Truckee River Watershed Council
Collaborative solutions to protect, enhance and restore the Truckee River Watershed

Lacey Meadows Assessment

Balance Hydrologics, Inc.®

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

THE INSTITUTE FOR BIRD POPULATIONS

Dr. Susan Lindström, PhD
Consulting Archaeologist

Lacey Meadows Assessment
Sierra and Nevada Counties, California

A report prepared for:

TruckeeRiverWatershedCouncil
Collaborative solutions to protect, enhance and restore the Truckee River Watershed

Prepared by:

BALANCE HYDROLOGICS, INC.
Brian Hastings, P.G., Geomorphology and Hydrologist
Dave Shaw, P.G., Geologist and Hydrologist

H.T. HARVEY & ASSOCIATES
Dan Stephens, Principal Restoration Ecologist
Pat Reynolds, M.S. Associate Restoration Ecologist
Matt Wacker, M.S. and M.C.P., Senior Ecologist
Hillary White, M.S. Wildlife Biologist
Neil Klasson, M.S. Fish Biologist
Sharon Kramer, PhD Senior Associate Fish Biologist
Samatha Moturi, M.S. Geographic Information Systems Specialist

THE INSTITUTE FOR BIRD POPULATIONS
Rodney Siegel, PhD, Executive Director
Helen Loffland, PhD, Ornothologist

Dr. Susan Lindstrom, PhD
Archeologist and Anthropologist

Reviewed by:
Barry Hecht, C.E.G., CHg., Senior Principal (Balance Hydrologics, Inc.)
Dan Stephens, Principal (H.T. Harvey & Associates)

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A report prepared for:

Truckee River Watershed Council
Post Office Box 8568
Truckee, California 96162

By:

Balance Hydrologics, Inc.
Post Office Box 1077
Truckee, California 96160
(530) 550-9776
www.balancehydro.com

H.T. Harvey & Associates
1331 Garden Highway, Suite 310
Sacramento, California 95833
(916) 779-7350
www.harveyecology.com

The Institute for Bird Populations
19651 Forest View Circle
Pioneer, California 95666
(209) 295-3573
www.birdpop.org

Dr. Susan Lindstrom
Consulting Archeologist/Anthropologist
Post Office Box 3324
Truckee, California 96160
(530) 587-7072

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1. INTRODUCTION

1.1 PROJECT OBJECTIVES

The primary objective of this assessment is to describe the historical and present-day watershed and reach-scale hydrologic and geomorphic conditions in the Lacey Meadows watershed. This assessment follows a general ecological study of Lacey Meadows and Webber Lake (Gaither, 2011) and fulfills a recommendation to complete a more thorough watershed-scale study that includes both biological and geomorphic investigations. This assessment is a technical study to be used by the Truckee River Watershed Council (TRWC) and Truckee Donner Land Trust (TDLT) to: 1) identify functioning areas with high ecological value; 2) identify disturbed areas with impaired functions and values, and; 3) understand the root causes of these disturbances. In particular, we seek to address the following questions:

- What and where are the main historical land uses and to what degree have land management practices introduced or exacerbated sediment sources?
- What is the range and recurrence of peak flows in the watershed?
- What is the range of late summer baseflow that can be expected?
- Where do stream-aquifer interactions occur and how do these interactions relate to habitat?
- What are the linkages between water, sediment, and channel conditions throughout the watershed?
- What is the condition of the botanical and vegetative communities in the meadows and to what extent is conifer encroachment occurring?
- What areas provide potentially suitable habitat for special-status species?
- What restoration and land management strategies should be implemented to protect habitat and improve water quality?
- In what ways may proposed land management strategies affect existing habitat?

1.2 STRUCTURE OF THIS REPORT

This report provides a comprehensive description of the historic, biologic, ecologic, hydrologic, and geomorphic setting for the Lacey Meadows study area. The initial section (Section 2) of the assessment provides a basis for prioritization of land management and restoration approaches by describing the watershed setting.

Section 3.0 provides an assessment of the watershed condition based on background information collected, multi-day site reconnaissance, and limited analyses. We summarize relevant conclusions from our assessment in Section 4.0 as a precursor to development of a catalogue of disturbance sites and management recommendations or restoration actions. Section 5 focuses on identifying land management approaches that 1) are compatible with sensitive habitats, 2) sustain historical and current uses, 3) address key threats that inhibit or impair the integrity of the meadows.

1.3 ACKNOWLEDGMENTS

This work and information presented in this report draws on information and efforts kindly provided by a number of key individuals. John Svahn of the Truckee Donner Land Trust and Ken and Joan Bretthauer of the Webber Lake Resort coordinated site access and provided a great deal of information on the history of the site, as well as current and past land management strategies. A number of individuals participated in interviews with Dr. Susan Lindström, allowing her to develop a record of oral histories for the Webber Lake area, including: Ken and Joan Bretthauer, Larry and Par Buillivant, Marylou and Joe Moeckel, Bob Carnevale, Pat and Patty Meyers, and Gene Corporon. Randy Westmoreland of the USFS participated in a field reconnaissance site visit with the project technical team, and has offered useful interpretations of historical land uses and road and channel alignments. Mr. Westmoreland has also provided ideas and feedback on potential meadow restoration strategies.

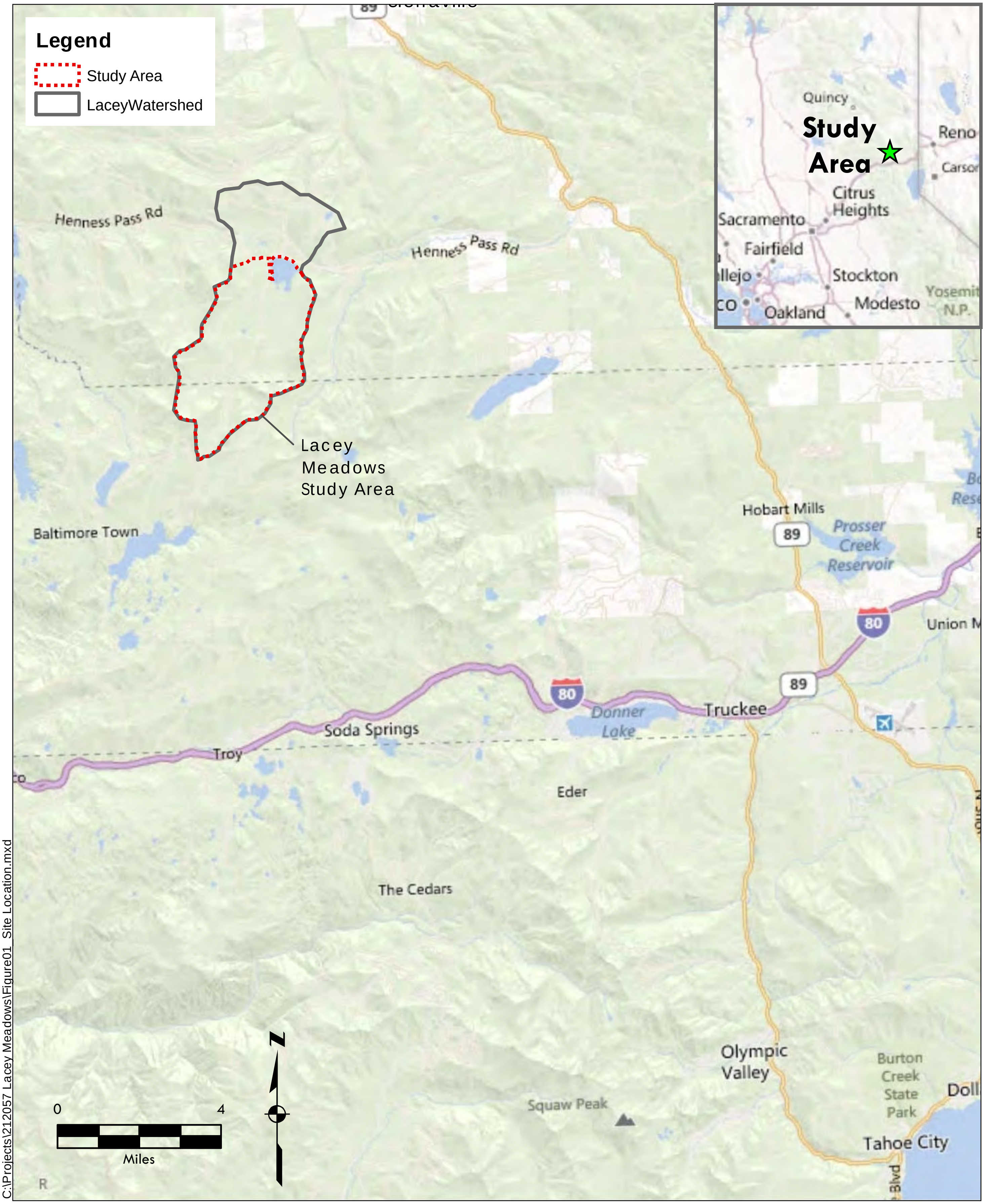
1.4 WORK CONDUCTED

The Lacey Meadows Watershed Assessment was carried out by a multi-disciplinary team of staff from Balance Hydrologics (hydrology and geomorphology), H. T. Harvey & Associates (rangeland ecology, botany, and wildlife biology), The Institute for Bird Populations (avian habitat), and Dr. Susan Lindström, Consulting Archaeologist (historical land use). We began this assessment with a review of available background information, drawing on a number of sources, including: historical maps, photos, aerial photographs, oral histories, land- and water-use histories, cultural resources, spatial (GIS) data, geologic and soil maps, and interviews with residents of the watershed. A biological resources assessment and a hydrologic/geomorphic assessment were completed, including a reconnaissance-based field assessment in July and August 2012.

This assessment has been conducted under contract to the Truckee River Watershed Council, and is funded by the Truckee River Fund of the Community Foundation of Western Nevada.

2. WATERSHED SETTING AND STUDY AREA

The Lacey Meadows watershed is located just east of the crest of the Sierra Nevada Range in the Sierra Nevada Geomorphic Province, roughly 16 miles northwest of Truckee, California (**Figure 1**) or identified using the Public Land Survey System (PLSS) as T19N, R14E, Sections 27-31, T18N, R14E, Sections 4 through 8, and T18N, R13E, Sections 1 and 12. Elevations in the watershed range from approximately 8,200 feet in the headwaters to 6,776 feet at Webber Lake. For the purpose of this assessment we identify two large montane meadows within the watershed and refer to them herein as Lower Lacey Meadow and Upper Lacey Meadow (**Figure 2**). Lacey Creek flows through these two meadows and into Webber Lake, a natural lake with a dammed outlet. The Webber Lake outflow is the headwaters of the Little Truckee River, tributary to the Truckee River. The Lacey Meadows Assessment Study Area is defined by the Lacey Creek watershed boundary, including minor intervening areas which drain to Webber Lake. The northern portion of the Webber Lake watershed (i.e., Coppins Valley and Lake of the Woods) is not included in this study area. Field studies were limited to Upper and Lower Lacey Meadows; areas outside the meadow system were assessed based on limited field data, historical and false-color infrared aerial photography, maps, existing datasets, and our team's experience in similar forest ecosystems within the northern Sierra Nevada. Appendix A includes a summary of historical maps and aerial photographs used in our assessment.



C:\Projects\212057 Lacey Meadows\Figure01 Site Location.mxd

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Figure 1. Regional Location Map
Lacey Meadows Watershed
Sierra and Nevada Counties, California

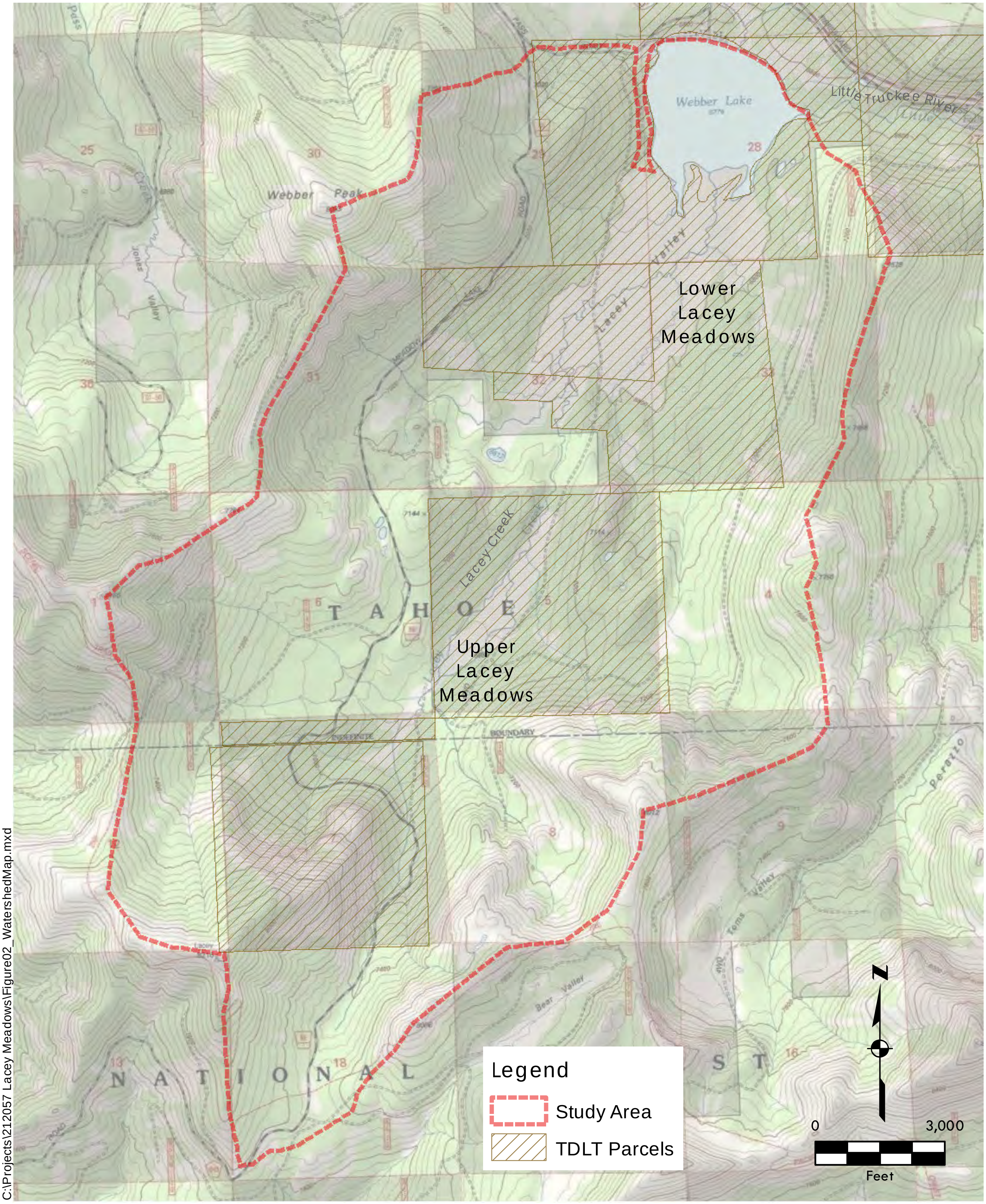

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Figure 2. Lacey Meadows Watershed
Sierra and Nevada Counties, California

2.1 CLIMATE

The Lacey Meadows watershed experiences cold and snowy/wet winters and warm dry summers. Temperatures can range from below zero degrees Fahrenheit in the winter to above 75 degrees in the summer. Mean annual precipitation ranges from approximately 37 inches at Webber Lake to over 50 inches near the highest elevations in the watershed. Precipitation falls mostly as snow between the months of October and April, with occasional afternoon thunderstorms during the summer months. Snow depths can exceed 120 inches in most winters with high-elevation snow cover lingering well into summer months of July and August (CDEC, 2012).

2.1.1 CLIMATE VARIABILITY: WET AND DRY PERIODS

Watershed processes are dependent on a number of factors including climate variability, as marked by periods of greater than average precipitation ('wet periods') and periods of below average precipitation or drought. Identification of historical wet and dry periods is an important component of this assessment, and provides context during evaluation and comparison of current and historical conditions. For example, wetland desiccation or meadow conversion to drier conditions may be a relatively temporary phenomenon resulting from successive dry years rather than a conversion due to land-use practices, while a series of wet years can recharge local groundwater and support a robust meadow and riparian community. Similarly, a single large flood event or succession of floods can generate significant changes to channel patterns or sediment supply—in effect, resetting the riparian community.

Figure 3 illustrates year-to-year precipitation variability[1]. It shows the annual percent deviation and cumulative percent deviation from mean annual precipitation in the

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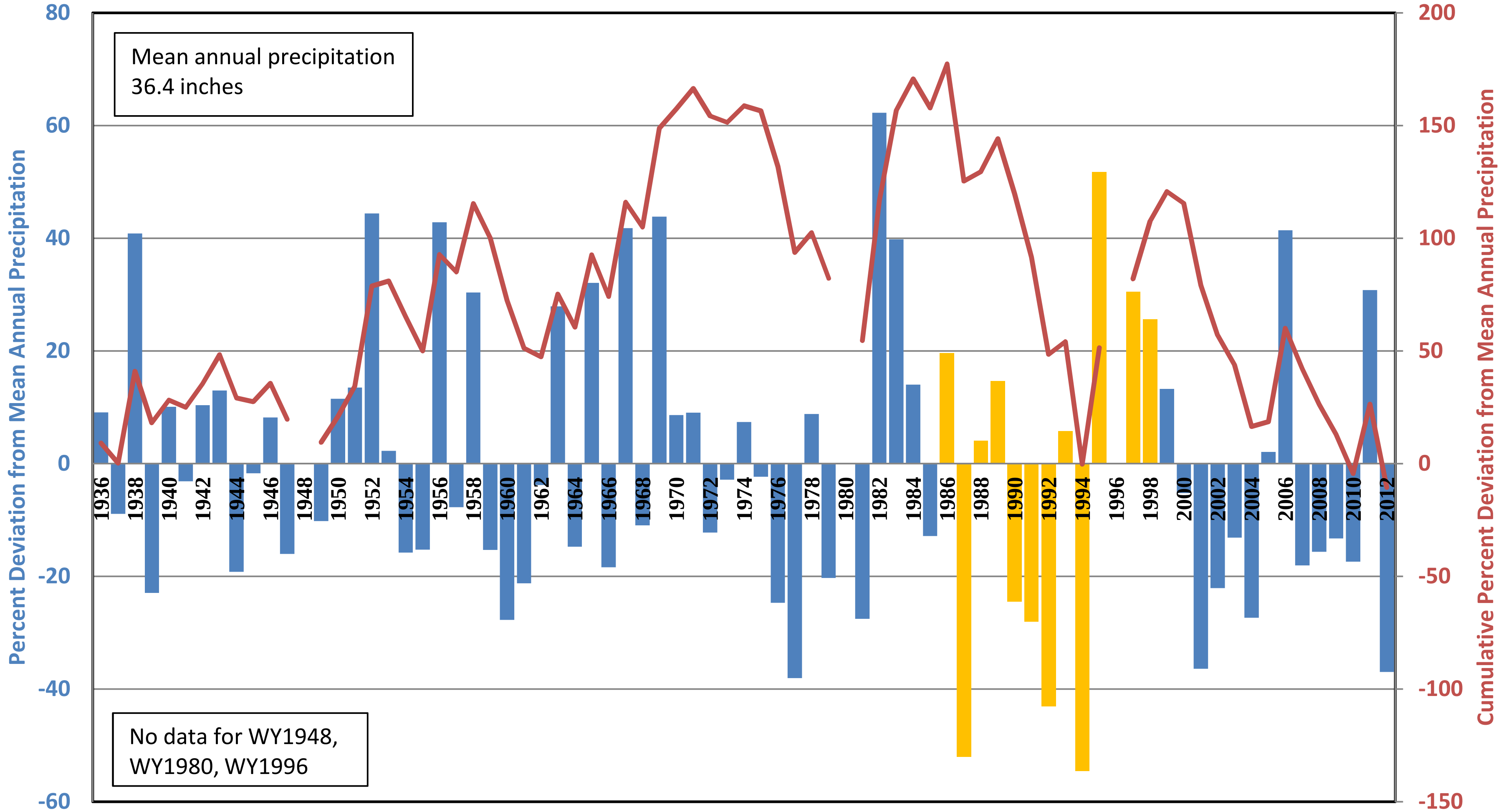
[1] Unless otherwise noted, all years are referred to as 'water years' in this report. A water year begins on October 1 and ends on September 30 of the named year.

vicinity of Lacey Meadows, and along with **Table 1,** provides context for interpretation of historical conditions, aerial photography and field investigations carried out as part of this study. A number of multi-year periods are apparent in Figure 3 and summarized in Table 1, with notable droughts indicated during the period from 1928 to 1935, 1976 to 1977, 1987 to 1994, 2000 to 2004, and 2007 to 2009.



Sources: WY1986-WY1998: CDEC station IDC (Independence Camp), WY1936-WY1985, WY1999-WY2012: station TKE(Truckee), adjusted by correlation

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Figure 3. **Percent Deviation and Cumulative Percent Deviation from Mean Annual Precipitation, Independence Camp, near Independence Lake, Sierra County, California, WY1936-WY2012.** The record illustrates alternating wet periods and dry periods; but more importantly, the most recent 10 to 12 years have been the driest in this period of record with a dramatic decline in cumulative precipitation (deviation from mean).

Table 1. Summary of wet and dry periods in the Truckee River Basin, 1875 - 2012.

Date	Annual precipitation characteristics	Conditions documented	Source
Dry Periods			
1928-1935	Tahoe City registered annual precipitation below long-term mean annual precipitation for each year within this period.	Lake Tahoe ceased to spill to the Truckee River Canyon	Western Regional Climate Center, station #048758; National Weather Service station ID: TAC; Lindstrom, 2011
1976-1977	Significant below average precipitation for both years		
1987-1994	1994 and 1987 were the first and second driest years on record, respectively.	Lake Tahoe lake levels reached lowest recorded elevation in 1992; massive timber mortality due to insect investations; low snowfall amounts 1990-1992 for Webber Lake	USFS, 2009; Lindstrom, 2011, CDEC, 2013
2000-2004	Annual precipitation was below average in all four years	Martis wildfire, 2001; other significant wildfires in the greater Tahoe area;	USFS, 2009
Wet Periods			
1875-1915	unavailable	Longest period (documented record) in which Truckee River flows were above average; era of historic logging and fluming activies; water rights first evaluated.	Lindstrom, 2011
1950-1952, 1956	Cumulative precipitation deviated +79 percent above long-term mean annual precipitation in 1952	Most significant flooding on record for the Tahoe-Reno area (1955)	Kattleman, 1992, USFS, 2009
1962-1971	Cumulative precipitation deviated +166 percent above long-term mean annual precipitation by 1971	Major floods in 1963 and 1964	USFS, 2009
1982-1983, 1986	Average annual snowpack of up to 200 percent; 1983 became the standard "High Water Year" for comparison to all other years; cumulative precipitation deviation +177 percent above long-term mean annual precipitation by 1986	Significant flooding along the Truckee River (March 1983)	Lindstrom, 2011; Kattleman, 1992, CDEC, 2013
1995-1999	Cumulative precipitation deviated +120 percent above long-term mean annual precipitation by 1999	New Years flood, 1997 recurrence: ~50-year flood, Truckee River at Farad	USGS, USFS, 2009
2010-2011	Greatest total seasonal snowfall depth since 1971; 5th highest snowfall depth on record; 120.6 inches (water-equivient) of snow in April-May, 2011 at Webber Lake.	April 1, 2011: 178% of normal snowpack	Central Sierra Snow Laboratory, Soda Springs, CA, CDEC, 2013 (Webber Lake)

Wetter-than-average periods occurred from 1875 to 1915 (generally), 1950 to 1952, 1956, 1962 to 1965, 1969 to 1970, 1982 to 1983, 1986, 1995 to 1997, and most recently 2010 to 2011. Some of these years were, such as 1956, were 'early', with little precipitation after mid-January; others were 'late', such as 1986, with four major storms during as many weeks after February 14 following a very dry early season. The record of annual peak flows on the Truckee River provides a sense of the timing of major floods which occurred in the region over the past 100 years, and is summarized in **Table 2**.[2] Periods of drought, particularly prolonged drought, stress or kill wetland and riparian vegetation and cause grazing animals to become increasingly concentrated in meadows and riparian areas, both of which can cause channel banks to become more susceptible to erosion during floods. Tables 1 and 2 indicate that these types of flood events occurred in 1937, 1980, 1997 and 2006. Other major floods in the Truckee River Basin were recorded in 1940, 1950, 1956, 1963, 1964, 1982, and 1986 as highlighted in Table 2.

It should also be noted that conditions during this assessment may potentially reflect drier conditions than the recent long-term average. Between 2000 and 2012, a dramatic decline in precipitation or cumulative percent deviation from mean annual precipitation is evident. Even though 2011 was one of the wettest years on record, the trend continues towards drier conditions relative to the norm for the period of record (see Figure 3). Given the number of dry years over the last decade, we might expect to see drier meadow conditions compared to those viewed on historical aerial photographs from earlier, wetter periods.

[2] Note that these peaks are mixture of instantaneous and mean daily peak flows.

Table 2. Summary of annual peak flows, Truckee River at Farad, California
Period of Record WY 1900-WY 2011

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1900	May 10, 1900		1,885[1,6]	**1956**	**Dec. 23, 1955**		**144,006**
1901	May 12, 1901		4,370[1,6]	1957	Jun. 06, 1957		3,276[1,6]
1902	Apr. 19, 1902		3,596[1,6]	1958	May 19, 1958	8.41	63,606
1903	Mar. 30, 1903		3,211[1,6]	1959	Jan. 12, 1959	3.76	10,506
1904	Feb. 24, 1904		6,730[1,6]	1960	Feb. 08, 1960	5.1	21,806
1905	Apr. 26, 1905		2,090[1,6]	1961	May 21, 1961	3.4	8766
1906	May 7, 1906		5,410[1,6]	1962	May 6, 1962	5.4	24,206
1907	Mar. 18, 1907		15,300[1,6]	**1963**	**Feb. 01, 1963**	**11.61**	**119,006**
1908	Apr. 21, 1908		1,870[1,6]	1964	Nov. 15, 1963	4.92	19,206
1909	Jan. 16, 1909		8,110[1,6]	**1965**	**Dec. 23, 1964**	**11.67**	**120,006**
1910	Mar. 19, 1910		3,890[1,6]	1966	Dec. 06, 1965	4.74	21,106
1911	Apr. 26, 1911		5,830[1,6]	1967	May 21, 1967	8.64	67,106
1912	May 15, 1912		2,230[1,6]	1968	Feb. 23, 1968	5.05	21,006
1913	May 18, 1913		1,875[1,6]	1969	May 11, 1969	7.73	51,206
1914	Apr. 15, 1914		4,280[1,6]	1970	Jan. 21, 1970	8.49	63,806
1915	May 12, 1915		4,470[1,6]	1971	Jun. 26, 1971	6.36	34,706
1916	Apr. 10, 1916		4,370[1,6]	1972	May 16, 1972	4.43	15,006
1917	Jun. 10, 1917		3,650[1,6]	1973	May 18, 1973	4.97	20,006
1918	Apr. 10, 1918		2,070[1,6]	1974	Apr. 02, 1974	6.31	34,106
1919	May 2, 1919		4,370[1,6]	1975	May 14, 1975	6.85	41,006
1920	May 21, 1920		2,030[1,6]	1976	Oct. 26, 1975	4.42	15,006
1921	May 14, 1921		2,100[1,6]	1977	Oct. 07, 1976	3.36	7636
1922	May 7, 1922		4,670[1,6]	1978	May 21, 1978	6.19	33,306
1923	May 11, 1923		2,620[1,6]	1979	May 15, 1979	5.59	25,506
1924	Feb. 08, 1924		767[1,6]	**1980**	**Jan. 14, 1980**	**9.7**	**81,506**
1925	Feb. 06, 1925		3,430[1,6]	1981	May 18, 1981	5.59	25,306
1926	Apr. 30, 1926		1,590[1,6]	**1982**	**Dec. 20, 1981**	**9.38**	**75,706**
1927	Apr. 27, 1927		3,700[1,6]	1983	Jun. 17, 1983	8.71	65,006
1928	Mar. 25, 1928		12,000[1,6]	1984	Nov. 24, 1983	7.98	54,206
1929	Jun. 16, 1929		1,480[1,6]	1985	May 20, 1985	5.21	19,706
1930	Apr. 23, 1930		1,720[1,6]	**1986**	**Mar. 08, 1986**	**10.6**	**95,506**
1931	Mar. 18, 1931		888[1,6]	1987	May 6, 1987	4.82	18,206
1932	May 13, 1932		2,950[1,6]	1988	Aug. 12, 1988	3.65	7756
1933	May 30, 1933		2,010[1,6]	1989	Mar. 11, 1989	4.97	17,706
1934	Mar. 29, 1934		2,500[1,6]	1990	Apr. 28, 1990	4.31	13,106
1935	Apr. 29, 1935		2,640[1,6]	1991	Mar. 04, 1991	5.53	25,106
1936	Apr. 18, 1936		3,314[1,6]	1992	Apr. 18, 1992	3.62	7496
1937	Apr. 15, 1937		2,340[1,6]	1993	May 24, 1993	5.75	25,406
1938	**Dec. 11, 1937**	**11.59**	**155,006**	1994	May 12, 1994	5.01	17,006
1939	Apr. 08, 1939		857[1,6]	1995	May 1, 1995	7.74	50,606
1940	**Mar. 30, 1940**	**7.7**	**71,206**	1996	May 18, 1996	8.93	68,406
1941	May 13, 1941	4.57	25,186	**1997**	**Jan. 02, 1997**	**13.13**	**149,006**
1942	Jun. 06, 1942	5.5	34,256	1998	Jun. 14, 1998	7.67	47,206
1943	Jan. 22, 1943	7.4	62,606	1999	May 26, 1999	7.58	45,706
1944	May 6, 1944		16,946	2000	May 24, 2000	5.41	17,806
1945	May 10, 1945		33,576	2001	May 15, 2001	4.32	8326
1946	Apr. 28, 1946		30,856	2002	Apr. 14, 2002	5.39	17,706
1947	Feb. 12, 1947		1,253[1,6]	2003	May 30, 2003	5.22	16,006
1948	Jun. 09, 1948		1,780[1,6]	2004	Mar. 23, 2004	4.68	11,206
1949	May 14, 1949		1,539[1,6]	2005	May 19, 2005	7.03	39,606
1950	May 28, 1950		2,607[1,6]	**2006**	**Dec. 31, 2005**	**10.77**	**101,006**
1951	**Nov. 21, 1950**	**14.5**	**175,006**	2007	May 18, 2007	4.67	11,106
1952	May 3, 1952		6,874[1,6]	2008	May 18, 2008	5.32	16,406
1953	Jun. 19, 1953		3,048[1,6]	2009	May 5, 2009	5.91	22,906
1954	Mar. 09, 1954		2,203[1,6]	2010	Jun. 06, 2010	6.33	27,706
1955	Jun. 08, 1955		1,254[1,6]	2011	Jun. 23, 2011	6.85	34,506

1. Discharge is a maximum daily average
6. DIscharge is affected by regulation or diversion (Tahoe City).

2.1.2 CLIMATE CHANGE

This study is not intended to describe potential future conditions in Lacey Meadows watershed that may result from climate change, as this is beyond the scope of the assessment. Instead, we cite current literature and the general trends climate scientists discuss for the Sierra Nevada for a context of anticipated conditions during future land management actions.

