and shrub corridors are now greatly altered or lacking altogether in much of the watershed. Willows and cottonwoods are uncommon in riparian areas. One prominent valley oak stand remains along Bear Creek at the south end of the Bear Valley. Modifications to water flow have consisted of channels to divert water to crops and stock ponds and two small dams. Impoundments for livestock water are present in Bear Valley, on the east side north of Highway 20, and in the southern canyons on the BLM Bear Valley Ranch. Some stock ponds are providing aquatic habitats for special status species such as western pond turtle and a variety of plants species that would be otherwise absent. Unusual ultramafic wetlands occur on Walker Ridge, on benches down slope from Walker Ridge, and along Highway 20 near the Colusa-Lake county line. Highway impacts and off-road riding are putting these wetlands at risk.

Vegetation on ultramafic soils is generally sparser and visually distinct species from vegetation on sedimentary soils. Ten of the eighteen rare plant species (CNPS Class 1B) found in the watershed occur exclusively on ultramafic soils. Other endemic species include three endemic insect species that have evolved to inhabit the unique environments generated at hot springs and nearby spring-fed creeks. The serpentine cypress wood-boring beetle is found only in stands of cypresses which themselves are limited to ultramafic soils. Other noteworthy wildlife species that depend on water quality are the naturally high diversity of dragonflies and damselflies, foothill yellow-legged frog, and bald eagle.

Stakeholder Issues

Stakeholders identified sixteen issues of concern in Bear Creek watershed to address:

- Toxic chemicals
- Sediment delivery to watercourses
- Creek channel alterations
- Creek and tributary headcuts
- Roads, trails, and fire lines
- Fire
- Oak woodlands
- Disturbances to ultramafic soils
- Non-native invasive species
- Low recruitment of native woody riparian plants
- Impacts from certain livestock grazing practices, wildlife browsing
- Growing demand for recreation and tourism
- Potential environmental impacts of energy developments
- Fiscal and policy obstacles for landowners to meet regulatory targets
- Climate change
- Information gaps

Most of these stakeholder issues do not stand alone but interrelate in multiple ways. Past land uses such as mining and agriculture have left that are root causes of present-day issues.

Water from Bear Creek and Sulphur Creek contains high amounts of mercury that significantly impact water quality and the biological integrity of aquatic ecosystems downstream in Cache Creek and ultimately in the Bay/Delta. Naturally high concentrations of mercury are present as well in the hot springs along Sulphur Creek and the cold springs east of Deadshot Canyon. Sources of anthropogenic mercury contamination of particular concern are sediment waste around inactive mercury mines in Sulphur Creek subwatershed and the Rathburn-Petray mine complex in Upper Bear Creek subwatershed. Secondary sources of mercury pollution are in areas of sediment deposition on the banks of lower Bear Creek where an estimated 91 pounds of total mercury remain after being transported from Sulphur Creek. The Central Valley Regional Valley Water Quality Control Board has established total daily maximum load targets, one each for mercury and methylmercury, as targets to reduce mercury originating from mercury mines in the watershed and restore water quality in the watershed.

A major concern is the multiple non-native invasive plant species that are displacing native vegetation. Non-native plant species such as barb goatgrass and yellow starthistle are now commanding attention because they are even invading ultramafic soils where they have been previously unknown. Disturbances from mining, roadwork, and livestock grazing are making ultramafic soils more susceptible to exotic plant invasions. Non-native plant species, such as arundo, tamarisk, and perennial pepperweed, are also invading riparian areas rapidly and are difficult and costly to remove.

Sustaining ecosystem services and vegetation productivity concerns both public land managers and landowners. Soil loss from erosion and sediment delivery into streams is a major concern. Reduced surface area produces less of desired vegetation for forage on rangelands in Bear Valley, Long Valley, and the BLM Bear Creek Ranch. Headcuts and channel incision are main sources of sediment to streams. Sulphur Creek, in particular, is experiencing rapid loss of soil as headcuts migrate upstream. With deepening stream channels, the water table in key riparian areas is dropping, making top soil layers drier for longer periods each year. In most cases, the causes of soil loss from headcuts and channel incision are not obvious.