Under modeled scenarios, summers in the Sierra Nevada are expected to become drier and hotter while winters become warmer and wetter. Extreme precipitation events may happen more frequently, while meadow and riparian vegetation may be more stressed (USDA, 2010). The Lacey Meadows watershed is in a particularly sensitive elevation range, such that rainfall may become more common during the winter months, resulting in a reduced snowpack. The timing and volume of runoff can therefore be expected to be altered in future years, such that summer baseflow would likely be reduced, with peak snowmelt occurring earlier in the spring. Finally, an increased frequency of rain-on-snow events would induce more frequent flooding and/or extreme events.

The Truckee River has seen nearly a century of conflict over water rights and water supply, and the U.S. Bureau of Reclamation has identified the Truckee River basin as having a high likelihood of experiencing water-supply conflicts in the future. With projected earlier spring runoff and reductions in snowpack, along with increased frequency and magnitude of flooding events, proposed land management and watershed restoration strategies that can effectively retain and recharge groundwater supplies, moderate floods, and maintain or extend low flows into the summer are likely to provide benefits to a wide range of water users, and should therefore be prioritized.

2.2 WATERSHED GEOLOGY

The Lacey Meadows watershed is characterized by a dynamic period of Tertiary volcanic activity that occurred between 5 and 24 million years ago, followed by a more recent period of glaciation and erosion. The watershed is dominantly underlain by volcanic rocks, with total absence of exposed Cretaceous granitics that are found in much of the Sierra Nevada. Additionally, a small portion of the watershed is underlain by Cretaceous metamorphosed marine sediments. **Figure 4** is a watershed geologic map showing the distribution of geologic formations in the watershed, as based on Saucedo and Wagner (1992) and discussed below.

2.2.1 BEDROCK GEOLOGY AND STRUCTURE

The steeper uplands of the Lacey Meadows study area are primarily characterized by highly erosive pyroclastic volcanic rocks (Tvp), including tuffs (volcanic ash deposits), volcanic mudflows, and andesitic rocks. Exposures of these rocks and their associated erosion characteristics are visible above Meadow Lake Road in the southern portion of the watershed. These rocks are subject to debris flows or other forms of mass wasting and can provide abundant coarse and fine sediment supply to Lacey Creek in Upper Lacey Meadow. The upper reaches of Lacey Creek have eroded into slightly older basalts and metavolcanic rocks (Mzv) which are more resistant to erosion relative to the andesitic and pyroclastic rocks. The metavolcanics provide elevation control to the Upper Lacey Meadow, where Lacey Creek flows over a slightly steeper bedrock reach between the two meadows.

Detailed geologic mapping has not been completed in the Lacey watershed, but various investigations (Hudson, 1948; Hudson, 1951; Saucedo and Wagner, 1992; Sylvester and others, 2008; Melody, 2009); have defined a series of northwest-southeast and north-south fault zones in nearby areas, part of the North Walker Lane deformation belt. Related tectonic deformation and faulting is likely responsible for the basic shape of the valleys, with normal (extensional) faulting probably contributing to the alignments of stream courses and structural troughs where the meadows have formed.

2.2.2 GLACIATION

The Lacey Meadow Watershed was subject to several glaciations between 10,000 and 90,000 years ago, leaving behind a range of soil types and subtle landforms. Terminal and lateral moraines likely dammed valleys to create lakes where meadows are now located. During glacial retreat, streams transported glacial outwash and alluvium to these lakes, ultimately filling them with sediment to form today's meadows. Outwash or alluvial terraces, remnants of valleys once filled to higher elevations than the present meadow, are preserved in a number of locations in both upper and lower Lacey Meadows. Sylvester (2008) and Birkeland (1964) both identify a series of terraces composed of glacial outwash from the most recent (Tahoe- and Tioga-age) glacial retreats. Glacial

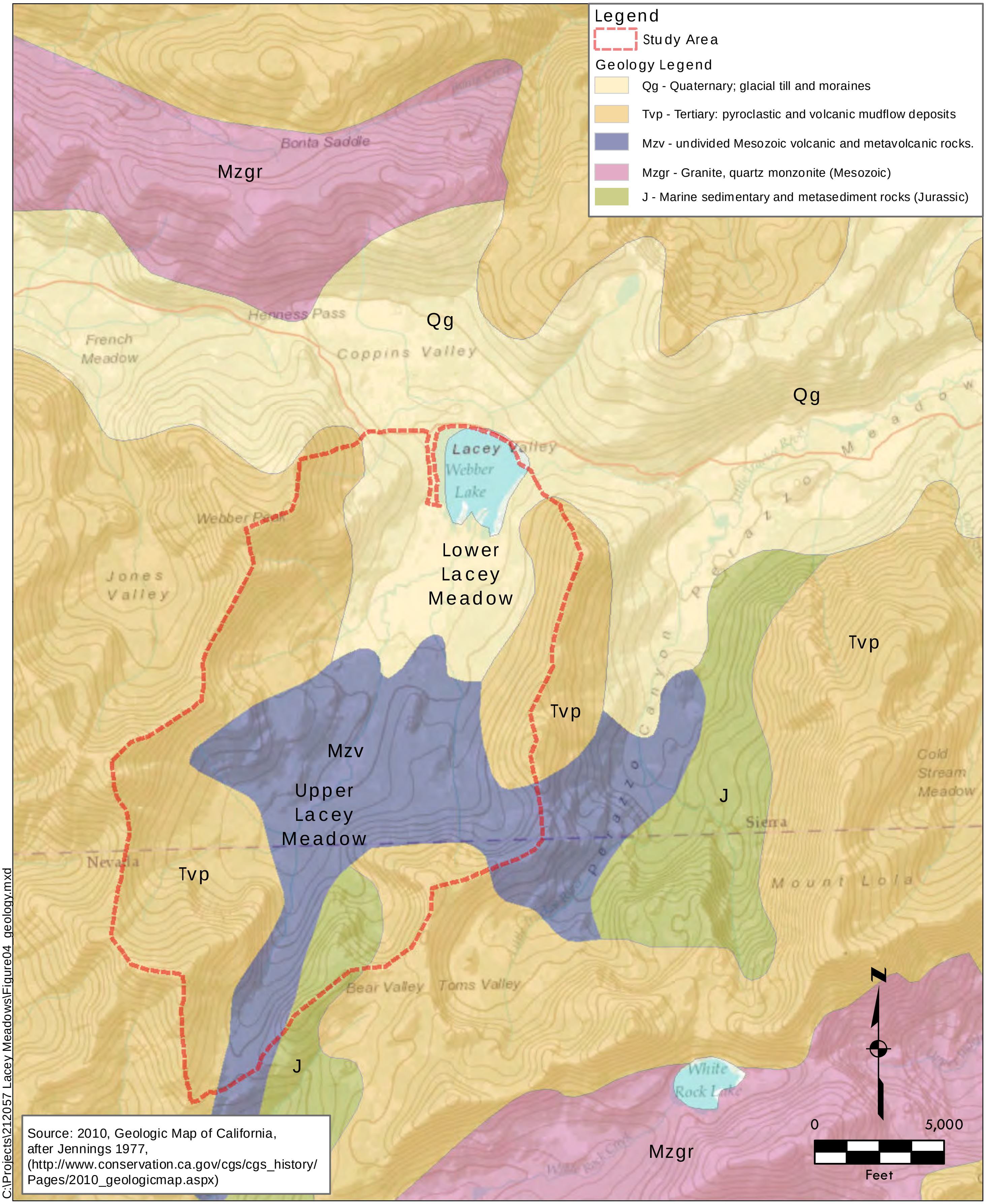

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Figure 4. Geologic map of the Lacey Meadows region Sierra and Nevada Counties, California

outwash terrace deposits are highly susceptible to erosion by modern streams, and serve as a source of course sediment to downstream areas. It is also important to recognize the subtle topographic relationship between terrace surfaces; terraces should not be expected to be flooded with the same frequency and duration as the active modern floodplain.

Glacial moraines from several relatively recent glaciations are recognizable throughout the eastern Sierra Nevada (Birkeland, 1964), as well as in areas adjacent to the meadows (Saucedo and Wagner, 1992). The youngest (Tioga) moraines are typically well-preserved with abundant boulder frequency, and tend to control streams rather than be modified by them. Linear crests in unconsolidated terrain with boulders are field indicators of moraine features, and the topographic depressions, or hollows, between these crests can be very effective at retaining ponded water and recharging groundwater. A number of small meadows and ponds in the upland forests surrounding Lacey Meadows appears to be examples of this, though these areas have not been thoroughly investigated in the field. Similarly a number of small ponds along Meadow Lake Road, west of the Upper Meadow, may have formed in these hollows.

The Southwest Pond, located upstream of the Lower Meadow, is evidence of a glacial cirque, while exposed bedrock in the Upper Lacey Meadow is polished with glacial striations—indicating glacial movement across these surfaces. Hummocky terrain along the meadow and unstratified sediment adjacent to the meadows are likely a result of glacial drift—unsorted deposits left behind by melting glaciers.

2.3 SOILS

The soils mantling the watershed generally reflect the underlying geologic units from which they have developed. Much of the uplands and steeper slopes include soils derived from volcanic tuffs and mudflows. Lower portions of the watershed include soils weathered from glacial deposits and alluvium and wetland soils. **Figure 5** is a map showing distribution of soil types within the Lacey Meadows Watershed, as mapped by Hanes (2002). In this section, we discuss a few of the more prominent soil types associated with the meadows or areas of disturbance.

Soils in the uplands include the Waca Series (soil types, WA, WC, WD, WE and to a lesser extent, AC, AD, ML, MK in Figure 5), Ahart-Waca Series (soil types AC, AD in Figure 5), and Meiss Series (soil types MH, MI, MK, ML in Figure 5) and are characterized as gravelly

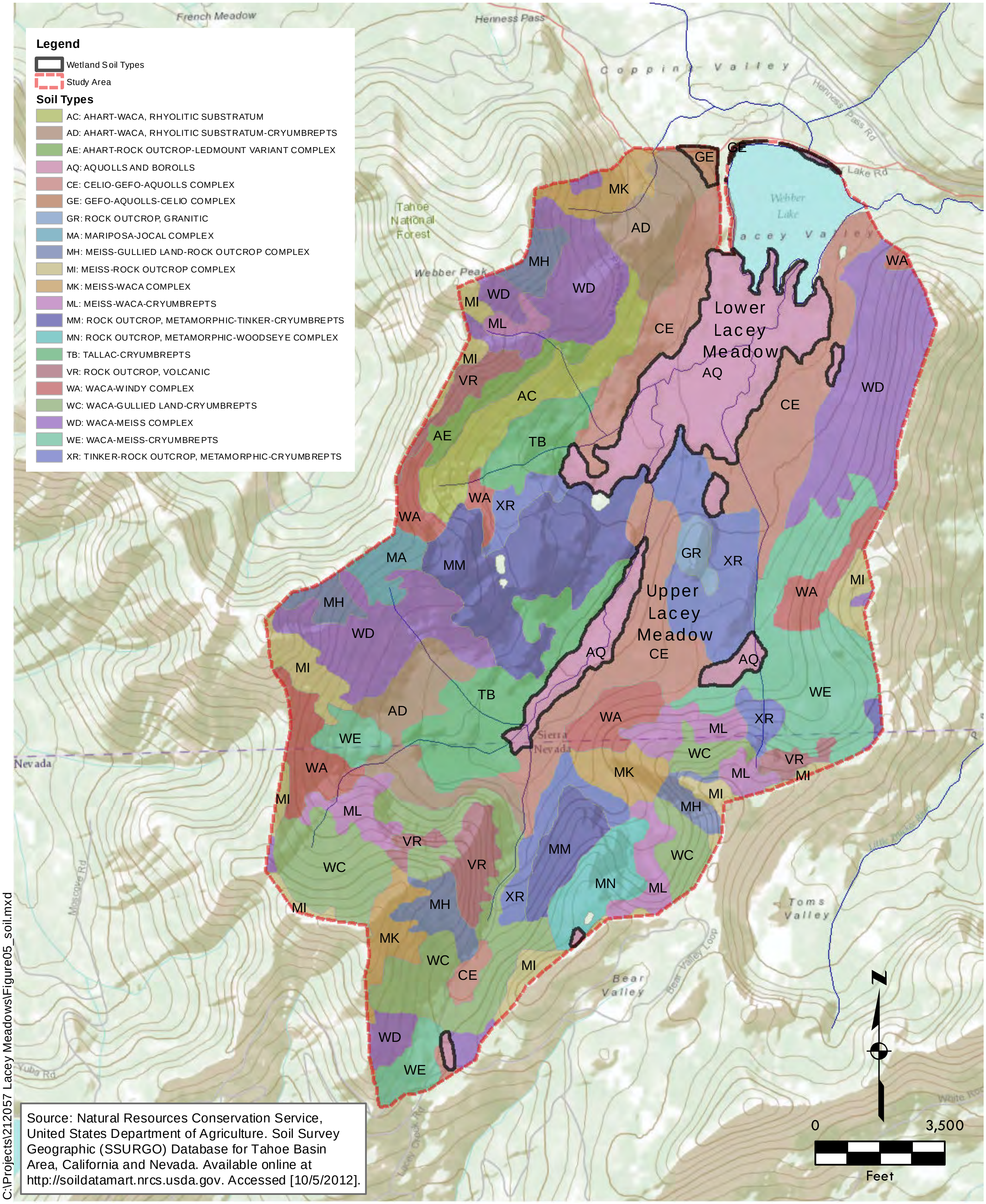

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Figure 5. Soils of the Lacey Meadows Study Area
Sierra and Nevada Counties, California

sands with moderate to high erosion potential. These soils are derived from exposed volcanic tuffs and mudflows and are typically more prone to gullying. In formerly logged areas where these soils are mapped, rills and gullies have formed. Once gullying begins to form in these soils, they tend to concentrate runoff and generate extensive erosion across large areas. Other steep terrains in the watershed include exposed rock outcrops of volcanic and meta-volcanic origin such as soil types: a) Rock outcrop, metamorphic-tinker-cryumbrepts (MM), b) rock outcrop, metamorphic-woodseye complex (MN) and, c) rock outcrop-volcanic (VR).

As Lacey Creek exits these steeper areas and crosses glacial moraine deposits adjacent to and upstream of Upper Lacey Meadow, soils transition to the Tallac and Celio Series; sandy loams weathered from glacial deposits and alluvium. These soils form the forest-meadow transition areas; they are very coarse and include glacial erratics. They tend to support a seasonal water table but are highly susceptible to erosion. The Tallac series (TB) are mapped along the western margin and alluvial fan of Upper Lacey Meadow and currently exhibit signs of active erosion such as headcut erosion in the ephemeral and intermittent tributaries to Lacey Creek. Conifers are well adapted to both Tallac and Celio soils. Areas where conifer encroachment is occurring in Lacey Meadows are likely underlain by these soils types.

Broad flat areas of the meadows or areas with low slopes include aquolls and borolls (AQ) and parts of Celio-gefo (CE) which are wetland soils that are characterized as poorly-drained silts and clays, weathered from alluvium. Typically, the surface layer can be thick and darkly colored with stratified coarse sand and clay underlain by older alluvium. These soils have a high water table during most of the year, supporting wetland vegetation such as alder, willow, rush and sedge. To a certain extent, upland or dry areas previously mapped as aquolls and borolls can be useful indictors of where disturbance or meadow conversion has recently taken place. Disturbance can include, but not limited to, lowering of the local water table from channel incision, grazing impacts, or streamflow diversions.

2.4 HYDROGRAPHY AND HYDROLOGY

Above Webber Lake, Lacey Creek has a watershed area of approximately 9.3 square miles and provides hydrologic support to both the Upper and Lower Meadow (see Figure 2). Webber Lake is also fed by other unnamed tributaries (i.e., Coppins Meadow and Lake of the Woods) outside the boundary of this study.

The Webber Lake outflow forms the headwaters of the Little Truckee River, which flows downstream over Webber Falls to Perazzo Meadows and Stampede and Boca Reservoirs, ultimately discharging to the Truckee River near Boca, California. An approximately 3-foot high shallow rock dam was constructed at the outlet of Webber Lake around 1914 to augment water storage and support recreation. Improvements were made to the dam since that time, though the dam height was not changed (Lindström, 2012). A metal fish weir and fish screens were added around 1985 in order to prevent stocked fish from entering downstream waters of the Little Truckee River. Ongoing maintenance of weed and debris buildup on the fish screens likely has an effect on lake levels and outflow rates.

Lacey Creek is a snowmelt-dominated system, with annual peak flows typically between March and June, coincident with snowmelt. Occasional rain-on-snow events result in significant flooding during other winter months. Lacey Creek is mapped as perennial on USGS topographic maps; however, in August 2012, it was mostly dry with intermittent flow in some reaches. A number of ephemeral tributaries to Lacey Creek and Webber Lake only flow during the spring or as the result of summer thunderstorms. For ease of communication we have established informal names such as 'Southwest Tributary,' or similar, for these tributaries.

2.5 CHANNEL FORM AND PROCESS

Channel processes can be framed in terms of spatial patterns of sediment production, transport, and deposition. **Figure 6** is a longitudinal profile of Lacey Creek and tributaries and shows a somewhat typical concave shape, with steeper channels in upper and tributary reaches, and relatively low gradients across the meadows. Smaller, steeper streams in the upper zone of a watershed function to erode and transport sediment, while larger, shallower streams in the lower zone of a watershed function to accumulate or deposit sediment. Watershed management strategies are likely to differ where these different processes dominate. It is also important to recognize that these zones are not static, and sediment transport processes may change in a particular location following large floods, wildfires, or during extreme droughts.

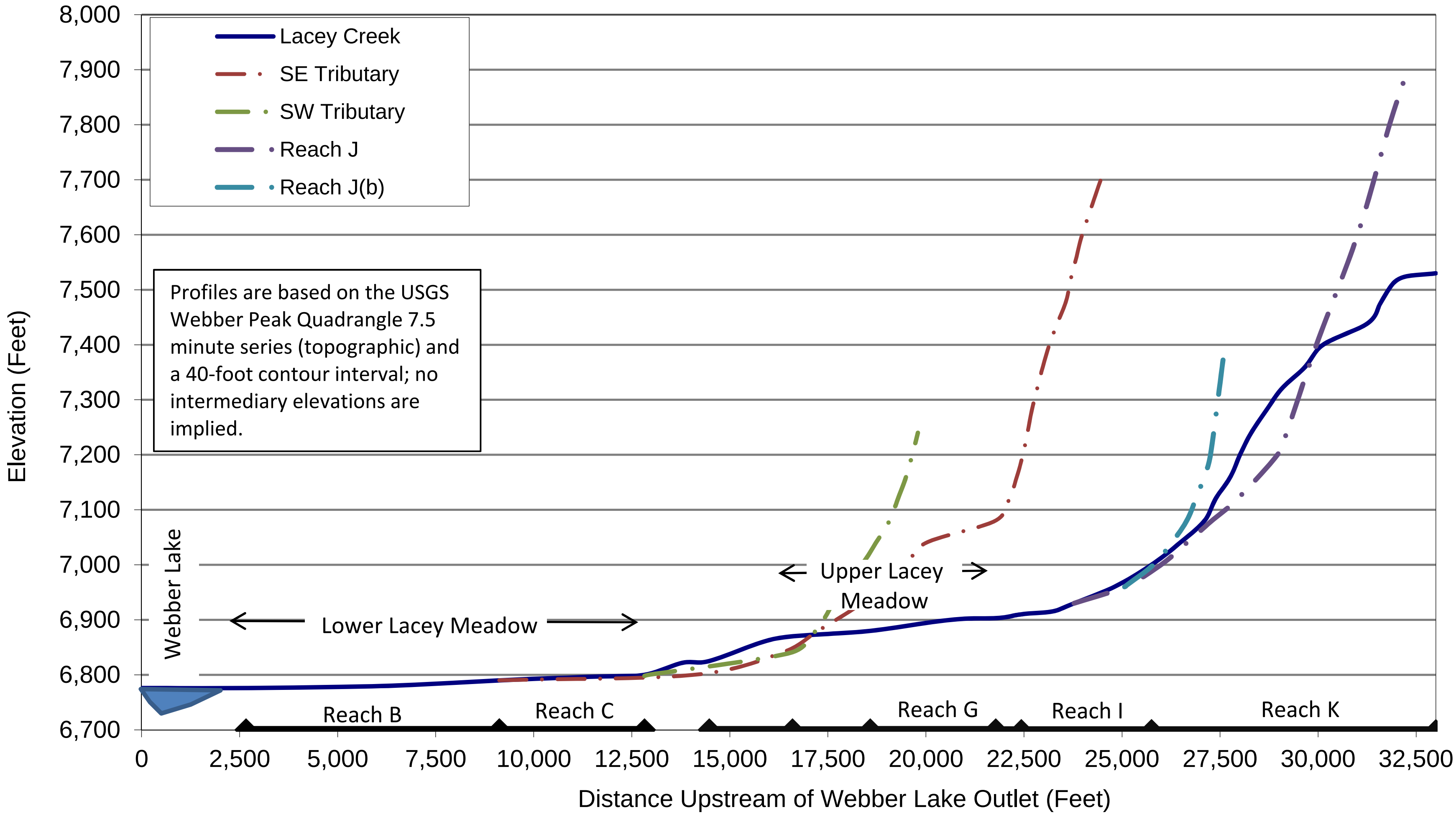

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Figure 6. **Longitudinal Profiles, Lacey Creek and Tributaries, Sierra and Nevada Counties, California.** Profiles based on Webber Peak Quadrangle 7.5 minute series (topographic) and 40 foot contour interval; no intermediary elevations are implied.

Lacey Creek flows from the crest of the Sierra Nevada and is within the zone of erosion and transport on a regional scale. Channels in Upper Lacey Creek are dynamic; they continue to evolve in steep bedrock-dominated areas, generating sediment from erodible volcanic bedrock and soils, temporarily depositing sediment in alluvial fans, glacial outwash terraces and meadow alluvium during extreme events, then metering that sediment to downstream areas during moderate flows. Channel form and patterns in the Upper Meadow areas are likely more responsive to land-use changes, drainage modifications, and drought cycles, wildfires, and extreme flow events.

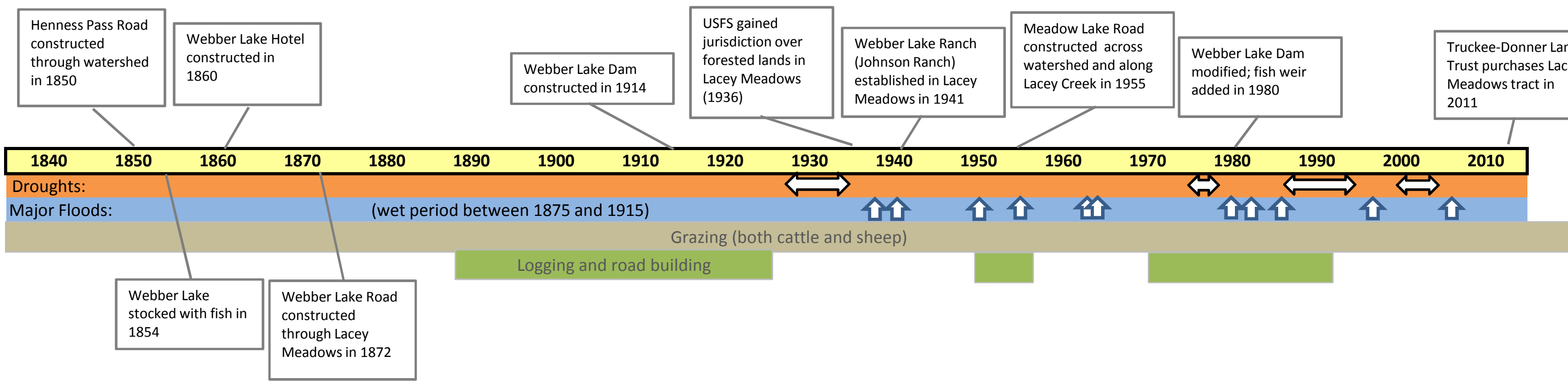
As Figure 6 shows, the meadows are low gradient features that punctuate the longitudinal profile and provide for channel adjustment, such as temporary sediment deposition and sequestration. Upper Lacey Meadow is moderately steeper than the lower meadow and channels are much more dynamic as a result. A bedrock sill separates the two meadows, providing a control on Upper Meadow slope and sediment transport dynamics. With an ample natural supply of coarse sediment from the uppermost watershed, land disturbances and sediment transport dynamics are most likely to be manifest in channel instability, avulsion and terrace formation in the Upper Meadow, while sediment storage and bedrock grade control may serve to modulate these effects on the Lower Meadow.

2.6 CULTURE, LAND USE, AND HISTORICAL LAND USE

Dr. Susan Lindström details the culture and historical land uses in Appendix B. A timeline of significant changes or occurrences of land-uses is provided in **Figure 7**. A number of events and land-use themes in the watershed appear to play an important role in current status of natural resources health and integrity, including: livestock grazing, road building, and to a lesser extent, logging. We briefly describe some of the history associated with these activities below.

2.6.1 LIVESTOCK GRAZING

Livestock grazing in high montane meadows of the Sierra has been documented as far back as the mid-1800s (Lindstrom, 2012). Grazing impacts to the stream environment are well documented in the literature. For example, high concentrations of suspended solids or other sediment loads, and fecal coliform or fecal streptococci are usually associated with impacts of grazing, and can have a major impact on altering an existing stream ecosystem or even creating an entirely new ecosystem (Johnson and



Sources: Major floods are based on annual peak flows, Truckee River at Farad, California, (USGS 10346000), WY1900-WY2011
Droughts are based multiple sources (WRCC 2011, USFS, 2009, Kattleman, 2009, 2011, CDEC , 2012

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Figure 7. **Timeline of historical land-use changes, events, droughts, and major floods, Lacey Meadows watershed, Sierra and Nevada Counties, California.**

others, 1977, Johnson and others, 1978, McKee and Wolf, 1963 *cited in* Kauffman and Krueger (1984). The National Fish and Wildlife Foundation (2009) has established a restoration business plan for Sierran meadows with specific objectives to address grazing impacts. Given its size and elevation, Lacey Meadows is likely a good candidate for alternative grazing practices or management strategies.

Lacey Meadows has historically been grazed by cattle and sheep, occasionally at high intensities, since at least as early as 1846 as western settlers and wagon trains traversed the Sierra Nevada over the Henness Pass Road to reach the Yuba Gold Fields and Central Valley (Lindström, 2012). Livestock grazing by both cattle and migratory sheep at moderate to high intensities intensified throughout the latter half of the 1800s into the early 1900s, with overgrazing cited as a major impetus for creation of the Tahoe National Forest in 1905 (Jackson and others, 1982) The Johnson family, who assumed ownership of the Webber Lake Property in the 1940s, primarily grazed sheep, though historical records indicate that cattle were also likely grazed within the meadow and surrounding lands during the early years of ownership by the Johnson family. A small dairy was operated on the property during this period as well (Lindström, 2012). At some point, the Johnson family began to lease the property for grazing, rather than grazing livestock they owned. A complete history of lessees is unknown; however, John Fiddyment, a prominent sheep rancher in Placer County, held the lease for an extended period of time prior to the acquisition of his sheep and grazing leases by Hay Brothers Sheep, the current lessee (D. Hay pers. com., 2012)

Under the current lessee, livestock use of Lacey Meadows has been limited to seasonal sheep grazing. In a typical year, approximately 1200 to 1500 dry ewes or ewes with lambs, depending on forage conditions, are grazed within Lacey Meadows, Sardine Valley, and adjacent uplands, which are a mix of Forest Service lands and private lands mostly owned by the Johnson family (D. Hay pers. com., 2012). The current Lacey Valley grazing lease with the Johnson Family permits 1500 head of sheep, with the grazing period mutually agreed to by the Johnsons and the grazing lessee.

Based on an interview with the Hay Brothers (D. Hay pers. com., 2012), management of sheep within Lacey Valley and the surrounding region can be summarized as follows. Beginning in mid-June to early July (depending on snowmelt and forage conditions), sheep are initially grazed in Sardine Valley. After leaving Sardine Valley, sheep are moved to Lacey Meadows, which serves as a base for grazing Lacey Valley and the surrounding, smaller meadows and upland areas that comprise the Tahoe National Forest Webber Lake allotment, which is grazed under a permit held by the Hay Brothers. The exact timing of animal movements and duration that animals are left in any one location within this region varies significantly from year-to-year based on precipitation and forage growth. In typical years, animals are lightly grazed within the Lower Lacey Meadow as they are driven up to the Upper Lacey Meadow. Animals are grazed in the upper meadow for a variable period of time before being driven out into surrounding meadows and upland areas, again based on forage production and the availability of key forage plants, most importantly, upland species such as wooly mule's ear (*Wyethia mollis*) and lupine (e.g., *Lupinus breweri*) as well as key herbaceous species found in meadows. The sheep herder, who remains with the herd throughout the grazing period, directs sheep among various bedding, watering, and foraging locations throughout the area. Water is exclusively provided by streams and creeks in this area, including Lacey Creek. Toward the end of the grazing period, roughly mid-September, sheep are brought back into Lacey Valley. Animals are again driven through Lacey Valley and trucked out near Coppins Meadow toward the end of September to early October.

2.6.2 ROADS

Roads can be a major watershed disturbance depending on their construction, stream crossing design, drainage patterns, road density (miles of road per square mile), and maintenance. In the northern Sierra Nevada, unpaved roads have shown 12- to 25-fold increases in sediment yield to nearby streams (Coe, 2002). Improper or undersized culverts can lead to channel scour and eventually fish passage barriers, as well as stream diversion (Furniss and others, 1997). Roadcuts along unstable hillslopes can promote landslides or debris flows. Roads can increase hydrologic connectivity with streams—increases in volume of runoff entering the streams can, in turn, increase flood magnitude and frequency. Maintenance, grading or use of existing roads during wet weather can quickly double the amount of sediment available for delivery to nearby streams (Coe, 2002). Finally, roads can modify channels and sediment supply through the process of stream capture. Stream capture occurs when a culvert at a stream crossing becomes overwhelmed or plugged with sediment resulting in redirection of streamflow. If the road is graded such that it can provide a flow path, the road becomes the active channel. Because most roads are very linear features, the process of stream capture results in a steep, eroding channel that can provide abundant sediment to downstream habitat. Stream capture often occurs at stream crossings when a culvert becomes plugged or at locations where roads intersect migrating meander bends. An understanding of road networks and their hydrologic connectivity with streams is essential to evaluating watershed function.

In 1872, the Webber Lake-Cisco Grove Road was constructed through Lacey Meadows and provided an alternate route over the Sierra Nevada, south of the Henness Pass Road. Increased access and movement over these passes increased cattle- and sheep-grazing in Sierra Nevadan meadows by mule trains and ranchers. Between 1890 and 1920 documented logging and grazing may have reduced vegetation cover, as is observed in the earliest available aerial photographs (1939). In 1920, it was reported that a road was constructed around Webber Lake, although little evidence of this road is present today (Lindström, 2012). Sometime after 1940, several unimproved roads were constructed in the Upper Lacey Meadow. Several of these roads intersected or crossed Lacey Creek where major channel changes occurred sometime between 1940 and 1966.

In 1955, Meadow Lake Road was constructed through the forested slopes of Lacey Meadows Watershed and provided improved access across the watershed. Over the last several decades, this dirt and gravel road has been well-maintained and widened with an in-board ditch and multiple stream crossings. In the upper watershed, this road follows the alignment of the original Webber Lake-Cisco Grove Road over the Sierra Nevada Crest.

During the last 50 years, additional roads were constructed in the watershed and were likely associated with logging. Logging in the watershed is documented to have occurred in 1958 and again in 1971 (Lindström, 2012). Road-building is commonly an operation of modern-day logging, used for harvesting and transport. Review of historical maps and aerial photographs suggest some roads are absent from 1981 maps and 1983 historical aerials, yet visible on 1993 aerial photographs and identified in the field. This may further suggest that a more recent period of road building and possibly logging occurred in the 1980s.

2.6.3 LOGGING

Industrial-scale logging is well-documented in the greater Tahoe-Truckee area and began around the 1860s when the cross-continental railroads came through the area.

The largest mill within the vicinity of Lacey Meadows was Hobart Mills, about 20 miles southeast. Lindstrom (2011, 2012) has documented some of the visual impacts from logging in the greater Lake Tahoe area. A significant impact from logging is associated with roads and railroads built to remove timber, as described above. Other impacts include changes to the structure and health of the forest. For example, much of the logging that occurred in the late 1800s and early 1900s included clear-cutting practices which subsequently produced forests of uniform age and structure with limited habitat diversity. In Lacey Meadows, there is no evidence that historical narrow-gauge railroads were used to transport timber to local mills.

The Sierra Nevada Wood and Lumber Company initially owned much of the public lands in the watershed (Lindström, 2012), until timber was largely depleted by the early 1930s and by 1936 and the USFS gained jurisdiction over a significant portion of the watershed. After 1936, the USFS records indicate very little harvesting in the Lacey Meadows watershed. Three known dates of logging (1952, 1958, and 1971) were identified from historical records and limited to Coppins Meadow (outside the study area boundary) and less than a square mile of land in the uplands east of Upper Lacey Meadow (see logging maps in Appendix B).

2.7 BIOLOGICAL RESOURCES

2.7.1 PLANT COMMUNITIES AND MEADOW HYDROGEOMORPHIC TYPES

Plant communities occurring within the Lacey Creek Watershed and within Lacey Meadows are described below. For the larger Lacey Meadows watershed, plant communities are based exclusively on the National Land Cover Dataset (NLCD) (Homer and others, 2012), with no original data collected. At the watershed scale, descriptions of plant communities are based on professional experience with similar habitat types in the Northern Sierra Nevada. At the meadow scale, more detailed mapping of plant communities was carried out by H. T. Harvey & Associates ecologist Matt Wacker.

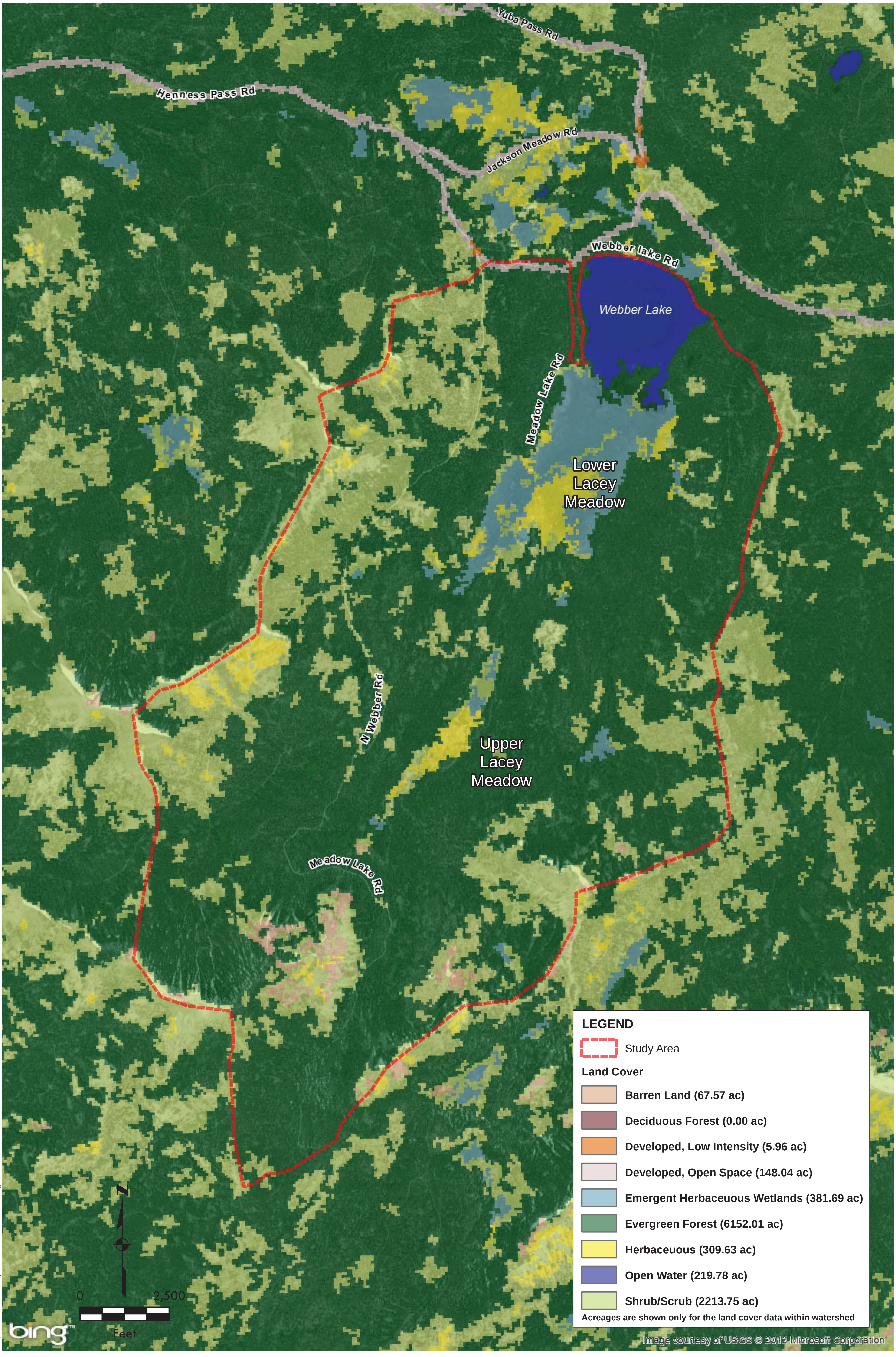
Meadow ecological condition is evaluated using the methods of Weixelman and others (2011), which is the standard method used by the U. S. Forest Service across the Sierra Nevada to measure meadow condition and trend, particularly with respect to current and historic grazing practices. Briefly, this method relies on assessment of meadow soil and plant community attributes to derive a meadow condition rating. Soil and plant community attributes are interpreted relative to meadow hydrology to determine where each assessment site is located along a continuum of low ecological function sites to high ecological function sites. Meadow hydrogeomorphic (HGM) types established by Weixelman and others (2011) were also mapped in conjunction with plant communities to aid in an assessment of the current ecological condition and the ecological functions potentially provided by Lacey Meadows, particularly with respect to current and historical grazing practices.

2.7.1.1 LACEY MEADOWS WATERSHED PLANT COMMUNITIES

Two land cover types and five plant communities are mapped in the NLCD for the Lacey Creek Watershed. In some cases, the NLCD classification approximates the more detailed Holland and Sawyer and Keeler-Wolfe classification (see below); however, in most cases the NLCD classification includes multiple Holland and Sawyer and Keeler-Wolfe classes, some of which are not found within Lacey Meadows. The distribution of land cover types and plant communities within the watershed is shown in **Figure 8**, and the primary characteristics of each land cover type or plant community are described below.

Barren Land - Barren land is characterized by bare rock, gravel, sand, silt, clay, or other earthen material with less than 15 percent vegetation cover. Vegetation, if present, is more widely spaced and scrubby. Generally, these are areas of bedrock, talus, slides, volcanic material, glacial debris, and other accumulations of earthen material. This land cover type corresponds to the Rock/Barren habitat described below for Lacey Meadows.

Developed - Developed areas are characterized by a high percentage (30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings) and includes large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Within the Lacey Meadows Watershed, developed areas include roadways and developed recreational areas (i.e., cabins, campgrounds) around Webber Lake. There is no corresponding habitat type mapped within Lacey Meadows.



N:\Projects\3400\3407-01\Reports\Watershed Assessment\Fig 8 Generalized Land Cover.mxd

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Figure 8. Lacey Meadows – Generalized Land Cover Types
Sierra and Nevada Counties, California

Emergent Herbaceous Wetland - Emergent herbaceous wetlands are plant communities with seasonally to permanently saturated soils where at least 80 percent of the vegetation is dominated by perennial herbaceous vegetation. This community type corresponds to the Montane Meadow plant community described below for Lacey Meadows.

Evergreen Forest - Evergreen forests are plant communities dominated by trees generally greater than 20 ft. tall with at least 25 percent tree cover. Common evergreen tree species either known to occur or likely to occur within the Lacey Meadows Watershed include: lodgepole pine (*Pinus contorta* ssp. *murrayana*), red fir (*Abies magnifica*), white fir (*Abies concolor*), and Jeffrey pine (*Pinus jeffreyi*). At higher elevations, western white pine (*Pinus monticola*) may also occur either as the lone species or, more frequently, intermixed with lodgepole pine and red fir. It should be noted that only lodgepole pine and red fir were observed during field reconnaissance surveys within Lacey Meadows conducted by H. T. Harvey & Associates and during prior surveys conducted by Dr. Jim Gaither (Gaither, 2011); however, other species are likely present within the watershed based on their widespread distribution within the surrounding region. Significant areas of dead and dying lodgepole pine were observed in evergreen forests, particularly west of Lower Lacey Meadow.

Depending on topography, aspect, and tree canopy cover, the understory community of evergreen forests may be dominated by a variety of shrubs, described below under Shrub/Scrub, or herbaceous species, described below under Herbaceous. Although not specifically mapped in NLCD dataset, this community type also includes scattered, small groves of quaking aspen (*Populus tremuloides*). This species appears to be more widely distributed outside the Lacey Meadows Watershed, but a small grove was observed along North Webber Road, southwest of Lower Lacey Meadow, and other small groves may be present within the watershed along streams, seeps, and other areas that favor aspen. This community type includes Lodgepole Pine Forest described below for Lacey Meadows.

Herbaceous - Herbaceous communities are characterized by less than 25 percent tree and shrub cover with a variety of perennial and annual grasses and forbs. Characteristic species within herbaceous communities are described below under Dry Montane Meadow; however, this community type as mapped in the NLCD also includes various rocky and dry upland areas such as slopes and ridgelines that would include species such as soft mule's ear, penstemon (*Penstemon* spp.), phacelia

(*Phacelia* spp.), coyote mint (*Monardella* spp.), buckwheat (*Eriogonum* spp.), and similar species.

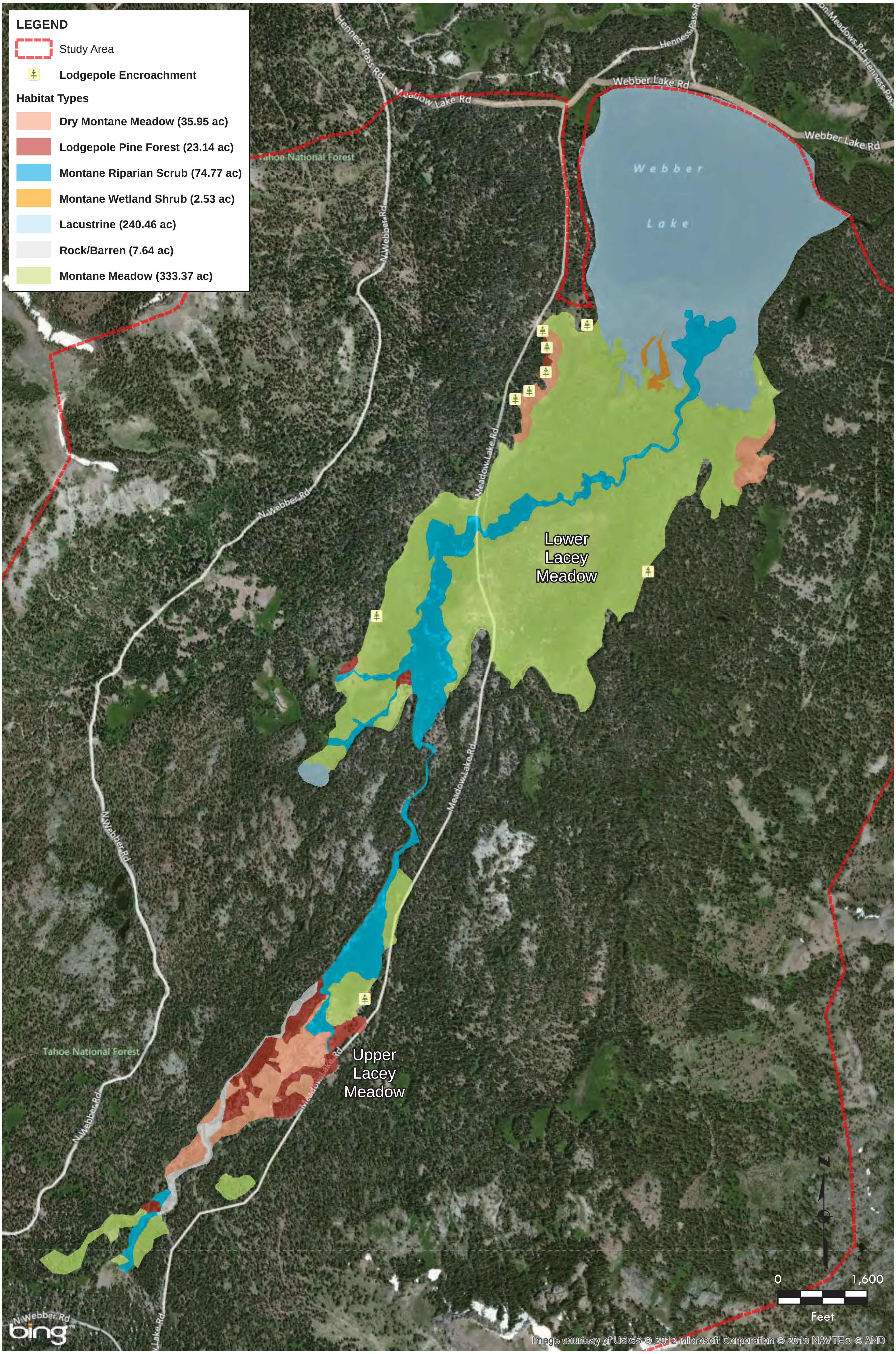
Open Water - Open water corresponds to lakes, ponds, and similar habitats with less than 25 percent vegetation cover. This community corresponds to Lacustrine habitat described below for Lacey Meadows.

Shrub/Scrub - Shrub and scrub communities, as mapped in the NLCD, include both riparian and upland shrub and scrub plant communities dominated by woody plants less than 15 ft. tall with at least 20 percent canopy cover. In addition to shrubs, it includes early succession forest communities and trees stunted by environmental conditions. Common species within upland shrublands can include various species in the following genera: *Ceanothus*, *Arctostaphylos*, *Ribes*, *Cercocarpus*, *Prunus*, *Chrysolepis*, *Chrysothamnus*, and *Symphoricarpos* among others as well as antelope bitterbrush (*Purshia tridentata*). Common species within riparian scrub and shrub communities are described below under Montane Riparian Scrub for Lacey Meadows.

2.7.1.2 LACEY MEADOWS PLANT COMMUNITIES

Five distinct plant communities and two habitats were mapped within Lacey Meadows: dry montane meadow, montane meadow, montane riparian scrub, montane wetland shrub, lodgepole pine forest, lacustrine, and rock/barren. Each of these communities or habitats is briefly described below. **Figure 9** shows the locations of these communities or habitats within Upper and Lower Lacey Meadow as well as the approximate acreage of each community type or habitat.

Dry Montane Meadow - Dry montane meadows were found on higher landforms surrounding Lower Lacey Meadow and at the upper end of Upper Lacey Meadow. This is a dry, open plant community characterized by bare ground interspersed with annual forbs and perennial grasses along with scattered shrubs and trees. Characteristic plant species include: mat muhly (*Muhlenbergia richardsonis*), little squirreltail (*Elymus elymoides*), slender hairgrass (*Deschampsia elongata*), California needle grass (*Stipa occidentalis* var. *californica*), California brome (*Bromus carinatus*), one-sided blue grass (*Poa secunda* ssp. *secunda*), various annual forbs (e.g., *Navarretia* spp., *Lupinus* spp., *Leptosiphon* ssp., *Polygonum sawatchense*, *Calyptridium umbellatum*), and upland perennial forbs such as Pasish's yampah (*Perideria perishii*) and potentilla (*Potentilla*



N:\Projects\3400\3407-01\Reports\Watershed Assessment\Fig 9 Generalized Vegetation Communities.mxd

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Figure 9. Lacey Meadows – Plant Communities
Sierra and Nevada Counties, California

spp.). Scattered Lemmon's willow (*Salix lemmonii*) and lodgepole pine were observed in some dry montane meadows, particularly within Upper Lacey Meadow.

Montane Meadow - Montane meadows were found on lower landforms along active and abandoned stream channels, lake margins, and in areas where shallow, summer groundwater is present. This community encompasses both mesic and wet environments dominated by perennial grammanoids (i.e., grasses, sedges, and rushes) and forbs with little bare ground. Shrubs and trees are not commonly found in this plant community. Characteristic species in mesic settings include: Kentucky bluegrass (*Poa pratensis*), meadow barley (*Hordeum brachyatherum* ssp. *brachyatherum*), slender wheatgrass (*Elymus trachycaulus*), California oatgrass (*Danthonia californica*), Baltic rush (*Juncus balticus*), yarrow (*Achiella millefolium*), Parish's yampah, mat muhly, lupine (*Lupinus* spp.), longstem clover (*Trifolium longipes*), California corn lily (*Veratrum californicum* var. *californicum*), and potentilla among other species. In wetter settings, such as abandoned stream courses and oxbows, at the margins of lakes, and in areas with shallow summer groundwater, many of these same species may be present but less commonly encountered. Dominant species are typically sedges, principally: Nebraska sedge (*Carex nebraskensis*), inflated sedge (*Carex vesicaria*), beaked sedge (*Carex utriculata*), short-beaked sedge (*Carex simulata*), and species of rushes (e.g., *Juncus nevadensis*), wood-rush (*Luzula comosa*), and bulrush (*Scirpus* spp.). Areas with persistent, shallow summer groundwater found at the upper margins of Upper Lacey Meadow along Lacey Creek also had a variety of perennial forbs such as: columbine (*Aquilegia formosa*), big leaf lupine (*Lupinus latifolius*), larkspur (*Delphinium* spp.), and California tiger lily (*Lilium pardalinum*).

Montane Riparian Scrub - Montane riparian scrub occurs along Lacey Creek and various perennial and ephemeral stream courses found throughout Upper and Lower Lacey Meadow. This community is comprised of low to moderate stature willow, primarily Lemmon's willow; although, arroyo willow (*Salix lasiolepis*) was commonly observed along the forested stretch of Lacey Creek in between Upper and Lower Lacey Meadow. Willow cover can be dense, as observed at the inlet of Lacey Creek into Webber Lake, or open and sparse. Montane riparian scrub frequently intermixes with montane meadow or, occasionally, dry montane meadow communities. Many willows, particularly within Upper Lacey Meadow were heavily browsed and hedged from repeated sheep browsing. It is also noteworthy that little to no willow recruitment was observed along Lacey Creek and its tributaries. Willow recruitment is known to occur under a specific sequence of events, typically coinciding with high flows during snowmelt and runoff (Mahoney and Rood, 1998). Specifically, successful recruitment of willows tends to occur when willow seeds fall on bare, moist, mineral soil, and the resulting seedlings are subsequently able to extend their developing roots at the same rate as stream flows are receding. The observed lack of willow recruitment may, therefore, be at least partially the result of modifications to the hydrology of Lacey Creek that have reduced the frequency during which flow conditions conducive to willow recruitment occur. This concept is discussed in more detail within Section 3.2.4, below.

Montane Wetland Shrub - This community is limited to the margins of Webber Lake where dense, nearly impenetrable stands of moderate-stature willows, most of which appear to be Lemon's willow, have formed along abandoned inlets to Webber Lake.

Lodgepole Pine Forest - Lodgepole pine forests are found at the dry margins of Lower Lacey Meadow, where the meadow transitions into upland habitat, and within Upper Lacey Meadow. Lodgepole pine is the sole tree found in this open-canopy plant community; individual trees range in size from small, pole-sized or sapling trees to large, mature trees. The understory is typically sparse and open and characterized by many of the species described above under dry montane meadows. Areas of active lodgepole pine recruitment were observed in many locations within the edges of Lower Lacey Meadow; active lodgepole pine recruitment was also obvious throughout the middle reach of the Upper Meadow.

Lacustrine - Although not typically considered to be a plant community, lacustrine habitat was mapped in Lacey Meadow and at Webber Lake. This is typically a deep to shallow, open water habitat. Floating aquatic plants such as pondweed (*Potamogeton* spp.) may be present in some areas, and shallow areas (e.g., areas less than 3 ft. deep) at lake margins can support growth of various species of moderate-stature, herbaceous monocots such as sedge, rush, and bulrush that are tolerant of prolonged, shallow inundation. These marshy habitats are commonly found at the upper end of Webber Lake with the amount of this habitat fluctuating as water levels are managed (i.e., raised or lowered) at the Webber Lake outlet or in response to snowmelt and runoff into Webber Lake.

Rock/Barren - Similar to lacustrine, rock or barren habitats are not generally considered to be plant communities and are, in fact, defined by a lack of significant plant cover.

Rock or barren habitats are found along Lacey Creek within Upper Lacey Meadow where a past flow event (or events) has eroded a large section of Lacey Creek and deposited cobble sized rock across the floodplain. With the exception of scattered, sparse annual forbs and occasional willow or lodgepole pine, this area is entirely devoid of vegetation.

2.7.1.3 LACEY MEADOWS HYDROGEOMORPHIC TYPES

Montane meadows are unique ecosystems defined by distinct combinations of topography, hydrology, and landscape setting (Weixelman and others, 2011). These three factors, taken together, form distinct meadow types each of which is capable of supporting a different suite of ecosystem functions and services. Different meadow types also vary in their responses to management practices, such as livestock grazing, and in their ability to respond to past disturbances, such as hydrologic alteration or repeated, heavy grazing. Understanding the types of meadow ecosystems found within Lacey Meadows, the plant communities these ecosystems currently support and are potentially capable of supporting (with modified management practices or active ecosystem restoration), and the ecosystem functions and services potentially provided by different meadow types provides an important foundation for assessing watershed conditions and watershed ecological functions.

Six distinct meadow Hydrogeomorphic (HGM) types were mapped within Upper and Lower Lacey Meadow: riparian low gradient, riparian middle gradient, lacustrine fringe, subsurface low gradient, discharge slope, and dry. The characteristics of each HGM meadow type, based on Weixelman and others (2011), are described below. The distribution of each meadow type within Upper and Lower Lacey Meadow is shown in **Figure 10**.

Riparian Low Gradient - Riparian low gradient meadows are associated with stream or river channels with an average gradient of less than 2 percent slope. Streams in this meadow type are sinuous and meandering with well-developed floodplains. Water inputs to the meadow include overbank flow from the stream channel and subsurface flow from the stream or surrounding uplands. Vegetation in riparian low gradient meadows is dominated by perennial grammanoids with little to no bare ground; most plants are capable of intermittent to prolonged growth in soils that are saturated within the top 12 to 24 inches of the soil profile. Willow or alder (*Alnus* spp.) may be present in

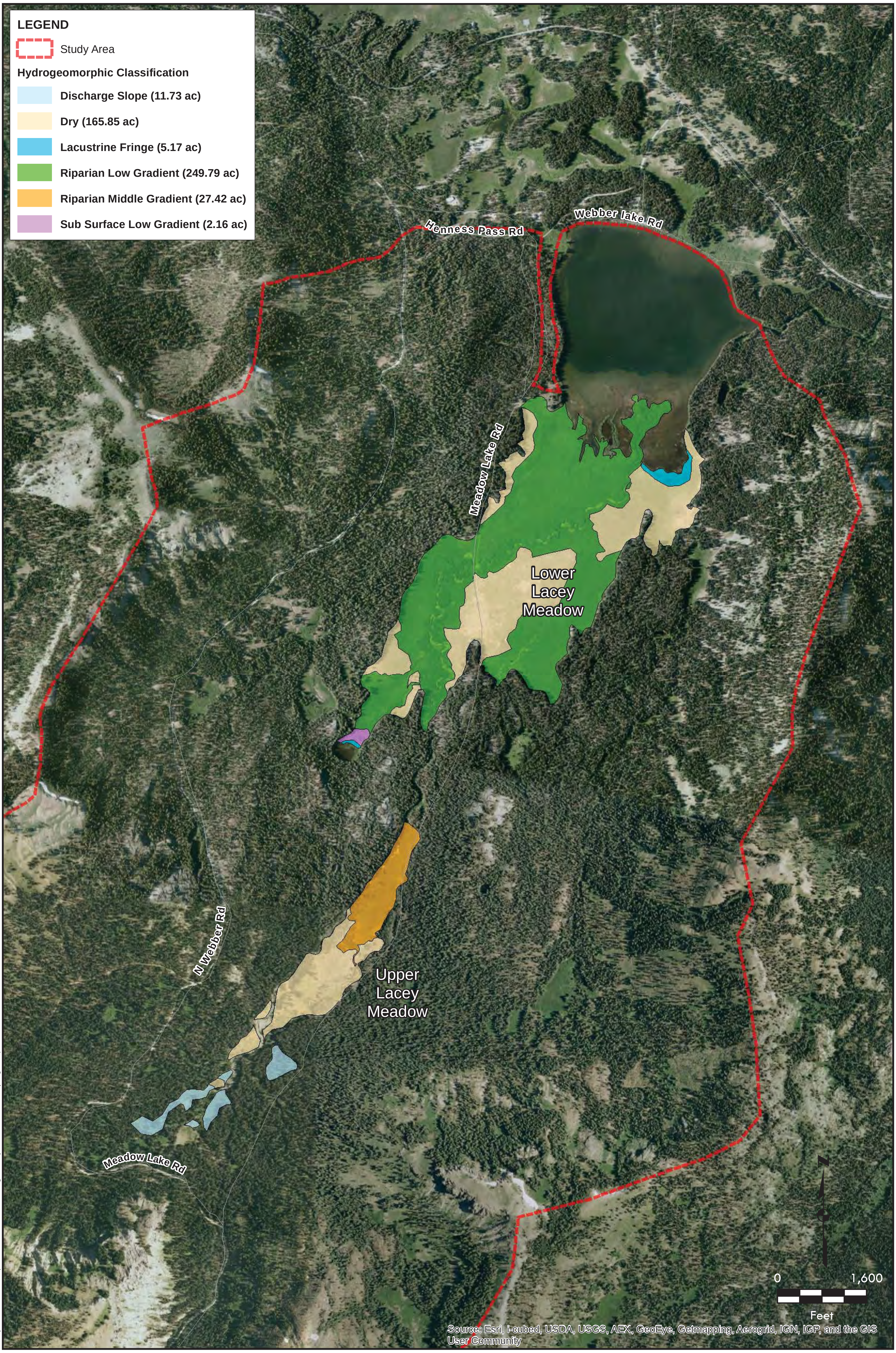

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Figure 10. Lacey Meadows - Meadow Hydrogeomorphic Classification
Sierra and Nevada Counties, California

some settings. Montane meadow and montane riparian scrub plant communities occur in this meadow type. This meadow type is found throughout Lower Lacey Meadow.

Riparian Middle Gradient - This meadow type is similar to riparian low gradient meadows, described above, with the obvious difference being a steeper stream gradient of between 2 percent and 4 percent. Because the stream gradient is steeper in these meadow types, the stream is typically composed of more rapids and pools, relative to low gradient meadows, and the floodplain is less well-developed. Hydrology and plants are similar to low gradient meadows except that woody shrubs (e.g., willow and alder) are typically more common along the stream banks. Montane meadow and montane riparian scrub plant communities occur in this meadow type. This meadow type is found at the lower end of Upper Lacey Meadow.

Lacustrine Fringe - This meadow type occurs along lake margins. Water inputs primarily come from the adjacent lake and may fluctuate throughout the growing season in response to snowmelt and runoff. Organic matter may accumulate in the soils of these meadow types, and basin peatland meadow types (as described in Weixelman and others, 2011) may intermix with lacustrine fringe meadows in some instances. Vegetation is similar to riparian low gradient and riparian middle gradient meadows, with the exception that species more tolerant of prolonged soil saturation or inundation frequently occur. Lacustrine, montane wetland shrub, and wet montane meadow (e.g., plant communities dominated by sedge, rush, and bulrush) plant communities occur in this meadow type. This meadow type is found at the margin of Webber Lake and along the margin of the 'Southwest Pond' at the southwest end of Lower Lacey Meadow.

Subsurface Low Gradient - Subsurface low gradient meadows occur in areas with no discernible stream channel and slopes less than 2 percent. Dominant water sources are surface water flow, typically from snowmelt, and groundwater throughflow. Stream channels are typically found at the upper and lower ends of these meadows, but not within the meadow itself. Vegetation is comprised of perennial grammanoids tolerant of saturated or inundated soils. Montane meadow plant communities occur in this meadow type. It is found at the southwest corner of Lower Lacey Meadow where throughflow groundwater appears to be the dominant source of meadow hydrology.

Discharge Slope - Discharge slope meadows occur where groundwater is discharged at or near the ground surface in the form of springs or seeps or at sites with saturated overland flow and no discernible stream channel. They usually occur on hillslopes, toeslopes, or alluvial fans. Hydrology is dominated by springs where water discharges at the land surface. Plant communities are similar to those described above for montane meadows. Discharge slope meadows occur at the upper end of Upper Lacey Meadow where numerous groundwater seeps are present.

Dry - Dry meadows occur on benches, terraces, slopes, and similar upland areas where precipitation and runoff are the dominant sources of hydrology. Soils in dry meadows may be wet or moist in the early portion of the growing season, typically during snowmelt and runoff, but are dry within the plant rooting zone throughout the remainder of the year. Vegetation is dominated by numerous species that vary depending on soil moisture, elevation, slope, and aspect. Plant communities found within dry meadows include dry montane meadows and lodgepole pine forest; lodgepole pine recruitment was observed in many dry meadows and may serve as an indication from riparian or subsurface meadows to dry. Dry meadows are found on the higher terraces along Lower Lacey Meadow and within the middle portion of Upper Lacey Meadow.

2.7.2 INVASIVE SPECIES

Invasive species include species of plants, vertebrates, and invertebrates that may adversely affect aquatic ecosystems as well as species of terrestrial plants (i.e., weeds) considered to be capable of producing adverse economic or ecological effects. Invasive species typically affect ecosystems by outcompeting native species for food and resources (e.g., space, light) or by otherwise altering ecosystem processes such as nutrient cycling, primary or secondary productivity, and wildfire frequency and intensity, among many others (USACE 2009, Bossard and others 2000).

Previous assessments completed for the Webber Lake property (Gaither, 2011) contained a thorough and detailed review of aquatic invasive species and their potential for occurrence within Webber Lake. This information is not repeated here except to note that aquatic invasive species, particularly a species believed to be a species of pondweed (Gaither, 2011), are periodically problematic within Webber Lake and have at times required active management. Other aquatic invasive species have the potential to be found within Webber Lake given their widespread and growing distribution within California and Nevada and their potential to be transported into Webber Lake and the Lacey Meadows Watershed through fishing, boating, and other recreational activities. Based on the Lake Tahoe Region Aquatic Invasive Species Management Plan, California-Nevada (USACE, 2009), aquatic invasive species with the potential to be found in Webber Lake and the surrounding watershed are summarized in **Table 3**.