Fires in 2008 burned more acres in the watershed than in other single year since fire records have been kept. Sensitive vegetation types on ultramafic soils in particular deserve special attention because of the slow rate of their natural revegetation post-fire and their many rare plant species, many of which may germinate or regain vigor from periodic fire. The fire-return frequency for ultramafic chaparral is about four times longer than for chaparral growing on sedimentary soils. Fire management to reduce fuels and avoid catastrophic fires will require a careful analysis and planning to make sure that prescribed burns are appropriate to the complex mosaic of soils,

vegetation, and topography across the watershed. Impacts from fire suppression include a 20-mile long bulldozer line through previously undisturbed ultramafic chaparral. Another emerging consideration is the amount of mercury that volatilizes and enters the atmosphere as the result of wildfire.

In western Colusa County, past woodcutting and efforts to improve land for livestock grazing resulted in losses of native oak woodlands. Problems with oak regeneration specific to Bear Creek watershed arise from widespread damage to seedlings from animal browsing and to saplings from antler rubbing by deer and elk. Competition from non-native vegetation, especially annual grasses, depletes soil moisture and makes tree establishment impossible at some sites. Fire suppression in the past five or more decades may be shifting the composition and fire-resilient features of mature oak woodlands as fire-prone trees such as gray (foothill) pine become more common and begin to overtop oaks. The value that people place on oaks is changing as people understand the ecosystem service that oaks offer for carbon storage, providing shade for livestock, and habitat for wildlife. Voluntary oak conservation guidelines initiated by the Colusa County Board of Supervisors are now in effect for the watershed and hold promise for stemming the loss of woodlands.

Both renewable and non-renewable energy resources are available in the watershed. People have studied potential development for oil, gas, wind, solar, and geothermal energy resources over the last fifty years. Local residents have already developed small-scale solar and wind energy generation. To meet national energy goals for renewable energy, the BLM is considering a wind energy project, part of which lies on the Bear Creek watershed portion of Walker Ridge. Care is needed in site planning to avoid eroding the predominantly ultramafic soils. Naturally high contents of heavy metals and possibly asbestos in ultramafic soils may contribute to loss in water quality in streams from erosion and debris flows during construction and to risks to workers breathing dust generated at work sites. Access roads and turbine pads on ultramafic soils may also fragment unusual vegetation communities and rare plant habitat. Mortality of bats and raptor birds is known to be high from turbines at other wind energy projects, but no information is available yet for Walker Ridge. Some of the animal and plant species likely to be impacted at Walker Ridge wind energy sites are designated as BLM sensitive species.

With acquisition of the BLM Bear Creek Ranch, recreation opportunities for the public have greatly increased in the watershed over the last decade. One major question for watershed stakeholders is how to manage recreation for the greatest benefit of a growing and increasingly urbanized public who have ever less contact with open space and wild lands. Sustained employment in recreation and tourism can contribute to economic diversification of communities near the watershed. Increased human presence on the public lands is not always beneficial to recreation activities. An increase in illegal marijuana growing in remote parts of the watershed

by heavily armed people as well as unauthorized shooting on the BLM Bear Creek Ranch pose threats to the personal safety of recreation visitors to the public lands.

Landowners and land managers must meet the regulatory targets established to accomplish restoration of water quality, air quality, and wildlife habitat for the benefit of society. Of immediate concern to private landowners is the financial burden placed on them to clean up abandoned or inactive mercury mines or, in some cases, to find the responsible parties to pay for the mine cleanups. Regulations regarding cleaning up and closing mines may appear draconic to landowners and may not gain their support to advance mercury remediation. The Central Valley Regional Water Quality Control Board is revising its orders for cleaning up mercury mines on private lands recently because of the need to follow specific procedures about informing potentially responsible parties. The Board is seeking to avoid unintended inequities for current landowners who have had no hand in creating mercury contamination.

Other significant barriers to making progress on improving environmental quality include lack of funding dedicated to revegetate areas that have burned severely or that have enduring scars on the landscape from measures to suppress fire and to prevent landslides. The costs for restoring vegetation on ultramafic soils are high, often greater than $20,000 per acre where both soil and vegetation have been removed. Without a financial commitment to restoration, natural revegetation on highly disturbed sites will proceed very slowly. In the meantime, sediment and soil erosion from disturbed sites is continuing.

Roads and trails in the watershed also contribute large amounts of sediment that impact water quality. Estimates on sediment amounts coming from county roads and off-highway trails are much higher. For example, production of sediment from trails in the vicinity of Sulphur Creek has exceeded 20,000 tons in recent decades. Deteriorating road conditions and unstable cut banks increase soil erosion and sediment deposition in creeks. In Leesville subwatershed, concentrated flows from culverts along county roads are diminishing land productivity for livestock forage. The longstanding deferral of road maintenance is contributing to roadside bank instability and headcuts in addition to creating safety hazards for motorists. Funding for maintaining and upgrading county roads is not adequate to address needed erosion control in the watershed.