Table 3. Aquatic Invasive Species Potentially Occurring within Webber Lake and Surrounding Watershed[1]

Name	Range	Ecology	Threat
Didymo *Didymosphenia geminate*	Native to North America. Occurs at Lake Tahoe.	Freshwater benthic diatom (algae) which inhabits cold, nutrient-poor, clear water in streams and rivers of mountainous regions.	Causes massive nuisance blooms that disrupt river and stream ecosystems. Now spreading to new areas of North America. Pattern of spread suggests spread by recreational fishers.
Eurasian watermilfoil *Myriophyllum spicatum*	Native to Europe, Asia and North Africa. Invasive throughout U.S. Occurs at Lake Tahoe.	Floating and submerged aquatic plant common to slow-moving, nutrient rich water.	Grows in dense floating mats that disrupt lake ecosystems and recreation. Spreads readily by fragments on boat trailers and motor boats. Also spreads by wind and downstream floating.
Curly leaf pondweed *Potamogeton crispus*	Native to Eurasia, Africa, and Australia. Invasive throughout U. S. Occurs at Lake Tahoe.	Aquatic plant that tolerates cold water.	Nuisance in waterways, harbors invasive fish, alters lake ecology, and promotes algal blooms.
Zebra mussel *Dreissena polymorpha*	Native to Eurasia. Invasive throughout the U. S. San Benito County (San Justo Lake). Extensively distributed in Colorado River system and associated water delivery system (canals, reservoirs) in Imperial, San Bernardino, Riverside, San Diego, and Orange Counties.	Small filter-feeding mollusk that attaches itself to hard or firm substrates as adults. Can form dense colonies of thousands of individuals per square meter.	Has the potential to alter lake ecosystems and damage commercial and recreational equipment. Can be spread by recreational boating.

Table 3. Aquatic Invasive Species Potentially Occurring within Webber Lake and Surrounding Watershed[1]

Name	Range	Ecology	Threat
Quagga mussel *Dreissena bugensis*	Native to Ukraine and Ponto-Caspian Sea of Eurasia. Invasive throughout the U. S. Extensively distributed in Colorado River system and associated water delivery system (canals, reservoirs) in Imperial, San Bernardino, Riverside, San Diego, and Orange Counties.	Small filter-feeding mollusk that attaches itself to hard or firm substrates as adults. Can form dense colonies of thousands of individuals per square meter.	Has the potential to alter lake ecosystems and damage commercial and recreational equipment. Can be spread by recreational boating.
Asian clam *Corbicula fluminea*	Native to eastern Mediterranean, southern Asia, Africa, and Australia. Invasive throughout U. S. Occurs at Lake Tahoe.	A benthic filter-feeding clam, but capable of attaching to hard substrates.	Alters lake ecosystem. Damages water equipment from biofouling in southern states.
New Zealand mud snail *Potamopyrgus antipodarum*	Native to New Zealand. Occurs in the Great Lakes and western United States. Nearest population is American River in Sacramento County.	A small aquatic snail capable of occurring at very high densities. Nocturnal grazer.	Can form dense aggregations and completely dominate consumption of aquatic primary production. May outcompete other grazers and inhibit colonization by other macroinvertebrates. Spread by recreational fishing (on boots, waders, etc.).
Mysid shrimp (Opossum shrimp) *Mysis relicta*	Circumpolar and native to Canada and northern United States. Invasive in numerous U. S. locations. Occurs at Lake Tahoe.	Small crustacean that resembles a crayfish. Maximum size 30mm. Feeds on zooplankton. Can be suspended or benthic.	Introduced as food for nonindigenous game fish. Causes severe change to lake ecosystems including extinction of native zooplankton.

Table 3. Aquatic Invasive Species Potentially Occurring within Webber Lake and Surrounding Watershed[1]

Name	Range	Ecology	Threat
Northern pike *Esox lucius*	Native to Canada, and Mississippi River drainage. Nearest population is Lake Davis (although subject to ongoing eradication campaign at this site).	Predatory fish.	Can drive native fish to extinction through predation. Can significantly alter fish communities. Spread by intentional introduction.

Notes:
[1] Information in this table is taken directly, with slight modification, from Gaither (2012).

Weeds were not observed with Lacey Meadows or surrounding forested areas during reconnaissance surveys conducted by H. T. Harvey & Associates on 22 August and 23 August 2012. Weeds potentially occurring within Lacey Meadows and the surrounding watershed, based on weeds known to occur or with the potential to occur in the Lake Tahoe Basin (LTBWCG, 2011), and weed species of interest to the Truckee River Watershed Council, are summarized in **Table 4**. Although these species have not been observed within the watershed, they may occur here based on the proximity of known infestations and the potential to be spread or to colonize the watershed through vehicle traffic, recreational use, disturbances such as heavy grazing or wildfire, or similar dispersal and colonization vectors.

2.7.3 GENERAL WILDLIFE

The following section provides an overview of general wildlife use within Lacey Meadows and the surrounding Lacey Meadows Watershed. The species discussed below were included based on 1) wildlife occurrence data obtained from the Tahoe National Forest, which tracks the occurrence of species considered to be sensitive or of special importance to the forest, 2) a review of a prior watershed investigation completed by Dr. Jim Gaither (2011), reconnaissance surveys of Lacey Meadows completed throughout 2012, 3) focused bird surveys within Lacey Meadows completed over the past decade, and 4) professional knowledge and prior experience regarding the species of wildlife that may be expected to be found within the region.

2.7.3.1 MAMMALS

Lacey Meadows and the surrounding watershed are comprised of a mosaic of connected habitat types. The Lacey Meadows complex is composed of a variety of habitat types that would most commonly provide foraging opportunities and sources of water for many mammal species. Upland forest and scrub habitats surrounding the meadow complex would provide a wider suite of habitat values for mammals, including foraging, denning, reproduction, and cover. The following common species of mammals are either known to occur or are expected to occur within the Lacey Meadows and the surrounding watershed: American black bear (*Ursus americanus*), North American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*), mountain lion (*Puma concolor*), Columbian black-tailed deer (*Odocoileus hemionus columbianus*), Rocky Mountain mule deer (*Odocoileus hemionus*), common porcupine (*Erethizon dorsatum*), raccoon

Table 4. Weeds Potentially Occurring in Lacey Meadows and the Lacey Creek Watershed (DiTomaso and Healy 2007)

Species	Ratings	Ecology Threat
Canada thistle *Cirsium arvense*	Cal-IPC: M CDFA: B	Clump or patch forming perennial to 3-4 ft tall with creeping roots; found in moist areas such as stream sides; reproduces vegetatively and from seed
Musk thistle *Carduus nutans*	Cal-IPC: M CDFA: A	Biennial to 4-5 ft tall; often associated with sandy fertile soils or soils high in calcium but can tolerate a wide range of soil types except highly acidic soils, soils that are nutrient poor, or soils with extremes in moisture content; reproduces by seed; found in disturbed areas
Bull thistle *Cirsium vulgare*	Cal-IPC: M CDFA: C	Biennial, annual, or short-lived perennial 6-7 ft tall; found in disturbed areas; reproduces from seed
Scotch thistle *Onopordum acanthium*	Cal-IPC: H CDFA: A	Biennial, annual, or short-lived perennial 5-10 ft tall; reproduces by seed; disturbed areas on many soil types but prefers fertile soils with high soil moisture
Purple starthistle *Centaurea calcitrapa*	Cal-IPC: M CDFA: B	Annual or perennial to 3-4 ft tall; reproduces by seed; disturbed areas on heavy, fertile soils
Russian knapweed *Acroptilon repens*	Cal-IPC: M CDFA: A	Erect perennial 3-4 ft tall; reproduces vegetatively from extensive root system with limited amounts of reproduction from seed; found in disturbed, open areas and grasslands
Spotted knapweed *Centaurea maculosa*	Cal-IPC: H CDFA: A	Biennial to short-lived perennial 3-4 ft tall; reproduces vegetatively or by seed; found in disturbed , open areas or rangeland on light and well-drained soils
Diffuse knapweed *Centaurea diffusa*	Cal-IPC: M CDFA: A	Usually biennial but can be annual to short-lived perennial 2-3 ft tall; reproduces by seed; found in disturbed, open areas or rangeland on light and well-drained soils
Yellow starthistle *Centaurea solstitialis*	Cal-IPC: H CDFA: C	Winter annual or sometimes biennial 6-7 ft tall; reproduces by seed and can form dense and impenetrable stands; found in many habitat types following disturbance
Purple loosetrife *Lythrum salicaria*	Cal-IPC: H CDFA: B	Erect, clumping perennial 6-8ft tall; reproduces primarily from vast quantities of seed; found in disturbed moist to wet sites along streams, ponds, and lakes
Hoary cress *Cardaria draba*	Cal-IPC: M CDFA: B	Clumping and vigorous spreading perennial 1-2 ft tall; reproduces primarily vegetatively but can also reproduce from seed; found in disturbed areas on a variety of soil types

Table 4. Weeds Potentially Occurring in Lacey Meadows and the Lacey Creek Watershed (DiTomaso and Healy 2007)

Species	Ratings	Ecology Threat
Perennial pepperweed *Lepidium latifolium*	Cal-IPC: H CDFA: B	Erect and vigorous spreading perennial up to 6 ft tall; reproduces vegetatively, including from root fragments, and from seed; found in disturbed areas on moist or seasonally-wet soils; tolerates alkalinity and salinity
Dalmatian toadflax *Linaria dalmatica*	Cal-IPC: M CDFA: A	Erect, creeping perennial up to 4 ft tall; reproduces from creeping roots and from large quantities of seed; found in disturbed areas on a variety of soil types but grows best on dry, coarse soils
Dyer's woad *Isatis tinctoria*	Cal-IPC: M CDFA: B	Erect biennial or occasionally annual or short-lived perennial; reproduces from seed; variety of disturbed and un-disturbed habitats usually on dry, rocky or sandy soils
Rush skeletonweed *Chondrilla juncea*	Cal-IPC: M CDFA: A	Erect perennial or biennial up to 4 ft tall; reproduces from spreading roots or from asexually-produced seed; found in disturbed areas, roadsides, and similar habitats on well-drained sandy or gravelly soils
Scotch broom *Cytisus scoparius*	Cal-IPC: H CDFA: C	Perennial shrub 10-15 ft tall; reproduces from seed; disturbed areas and openings on sandy soils; frequently associated with areas cleared or disturbed by logging in Sierra Nevada
Yellow toadflax *Linaria vulgaris*	Not rated	Similar to Dalmatian toadflax except prefers wetter habitats and has been found invading relatively undisturbed sites
Sulfur cinquefoil *Potentilla recta*	Not rated	Herbaceous perennial 2-3 ft tall; reproduces from seed; found in wide variety of disturbed habitats
Teasel *Dipsacus fullonum*	Cal-IPC: M CDFA: -	Herbaceous biennial or short-lived perennial up to 7 ft tall; reproduces from seed; found in a variety of disturbed sites but frequently roadside drainage ditches, riparian areas, and other moist areas
Klamathweed *Hypericum perforatum*	Cal-IPC: M CDFA: C	Erect perennial to 4 ft tall; reproduces from seed and vegetatively from rhizomes; found in rangeland and open, disturbed areas such as roadsides and logged sites; plant populations cycle in relationship to populations of leaf-feeding beetles that can produce excellent control of Klamath weed, particularly below 5000 ft elevation
Oxeye daisy *Leucanthemum vulgare*	Cal-IPC: M CDFA: -	Clumping perennial to 3 ft tall; reproduces from seed and vegetatively from roots and root fragments; found in disturbed roadsides, pastures, grassland, and similar habitat often in association with moist, clay soils

Table 4. Weeds Potentially Occurring in Lacey Meadows and the Lacey Creek Watershed (DiTomaso and Healy 2007)

Species	Ratings	Ecology Threat

Notes:
[1] Rating Codes

California Invasive Plant Council (Cal-IPC)

H: High — These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

M: Moderate — These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

California Department of Food and Agriculture (CDFA)

A — A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

B — An pest of known economic or environmental detriment and, if present in California, it is of limited distribution. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

C — A pest of known economic or environmental detriment and, if present in California, it is usually widespread. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

(*Procyon lotor*), striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), ground squirrels (*Spermophilus spp*.), chipmunks (*Neotamias spp*.), voles (*Arborimus spp*.), and yellow-bellied marmot (*Marmota flaviventris*).

Additionally, there is debate regarding the status of beaver in the Sierra Nevada and whether observed signs of beaver in the Webber Lake area are from the activities of North American beaver, which may or may not be native to the Sierra Nevada, or the native Sierra mountain beaver (*Aplodontia rufa californica*). Although there were no signs of beaver activity observed in Lacey Creek during reconnaissance surveys conducted by Balance Hydrologics and H. T. Harvey & Associates in August 2012, signs of beaver activity consistent with North American beaver, including a small dam and cut willow stems, have been documented by others (Gaither, 2011) on the northern boundary of Webber Lake. Lindström (2012) conducted extensive archival and oral history research and could not conclude if historic beaver accounts by the Washoe Tribe and early non-Washoe settlers referred to the native Sierra mountain beaver or North American Beaver. Based on her research, Lindström (2012) concludes that beaver were not an important Native American game species and that there was not a historic fur trade in the area, despite extensive exploration of the Sierra Nevada by fur traders in the 1800s. She therefore concludes that North American beaver were likely not native to the area. Other studies have offered conflicting evidence, some supporting the long-held notion that North American beaver in the Upper Truckee River Watershed were non-native and intentionally introduced in the 1940s (Beier and Barrett, 1989) and others maintain that the North American beaver was native to the Sierra Nevada (Lanman and others, 2012; James and Lanman, 2012). The status and distribution of Sierra mountain beaver within the surrounding region is described in more detail below.

2.7.3.2 AMPHIBIANS

Amphibians are most likely to occur in close proximity to the various lakes, streams, meadows, and ponds found both within Lacey Meadows and the surrounding watershed. Common species expected to use these habitats for foraging and reproduction include: long-toed salamander (*Ambystoma macrodactylum*), Pacific chorus frog (*Pseudacris regilla*), and western toad (*Bufo boreas*). It should be noted that the presence of introduced, predatory fish such as rainbow trout (*Oncorhynchus mykiss*), brown trout (*Salmo trutta*), and eastern brook trout (*Salvelinus fontinalis*) throughout Webber Lake and Lacey Creek and its tributaries may reduce habitat suitability for these species; although isolated pools (i.e., deep pools not connected by flowing surface water to the rest of the stream) may provide suitable amphibian micro-habitats if there is an associated lack of predatory fish.

2.7.3.3 BIRDS

Despite their relatively sparse distribution and sensitivity to disturbance, montane meadows like Lacey Valley play a crucial role in the life-history and ecology of many Sierra bird species (Grinnell and Miller, 1944; Orr and Moffitt, 1971; Stewart, 1977; Gregory and others, 1991; Gaines, 1992; Cicero, 1997; Lynn and others 1998, Morton 1992, Bombay and others, 2003b; Cain and Morrison, 2003; Heath and Ballard, 2003; Borgmann, 2010). The juxtaposition of water, herbaceous vegetation, and riparian shrubs create needed habitats for both aquatic and terrestrial life stages of many insect species on which meadow birds prey (Erman, 1984; Gray, 1993; Erman, 1996; Hatfield and LeBuhn, 2007). In addition, Sierra meadows provide dense herbaceous cover for avian nesting, predator avoidance, and thermal cover as well as bountiful seed crops for granivorous birds in late summer and fall.

Because Lacey Meadows and the surrounding watershed have been largely privately owned and access has been controlled for over 100 years, few formal bird surveys have been conducted until recently. Most recent survey efforts have focused only on the breeding population of state endangered willow flycatcher (*Empidonax traillii*), with the documentation of other species being opportunistic in nature. Nonetheless, over the last two decades a relatively complete picture of the bird community within the watershed has been compiled, and a number of uncommon species have been documented. A species list totaling 106 species has been generated by assessing the available reports and field notes (**Appendix C**). The Gaither report (2011) includes a species list compiled by an unknown observer (Appendix C, column A). Willow flycatcher surveys in 1998 and 1999 also listed all other species detected during broadcast surveys, and nest and territory visits sometimes resulted in opportunistic detections of breeding or presence of other notable species between 1998 and 2008. All of these willow flycatcher-related observations are in column B of Appendix C. In June and early July of 2012 the Institute for Bird Populations (IBP) conducted 2 visits to Lower Lacey Meadow to complete avian monitoring (Appendix C, column C) as part of a Sierra-wide effort. This consisted of surveying 25 point count stations (**Appendix D**), as well as an area search across the entire lower meadow (Loffland and others, 2011). Also in 2012, Helen Loffland of the Institute for Bird Populations and Hillary White of H. T.

Harvey & Associates recorded all species detected during field visits during July and August (Appendix C, column D). Species observations from these different survey efforts represent a relatively thorough account of bird species that have used the site over the last two decades.

2.7.3.4 FISH

Moyle and others (1996), identified four zoogeographic regions (drainages) in the Sierra Nevada, each defined by distinctive native fish communities sharing few species in common. The Lahontan drainage, consisting of the Susan, Truckee, Carson, and Walker River drainages, is characterized by ten native fish species (**Table 5**), which are distributed widely throughout the drainage from lowlands to elevations above 6600 ft. Despite their widespread distribution in the surrounding region, it is probable, although not certain, that these fish were absent from Webber Lake and Lacey Creek since Webber Falls, located downstream of Webber Lake on the Little Truckee River, is a natural barrier to fish movement from lower reaches of the Truckee River system. Fish absence is typical in other high elevation eastern Sierra watersheds (La Rivers 1994, Moyle and others 1996), and, prior to Euro-American settlement, nearly all Sierra Nevada lakes and streams were fishless above 6000 ft (Knapp, 1996) due to a combination of glaciation and steep topography that created natural barriers to upstream fish movement.

Table 5. Fishes of the Lahontan Drainage (Moyle et al. 1996)

Mountain whitefish	*Prosopium williamsoni*
Lahontan cutthroat	*Oncorhynchus clarki henshawi*
Paiute cutthroat	*Oncorhynchus clarki seleniris*
Lahontan lake tui chub	*Gila bicolor pectinifer*
Lahontan creek tui chub	*Gila bicolor obesa*
Lahontan redside	*Richardsonius egregius*
Lahontan speckled dace	*Rhinichthys osculus robustus*
Tahoe sucker	*Catastomus tahoensis*
Mountain sucker	*Catostomus platyrhynchus*
Paiute sculpin	*Cottus beldingi*

Non-native fish were introduced to historically fishless high elevation lakes through private and government sponsored programs beginning in the mid-1800s and continuing far into the 1900s (Knapp and others, 2001). The introduction of fish to Webber Lake may have initially consisted of native species including “trout and minnows” (Lindström, 2012) from the Little Truckee River below Webber Falls. Subsequent introductions included non-native fish species, largely game fish, such as: rainbow trout, brook trout, brown trout, catfish (K. Bretthauer, pers. comm., as reported in Gaither 2011) and carp (Lindström 2012); although, historical records do not identify the fish species stocked. These non-native fish are the primary target species for anglers in Webber Lake and likely dominate the species composition in the lake and in Lacey Creek. Rainbow trout populations continue to be supplemented by continued stocking of triploid (sterile) rainbow trout. According to Webber Lake managers, the planting of fish species other than rainbow trout in Webber Lake has been prohibited by the California Department of Fish and Wildlife. (K. Bretthauer, pers. comm., as reported in Lindström, 2012). The Lacey Creek fish population consists of fish species that have migrated upstream from Webber Lake. During site visits in summer 2012, abundant brook trout were observed throughout the upper reaches of Lacey Creek within Upper Lacey Meadow, and several other species including rainbow trout, brown trout, and smaller, unidentified fish (e.g., dace or sculpin) were observed in scattered locations, particularly within the lower reaches of Lacey Creek within Lower Lacey Meadow.

2.7.4 SPECIAL-STATUS SPECIES

Special-status species include species listed as either threatened or endangered under the California or Federal Endangered Species Acts (ESA), CDFW Species of Concern, CDFW Fully Protected Species, and Tahoe National Forest Sensitive Species. For plants, special-status species also include species listed in the California Native Plant Society’s (CNPS) Inventory of Rare, Threatened, or Endangered Plants of California (CNPS, 2012).

To identify special-status species potentially occurring within Lacey Meadows and the surrounding Lacey Meadows Watershed, the California Natural Diversity Database (CNDDB) was queried for all species observations reported within 5 mi of Webber Lake (CDFW, 2012). The CNDDB is a comprehensive database of species observations maintained by CDFW. It is important to note that the CNDDB only contains records of species observations voluntarily submitted to CDFW; thus, the lack of species observations within a particular region may be indicative of a lack of previous survey efforts and not necessarily a lack of special-status species occurrences. To supplement CNDDB data, records of special-status species occurrences were also obtained from the Tahoe National Forest (USFS Tahoe NF, 2012), and a query of the CNPS Online Inventory, 8th ed. (CNPS, 2012) was completed to identify special-status plants occurring on the Webber Peak 7.5 minute United States Geological Survey topographic quadrangle and the surrounding eight 7.5 minute quadrangles (Haypress Valley, Sattley, English Mountain, Sierraville, Independence Lake, Cisco Grove, Soda Springs, and Norden). Finally, special-status species potentially occurring within Lacey Meadows and the surrounding Lacey Meadows Watershed were included based on professional experience and opinion, even if they were not otherwise documented as occurring in these areas within the above-referenced sources. The known locations of special-status wildlife and plant species within Lacey Meadows and the surrounding region, based on location information contained in the CNDDB and Tahoe National Forest records, are shown in **Figure 11** and **Figure12**, respectively.

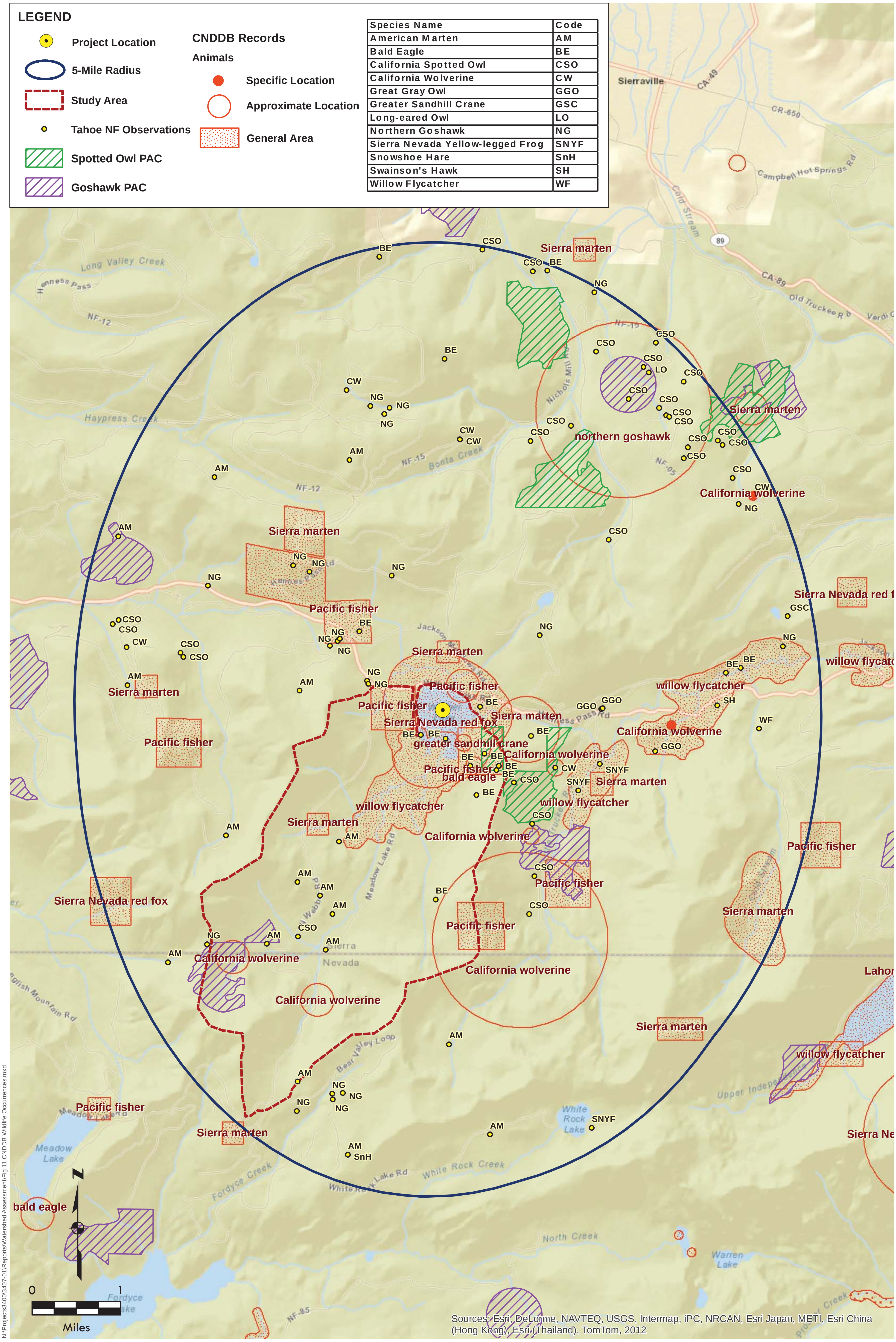

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Figure 11. Lacey Meadows – Special-Status Wildlife Occurrences
Sierra and Nevada Counties, California

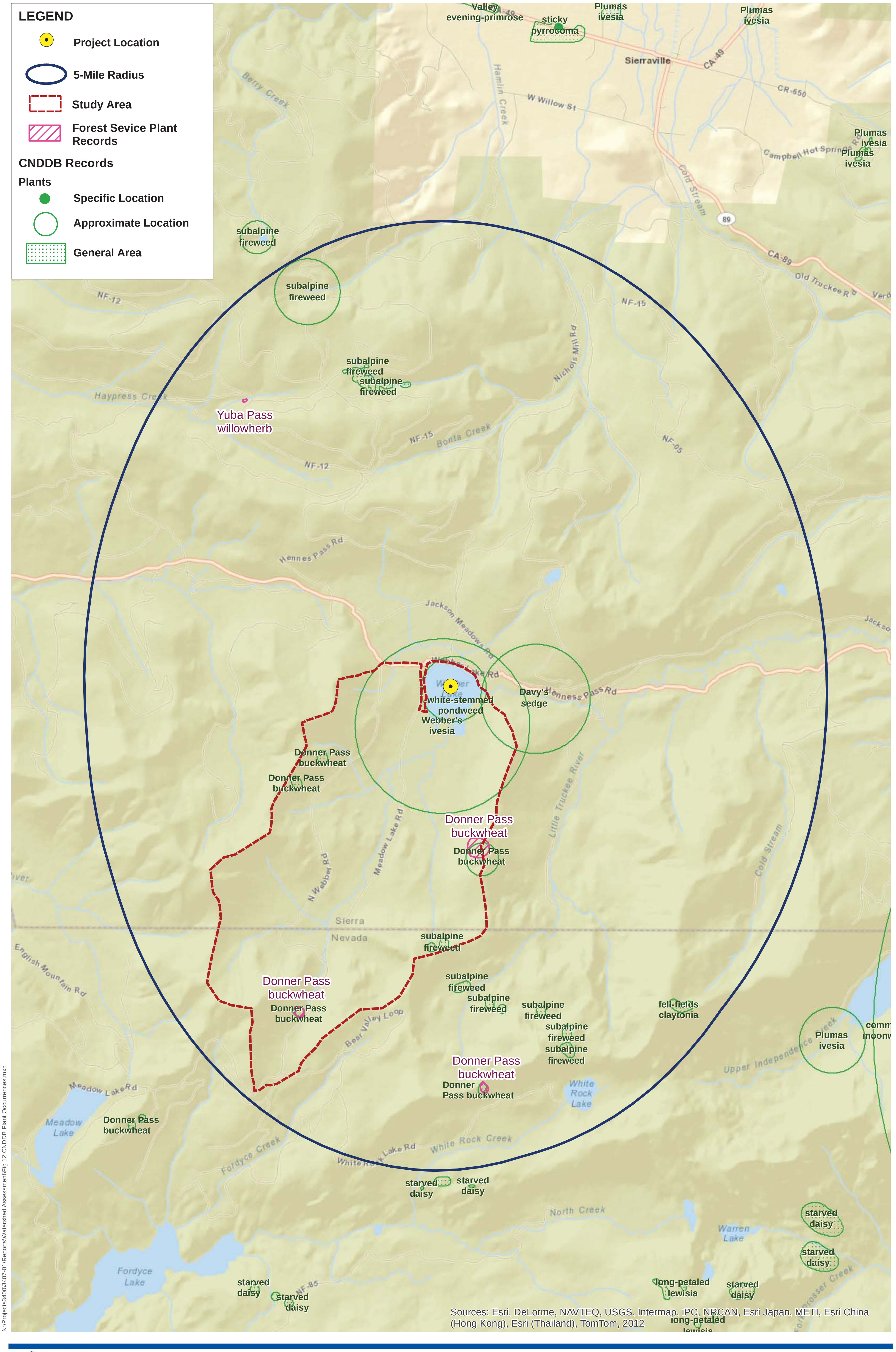

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Figure 12. Lacey Meadows – Special-Status Plant Occurrences Sierra and Nevada Counties, California

The distribution, ecology and life history, and potential for occurrence with Lacey Meadows or the Lacey Meadows Watershed for each of these species are summarized in **Table 6**, for wildlife, and **Table 7**, for plants. An assessment of potential for occurrence was based on queries of existing occurrence records and professional experience and opinion and rated as follows:

- ***Known to Occur:*** species documented as occurring within Lacey Meadows or the surrounding Lacey Meadows Watershed;
- ***Likely to Occur:*** species known from within 5 mi of Webber Lake, and habitats within Lacey Meadows or the surrounding watershed are suitable for the species;
- ***May Occur:*** species is not known from within 5mi of Webber Lake, but the species does occur regionally and/or habitats found within Lacey Meadows and the surrounding watershed are marginally suitable for the species; or,
- ***Unlikely to Occur:*** the species is only rarely found regionally, restricted to particular habitat types (e.g., particular soil types), and/or habitats found within Lacey Meadows and the surrounding watershed are unsuitable for the species.

All special-status species either known to occur or likely to occur within the Webber Lake property and Lacey Meadows Watershed are described in more detail below; a description of the mountain beaver is also included due to its management interest and uncertain presence within the watershed. Descriptions of special-status plants that may occur or that are unlikely to occur within the watershed are not included; however, these species are included along with other special-status plants in Table 7. Similar to the mountain beaver, Webber's ivesia (*Ivesia webberi*) is discussed below due to its historic significance to the Webber Lake property.

2.7.4.1 SPECIAL-STATUS WILDLIFE

California wolverine (*Gulo gulo leteus*) - The California wolverine was listed as a threatened species by the state of California in 1971 and is a CDFW Fully Protected species. Additionally, it is a Federal ESA Candidate species and a Tahoe National Forest Service Sensitive species. It is a scarce resident of North Coast and Sierra Nevada Mountains. In the northern Sierra Nevada it inhabits mixed conifer, red fir, and lodgepole habitats and probably uses subalpine conifer, alpine dwarf-shrub, wet

Table 6. Special-status Wildlife Species, Their Status, and Potential to Occur in the Lacey Meadows Watershed

Name	Status[1]	Habitat	Potential for Occurrence
Mammals			
California wolverine *Gulo gulo leteus*	ST	Lodgepole pine forest, mixed conifer, montane chaparral, montane wet meadow. Elevation range is 4300-7300 ft.	Known to Occur. CNDDB query returned 5 records in the Webber Lake quad and 7 records in surrounding watershed. One occurrence documented with FS remote sensor camera (March 16, 2008) and four other sightings occurred within the project area in 2008, 2009, and 2010.
Sierra marten *Martes americana sierrae*	USFS-S	Old growth fir forests and high elevation riparian lodgepole pine associations. Elevation range is 3400-10400 ft.	Known to Occur. 173 USFS records from remote sensor camera and confirmed tracks from 2000-2003 within the 5 mi buffer of the project area.
Sierra mountain beaver *Aplodontia rufa californica*	CSSC	Open and intermediate-canopy coverage in riparian-deciduous vegetation with a dense understory near water. Deep, friable soil for burrowing. Elevation range is 5800-7600 ft.	May Occur. Historic records based on Lindstrom 2012 research. Suitable habitat exists.
Sierra Nevada red fox *Vulpes vulpes* necator	ST USFS-S	Lodgepole pine forest, mixed conifer, and alpine fell-fields. May hunt in forest openings, meadows, and barren rocky areas. Elevation range is 4500-11500 ft.	Unlikely to occur. CNDDB query returned 2 records in the Webber Lake quad and 3 records in surrounding watershed, but these observations are questionable. Widespread, recent surveys have only found extant populations around Lassen NP and Yosemite-Sequoia-Kings Canyon NP.
Pacific fisher *Martes pennanti*	CSSC USFS-S	Mixed conifer with closed canopies and complex understory structure, montane riparian scrub. Elevation range is 4000–8000 ft.	Known to Occur. CNDDB query returned 7 records in the Webber Lake quad and 4 records in the surrounding watershed.
Sierra Nevada snowshoe hare *Lepus americanus tahoensis*	CSSC	Montane riparian scrub, mixed conifer, lodgepole pine forest, aspen, chaparral, montane meadow. Elevation range is 4850-8600 ft.	Known to Occur. Two USFS records in 2001 using remote sensor camera station.
Pallid bat (*Antrozous pallidus*)	CSSC USFS - S	Grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests.	May Occur. Documented in vicinity of Webber Lake (D. Johnson pers. obs.).

Table 6. Special-status Wildlife Species, Their Status, and Potential to Occur in the Lacey Meadows Watershed

Name	Status[1]	Habitat	Potential for Occurrence
Townsend's big-eared bat (*Corynorhinus townsendii*)	CSSC USFS - S	Coniferous forests, riparian communities, deserts, native prairies, and coastal habitat.	May Occur. Documented in vicinity of Webber Lake (D. Johnson pers. obs.).
Spotted bat (*Euderma maculatum*)	CSSC	Arid deserts, grasslands, and mixed conifer forests. Roosts in cliffs and rocky outcrops.	May Occur. Suitable habitat present in Lacey Meadows.
Amphibians			
Sierra Nevada yellow-legged frog *Rana sierrae*	ST USFS-S	Streams, lakes, and ponds in montane riparian, lodgepole pine forest, subalpine conifer, and wet meadow habitats. Elevation range is 2040-12070 ft.	Likely to Occur. Suitable habitat exists in the project area and this species has been detected in other meadow complexes within the watershed (Paradise Lake and Warren Lake areas). Presence of predatory fish may be the limiting factor in their occurrence in the vicinity of Webber Lake; however, likely to occur in fishless habitats.
Birds			
American White Pelican *Pelecanus erythrorhynchos*	CSSC	Lakes with marshy edges and emergent vegetation or wetland shrub habitat	Known to Occur. Routinely documented on Webber Lake and in the lacustrine shrub vegetation and mudflats along the southern lake boundary within Lacey Valley during late spring and summer. Suitable nesting habitat exists, but not likely extensive enough to support a breeding colony.
Bald Eagle *Haliaeetus leucocephalus*	CSSC USFS-S	Lakes and rivers, with mature montane coniferous forest nearby.	Known to Occur. Documented nest site at southwest side of Webber Lake.
Northern Harrier *Circus cyaneus*	CSSC	Forages in marshes, grasslands, meadows, and treeless habitats. Nests on ground in patches of dense, tall, vegetation.	Known to Occur. Based on consistent sightings at Lacey Valley, it is assumed the species routinely nests in Lacey Meadows.

Table 6. Special-status Wildlife Species, Their Status, and Potential to Occur in the Lacey Meadows Watershed

Name	Status[1]	Habitat	Potential for Occurrence
Northern Goshawk *Accipiter gentilis*	CSSC USFS-S	Mature coniferous forest with large diameter trees and high canopy closure. Frequently forages along meadow edges or in aspen/willow shrub communities.	Known to Occur. Confirmed nest sites in multiple forested locations surrounding Lacey Valley.
Yellow Rail *Coturnicops noveboracensis*	CSSC	Sedge marshes and wet meadows with shallow standing water or moist soil. Occupied sites are generally bordered by coniferous forests.	May Occur. Habitat exists, but no nearby occurrences are reported.
Greater Sandhill Crane *Grus canadensis tabida*	ST FP	Marshes and meadows adjacent to grassland or other short vegetation uplands. Nearby montane dry or wet meadow.	Known to Occur. Lacey Valley is currently one of the most southerly breeding locations for this species in California.
Black Tern *Chlidonias niger*	CSSC	Lakes with marshy edges and emergent vegetation or wetland shrub habitat.	Known to Occur. Confirmed nesting along Webber Lake margin at lower Lacey Valley in 2001 and 2003.
California Spotted Owl *Strix occidentalis occidental*	CSSC	Coniferous forests that have a complex multi-layered structure, dense canopies, and large diameter trees.	Known to Occur. There are several records for this species within the Lacey Valley 5-mi buffer.
Short-eared Owl *Asio flammeus*	CSSC	Breeds on marshes and grasslands. Irruptive with significant range expansions when wet weather conditions result in population explosions of prey items.	Known to Occur. Historical records from Sierra Valley to the north. Presumed nesting in Lower Lacey Valley based on observations in June 2001.
Long-eared Owl *Asio otus*	CSSC	Mature montane coniferous forest adjacent to wet or dry montane meadows or other riparian habitats.	Likely to Occur. Suitable habitat exists in the project area and this species has been detected in other riparian complexes within the watershed (Bonta Creek).
Great Gray Owl *Strix nebulosa*	SE USFS-S	Forages in meadows and nests within 200m of meadow edges in the Sierra Nevada between 2,500 -8000 ft. Meadows as small as 10 acres will support infrequent breeding.	Likely to Occur. Suitable habitat exists in the project area and this species has been detected in other meadow complexes within the watershed (Perazzo Meadows).

Table 6. Special-status Wildlife Species, Their Status, and Potential to Occur in the Lacey Meadows Watershed

Name	Status[1]	Habitat	Potential for Occurrence
Black-backed woodpecker *Picoides arcticus*	SE, candidate (2012)	Montane coniferous forests, especially with lodgepole pine, firs, snags, windfalls, and burns. Elevation range is 6000-9500 ft.	Known to Occur. Detections have occurred in the vicinity of Lacey Valley and Webber Lake, but breeding status on the site has not been confirmed.
Willow Flycatcher *Empidonax traillii*	SE USFS-S	Medium to large meadows with extensive areas of montane wet meadow, emergent vegetation and large stands of willow or other riparian deciduous shrubs.	Known to Occur. Intensively monitored and confirmed breeding since the 1980s, primarily in the main meadow directly south of Webber Lake.
Vaux's swift *Chaetura vauxi*	CSSC	Lakes and rivers, with mature montane coniferous forest nearby.	Known to Occur. Documented in Gaither report, but it is unclear if the detection was during the breeding season or if it was during migration.
Yellow Warbler *Dendroica petechia*	CSSC	Meadows, riparian areas, or recent burned areas with large stands of willow or other deciduous shrubs.	Known to Occur. Well documented on all survey efforts for Lacey Valley and is a relatively abundant breeder at the site.
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*	CSSC	Dense, shallow to moderately flooded emergent vegetation dominated by sedges, rushes, or reeds.	Known to Occur. Has been documented during survey efforts in Lacey Valley.

Table 6. Special-status Wildlife Species, Their Status, and Potential to Occur in the Lacey Meadows Watershed

Name	Status[1]	Habitat	Potential for Occurrence

Notes:
[1] Status Codes

U. S. Fish and Wildlife Service
FE: Federally Endangered
FT: Federally Threatened

California Department of Fish and Game
SE: State Endangered
ST: State Threatened
CSSC: California Species of Special Concern
FP : California Fully-Protected Species

Tahoe National Forest
USFS-S: U.S. Forest Service Sensitive Species (USFS 2005)

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Species Known to Occur within Lacey Creek Watershed					
Davy's sedge *Carex davyi*	Perennial herb	1B.3	4950' to 10560'	Subalpine and upper montane conifer forest	Yosemite north tough Truckee/Tahoe Basin; CNDDB documents 1 record from Webber Lake and additional records in surrounding areas

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Donner Pass buckwheat *Eriogonum umbellatum* var. *torreyanum*	Perennial herb	1B.2 USFS -S	6122' to 8646'	Openings in upper montane coniferous forest on rocky, volcanic soils	Tahoe Basin and Donner Pass; 4 CNDDB/Tahoe NF records within watershed and additional populations documented outside watershed within 5 mi of Webber Lake
White-stemmed pondweed *Potamogeton praelongus*	Perennial rhizomatous herb	2.3	5940' to 9900'	Lakes	Webber Lake, Catfish Lake, and Lassen NP; Webber Lake collection is from 1894; assumed to still be extant but should be verified through field surveys
Species Likely to Occur within Lacey Creek Watershed					
Subalpine fireweed (aka Yuba Pass willowherb) *Epilobium howellii*	Perennial stoloniferous herb	4.3 USFS – S	6600' to 10296'	Mesic to wet habitats in meadows, seeps, and subalpine conifer forest	Central to Southern Sierra Nevada, Bridgeport vicinity, Alpine County, Donner Pass, Plumas County; roughly 10 CNDDB records within 5 mi of Webber Lake and suitable habitat present in the watershed
Starved daisy *Erigeron miser*	Perennial herb	1B.3 USFS – S	6072' to 8646'	Rocky upper montane conifer forest	Bridgeport vicinity, Donner Pass, Lake Almanor vicinity; 2 CNDDB records just outside 5 mi Webber Lake buffer, outside watershed; suitable habitat found within the watershed
Species that May Occur within Lacey Creek Watershed					

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
English sundew *Drosera anglica*	Perennial herb (carnivorous)	2.3 USFS – S	4290' to 6600'	Bogs, fens, meadows, and seeps	Northern Sierra Nevada to Cascades; known from Sagehen Creek meadows and similar habitats within Tahoe NF; could be found within meadows and seeps within Lacey Creek Watershed
Scalloped moonwort *Botrychium crenulatum*	Perennial rhizomatous herb	2.2 USFS – S	4184' to 10824'	Bogs, fens, seeps, meadows	Distributed throughout Sierra Nevada, populations known from Tahoe NF and Sagehen Creek; could be found within meadows and seeps within Lacey Creek Watershed
Bolander's bruchia *Bruchia bolanderi*	Moss	2.2 USFS – S	5610' to 9240'	Damp soil, meadows, seeps	Widely distributed but uncommon throughout Sierra Nevada; may be found in meadows and seeps
Three-ranked hump moss *Meesia triquetra*	Moss	4.2 USFS – S	4290' to 9745'	Mesic to wet bogs, meadows, fens	Widely distributed but uncommon in Sierra Nevada, Cascades, North Coast; known from Tahoe NF in wet meadows and similar habitats
Broad-nerved hump moss *Meesia uliginosa*	Moss	2.2 USFS – S	4290' to 9253'	Similar to M. triquerta	Widely distributed but uncommon in Sierra Nevada, Cascades, North Coast; known from Sagehen Creek meadow
Robbins' pondweed *Potamogeton robbinsii*	Perennial rhizomatous herb	2.3	5049' to 10890'	Lakes	Sierra Nevada, Cascades, North Coast Range; could be found within lakes and ponds

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Alder buckthorn *Rhamnus alnifolia*	Perennial deciduous shrub	2.2	4521' to 7029'	Meadows and riparian areas in conifer forests	Alpine County, Tahoe/Truckee, Lake Almanor vicinity; known along upper Little Truckee River roughly 7 mi below Webber Lake
White beaked-rush *Rhynchospora alba*	Perennial rhizomatous herb	2.2	198' to 6732'	Bogs, fens, meadows, seeps	Yosemite north to Cascades and North Coast Range; could occur in meadows and seeps but most of watershed outside elevation range
Water bulrush *Schoenoplectus subterminalis*	Perennial rhizomatous herb	2.3	2475' to 7425'	Lake margins	Central Sierra Nevada, Cascades, North Coast Range; not observed during reconnaissance field surveys but could occur along lake margins within watershed
Western campion *Silene occidentalis* ssp. *occidentalis*	Perennial herb	4.3	4059' to 6897'	Dry, open areas in chaparral and conifer forest	Pyramid Peak north to Lassen National Park vicinity, Modoc Plateau; suitable habitat found within watershed
Water awlwort *Subularia aquatica* ssp. *americana*	Annual herb	4.3	6270' to 10230'	Lake margins	Yosemite north to Cascades; could occur along lake margins
Threetip sagebrush *Artemisia tripartita* ssp. *tripartita*	Perennial shrub	2.3	7260' to 8580'	Openings in upper montane conifer forest on rocky, volcanic soils	Tahoe Basin and Plumas County; suitable habitat limited within Webber Lake property but could occur

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Woolly-leaved milk-vetch *Astragalus whitneyi* var. *lenophyllus*	Perennial herb	4.3	7046' to 10065'	Alpine boulder and rock, subalpine conifer forest	Tahoe Basin, Donner Pass, Butte, Plumas and Alpine Counties; suitable habitat limited within Webber Lake property but could occur
Mud sedge *Carex limosa*	Perennial rhizomatous herb	2.2	3960' to 8910'	Bogs, fens, meadows, and seeps in conifer forests	Central Sierra Nevada, South Lake Tahoe/Emigrant Pass, Cascades; species is known from Sagehen Creek meadow; could occur along lake margins
Species Unlikely to Occur within Lacey Creek Watershed					
Webber's ivesia *Ivesia webberi*	Perennial herb	1B.1 USFS – S	3300' to 6848'	Clayed, gravelly soils over andesitic bedrock in Great Basin scrub and lower montane conifer forest	Eastern Sierra Valley, Plumas County; CNDDB documents 1 record from Webber Lake area, but Witham (2000) concludes that this is an erroneous record and that no suitable habitat is present at Webber Lake; known populations found further east into Nevada
Fell-fields claytonia *Claytonia megarhiza*	Perennial herb	2.3	8580' to 11656'	Alpine boulder and rock	Central Sierra Nevada, Ebbet's Pass; CNDDB documents 1 occurrence along Mt. Lola but suitable habitat is absent within watershed and outside known elevation range

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Thread-leaved beakseed *Bulbostylis capillaris*	Annual herb	4.2	1304' to 6848'	Meadows or seeps in conifer forest	Widespread in Central to Northern Sierra Nevada and Cascades to north of Redding; most of watershed outside elevation range of species
Sierra Valley evening-primrose *Camissonia tanacetifolia* ssp. *quadriperforata*	Perennial herb	4.3	4290' to 5841'	Clay or sandy soils in Great Basin scrub and lower montane conifer forest	Sierra Valley; watershed is outside known range for species and suitable habitat is limited
Sierra Valley ivesia *Ivesia aperta* var. *aperta*	Perennial herb	1B.2 USFS – S	4884' to 7590'	Seasonally wet areas in Great Basin scrub, lower montane conifer forest, juniper/pinyon pine woodland	Sierra Valley; watershed is outside known range of species and suitable habitat is limited
Dog Valley ivesia *Ivesia aperta* var. *canina*	Perennial herb	1B.1 USFS – S	5280' to 6600'	Volcanic, rocky soils in dry meadows and lower montane conifer forest	Sierraville to Loyalton; watershed is outside known range of species and suitable habitat is limited
Plumas ivesia *Ivesia sericoleuca*	Perennial herb	1B.2 USFS – S	4323' to 7260'	Seasonally wet, volcanic soils in Great Basin scrub and lower montane conifer forest	Eastern Sierra Valley north to Janesville; watershed is outside known range of species and suitable habitat is limited; found along Independence Lake and east of Hwy 89 along Henness Pass Rd

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution
Santa Lucia dwarf rush *Juncus luciensis*	Annual herb	1B.2	990' to 6732'	Chaparral, Great Basin scrub, meadows, vernal pools	Martis Valley north through Cascades, Central and Southern Coast Range; suitable habitat limited within watershed
Long-petaled lewisia *Lewisia longipetala*	Perennial herb	1B.3 USFS – S	8250' to 9653'	Alpine boulder and rock, granite soils, subalpine conifer forest	Emigrant Pass to Donner Pass; suitable habitat is limited in watershed and not within known distribution of species
Northern bugleweed *Lycopus uniflorus*	Perennial herb	4.3	17' to 6600'	Bogs, fens, marshes, swamps	Yosemite, Cisco Grove, Lake Almanor vicinity, Cascades to north Coast Range; majority watershed not within elevation range for species
Tall alpine-aster *Oreostemma elatum*	Perennial herb	1B.2 USFS – S	3317' to 6930'	Bogs, fens, meadows, and seeps in lower montane conifer forest	Plumas and Lassen Counties; species not observed in Lacey Meadows and most of watershed outside elevation range for species
Stebbins' phacelia *Phacelia stebbinsii*	Annual herb	1B.2 USFS – S	2013' to 6633'	Cismontane woodland, lower conifer forest, meadows	American and Yuba River drainages; suitable habitat limited within watershed and most of watershed outside known distribution
Sticky pyrrocoma *Pyrrocoma lucida*	Perennial herb	1B.2 USFS – S	2310' to 6435'	Alkaline clay in great basin scrub, lower montane conifer forest, meadows	Sierra Valley to Janesville/Quincy; suitable habitat limited within watershed

Table 7. Special-Status Plants Potentially Occurring within Lacey Creek Watershed

Species	Lifeform	Status[1]	Elevation Range	Habitat	Distribution

Notes:
[1] Status Codes

California Native Plant Society:

1A. Presumed extinct in California
1B. Rare or Endangered in California and elsewhere
2. Rare or Endangered in California, more common elsewhere
3. Plants for which we need more information - Review list
4. Plants of limited distribution - Watch list

New Threat Code extensions and their meanings:
.1 - Seriously endangered in California
.2 – Fairly endangered in California
.3 – Not very endangered in California
Note that all List 1A (presumed extinct in California) and some List 3 (need more information- a review list) plants lacking any threat information receive no threat code extension

Tahoe National Forest

USFS – S: U. S. Forest Service Sensitive Species (USFS 2005) meadows, and montane chaparral with an elevational range of 4,300-7,300 feett (Zeiner and others, 1998-1990). It feeds primarily on small mammals and carrion (Grinnell and others, 1937; Ingles, 1965; Hornocker and Hash, 1981; Krott, 1982), but other prey includes marmots, ground squirrels, gophers, mice, deer carcasses, berries, insects, and other vertebrates. It hunts in more open areas, using dense cover for resting and reproduction. Daily movements recorded in Montana indicated that this species can range between 3 miles and 81 miles (Hornocker and Hash, 1976). This species is known to occur within the Lacey Meadow system and surrounding watershed based on a series of photos taken in the Tahoe National Forest on March 16-19, 2008 by a remote sensor camera, and 4 other sightings, also by remote sensor camera, have occurred within the watershed in December and February 2009 and January 2010.

Pacific fisher (*Martes pennanti*) – The Pacific fisher is designated as a Species of Special Concern in the state of California and a Tahoe National Forest Service Sensitive species. Fishers occur in habitats that are dominated by conifers and contain variable amounts of hardwood forests (Buskirk and Powell, 1994). They select old growth and late seral conifer forests that provide closed canopies and a complex forest floor structure (Buskirk and Powell, 1994). Fishers are associated with riparian habitats and often occur in close proximity (1500 ft) to open water (Buskirk and Powell, 1994, Self and Kerns, 2001). They have also been reported to use brushy or open-forest areas (Self and Kerns, 2001). This high-brush-ground-cover, open-forest condition is relatively common in some portions of lower elevation California forests, particularly in high rainfall areas. Fishers are opportunistic foragers and feed on a variety of food items including small mammals, birds and their eggs, ungulate carrion, insects, fruits, nuts and vegetation (Powell, 1981). Fishers occur at elevations of 4000–8000 ft. in the Sierra Nevada (Freel and Stewart, 1991, U.S. Department of the Interior, 2006). The Pacific fisher is known to occur within the Lacey Meadow system and surrounding watershed.

Sierra marten (*Martes americana sierrae*) – The Sierra marten is a subspecies of American marten with an elevational range from 3,400 to 10,400 feet (Freel and Stweart, 1991). It is a USFS Sensitive species found throughout much of its historic range from Trinity and Siskiyou counties east to Mount Shasta, south through the Cascade and Sierra Nevada mountain ranges to Tulare County (Zielinski and others, 2001; Grinnel and others, 1937; Kucera and others, 1996). Mesocarnivore surveys conducted on the forests of the Sierra Nevada from 1996 to 2002 reported Sierra martens in Amador, Calaveras, El Dorado, Fresno, Lassen, Madera, Mariposa, Placer, Plumas, Shasta, Sierra, Tehama, Tulare, and Tuolumne counties (Zielinksi and others, 2005). In the Sierra Nevada, martens prefer old growth fir forests and high elevation riparian lodgepole pine associations (Spencer and others, 1983). American martens are considered to be uncommon and are known to occur in very low densities (Buskirk and Ruggiero, 1994). American martens are omnivores that eat a variety of different food types including small mammals, vegetation (fruits, berries, nuts, fungi, lichens, grass, conifer needles, leaves, twigs and bark), birds, fish, insects, and carrion (Martin, 1994). This species is known to occur within the Lacey Meadow system and surrounding watershed.

Sierra mountain beaver (*Aplodontia rufa californica*) – The Sierra mountain beaver is one of 6 subspecies of mountain beaver occurring in California (Hall, 1981) and is designated as a CDFW Species of Special Concern. It is uncommon throughout its range and appears to have a scattered distribution in montane riparian habitats in the Sierra. This species frequents open habitats and habitats with intermediate-canopy cover in riparian-deciduous vegetation with a dense understory near water. They feed on vegetative plants, specifically lupines, willows, grasses, thimbleberry (Zeiner and others, 1990), conifers, and deciduous trees (Voth, 1968). Mountain beavers breed from December through March, producing one litter of 2-3 young per year, using deep, friable soils in dense thickets near a stream for burrowing. Shrews, moles, snowshoe hares, brush rabbits, deer mice, voles, minks, long-tailed weasels, and spotted skunk use mountain beaver burrows (Maser and others, 1981). Predators include bobcats, long-tailed weasels, minks, coyotes, and owls (Zeiner and others, 1990). This subspecies is known to occur in the Tahoe Basin in Washoe and Douglas counties. Based on historical research and oral history accounts, Lindström (2012) determined that this species may have occurred in the Lacey Meadow system and surrounding watershed. This species may occur in the project area based on suitable habitat within the project area and documented historical accounts; however, there were no documented occurrences in the CNDDB or USFS databases, and no observations of beaver activity made during the course of this assessment.

Sierra Nevada red fox (*Vulpes vulpes necator*) - The Sierra Nevada red fox was listed as a threatened species by the State of California in 1980. It is one of ten recognized North American subspecies of *Vulpes vulpes* (Hall, 1981). CDFW uses location and elevation to distinguish this subspecies from other subspecies of red fox, as there are no visible characteristics to reliably distinguish the two (Perrine and others, 2007; Lewis and others, 1993). The Sierra Nevada red fox occurs at elevations from 4,500 – 11,500 feet but is most commonly found above 7,000 feet (Aubry, 1997) in the Cascade and Sierra Nevada Mountains. The Sierra Nevada red fox inhabits various habitats in alpine and subalpine zones; their preferred habitat is red fir, lodgepole pine forests and alpine fell-fields. They hunt in forest openings, meadows, and barren, rocky areas (CDFW, 1991). They mate in February, gestation is just over 50 days, and pups are born in late March to early April (Aubry, 1997). Within the Sierra Nevada, the Sierra Nevada red fox is believed to be critically endangered and is known to occur only in the vicinity of Lassen National Park and in the vicinity of Yosemite National Park and, possibly, Sequoia-Kings Canyon National Parks (Perrine and others 2010). The CNDDB contains several historic red fox observations in and around Lacey Valley within the Tahoe National Forest (CDFW 2012), but based on the best available scientific information and verified observations of experts, this species may occur but is unlikely to occur within Lacey Meadows and the surrounding watershed.

Sierra Nevada snowshoe hare (*Lepus americanus tahoensis*) – Both subspecies of snowshoe hare that are found in California are CDFW Species of Special Concern (Williams, 1986). In California, the Sierra Nevada snowshoe hare is primarily found in montane riparian habitats with thickets of alders and willows and in stands of young conifers interspersed with chaparral (Zeiner and others, 1990). The early seral stages of mixed conifer, subalpine conifer, red fir, Jeffrey pine, lodgepole pine, and aspen are likely habitats, primarily along edges and especially near meadows (Orr, 1940; Ingles, 1965). In the summer, their diet consists of grasses, forbs, sedges, and low shrubs (Zeiner and others, 1990). Needles and bark of conifers and leaves and green twigs of willow and alder are eaten in the winter (Wolff, 1980). Bobcat, weasel, fox, coyote, and great-horned owl are the main predators of snowshoe hare. Snowshoe hare is likely to occur within the Lacey Meadow system and surrounding watershed.

Pallid bat (*Antrozous pallidus*) – The pallid bat is designated as a CDFW Species of Special Concern and Forest Service Sensitive species. It occurs throughout California with the exception of the northwest corner of the state and the high Sierra Nevada (Hall, 1981; Zeiner and others, 1990). It is a colonial species with colonies ranging in size from a few individuals to over a hundred, but usually consisting of at least 20 individuals (Wilson and Ruff, 1999; Sherwin and Rambaldini, 2005). Pallid bats are most commonly found in oak savannah and in open dry habitats with rocky areas, trees, buildings, or bridge structures that are used for roosting (Zeiner and others, 1990; Ferguson and Azerrad, 2004). Typically, pallid bats use separate day and night roosts (Hermanson and O'Shea, 1983). In general, day roosts are more enclosed, protected spaces than are night roosts, which often occur in open buildings, porches, garages, highway bridges, and mines. Roosts generally have unobstructed entrances/exits, and are high above the ground, warm, and inaccessible to terrestrial predators (Sherwin and Rambaldini, 2005). Pallid bats do not migrate long distances between summer and winter sites (Johnston and others, 2006). After mating during the late fall and winter, females and males share a common wintering roost, usually along a canyon bottom where temperatures are relatively stable and cool, and then females leave the common winter roost in early spring to form maternity colonies, often on ridge tops or other warmer locales (Johnston and others, 2006). Maternity colonies in California may be active from May to October (Gannon, 2003). Pallid bats forage on a variety of insects, including beetles, centipedes, cicadas, crickets, grasshoppers, moths, and others, both gleaned from surfaces and taken aerially (Johnston and Fenton, 2001). Their roosts are very susceptible to human disturbance, and urban development has been cited as the most significant factor contributing to their regional decline (Miner and Stokes, 2005). This species may occur within the Lacey Meadow system and surrounding watershed (D. Johnston, pers. obs.).

Spotted bat (*Euderma maculatum*) – The spotted bat is designated as a CDFW Species of Special Concern. Habitats occupied include arid deserts, grasslands and mixed conifer forests. Elevation range extends from below sea level in California to above 10,000 feet in New Mexico (Black and Cosgriff, 1999). Roosts are found in small cracks in cliffs and rocky outcrops. The spotted bat appears to be a dietary specialist (Ross, 1961; Easterla, 1965; Easterla and Whitaker, 1972), feeding primarily on moths over water and along washes. It may move from forests to lowlands in autumn. Little is known about the population biology of spotted bats; although, available data suggest that females roost singly, and give birth to a single young (Findley and Jones 1965, Watkins, 1977), with births occurring in June or early July. This species may occur within the Lacey Meadow system and surrounding watershed based on the distribution of this species and the presence of suitable habitat.

Townsend's big-eared bat (*Corynorhinus townsendii*) – Townsend's big-eared bat is designated as a CDFW Species of Special Concern and a Tahoe National Forest Service Sensitive species. Pierson and Rainey (1998a) identified 39 active Townsend's big-eared bat maternity colonies and 55 maternity roost sites scattered throughout California. The distribution is strongly correlated with the availability of roosting habitat and the absence of human disturbance at roost sites (Pierson and Rainey, 1998a; Sherwin and Piaggio, 2005). The Townsend's big-eared bat is associated with a variety of different habitat types including coniferous forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitats (Sherwin and Piaggio, 2005). The Townsend's big-eared bat is a colonial species, with females aggregating in the spring at maternity colonies to begin their breeding season. Maternity colonies in California may be active from March to September (Pierson and Rainey, 1998a). Females typically give birth to one young, and both females and young show a high fidelity to their group and their specific roost site (Pearson and others, 1952). The Townsend's big-eared bat is easily disturbed while roosting in buildings, and females are known to abandon their young when disturbed (Humphrey and Kunz 1976). They forage primarily upon small moths, and feeds both in-flight and by gleaning insects from foliage (Zeiner and others, 1990). This species may occur within the Lacey Meadow system and surrounding watershed (D. Johnston pers. obs.).

Sierra Nevada yellow-legged frog *(Rana sierra)* – The Sierra Nevada yellow-legged frog was listed as a California threatened species by the California Fish and Game Commission in February 2012. Additionally, it is a Federal and State ESA Candidate species and Tahoe National Forest Service Sensitive species. This species occurs in the Sierra Nevada from Plumas County to Fresno County and is associated with streams, lakes, and ponds in montane riparian, lodgepole pine, subalpine conifer, and wet meadow habitats. This aquatic species is always encountered within a few feet of water. Reproduction does not take place until lakes and streams are free of ice. Tadpoles may require up to two over-wintering periods to complete their aquatic development (Cory, 1962). During winter, adults hibernate beneath ice covered streams, lakes, and ponds. Terrestrial hibernation has not been documented. They feed primarily on aquatic and terrestrial invertebrates and favor terrestrial insects. Adults and tadpoles are commonly preyed upon by garter snakes and introduced trout (Cory, 1963, Zweifel, 1968). To the extent that suitable habitats within the watershed lack predatory fish such as trout, this species is likely to occur within the Lacey Meadow system and surrounding watershed. Stream reaches with significant trout populations, such as most of Lacey Creek within Upper and Lower Lacey Meadows, are not likely to provide suitable habitat for this species.