Concerns about climate change over different time scales are preoccupying private landowners and public land managers. For landowners, loss of water from short-term droughts seen in recent years and the specter of longer droughts in the future resulting from changing climate conditions puts agriculture at risk in the watershed. One challenge to stakeholders is to formulate actions that directly improve the capacity of the watershed to adapt to climate change and also support State of California and national goals for alleviating impacts to ecosystem services related to climate change. Options to consider for an adaptive response to climate change include: using ecosystem system services to store more atmospheric carbon in vegetation and soils (carbon

sequestration); conservation planning for biological diversity; increasing hydrologic function to deliver and store more water in Bear Valley; and building a renewable energy infrastructure that does not degrade watershed habitats as it reduces national demand for fossil fuels.

Information Needs

Despite all the information, gaps in needed information exist especially in regard to advancing watershed management and sustaining and renewing ecosystem services. Important gaps in information to address include:

- connections between plant species and soil series, to aid in selecting species for successful plant propagation at mine sites and other heavily disturbed sites
- vegetation mapping using the most recent vegetation classification system for California
- ground water resources, particularly ground water quality and recharge rates
- monitoring data for water flows and chemical elements and ions potentially affecting water quality at sites throughout the watershed
- weather stations, particularly in Bear Valley, to aid ranchers and to track the long-term trends in climate patterns affecting agriculture
- information on channel longitudinal and cross sections to document changes to the shape of stream channels, especially where channel incision and headcuts are occurring
- appropriate fire management corresponding to fire behavior modeling, desired fire regime, and soil-plant correlations
- documentation of native plants and animals in remote parts of the watershed, focusing on sites with ultramafic soils
- best management practices for increasing water retention time and raising water tables in the watershed, with particular attention to hydrologic function in Bear Valley
- locations of mercury methylation sites in the watershed for focusing site management to reduce net methylmercury production
- distributions and concentrations of other heavy metals in soils downstream from mine sites and in soils with ultramafic properties

Information about the watershed is not evenly available across subwatersheds. Subwatersheds with the least amount of information are: Mill Creek, the canyons west of Cortina Ridge, the Hamilton area, Warnick Canyon, and Leesville. The last four areas are on private land where publicly available data are scant.

Watershed Improvement Projects and Job Opportunities

An analysis of individual subwatersheds or groups of similar adjacent subwatersheds helped to clarify the scope and location of strategic watershed improvement projects and where job opportunities exist. Job opportunities are most promising in the following areas:

- development of low-impact renewable energy infrastructure
- closure, remediation, and revegetation of mercury mine sites
- restoration projects to improve water storage, restore more natural stream flow, and raise the water table in Bear Valley
- environmental education linked to public outreach and recreation opportunities
- rangeland management for livestock and environmental benefits from oak woodlands
- road maintenance and redesign
- monitoring changes in water quality and flow, wildlife and rare plant populations, productivity of vegetation, non-native plant invasions, and recreation use.

Specific projects identified for initiating watershed improvement and providing employment would focus on:

- reforesting oak woodlands to create greater canopy cover, cooling and shading benefits, wildlife habitat improvement, and soil conservation
- converting non-native grasslands back to chaparral on public lands to create greater habitat connectivity for native plant and animal species
- developing environmental education and recreation programs for the BLM Bear Creek Ranch
- cleaning up mercury-contaminated mine sites in Sulphur Creek subwatershed, at the Rathburn-Petray mine complex, and along lower Bear Creek where mercury-rich sediment has accumulated
- repairing roads and adjacent slopes, especially along Highway 16 and in Leesville subwatershed
- inventorying plants and animals on ultramafic soils, in rare wetlands, and in and around hot springs, with a particular focus on sites being considered for developing renewable energy and the species (e.g., bats, raptors, endemic plants) most likely to be impacted by energy development
- Bank stabilization through fencing and revegetation in Bear Valley and the BLM Bear Creek Ranch where wildlife and livestock concentrate

An accompanying publication to this watershed, *Bear Creek Watershed Stewardship Priorities, 2010-2014*, provides details for watershed management projects designed to improve watershed conditions in the near future.