American White Pelican (*Pelecanus erythrorhynchos*) – The American white pelican is a CDFW Species of Special Concern that breeds on protected islands and peninsulas at lakes and marshes in Northeastern California as far south as Lake Tahoe (Shuford, 2005, Shuford, 2008a). They use ground nests or floating masses of vegetation and often nest colonially with other species from March through July. This species also travels long distances to forage during the breeding season, and some non-breeding individuals spend the entire summer at good foraging sites (Knopf and Kennedy, 1980, Shuford, 2005). American White Pelicans are routinely seen on Webber Lake and in the lacustrine shrub vegetation and mud flats along the southern lake boundary with Lower Lacey Meadow. These birds were documented in most information sources for Lacey Valley and seen annually throughout the late spring and summer months (H. Loffland, pers. obs.). Some suitable and protected islands of nesting habitat exist but they not likely extensive enough to support a breeding colony. Nonetheless, it is unknown whether the species is breeding at the site in very small numbers or simply foraging there.

Bald Eagle (*Haliaeetus leucocephalus*) – The bald eagle was listed as a federally endangered species in 1967 by the U.S. Fish and Wildlife Service (FWS) and to the California list of endangered species in 1971. The FWS removed the bald eagle from the list of threatened and endangered species in 2007, but remains endangered and CDFW Fully Protected Species. It is also designated as a Tahoe National Forest Service Sensitive species. California's breeding population of bald eagles is resident yearlong in areas where the climate is relatively mild with breeding sites distributed across all National Forests in the Sierra Nevada. Between mid-October and December, migratory individuals from areas north and northeast of the state arrive in California as well. Wintering populations remain in California through March or early April. Nesting territories are normally associated with lakes, reservoirs, rivers, or large streams (Lehman, 1979). Bald eagle nests are usually located in uneven-aged (multi-storied) stands with old growth components (Anthony and others, 1982). Most nests in California are located in predominantly coniferous stands. Factors such as relative tree height, diameter, species, position on the surrounding topography, distance from water, and distance from disturbance also appear to influence nest site selection (Lehman and others, 1980, Anthony and Isaacs, 1981).Trees selected for nesting are characteristically one of the largest in the stand or at least co-dominant with the overstory. Nest trees usually provide an unobstructed view of the associated water body and are often prominently located on the landscape. Live, mature trees with deformed tops are occasionally selected for nesting. In California, 73 percent of the nest sites were within 0.5 miles of a body of water, and 89 percent within 1 mile. No nests were known to be over 2 mi from water. Bald eagles often construct several nests within a territory and alternate between them from year to year. Up to 5 alternative nests may be constructed within a single territory (FWS, 1986). The most common food sources for bald eagle are fish, waterfowl, jackrabbits, and various types of carrion (FWS, 1986). Due to the presence of abundant fish and waterfowl and low human disturbance within the meadow and surrounding forest, Webber Lake and Lacey Valley provide high quality habitat for this species. Bald Eagles are known from a number of lake and river settings on the Tahoe National Forest and have been documented at Webber Lake on a relatively continuous basis. A nest location is reported for the southwest side of the lake. Sightings occurred in all bird survey efforts and the Forest Service and CNDDB databases.

Northern Harrier (*Circus cyaneus*) – The northern harrier is a CDFW Species of Special Concern that breeds and forages in marshes, grasslands, meadows and other treeless habitats in Northeastern California, in the Eastern Sierra Nevada, and in the Central Valley and coastal regions (Davis and Niemela, 2008). Harriers nest on the ground in patches of dense, tall, vegetation in undisturbed areas (MacWhirter and Bildstein, 1996). In wetland/meadow areas such as Lacey Valley, primary prey species are voles (*microtus* spp.) and birds (especially American coots and blackbirds) (Davis and Niemela, 2008). This species has experienced habitat losses with the draining of wetlands and conversion of open habitat into agricultural production (grazing, alfalfa, rice, etc). High quality habitat for this species exists at Lacey Valley and downstream along the Little Truckee River. Due to the consistent sightings of this species at Lacey Valley, it is assumed that they are breeding there.

Northern Goshawk (*Accipiter gentilis*) – The northern goshawk is a CDFW Species of Special Concern and a Tahoe National Forest Service sensitive species. This species nests and forages primarily in mature montane coniferous forest with large diameter trees and high canopy closure. It sometimes nests and forages in mature aspen stands and will frequently forage along meadow edges or in aspen/willow shrub communities (Keane, 2008). Primary prey are songbirds, gray squirrel and other small mammals. This species is known to nest in multiple forested locations within the Lacey Meadows Watershed based on CNDDB and Forest Service records.

Yellow Rail (*Coturnicops noveboracensis*) - The yellow rail is a CDFW Species of Special Concern that breeds in sedge marshes and wet meadows with shallow standing water or moist soil in coastal California, Northeastern California, and in the Eastern Sierra

Nevada (Sterling, 2008). Very little is known about this species, especially in montane meadow and marsh settings in the Sierra, but they were historically found in these settings in Bridgeport Valley, and have recently been found in the vicinity of Mount Shasta in Siskiyou County and in Modoc County. Occupied sites are generally bordered by coniferous forest and seasonally flooded up from 1 to 12 inches in depth. The yellow rail has not been reported from Lacey Valley, but without targeted surveys of this secretive species, absence cannot be assumed, especially in light of other breeding rail species at the site. Therefore, this species may occur within Lacey Meadows or the surrounding watershed.

Greater Sandhill Crane (*Grus canadensis tabida*) - The Greater sandhill crane is designated by the State of California as a threatened species. It winters in the Central Valley and breeds across six counties in Northeastern California, South to Sierra County. During all seasons, the greater sandhill crane relies on freshwater wetlands. They breed primarily in bulrush and sedge-dominated marshes or meadows adjacent to grassland or other short vegetation uplands (Littlefield, 1982, Ivey and Herzinger, 2001). Nests are most frequently found in patches of rushes and in areas protected by standing water in the vicinity. This species is very susceptible to disturbance and will sometimes abandon nests in the presence of repeated human or livestock activity. Nest predation from coyote and common raven is a significant factor in reproductive success, and drought conditions often lead to increased predation rates (Littlefield, 1989). Cranes are susceptible to draining of wetlands for agricultural or residential conversion, trampling of young and reduction in nest cover by livestock, mortality from mowing and habitat abandonment from human related disturbance. Greater sandhill cranes have been documented in Lacey Valley during all survey efforts and during most if not all years of the willow flycatcher demography study. Webber Lake Ranch caretakers have also taken actions to avoid the cranes being disturbed during the breeding season by limiting or prohibiting people from accessing the meadow area downstream of the Webber Lake Road crossing in Lacey Valley. Fledgling cranes (colts) have been observed with adults during many years, and in 2012 Helen Loffland observed one colt with two adults on July 23. Most crane observations occur in the northeast part of Lower Lacey Valley on the east side of the creek. Lacey Valley is currently one of the most southerly consistent breeding locations for this species in California.

Black Tern (*Chlidonias niger*) – The black tern is a CDFW Species of Special Concern. It is primarily insectivorous in California, but in some locales fish may play and important role in diet. Nests are built semi-colonially on floating masses of vegetation that are typically anchored to (or lodged in) emergent vegetation or beds of submerged aquatic plants. Most breeding sites are dominated by low emergent vegetation (usually <3 feet), most often spikerush (*Eleocharis* ssp.) (or rushes, where there is an open water to vegetation ratio of 1:4). Sometimes yellow pond lily (*Nuphar lutea*), smartweed (*Polygonum* ssp.), or bullrush have been utilized in nesting (Orr and Moffitt, 1971, Shuford, 2008b). Nests are typically located over water 10 to 36 in deep, and are sometimes found in abandoned grebe nests, on floating logs, or plant debris, or small earthen hummocks (Orr and Moffitt, 1971, Shuford, 2008b). Black tern is a semi-colonial bird historically found in freshwater marshes of central California and northeastern California and eastern Sierra mountain valleys. The species is currently found in greatest abundance in northeastern California with a smaller population in select Central Valley locations. In the Sierra Nevada, the southern-most locations documented in the literature are in the Sierra Valley and in Kyburz Flat. Black terns were observed nesting along the lake margin at lower Lacey Valley by willow flycatcher crew members in 2001 and 2003 (these were recorded in CNDDB reports, so it is unknown why they do not appear in current CNDDB records). They were not reported in other years, but not all opportunistic observations were recorded on forms, so absence cannot be presumed in other years of the study. Black terns are known to occupy some marshes on an irregular basis, so their absence during surveys in 2012, should not necessarily be interpreted as the result of change in habitat condition or overall species decline.

California Spotted Owl (*Strix occidentalis occidental)* – The California spotted owl is a designated as a CDFW Species of Special Concern. It is a subspecies of the spotted owl (*Strix occidentalis*) that only occurs in California. It is found on the western side of the Sierra Nevada and very locally on the eastern slope, occurring from Shasta County south through the Sierra Nevada to Kern County as well as in the coastal ranges from Monterey County south to Baja California (Verner and others, 1992, Gutierrez and others, 1995). California spotted owls occur in a wide variety of habitats; although, individuals that occur at high elevations in the Sierra Nevada prefer habitats dominated by conifers (Gutierrez and others, 1995). This subspecies is strongly associated with forests that have a complex multi-layered structure, dense canopies, and large-diameter trees (Verner and others, 1992, Gutierrez and others, 1995, USFWS, 2006, USFS, 2008). In the Sierra Nevada, approximately 80 percent of known sites are found in mixed-fir conifer forest (USFS, 2001). The species is sensitive to disturbance and requires several hundred acres of mature forest for breeding (Beedy and Granholm, 1985). The presence of large trees (>35.4 inches in diameter at breast height [dbh]) is essential for nesting and roosting habitat, while foraging habitat is more variable and includes both intermediate and old-growth forests (Gutierrez and others, 1995). California spotted owls do not construct their own nests, rather they use existing nest structures or cavities in the hollows of trees. The breeding season for California spotted owls extends from mid-February to mid-October (USFS, 2008). This species may occur in the project area.

Great Gray Owl (*Strix nebulosa*) - The great gray owl is a California endangered species and a Tahoe National Forest Service Sensitive species. The Sierra Nevada population is the southernmost population in North America. Although there have been a number of recent observations of great gray owl breeding in foothill oak/pine savannah settings in California, the majority of the great gray owl population in the Sierra Nevada utilizes meadows for foraging, and nest locations are almost all within 600 feet of a meadow edge. The highly restricted range of the Sierra Nevada great gray owl population and its apparent genetic differentiation from great gray owls elsewhere (Hull and others, 2010) indicate an isolated and at risk population (Beck and Winter, 2000). Most breeding locations are known from elevations between 2,500 and 8,000 feet. Evidence in the Yosemite Region suggests that great grey owls need meadows at least 25 acres in size for persistent occupancy and reproduction (Winter, 1986), but meadows as small as 10 acres will support infrequent breeding. These birds require 2 distinct vegetation communities for different aspects of their life history, both of which have been subject to anthropomorphic disturbances. Great gray owls nest primarily in large-diameter trees with broken tops. Nest sites are almost always in close proximity to meadows, which are used intensively for foraging for microtine rodents (voles) and pocket gophers. Some evidence indicates that meadows in higher ecological condition support more voles which may be a preferred prey species. In addition, meadows that maintain higher grass heights throughout the summer season and that are not permanently saturated provided the optimal conditions for prey species.

There are a number of historic observations on the Tahoe National Forest but most important are multiple detections in the last 5 years that have occurred in or near the Lacey Valley/Little Truckee watersheds. According to Forest Service records, a pair was located approximately 7.5 miles to the west of Webber Lake in 2012, and surveys in and around the Perazzo Meadows complex, approximately 1.8 miles downstream of Lacey Valley, have resulted in multiple great gray owl detections. Surveys in the Coppins Meadow area, just North of Lacey Valley have not resulted in owl detections (Kevin

Roberts pers. comm.). Both breeding and foraging habitat exists along all forested boundaries of meadows within the Lacey Meadows complex. Little timber harvest has occurred in direct proximity to the meadows; however, sheep grazing may reduce rodent levels in areas where grazing pressure is greatest. This species is likely to occur. Suitable habitat exists in the project area and this species has been detected in other meadow complexes within the watershed (Perazzo Meadows).

Long-eared Owl (*Asio otus*) - The Long-eared owl is a CDFW Species of Special Concern that breeds in coniferous and broad-leaved woodlands bordering marshes, meadows, and riparian areas. While distributed across much of the state, the stronghold for the species in California is thought to be in Northeastern California and the Sierra/Cascade Range (Hunting, 2008). While not documented in Lacey Valley, abundant habitat exists for the species and one record exists within the Forest Service database approximately 5 miles north of Webber Lake near Bonta Creek. This species is likely to occur in the project area due to suitable habitat and it has been detected in other riparian complexes within the watershed (Bonta Creek).

Short-eared Owl (*Asio flammeus*) - The short-eared owl is a CDFW Species of Special Concern that breeds on marshes and grasslands in northeastern California, on the eastern foothills of the Sierra Nevada south of Lake Tahoe, and in the Central Valley (Roberson, 2008). This species is irruptive and has significant range expansions when wet weather conditions result in population explosions of voles (*Microtus* spp.), their primary prey. There are historical records from Sierra Valley to the north and from similar lake-side settings at Mono Lake and June Lake to the south. This species is a ground-nesting, twilight hunter and requires good nesting cover from grassland or marsh vegetation 12 to 20 in high (Holt and Leasure, 1993; Roberson, 2008). Short-eared owls were observed in Lacey Meadows on two occasions during 2001 but have otherwise not been observed (H. Loffland pers. obs.).

Black-backed Woodpecker (*Picoides arcticus*) – The black-backed woodpecker was designated as a candidate for listing under the California ESA by the California Fish and Game Commission on January 6, 2012. It is an uncommon, yearlong resident with an elevation range from 6,000 to 9,500 feet, predominantly found in montane coniferous forests, especially fir and lodgepole pine forests (Grinnell and Miller, 1944). Most individuals are probably yearlong residents, but some downslope movement occurs in winter (Gaines, 1977) and may follow insect infestation of dead trees. It is associated with and attracted to forest stands with wood-boring insect infestations, including burns and windfall areas where it flakes away bark or drills into trunks of conifers to obtain larval and adult insects, mostly wood-boring beetles. It prefers relatively large trees for foraging and nesting where canopy cover may range from sparse to dense (Short, 1974). In California, this species excavates nesting cavities in the trunk of living conifers or snags (Raphael and White, 1984). This species may occur in the Lacey Valley, but there are no confirmed breeding records in the meadow area surrounding Webber Lake.

Willow Flycatcher (*Empidonax traillii*) – Two subspecies of willow flycatcher regularly occur in the northern Sierra Nevada. *E.t. adastus* and *E. t. brewsterii* are found along the east and west slopes (respectively) of the Sierra Nevada and southern Cascades (Unitt and others, 2003). Analyses of DNA and song recordings from Willow flycatcher breeding in Lacey Valley and the nearby vicinity failed to successfully differentiate between the *E .t. adastus* and *E. t. brewsterii* subspecies and as such these birds are considered to be intergrades between the two subspecies (Paxton, 2000, Sedgwick, 2001). Both subspecies are designated as endangered by the State of California and Forest Service Sensitive species.

Anecdotal and demographic studies indicate a dramatic decline in the Sierra Nevada willow flycatcher population since the 1920s when this species was considered locally common in riparian areas (Ray, 1903, Orr and Moffitt, 1971, Gaines, 1992). These regional declines, as well as local extirpations from most southern Sierra locations, have been well documented since 1980 (Harris and others, 1987, Bombay and others, 2003b, Siegel and others, 2008, Mathewson 2010). Ten years of willow flycatcher population monitoring during the 1990s and 2000s indicated 17 percent annual declines in the area immediately south of Lake Tahoe, 6 percent annual declines in the northern Sierra (including data from Lacey Valley), and 1 percent declines along the Cascade/Sierra interface (Mathewson and others, in press). With few exceptions, sites in the region that consistently support more than 3 territories annually are restricted to the northern Sierra Nevada and southern Cascades (Mathewson and others in press). A few clusters of meadows that are still occasionally occupied by willow flycatchers persist in areas south of Lake Tahoe, primarily in Alpine County on the east side of the Sierra Nevada (Mathewson, 2010). Additional, more isolated breeding sites are known in the vicinity of Mono Lake and the East Carson and Walker River watersheds (McCreedy and Heath, 2004, H. Loffland, pers. obs). Sites that supported multiple territories along the west slope in the vicinity of the Sierra and Stanislaus National Forests and Yosemite National

Park during the 1980s and early 1990s have remained unoccupied for many years, and they are presumed to have been extirpated (Green and others, 2003, Siegel and others, 2008).

In the Sierra Nevada, willow flycatchers breed almost exclusively in willow-dominated, wet montane meadows. These birds occupy sites with extensive stands of shrubby willow mixed with alder and other deciduous shrubs at least 6 feet in height. With few exceptions, the species is associated with two types of meadow settings: 1) riparian meadows where water fills backwater oxbows or beaver ponds and 2) discharge slope meadows where water flows over the surface in spring-fed areas (Bombay and others, 2003a, 2003b, Green and others, 2003, Mathewson, 2010). In fact, many of the largest meadows occupied by willow flycatchers contain both of these hydrologic types. Most meadows occupied by willow flycatchers have at least some surface water that persists throughout the summer and have a vegetation community that thrives in saturated and/or flooded conditions. Large floodplain meadow systems such as those at Lacey Valley and Perazzo Meadows in Sierra County and Warner Creek in Lassen County contain the greatest densities of Willow Flycatchers at this time (Humple and Burnett, 2004, Mathewson, 2010).

Willow flycatchers were intensively monitored in Lacey Valley from 1998 until 2009, with some minimal territory mapping occurring in 2010, and again in 2012. Surveys in the 1980s and 1990s documented numbers of breeding territories on an annual basis. In 1997, the willow flycatcher demography study was initiated and Lacey Valley was added as a study site in 1998. Willow flycatcher territories and nests in Lacey Valley were monitored on a weekly basis during the summer months through 2009 (Mathewson and others, 2011). Territories numbered from 12 to 14 through 2001 and then steadily declined to 3 or 4 in 2008 and 2009. During point counts in June 2012, the IBP monitoring crew detected and mapped 3 territories, and Helen Loffland located a fourth territory with an active nest during her visit on 23 July 2012. With two exceptions, all territories at Lacey Valley have been documented in the Lower Meadow directly south of Webber Lake, primarily in the area between the lake and the road crossing of Lacey Creek. Sanders and Flett (1986) located one territory in the small meadow on the west side of the lake near the campground, and the demography study located a single territory in one year at the meadow on the north side of the lake just east of the historic hotel.

Vaux's Swift (*Chaetura vauxi*) – The Vaux's swift is a CDFW Species of Special Concern that is primarily known from the coastal redwood forests. It is documented as breeding in small numbers in northeastern California and the west slope of the Sierra Nevada. The species nests in hollow trees or snags or old chimneys, which it uses for night roosts as well (Hunter, 2008). Vaux's swift forage over many habitats but especially open water and wetlands up to 3 miles from nest sites (Hunter, 2008). The species is also found in these habitats during migration. Vaux's swift was documented in Lacey Valley in the Gaither report (2011), but the date of this detection is unknown as is any information that could clarify whether this was a migratory or breeding observation.

Yellow Warbler (*Dendroica petechia*) – The yellow warbler is a CDFW Species of Special Concern that breeds in riparian woodlands and shrublands across much of California, excepting the Central Valley, deserts, and higher elevations of the west slope of the Sierra Nevada. The species reaches some of its greatest abundances in willow-dominated wet meadows of northeastern California and the east slope of the Sierra Nevada (Heath, 2008). This species was documented in all surveys for Lacey Valley and is a relatively abundant breeder at the site (Cain and others, 2003).

Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) - The yellow-headed blackbird is a CDFW Species of Special Concern. It is locally common in the marshes found in large mountain valleys of northeastern California and the eastern Sierra Nevada (Jaramillo, 2008). This species nests in tall, emergent vegetation over relatively deep water. Typically nests are found in cattails (*Typha* spp.) or bullrush, but locally (Sierra Valley) the species is documented using spikerush, as it does in Lacey Valley. Yellow-headed blackbirds are not numerous in Lacey Valley and have not been documented during every survey effort. Nonetheless, the interface between Lower Lacey Meadow and Webber Lake provides habitat for this species on at least an occasional basis.

2.7.4.2 SPECIAL-STATUS PLANTS

Davy's Sedge (*Carex davyi*) – Davy's sedge is an erect, clumped, perennial sedge (family: Cyperaceae) growing approximately 10 to 15 inches in height (Baldwin and others, 2012). It is found in dry and sparsely vegetated meadows and slopes in upper montane and subalpine conifer forests from roughly 4,500 to over 10,000 feet in elevation from the central and northern Sierra Nevada north through the Cascades into Washington (Baldwin and others, 2012; CNPS, 2012). Davy's sedge is known to occur within the Lacey Meadows Watershed. It has been collected near the Webber Lake outlet (CCH, 2012), and several other observations have been recorded from the surrounding region (CNDDB, 2012, CCH, 2012). Webber Lake populations appear to mark the northern extent of known populations within the Sierra Nevada (CNPS, 2012). CNPS (2012) has ranked Davy's sedge on list 1B.3, which indicates that plant is rare, threatened or endangered throughout its range, but not very rare within California. It is known from 20 or fewer populations within California (CNPS, 2012).

Webber's Ivesia (*Ivesia webberi*) – Webber's ivesia is a perennial, tap-rooted low spreading herb in the rose family (Rosaceae) that grows roughly 10 inches in diameter with erect to decumbent stems reaching approximately 5 in in height (Baldwin and others, 2012). It is found growing on shallow, clayey soils with a gravelly surface layer on andesitic bedrock in mid-elevation benches and flats, typically in Great Basin scrub and lower montane conifer forests from 3,300 to 6,800 feet in elevation (Witham, 2000). Plant cover in locations where Webber's ivesia is found is typically sparse and open. Although a historic record of Webber's ivesia surrounding Webber Lake is recorded in CNDDB (2012), field surveys (Witham, 2000) failed to locate the species at Webber Lake and concluded that there was no suitable habitat for the species in the vicinity of Webber Lake:

"Similarly, two California occurrences are suspected erroneous. In the original species description, Gray (1874) erroneously cites Indian Valley and around the residence of Dr. Webber, the owner of Webber Lake. Dr. Webber also owned property in Sierra Valley and it was from his ranch that the plant was collected (Lemmon, 1908). Subsequent work by Keck (1938) states that no collections were found in Gray Herbarium labeled either Indian Valley or Dr. Webber. No suitable habitat has been found in the vicinity of Webber Lake (Witham, personal observation)." (Witham, 2000, p.14 and references cited therein)

Webber's ivesia is found in 15 main population centers within Sierra, Dog, and Honey Lake Valleys and adjacent areas of Nevada north and south of Reno into the Pine Nut Mountains in Douglas County, Nevada (Witham, 2000). CNPS (2012) has placed Webber's ivesia on list 1B.1, its highest rarity ranking excluding plants believed to be extinct, indicating that it is rare, threatened, or endangered throughout its range and seriously endangered in California.

Donner Pass Buckwheat (*Eroigonum umbellatum* var. *torreyanum*) – Donner Pass buckwheat (also known as Torrey's buckwheat) is a named variety of the ubiquitous sulphur buckwheat (*Eroigonum umbellatum*). It is a perennial shrub in the buckwheat family (Polygonaceae) that forms large, low mats roughly 4 to 12 inches high and up to 6 feet across (Urie, 2000). Donner Pass buckwheat is found growing from roughly 7,200 to 8,200 feet in alpine and subalpine areas of patchy vegetation within conifer forests and scrub on the east side of the Sierra Crest near Donner Pass. Soils are typically shallow and derived from andesitic rock; this species is usually found in areas of moderate slope although it can be found in flatter with spare shrub and tree cover or, occasionally, steep rocky slopes (Kan, 1993 as cited in Urie, 2000). This species is known to occur within the Lacey Meadows Watershed at 3 locations along Webber Peak (CNDNDB, 2012), and additional populations are located within 5 miles south of Webber Lake toward Donner Pass. The entire known distribution ranges from Webber Mountain in the north to Silver Peak, just north of Squaw Valley, in the south and consists of 16 known populations within this range (Urie, 2000). CNPS (2012) has placed Donner Pass buckwheat on list 1B.2 indicating that it is rare, threatened, or endangered throughout its range and fairly endangered in California.

White-Stemmed Pondweed (*Potamogeton praelongus*) – White stemmed pondweed is a perennial, rhizotomous floating aquatic plant in the pondweed (Potamogetonaceae) family. It is found in deep, coldwater lakes from roughly 6,000 to 10,000 ft in elevation (Baldwin and others, 2012). It is widely distributed in the Northern Hemisphere within suitable coldwater, alpine lake habitats from California north to Alaska and extending into Mexico, Greenland, eastern Asia, and Northern Europe. Within California, it is known from 4 CNDDB occurrences; two are within or adjacent to Lassen National park, and the remaining 2 are from Webber Lake and Catfish Lake near Jackson Meadows Reservoir (CNDDB, 2012). The Webber Lake collection is from 1894 and has not subsequently been re-verified (CNDDB, 2012); this historic collection should be field verified to determine if this plant still occurs within Webber Lake. Additional herbarium specimens for white-stemmed pondweed have been recorded within Shasta, Plumas, Mono, Trinity, and Modoc Counties (CCH, 2012). CNPS (2012) has placed white-stemmed pondweed on list 2.3 indicating that it is rare, threatened, or endangered in California but more common elsewhere and not very endangered in California.

Sub-Alpine Fireweed (*Epilobium howellii*) – Subalpine fireweed (also known as Yuba Pass willowherb) is a wispy, perennial herb in the evening primrose family (Onagraceae) growing 3 to 8 in high and spreading by short stolons. It is most commonly found growing in wet and boggy areas within the Sierra Nevada from roughly 6,600 to nearly 9,000 feet in elevation (Baldwin and others, 2012). Originally collected in 1975 along Yuba Pass (Taylor, 2000), it has since been found in numerous locations throughout the Sierra Nevada (CNPS, 2012) and is now known to occur in at least 23 different 7.5 minute USGS topography quadrangles ranging from Webber Peak in the north to areas in the Sierra National Forest east of Fresno (CNPS, 2012) in the south. Sub-alpine fireweed is likely to occur within the Lacey Meadows Watershed with at least a dozen collections made within 5 miles of Webber Lake (CNDDB 2012). Sub-alpine fireweed is also known from numerous collections within the surrounding region (CNDDB, 2012). CNPS (2012) has placed sub-alpine fireweed on list 4.3, its lowest rarity ranking, indicating that it is uncommon in California and not very endangered.

Starved Daisy (*Erigeron miser*) – Starved daisy is perennial, spreading herb in the sunflower family (Asteraceae) that grows up to 10 in high. It is found on granitic, rocky slopes and crevices in the Sierra Nevada from roughly 6,000 to 9,000 feet in elevation (Baldwin and others, 2012). There are herbarium records for this species from 7 counties: Mono, Butte, Nevada, Placer, Lassen, El Dorado, and Sierra (CCH, 2012), and the CNDDB (2012) lists 23 occurrences for the species from the central Sierra Nevada north to the Cascades. Starved daisy is likely to occur within the Lacey Meadows Watershed. There are 2 recorded observations of starved daisy just outside the 5 mi Webber Lake buffer to the south and suitable habitat for the species is found within the watershed. CNPS (2012) has placed starved daisy on list 1B.3 indicating that it is rare, threatened, or endangered throughout its range and not very endangered in California.

2.8 WILDFIRE

Wildfire has historically played an important role in Sierra Nevadan forests, and was likely a frequent occurrence in the region prior to the arrival of emigrants. There is some evidence that the Washoe Tribe used fire to maintain or control the understory vegetation (Lindström and others, 2000). In the late 1800s Basque sheep herders set fire to high-elevation meadows in an attempt to improve range conditions (Leiberg, 1902). Since the early 1900s, wildfire has been actively suppressed as a policy to prevent loss of resources, property, and provide public safety. Wildfire suppression has drastically changed the composition of the forest and steadily increased the threat of wildfire over the past 100 years.

When wildfires do occur in today's mixed conifer forests they can result in high intensity, high severity fire (MacDonald and Larsen, 2008). The effects of high-severity fires on watershed processes are well documented in the literature (Carroll and others, 2007, Ice and others, 2004, MacDonald and Larsen, 2008). These studies suggest that erosion resulting from wildfire can generate considerably more erosion, enlarge channel networks, and degrade water quality when compared to chronic sources of sediment (e.g., roads).

The Sierra Coordinated Resources Management Council (2008a) has identified portions of Lacey Meadows Watershed as moderate to high threat for wildfire, and indicates that wildfire has been absent in the Lacey Meadows Watershed and adjacent areas since 1880 or earlier (**Figure 13**). The Sierraville Ranger District of the Tahoe National Forest has not documented any prescribed fire within USFS lands of Lacey Meadows Watershed in recent history (R. Burks, pers. comm). Based on limited field observations, forested uplands in the Lacey Meadows watershed exhibit very dense growth, with even-aged forest stands, likely regrowth from clear-cutting in the 1950s or 1970s. If a wildfire were to occur in the Lacey Meadows Watershed, many of the existing natural resources documented in this assessment may be highly altered, degraded or impaired for several years or decades, especially in areas of the Upper Meadow that appear to respond rapidly to disturbance.

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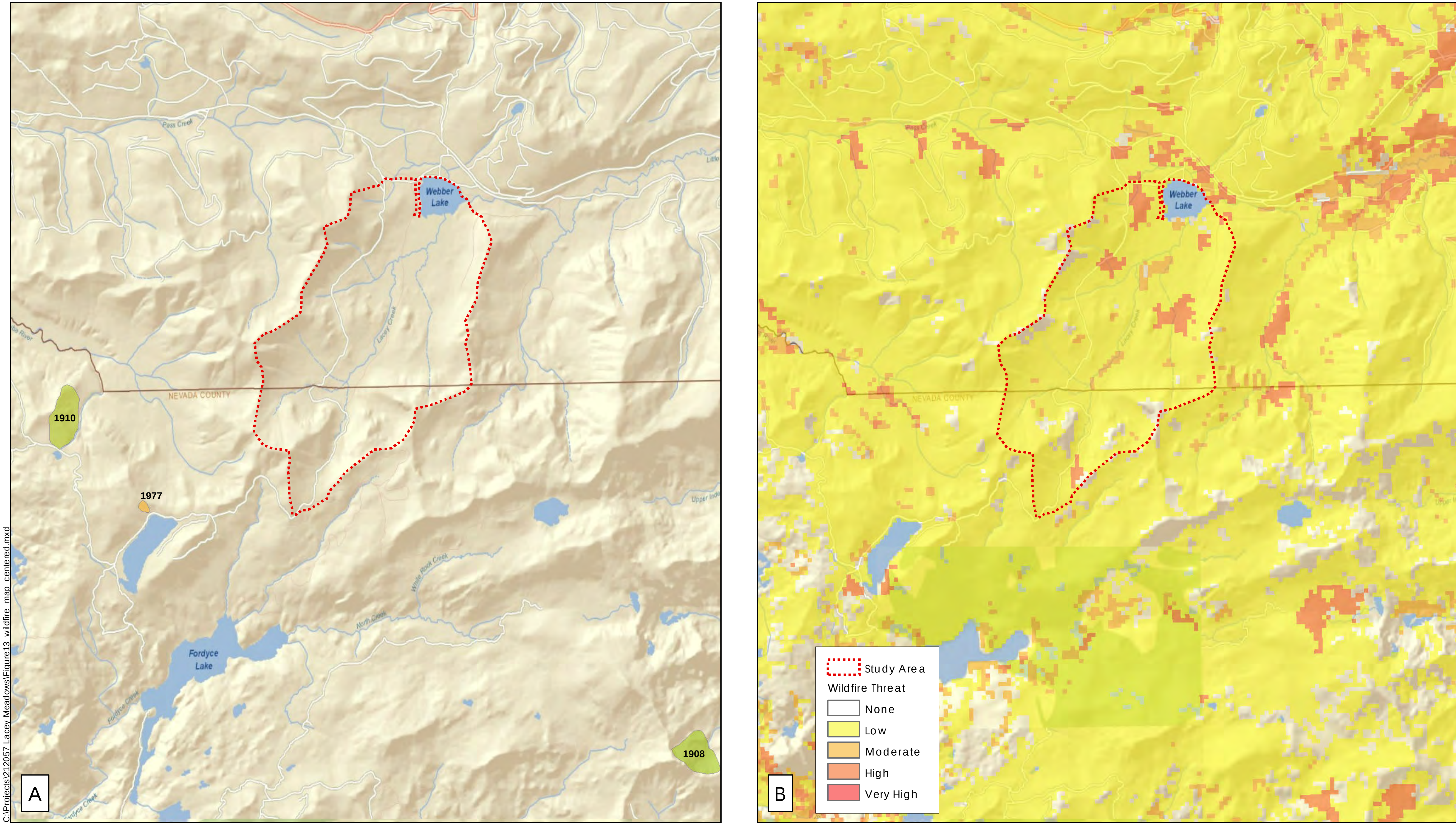

Figure 13. (A) Wildfire History [1880-2008] and (B) Threat of Wildfire [2008]
Lacey Meadows Region
Sierra and Nevada Counties, California

0 7,000
Feet

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3. WATERSHED CONDITION

This section of the report is intended to document watershed conditions, as evaluated through a field-based approach, and sets the stage for identifying disturbed and impaired areas and associated watershed management strategies, as summarized in Chapter 4. Watershed conditions, including ecosystem functions and values, were evaluated using extensive reconnaissance of the meadow, streams and uplands, the most recent scientific principles available, professional experience, local knowledge, and GIS analysis. Our work first focused on an assessment of the road network within the Lacey Meadows Watershed, as roads can be a major source of sediment supplied to streams and can cause a variety of morphological changes to stream channels, which can in turn adversely affect stream and meadow ecosystems. We then examined the hydrologic and ecological functions currently provided by Lacey Creek and Lacey Meadows. As part of this assessment, we identified various factors that may be limiting or otherwise adversely affecting Lacey Meadows and that could be potentially addressed through modifications to current management practices or stream or habitat restoration activities.

Stream and riparian corridors were evaluated on August 22-23, 2012 during a dry, hot summer following a winter with below average precipitation and a decade with overall low or decreasing precipitation. The field team consisted of ecologists with H. T. Harvey & Associates, Dr. Helen Loffland from The Institute of Bird Populations, archeologist and anthropologist Dr. Susan Lindström, and Balance Hydrologics hydrologists and geomorphologists. Field activities consisted of stream walks within the meadows and portions of the uplands and quantitative assessment of channel morphology, aquatic habitat, and hydrology. Our team traveled existing roads and walked former logging roads and skid trails to identify stream capture by roads, culvert crossings or road-induced landslides. Habitat conditions within the meadow and stream system were documented by traversing the meadows along meandering transects and recording the presence of wildlife and the condition and composition of plant communities.

3.1 ROAD NETWORK SURVEY

3.1.1 ROADS IN LACEY MEADOWS WATERSHED

Roads and stream crossings within the Lacey Meadows Watershed are illustrated in **Figure 14**. Detailed documentation of road-stream hydrologic connectivity in Lacey Meadows Watershed is beyond the scope of this assessment; however, we identified roads using: a) 2011 aerial photographs, b) historical USGS topographic maps (1895, 1940, and 1981), and c) surveying existing roads using a Garmin GPS map 60CSx receiver, and evaluated their proximity to existing channels (e.g., number of stream crossings). Although the study area is only 9.3 square miles, the number of roads within the study area is equivalent to 21.9 miles (2.4 miles of road per square mile), with at least 107 stream crossings.

Our field-based evaluation of road density, number of stream crossings, and channel conditions downstream from these crossings suggests roads directly increase runoff collection and conveyance to nearby streams and create other road-related issues such as: a) interception and redirection of hillslope and road runoff to streams, b) stream capture, c) maintenance and erosion of road surfaces and inboard ditches, d) undersized or sediment-plugged culverts, e) channel confinement or re-alignment, and f) dissected or altered meadow hydrology. In particular:

- Many channels located downstream from Meadow Lake Road exhibit actively eroding banks and incising beds. These conditions may be the result of increased runoff from road interception and redirection and/or undersized culverts.
- Stream capture was identified in several locations in the Lacey Meadows Watershed and mostly within or adjacent to the meadows (see **Figure 14**). These locations include Webber Lake Road in T19N, R14E, Section 29, and T18N, R14E, Section 5; a logging road at the intersection with Webber Lake Road in the same section; and an old unmarked road that leaves Webber Lake Road and heads north to Lacey Creek (T18N, R14E, Sections 6 and 7).
- Road grading and in-board ditch excavations are common forms of maintenance along Webber Lake Road to remove washboards and in-board

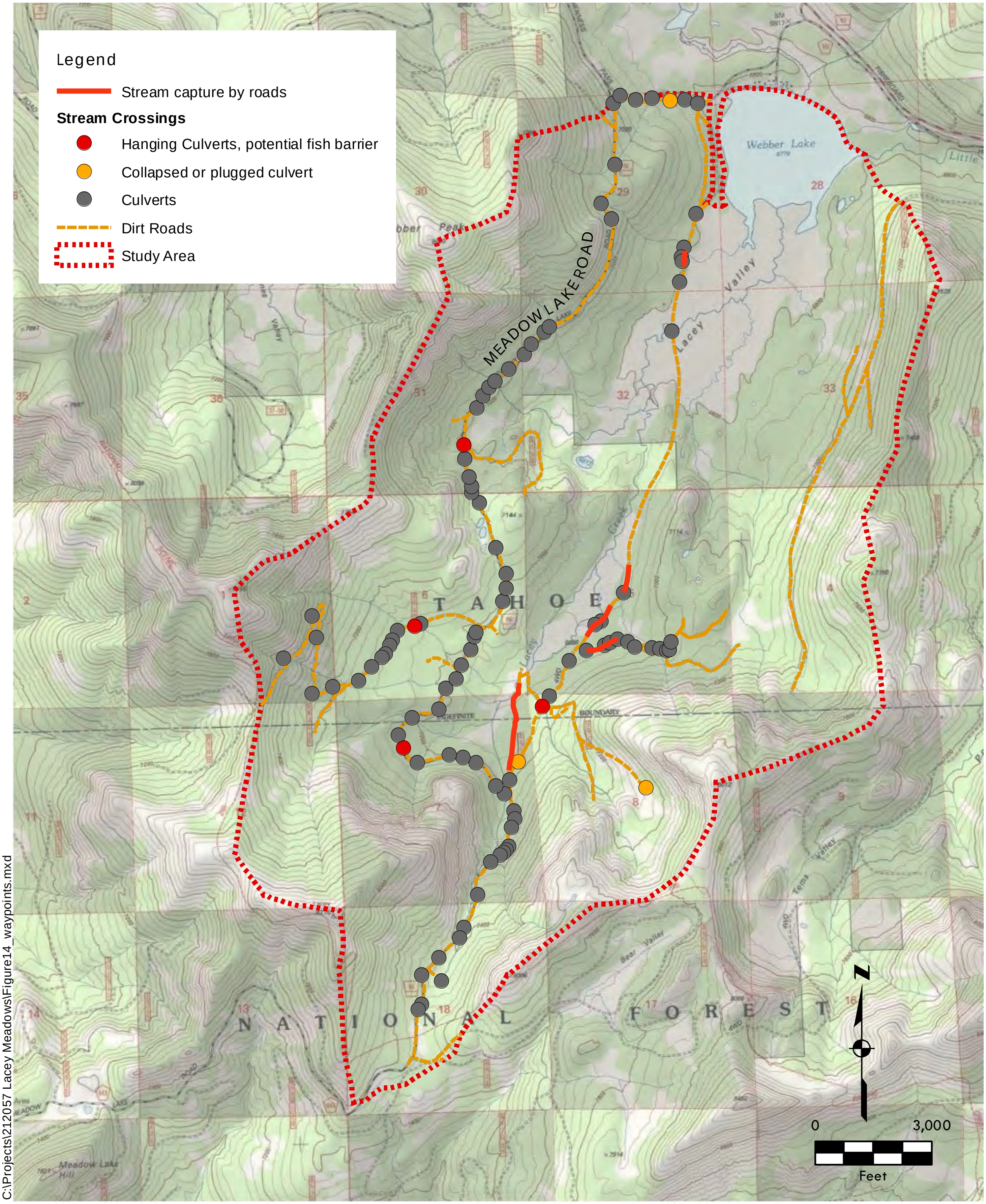

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Figure 14. Roads and Stream Crossings
Lacey Meadows Study Area
Sierra and Nevada Counties, California

- ditch filling that occur over the summer, a practice which typically exacerbates chronic sources of fine sediment to the streams if they have high connectivity. Undersized culverts at a stream crossing along Henness Pass Road appears to cause frequent plugging from sediment and is maintained (i.e., sediment removed) on a frequent basis.
- Of the 107 stream crossings (or culverts) on existing roads, at least four appear to have generated considerable scour at their outlets and resulted in 'hanging culverts'. These hanging culverts impede fish passage to upstream habitat. At least three culverts were characterized as collapsed or plugged with sediment (**see Figure 14**).
- Construction and maintenance of the Meadow Lake Road above the Upper Lacey Meadows (T18N, R14E, Section 7) has confined Lacey Creek along the toe of slope and appears to exacerbate hillslope failures and sediment delivery to the channel.
- Where Webber Lake Road traverses Lower Lacey Meadow the road surface is graded to below the elevation of the meadow surface. As a result, the hydrology of the meadow in these sections appears to be altered such that drier meadow conditions or vegetation conversion is prevailing.

3.2 STREAM AND RIPARIAN CORRIDOR ASSESSMENT

A stream and riparian corridor assessment was carried out in order to make useful comparisons between intact and impaired channel reaches, document sediment sources, characterize hydrology and channel conditions, and evaluate channel and riparian conditions over time.

3.2.1 SEDIMENT SOURCES

The physiography of the upper watershed consists of high-elevation, steep terrain in the sediment-production zone. As the channels cross the Lacey Meadows depositional zones, sediment may be deposited and temporarily stored, or create dynamic or disturbed channel environments that are directly related to their upstream sources. Following episodic sediment deposition, these zones then become sources, producing sediment and metering it to downstream areas.

When fine sediment deposition in fluvial systems exceeds sediment transport, fine sediment deposits can cover gravel bottoms that many organisms need for feeding and reproduction, and may fill the deep pools and cover the rocks and woody debris where fish live and feed (Roseboom and others, 1983 cited in National Research Council, 1992). Surpluses of fine sediment can originate from sources both natural (e.g., debris flows, landslides, etc.) and anthropogenic (e.g., roads, grazing impacts, channel modifications, etc.). Sediment sources can also be both chronic (e.g., road runoff) and/or discrete (e.g., bank erosion during floods or modification). **Table 8** identifies the major sediment source types in Lacey Meadows Watershed. Roads within the Lacey Meadows Watershed are one of the most significant sources of both fine and coarse sediment, as described in Section 2.6 and 3.1. Other potential sediment sources are briefly discussed below in order of their inferred significance.

3.2.1.1 NATURAL SOURCES

The Lacey Meadows Study Area has both geologic and climate characteristics that are conducive to sediment production and transport. Much of the watershed includes steep terrain underlain by erosive volcanic and metavolcanic rocks. Combined with occasional high intensity storms at this elevation and periodic rain-on-snow events, this landscape is subject to debris flows, landslides, dry ravel, and in some cases, transport at high frequency, more moderate flows. The best example of these processes in the watershed is the east face of Lacey Peak (8,216 feet) where steep, unvegetated slopes foster gully formation and provide an abundant source of sediment to Lacey Creek.

3.2.1.2 OTHER SOURCES

Channel scour and bank erosion: Channel scour and bank erosion are natural processes; however when they occur in a manner that impairs channel function under the existing climate and hydrologic regime, then they become excessive and a source of sediment. In-channel sediment sources appear to be the result of historical watershed impacts and on-going disturbances described in this report. For example, increased hydrologic connectivity of roads with streams has likely increased the frequency and magnitude of floods. In turn, these floods do more work on the channel and result in large-scale bank failures or bed scour. Furthermore, grazing or trampling of streambanks and riparian areas increase the banks susceptibility to erosion. Finally, channel modifications in the Upper Lacey Meadow have formed

Table 8. Summary of sediment source types
Lacey Meadows, Sierra and Nevada Counties, California

Source	*Rank*	*Location*	*Comment*
Roads	1	At stream crossings, stream capture locations, inboard ditches watershed-wide	Likely the dominant source of altered hydrology and both direct and indirect sediment sources
Channel scour and bank erosion	2	Reaches B, C, G, H, I, J, and K, stream capture locations, knickpoint migration	Natural and excessive sources
Grazing (direct and indirect)	3	Along streambanks	More pronounced in Upper Lacey Meadow
Logging (direct and indirect)	4	Sections 5, 8	Mostly recovering, last logging period 1970s
Landslides, gullying and rilling	5	Sections 7,8, and 18	Natural sources from steep volcanic terrains or logging land-use induced

Notes:
1. Rank is qualitative and based on limited observations in the watershed
2. Many sources are linked 'cause and effect'. For example, roads may be exacerbating channel scour and bank erosion

channels in non-alluvial environments, such as forest fringe and upland moraine features).

Grazing: Cattle and sheep tend to congregate in meadow or riparian environments, attracted by the availability of water, shade, and quality of forage. Overgrazing in riparian areas has shown to induce damaging effects on water quality and aquatic habitat including increases in runoff, suspended sediment loads, and nutrients (Kauffman and Krueger, 1984). Grazing impacts such as: a) bank trampling; b) partial or complete removal of bankside vegetation from grazing, c) willow browsing and hedging, and; d) near-channel soil disturbances and compaction are evident in both Upper and Lower Lacey Meadows. These impacts were particularly prevalent in Upper Lacey Meadow where many segments of channel were denuded of vegetation, stream banks were chiseled or trampled, willows were heavily browsed by sheep, and many areas surrounding the stream supported little to no vegetation cover and were susceptible to erosion. Trampled and denuded streambanks exhibit signs of channel widening.

If future in-channel restoration projects are carried out, grazing management solutions will require careful consideration and implementation. Compatibility between grazing and aquatic resources may be possible through alternative management solutions such as flash or rotational grazing, reduced grazing in sensitive areas or exclusion zones from riparian or stream corridors (Clary and Booth, 1993).

Logging: Forested areas in highly erodible soils or geology provide a natural buffer from high intensity rainfall and hillslope runoff. Forest canopy provides interception while forest duff and dead and down trees slow runoff velocities.

Portions of the Lacey Meadows Watershed were logged in the 1950s and again in the 1970s (see logging maps in Appendix B) with some possible (undocumented) logging in the 1980s. In some areas, these methods may have removed significant canopy and forest floor cover from erosion-prone soils. Today, rilling and gullying can be observed in many of the upland areas that were logged. These effects were most visible in the areas surrounding the Upper Lacey Meadow, particularly T18N, R14E, Section 5.

3.2.2 CHANNEL REACH CLASSIFICATION

Figures 15 and 16 provide a channel-reach classification for the Lower and Upper Meadow, respectively. For the purposes of this assessment, a stream reach classification was developed according to channel form, processes, and disturbances and for clarity of discussion. Channel conditions were assessed through interpretation of historical aerial photographs and maps (see Appendix A), qualitative observations during stream reconnaissance walks, and measurement of channel morphology, habitat hydrology, and substrate (**Table 9 and 10)** at 14 locations in the Lower and Upper Meadow (see Figures 15 and 16). Each reach was classified based on several characteristics including: a) approximate channel slope, b) channel planform, c) channel morphology, d) dominant bed material size, e) dominant sediment transport processes and, f) influence of land-uses or modification of channels or hydrology. Fifteen reaches were identified (Reaches A through K) in Lacey Creek and three additional reaches were defined in tributaries (West, SE, and SW Tributaries). We refer to these reaches in subsequent sections of this report.

3.2.2.1 CHANNEL-REACH PLANFORM CLASSIFICATION

Lacey Creek is a dynamic channel system that responds to both streamflow and sediment inputs and adapts a channel planform relative to its channel slope. Lacey Creek is representative of a mountain stream with a concave profile (steep reaches transitioning to low-gradient reaches). Based on our field observations, we describe planform for each reach as braided (multiple channels), straight, or a single-thread meandering channel (see Table 9).

Observations along Lacey Creek suggest that reach-scale channel form is generally consistent with relationships between bankfull streamflow and channel slope, as established by Leopold and Wolman (1957) and shown in (**Figure 17**). Furthermore, Reach C and G(a) appear to be in transition between meandering and braided channels. These reaches may be responding to past or current disturbances in the watershed, such as increases in sediment supply or runoff, and warrant careful consideration before restoration recommendations are developed. For instance, a meandering channel planform may not be appropriate or stable form for Reach C or G(a), if they are tending toward a braided morphology in response to disturbance, with the resulting increase in coarse-sediment supply. However, if upper watershed sediment sources are addressed, meandering channel forms may be appropriate.

Table 9. Metrics and observations for channel conditions, Lacey Creek and Tributaries, 2012
Lacey Meadows study area, Sierra and Nevada Counties, California

XS-ID	GPS ID	Channel Reach	Channel Type	Estimated streamflow	Bed Material Source	Bed sediment size (mm)			Bank conditions	Active Channel Depth	Active Channel Width	Active w/d ratio	Maximum Bank Height	Maximum Channel Width	Max w/d ratio	Did 2012 peak flow access meadow?
				(cfs)		*D-10*	*D-50*	*D-90*		*(ft)*	*(ft)*		*(ft)*	*(ft)*		*(yes/no?)*
LOWER LACEY CREEK (LOWER MEADOW)																
1	566	B	meandering pool-riffle	0	volcanics, meta-volcanics, glacial outwash		11		eroding	4.5	25	5.6	6	28	4.7	no
2	570	B	meandering pool-riffle	0	volcanics, meta-volcanics, glacial	2	16	23	stable	2.8	18	6.4	4	30	7.5	no
3	550	B	meandering pool-riffle	0	glacial outwash/meta-volcanics	2	11	45	stable	3	18	6.0	4.5	32	7.1	no
4	554	C	meandering pool-riffle	0	glacial outwash/meta-volcanics		16	90	eroding	4	25	6.3	5.5	55	10.0	no
					Average	2	14	53		4	22	6	5	36	7	
REFERENCE REACH (LOWER MEADOW)																
5	562	SE Trib	meandering pool-riffle	0	volcanics	<2	8	23	stable	2.3	15	6.5	3.8	18	4.7	yes
UPPER LACEY CREEK (UPPER MEADOW)																
6	541	F	straight pool-riffle	0.2	glacial outwash		45		stable	2.5	18	7.2	2.5	>30	16	yes
7	536	G(a)	meandering pool-riffle	0	Metavolcanics/ glacial outwash	8	32	256	eroding	2	14	7.0	4.5	53	11.8	no
10	532	G(a)	straight pool-riffle	0.2	glacial outwash	8	32	>560	eroding	3.5	22	6.3	5.5	28	5.1	no
11	n/a	G(a)	braided	0	Volcanics, metavolcanics, glacial outwash		32		eroding	2.5	25	10.0	3.5	200	57.1	yes
12	531	G(a)	straight pool-riffle	0.1	Volcanics, metavolcanics, glacial outwash	8	32	>560	eroding	2.5	20	8.0	4	25	6.3	no
13	n/a	I(a)	braided	0.05	Volcanics, metavolcanics, glacial outwash	<2	23	180	eroding	2	85	42.5	3	115	38.3	--
14	n/a	I(b)	briaded	0	Volcanics, metavolcanics, glacial outwash	8	64	300	eroding	2.5	25	10.0	3.5	50	14.3	--
15	n/a	I(a)	step-pool	0.1	Metavolcanics/ glacial outwash	8	90	256	eroding	2.75	20	7.3	4.5	35	7.8	--
					Average	8	44	248		2.5	29	12	4	72	20	
REFERENCE REACH (UPPER MEADOW)																
8	542	G(b)	meandering pool-riffle	0	glacial outwash		8		abandoned	1.5	28	18.7	4.5	53	11.8	n/a
9	n/a	G(b)	meandering pool-riffle	0	glacial outwash		16		abandoned	2.5	28	11.2	5	60	12.0	n/a
					Average		12			2.0	28	14.9	4.8	57	12	

Table 10 Metrics and observations, habitat hydrology, Lacey Creek and Tributaries, 2012
Lacey Meadows Study Area, Sierra and Nevada Counties, California

XS-ID	GPS ID	Channel Reach	Channel Type	Estimated streamflow	Water Temp	Specific Conductance (SC)	SC @ 25 deg C	Baseflow Pool Area	Baseflow Pool Max Depth	Baseflow pool/riffle ratio	Undercut bank length	Undercut bank depth	Estimated riparian cover	Evidence of beaver activity?
				(cfs)	*(deg C)*	*(uS)*	*(uS)*	*(ft2)*	*(ft)*		*(ft)*	*(ft)*	*(%)*	
LOWER LACEY CREEK (LOWER MEADOW)														
1	566	B	meandering pool-riffle	0	16.2	44	54	170	1	--	40	0.5	1	no
2	570	B	meandering pool-riffle	0	16	44	56	900	3.2	60/40	15	1	20	no
3	550	B	meandering pool-riffle	0	9.2	40	56	300	1.5	60/40	10	0.5	10	no
4	554	C	meandering pool-riffle	0	--	--	--	--	--	--	--	--	--	no
REFERENCE REACH (LOWER MEADOW)														
5	562	SE Trib	meandering pool-riffle	0	--	--	--	--	--	--	--	--	<1	no
UPPER LACEY CREEK (UPPER MEADOW)														
6	541	F	straight pool-riffle	0.2	19	55	65	975	0.2	60/40	0	0	10	no
7	536	G(a)	meandering pool-riffle	0	--	--	--	--	--	--	--	--	<1	no
10	532	G(a)	straight pool-riffle	0.2	15.5	46	56	800	1.3	60/40	25	2	15	no
11	n/a	G(a)	braided	0	--	--	--	--	--	--	--	--	5	no
12	531	G(a)	straight pool-riffle	0.1	20	50	55	120	0.8	50/50	0	0	10	no
13	n/a	I(a)	braided	0.05	--	--	--	90	0.5	25/75	0	0	5	no
14	n/a	I(b)	briaded	0	--	--	--	--	--	--	--	--	5	no
15	n/a	I(a)	step-pool	0.1	4.8	84	53	5	0.2	--	--	--	20	no
REFERENCE REACH (UPPER MEADOW)														
8	542	G(b)	meandering pool-riffle	0	--	--	--	--	--	--	--	--	50	no
9	n/a	G(b)	meandering pool-riffle	0	--	--	--	--	--	--	--	--	5	no

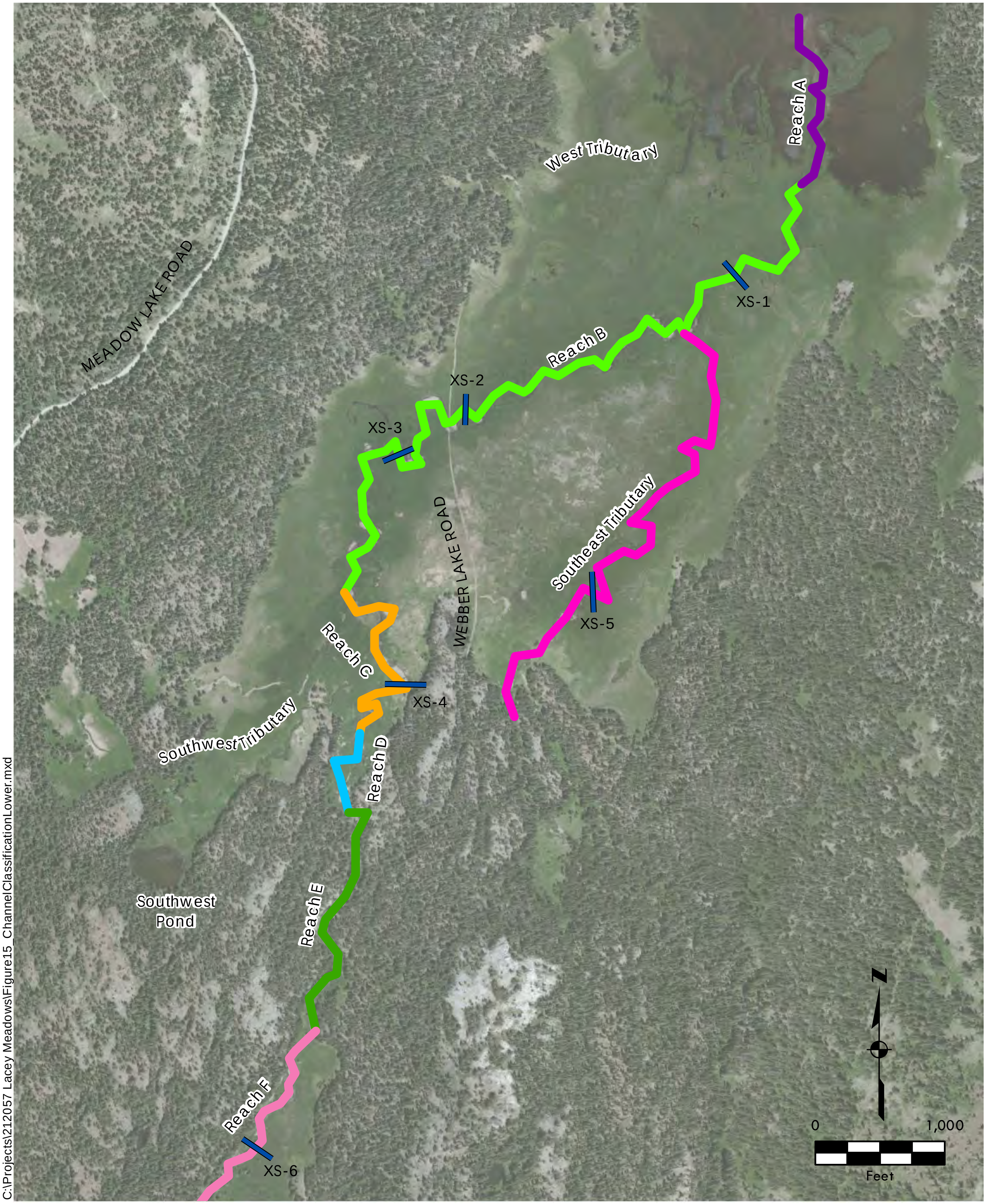

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Figure 15. Channel reaches map
Lower Lacey Meadow
Sierra and Nevada Counties, California

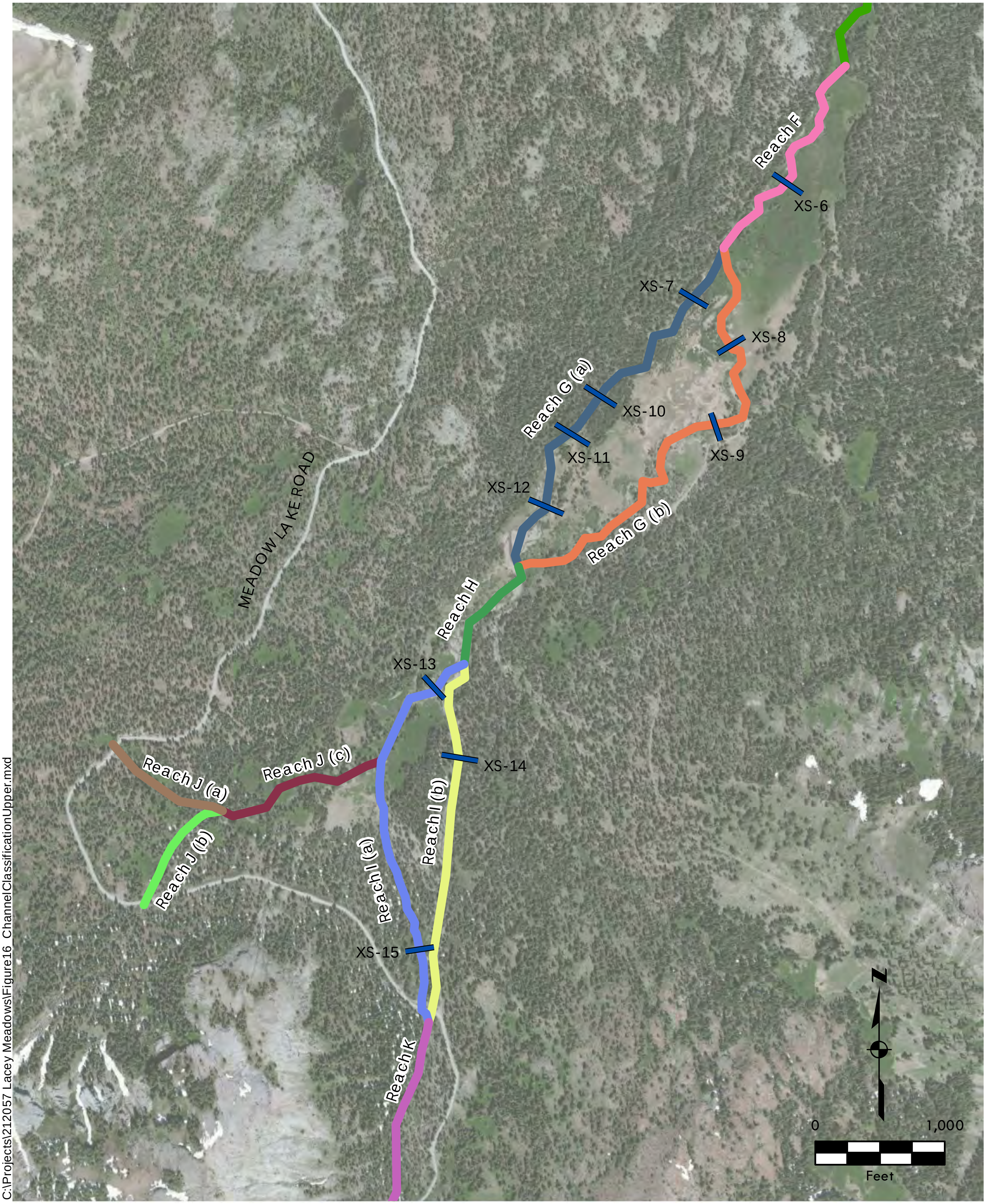

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Figure 16. Channel reaches map
Upper Lacey Meadow
Sierra and Nevada Counties, California

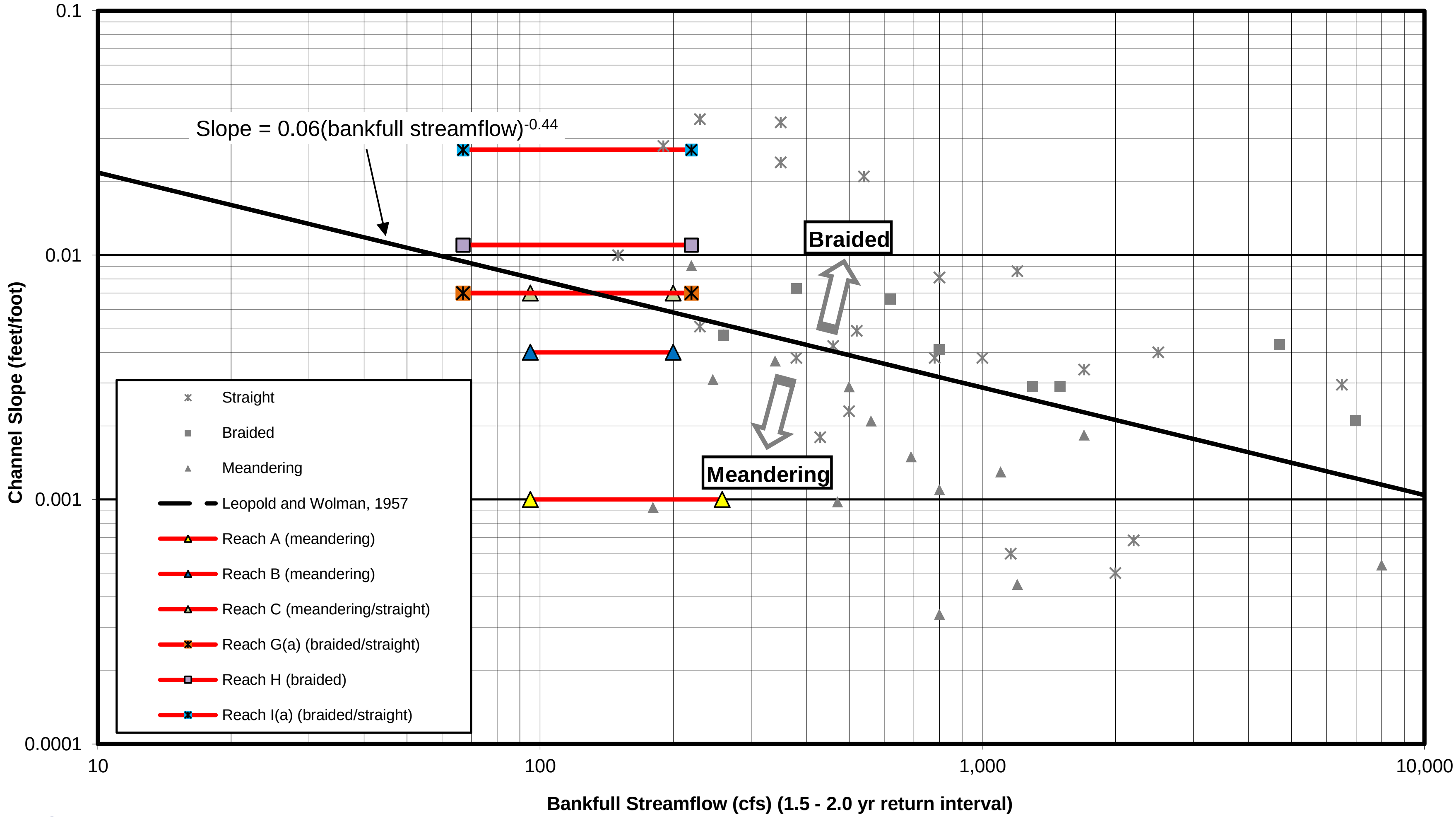

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Figure 17. Lacey Creek channel planform (selected reaches) compared to predicted planform based on Leopold and Wolman (1957). Lacey Creek channel slope was measured from 40-ft contour interval topographic map; a range for bankfull streamflow was estimated from field measured parameters and using published empirical equations

3.2.2.2 CHANNEL-REACH MORPHOLOGY CLASSIFICATION

Similar to channel planform, channel morphology changes relative to channel slope and reflects processes within that segment of the watershed. Montgomery and Buffington's (1997) classification system can be used to relate morphology and processes in mountain channels. In **Figure 18**, we plot Lacey Creek by reach based on general slopes measured from topographic maps as compared to the general distribution of alluvial channel types presented by Montgomery and Buffington (1997). Processes such as scour, deposition, and function of large woody debris can be inferred from the graph and applied toward channel restoration planning in specific areas.

The predicted channel morphology generally conforms to our observations in the field. Reach A, which experiences inundation from Webber Lake dam operations, exhibits slopes and channel bedforms such as ripples and dunes, commonly associated with low-gradient sand-bed channels with limited sediment transport ability. Reaches B, C, D, F, and G exhibit slopes less than 1.5 percent and express pool-riffle morphology, typical of channels with well-defined floodplains in mountain meadows. Reaches H, I, and the lower segment of Reach J are located on an alluvial fan with slopes of between 1.5 and 3 percent, with braided or multiple-channels, typical of an alluvial fan. Both reaches have plane-bed morphology, are relatively straight, unconfined systems with beds comprised of sand and gravel, with cobble and small boulders. Plane-bed morphology is further characterized by long stretches of relatively featureless bed; however, introduction of flow obstructions (i.e., instream wood) may force local pool and bar formation (Montgomery and Buffington, 1997). Reach E exhibits a slope just over 2 percent and is partially (locally) controlled by bedrock, expressing a step-pool morphology. Finally, Reach K, with a slope approaching 7 percent, exhibits a mixture of step-pool and cascade type morphology. Instream wood in this reach is largely immobile and serves as structure and sediment traps. The channel reach morphology can generally be used as guidance for restoration of form, structure and process if restoration is sought.

3.2.2.3 REFERENCE REACH

Comparison of a disturbed reach to a relatively undisturbed reach (reference reach) under similar climate, geology, soils, and vegetation establishes potential targets or criteria for restoration. However, as is common in stream and meadow restoration practice in California, identifying a relatively undisturbed reference reach can be

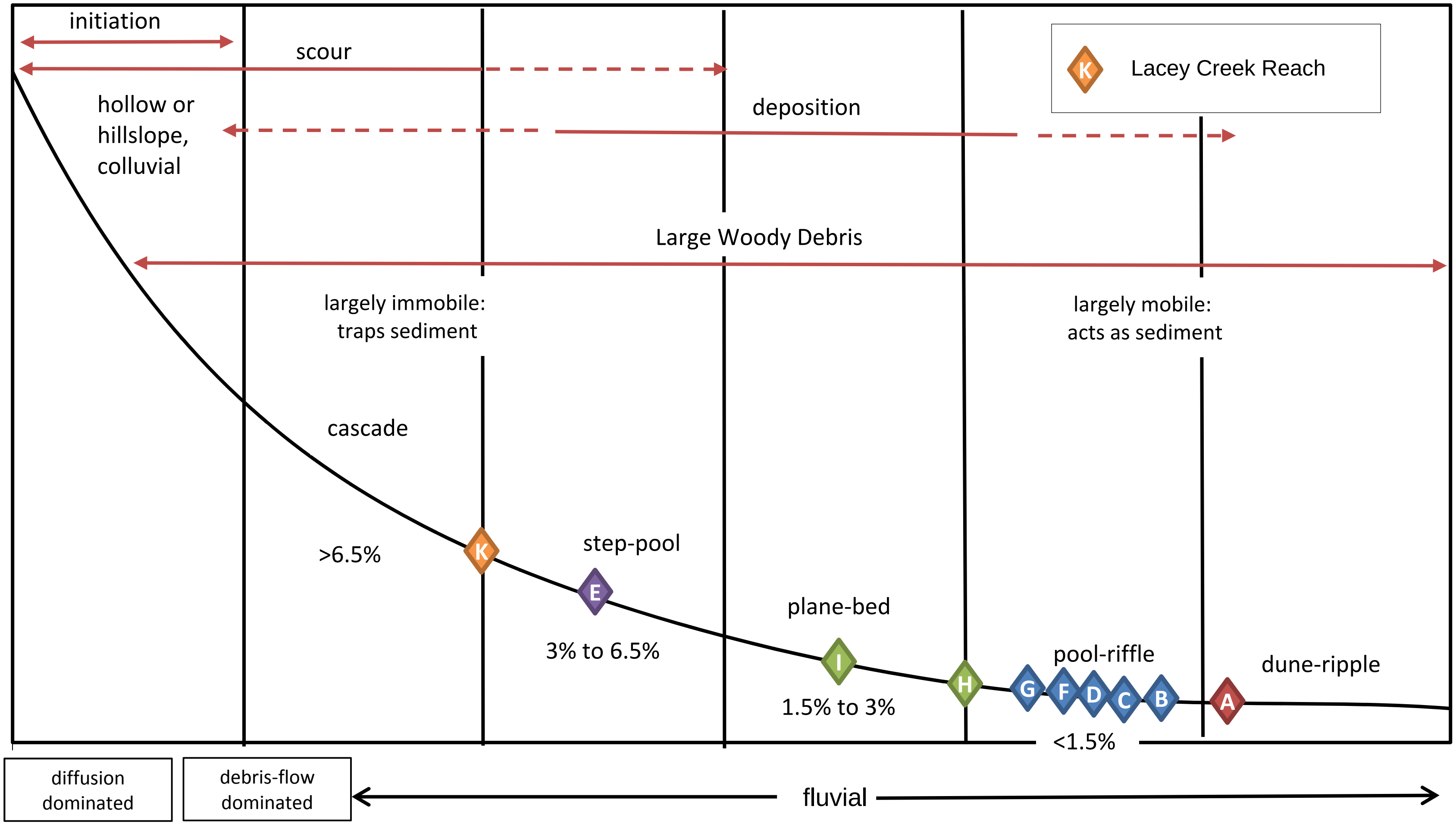

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Figure 18. Channel morphology of selected reaches in relation to general distribution of alluvial channel types adapted from Montgomery and Buffington (1997), Lacey Creek, Sierra and Nevada Counties, California. Field identification of channel morphology and slopes measured from topographic maps are consistent with channel types as reported by the literature and can be used for guidance for future restoration.

difficult. Given the relative difference in channel slope in Lacey Creek between the Lower and Upper Meadow, we identified two quasi-reference reaches: 1) Lower Meadow: the **SE Tributary**, and 2) Upper Meadow: an abandoned channel (pre 1966) in the Upper Lacey Meadow **(Reach G(b))**. These reaches were selected based on whether or not they supported hydrologic or geomorphic functions (i.e., floodplain connectivity, sediment transport and deposition). Although almost 50 years have passed since Reach G(b) was occupied by annual flows, the remnant channel still expresses morphology characteristic of a less-degraded system (e.g., vegetated banks, floodplain connectivity, point bar and riffle features). It is likely that the abandoned channel was affected by land-uses in the first half of the century, but the reach provides a snapshot in time, largely unaffected by streamflow and/or sediment changes in the watershed in the second half of the century. The abandoned channel can provide insightful information for future channel restoration or management; widths may be an appropriate guidance metric, although depths may be misleading due to some filling by overbank flows and organic materials. Channel metrics for both Reach Gb and the SE Tributary are included in **Table 9**.

3.2.3 HYDROLOGY

We have characterized the hydrology using measured channel geometry, empirical approaches, and comparisons to nearby gaging stations operated by Balance Hydrologics for the Truckee River Watershed Council and U.S. Forest Service. **Table 11** summarizes an estimated range of flows for Lacey Creek and nearby gaged watersheds. A USGS topographic map (1981) delineates Lacey Creek as a perennial stream; however, mid-summer observations (2012) make it clear that some reaches, especially in sediment deposition zones within the meadows, do not presently support year-round flow, even while the streams continue to flow in bedrock-controlled reaches. In 2012, Lacey Creek went dry sometime in late August and supported few isolated pools connected via hyporheic flow through coarse bed material.

One of the primary objectives of outlining meadow hydrology is to understand the relative extent of frequency at which flood waters access or inundate flooplain or meadow surface. Typically, streamflow in a pool-riffle channel crossing a meadow system can be expected to overtop its banks or engage its floodplain at least 5 or 6 times in a decade—sometimes referred to as the 1.5-year or 2-year flow or ‘bankfull discharge’. Inundation of a meadow surface at these frequencies serves many eco-

Table 11. Summary of estimated streamflow statistics in Lacey Creek and Upper Little Truckee River Watershed

	Watershed Area	Average summer baseflow	Bankfull streamflow (1.5-2 yr flood)[4]	2012 Peak flow[5]	10-yr flood[6]	100-yr flood[6]
	(sq. miles)	*(cfs)*	*(cfs)*	*(cfs)*	*(cfs)*	*(cfs)*
Lacey Creek above Lower Lacey Meadow	6.1	0-0.5	67-220	240-500	--	--
Lacey Creek above Webber Lake [1]	9.3	0-0.2	95-285	340-760	*371*	*1,150*
Perazzo Creek above Perazzo Meadows [2]	6.1	0.2-0.8	140	500	--	--
Little Truckee River above Perazzo Meadows [3]	15.8	0-1.0	290	694	--	--

Notes:
1. Lacey Creek above Webber Lake represents the most downstream point in the study area; USGS streamstats were computed for this location only.
2. Perazzo Creek above Perazzo Meadows : an adjacent watershed of similar size (6.1 sq. miles) with similar geology, climate, and land-use. Gaging station maintained and operated by Balance Hydrologics, Inc.; baseflows computed from WY2011; bankfull estimated from channel geometry, high-water marks, and stage-discharge rating curve
3. Little Truckee River above Perazzo Meadows : gage located approx. 2 miles downstream of Webber Lake outlet. Gaging station maintained and operated by Balance Hydrologics, Inc.; baseflow computed from WY2011-WY2012; bankfull streamflow estimated from channel geometry, high-water marks, and stage-discharge rating curve.
4. Bankfull estimates based on Manning's equation and Continuity equation with parameters measured directly in the field or published literature
5. WY 2012 peak flow for Lacey Creek was approximated by two methods: a) WY 2012 peak flow (unit discharge) at Perazzo Creek above Perazzo Meadows; and b) field measurements of channel geometry and high-water marks, and published emperical equations.
6. 10-yr and 100-yr estimates computed using USGS Streamstats : http://water.usgs.gov/osw/streamstats/ssonline.html (estimated standard error: 83 % -96 %),

hydrologic functions, such as depositing fine sediment and nutrients to meadow soils and plants while recharging local groundwater.

High-water marks identified along Lacey Creek suggested 2012 peak flow was contained within the active channel in most locations. Estimates of 2012 peak flow for Lacey Creek (340 cfs to 760 cfs) were well above estimates for 1.5- to 2-year discharge (95 cfs to 285 cfs). If we assume that the 2-year discharge corresponds to 'bankfull discharge, this year's peak flow should have inundated Lacey Meadows. The hydrology analysis and field evidence indicate that channel-floodplain connectivity is limited in the Lacey Meadow system, likely the symptom of an incised channel system.

3.2.3.1 SURFACE-GROUNDWATER INTERACTION

Springs and shallow groundwater discharge are an important source of baseflow in Lacey Creek. Springs and associated discharge slope meadows tend to be located in the upper watershed near the contacts of different volcanic units and near outcrops between volcanic and glacial deposits (see Figure 10). Areas of shallow bedrock also tend to support a shallow water table and wetland vegetation during dry years or periods of drought. **Figure 19** shows a 1992 false-color infrared aerial photograph of the Upper Lacey Meadow. False-color infrared images provide a tool for investigating areas of surface-groundwater interaction, indicating areas of groundwater discharge or shallow groundwater by highlighting the presence of photosynthetically active vegetation. Healthy (actively transpiring) green vegetation appears red in the image and delineates areas where vegetation is able to reach shallow groundwater or abundant soil water. The image in Figure 19 was recorded in July of 1992, during the dry season in a period of drought (1987-1993), and helps identify areas of the meadows which support riparian and wetland habitat during times of stress. These areas may provide a starting point for future management objectives or protection.

Groundwater discharge supports baseflow and habitat into the summer and through drought periods, ultimately relying on adequate aquifer recharge for supply. Groundwater recharge tends to occur in low-gradient areas where soils and geology are conducive to rapid infiltration rates. If Lacey Creek is incised, with limited channel-floodplain connectivity, the channel may serve to drain shallow groundwater. Where roads and other watershed disturbance increase runoff and the rate of water delivery from the watershed, recharge may become impaired. Restoration and land management actions which slow runoff and increase infiltration are likely to extend low

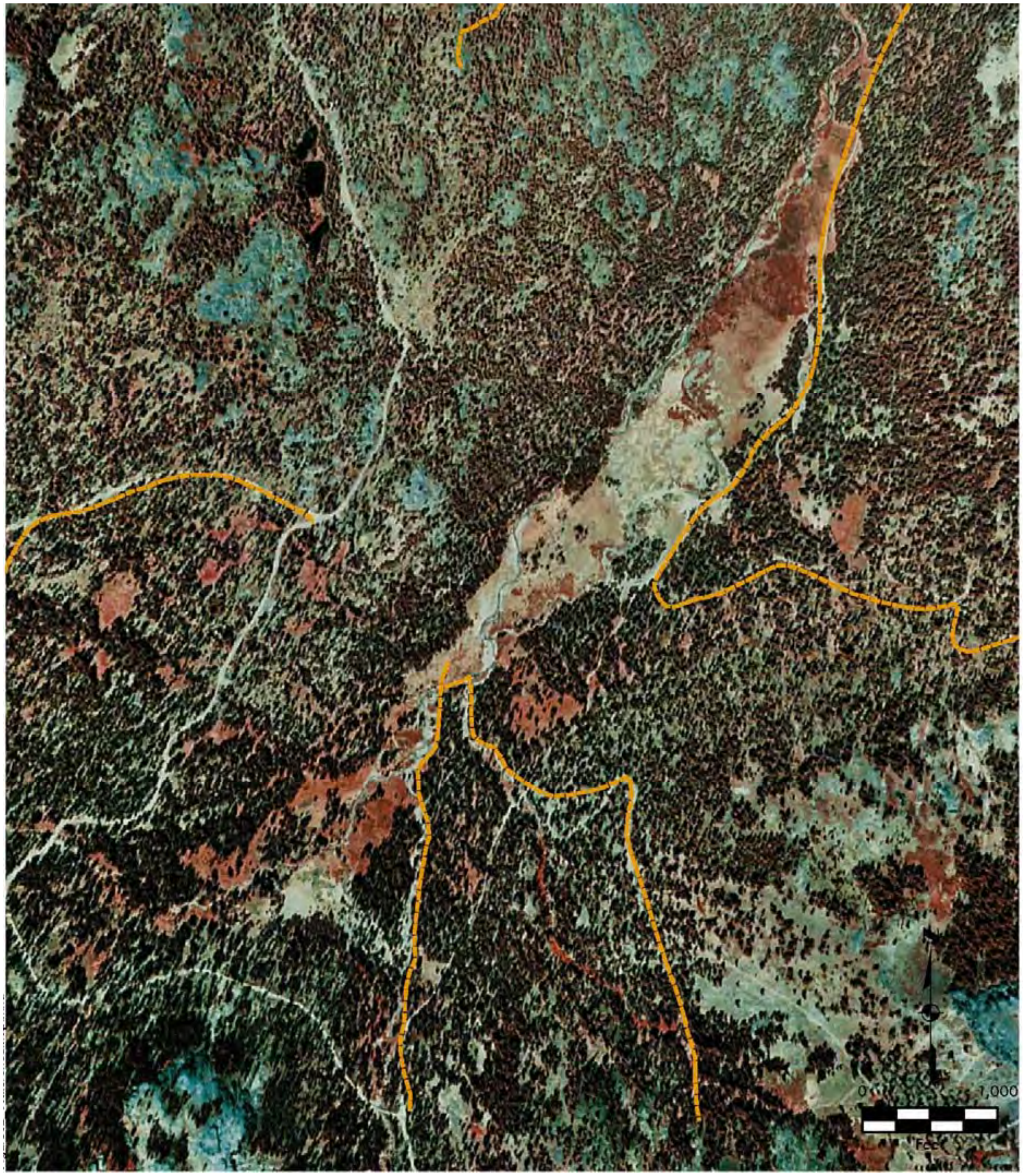

Figure 19. **Inferred suface-groundwater interactions, Upper Lacey Meadows (1992 color infrared)**
Imagery indicates areas of inferred shallow groundwater or groundwater discharge (red) and dry areas (white)

flows later into the summer, improving habitat value. This may consist of improving infiltration, channel-floodplain connectivity, perhaps through modifying roads and road drainage or restoring a higher frequency of overbank flows to incised reaches.

3.2.4 LACEY CREEK CHANNEL CONDITIONS

This section includes detailed descriptions of the channel conditions, reach by reach from downstream to upstream, and highlights where degradation appears to be occurring and where channel functions (such as floodplain connectivity) appear to be intact or partially intact.

Using information collected from stream reconnaissance and hydrology calculations, we characterized channel conditions overall and by reach through systematic measurement of channel geometry and conditions at representative reaches. At 15 cross-sections, we measured active channel widths and depths using field evidence (i.e., absence or presence of deposition, vegetation change, abrupt change in slope). Similarly, maximum channel-corridor widths and depths were measured as defined by a terrace or meadow surface. In addition, bed material was characterized (e.g., geologic origin and median diameter of sediment), channel planform and morphology were described as well as observations of high-water marks and aquatic habitat. Cross-section metrics are provided in **Table 9**, while habitat hydrology observations are included in **Table 10**.

Overall, Lacey Creek appears to offer and sustain aquatic habitat, as indicated by an abundance of fish. However, the fluvial system appears to be in a state of response to historical and, in some cases, ongoing disturbances in the watershed as evidenced by excessive sediment deposition, streambank erosion, and channel incision. **Figure 20** illustrates one widely accepted view on the evolution of incised channels (Schumm, 1999). After initial incision, widening ensues leading to aggradation and eventually a new equilibrated state. In general, we observe Lacey Creek exhibiting the first four of these states, from the initiation of incision to widening, with few reaches exhibiting equilibrated, or meta-stable conditions. Identifying the stage of incision is critical to understanding when and how to intervene if restoration is sought. For instance, bank stabilization or protection applied to an incising channel in the initial stages of incision would likely result in their failure due to the processes operating on the channel bed.

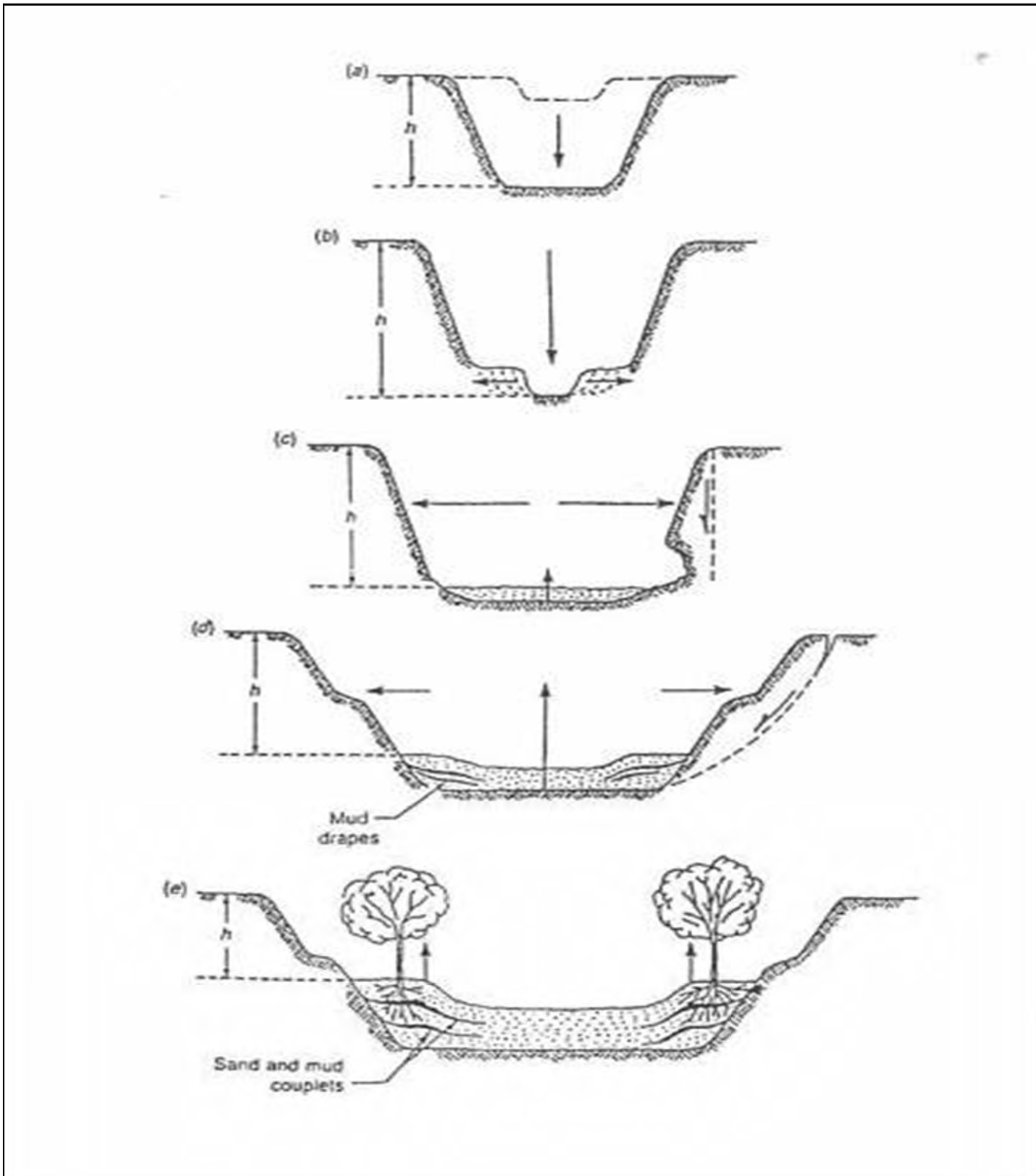

Figure 20. **Evolution model of channel incision (adapted from Schumm, 1999).** Initial incision (a. b) progresses to widening (c,d), to aggradation (d,e), and eventual stabilty (e). The dashed cross-section (a) represents the pre-incision channel.

3.2.4.1 WEBBER LAKE

The addition of the dam and later fish screens at the outlet of Webber Lake likely flooded the lowest portions of the meadow, increasing lacustrine areas and inundating channels and the meadow surface. As a result, naturally formed deltas and emergent marshes at the edge of the lake may have been converted, while natural levees along the Lacey Creek channel may have served to limit the formation of distributary channels at the margin of the lake.

A search of California's Electronic Water Rights Information Management System (eWRIMS, 2013) does not indicate an active water right for Webber Lake or Lacey Creek. In the past, Webber Lake water-surface elevations have been controlled by operations at the dam, with water levels fluctuating by as much as 3 to 4 feet (LaRivers, 1994). Currently, water surface levels may fluctuate in response to the management of removable fish screens—used seasonally to minimize fish migration over the dam. The change in water surface elevations, although small by some reservoir standards, propagates upstream in Lacey Creek and has significant effects on hydrologic and geomorphic processes in the Lower Lacey Meadow (as described under Reach A). The annual effects of changing base-level can directly affect channel morphology and aquatic habitat. For instance, when Webber Lake is at its maximum water- surface level, the lake propagates upstream more than 0.4 miles from its lowest level[3]. Under the historical and current management practices, the timing of the maximum water-surface levels coincides with peak streamflow and sediment loading. The higher base-level promotes sediment deposition well upstream of the late-summer mouth of Lacey Creek. Subsequently, when Webber Lake is lowered in the late summer or fall, lake level falls, transferring the location of sediment deposition. At this time, there is typically insufficient streamflow to transport the sediment that was deposited during higher flows of the spring, and the peak flow sediment deposits appear to become a barrier for fish.

[3] As measured from the channel outlet at the northern end of the natural levees.

A fluctuating base-level also influences the groundwater table controlled by the lake level within the lower portions of the meadow. The cyclical wetting and drying of the finer soils triggers bank collapse, sloughing and knickpoint erosion. All knickpoints were observed in smaller tributaries to Webber Lake including the West Tributary. When incision occurs in valleys comprised of fine sediment, water is confined to the incised channel and erosion can propagate upstream for some distance (Schumm, 1993), and may explain why Lacey Creek is incised in the lower meadow.

West Tributary: A small and ephemeral tributary drains the western slopes above Lower Lacey Meadow and discharges to a separate inlet of Webber Lake. Both Meadow Lake Road and Webber Lake Road cross the West Tributary. At this crossing, Webber Lake Road appears to intercept streamflow, diverting a portion of the flows away from the meadow. In response, the meadow on the downstream side of the road appears to be drying, with newly-recruited conifers appearing to take the place of herbaceous communities over the past decade.

3.2.4.2 LOWER LACEY CREEK CHANNEL CONDITIONS

Based on classifications discussed in previous sections, Lower Lacey Creek (Reaches A—D, including SE and SW Tributaries) is characterized by a lower gradient reach that has dominantly formed in glacial outwash, till, and more recent alluvium. These characteristics, combined with historical disturbance, support a meandering single-channel planform and pool-riffle morphology. Lower Lacey Creek is joined by the SW tributary, near the head of the meadow and the SE tributary mid-way across Lower Lacey Meadow (see **Figure 15**).

Reach A: Reach A includes portions of the channel affected by inundation or fluctuating water levels from dam operations at Webber Lake outlet. Reach A is characterized by a wide, shallow channel set within natural sand bars with some gravel, mobile bed material, and abundant riparian vegetation.

Reach B extends upstream from areas influenced by Webber Lake dam operations, across a significant portion of Lower Lacey Meadow to a confluence with an ephemeral tributary. Reach B is characterized by a single meandering channel, sandy-gravel substrate with an approximate channel slope of 0.4 percent and supports pool-riffle morphology and intermittent willow riparian. In sections, Reach B continues to exhibit active meanders and channel migration as evidenced by bank erosion and point bar formation, while other sections appear to be at initial stages of channel incision. In August 2012, pools were connected by shallow flows across riffles, measured less than 3 feet deep and ranged between 150 to 900 square feet in area, providing habitat for numerous fish.

Absence of high-water marks (i.e., wood, sediment and debris) on the meadow surface along Reach B suggests that peak flows in 2012 (greater than a 2-year recurrence) were confined to the active channel. Incision in this area appears to be affecting shallow groundwater conditions, and historical aerial photography indicates a transition from wet meadow herbaceous vegetation to dry, upland vegetation (e.g., upland grasses such as squirrel tail and lodgepole pine).

An 1889 topographic map shows two distinct channels flowing along the length of the valley, each discharging to Webber Lake in two distinct locations. While the accuracy of the map may not be reliable, given the scale and surveying technology, the indication of two distinct channels at that time, compared with only one primary channel today, suggests that Reach B may have avulsed (naturally) or been realigned to flow into the Reach A, or SE Tributary channel. This realignment would have resulted in significantly higher flows concentrated in a relatively small channel, and may also help explain the degraded and incised conditions observed in Reach B in the vicinity of cross-section-1 (XS-1, **Table 9**).

SE Tributary drains almost 2 square miles of a significant portion of the eastern watershed and discharges to Lacey Creek in Reach B. The SE Tributary drains a watershed of older metavolcanics and pyroclastic volcanics. The tributary forms a single-threaded, meandering, pool-riffle channel across the Lower Meadow with a gravel and sand substrate---fining in the downstream direction. Observed conditions throughout the meadow reach suggest the channel is relatively stable with minor areas of bank instability and channel incision, perhaps as indication of fewer disturbances in this portion of the greater watershed. This reach is used as a 'reference reach' for future restoration objectives.

Reach C is in the southwest corner of the Lower Meadow and appears to be a transitional reach. It receives additional streamflow and sediment supplies from the SW tributary and other intermittent and ephemeral tributaries. Reach C is characterized by a single meandering channel, gravel substrate with contributions of coarser material, a channel slope of 0.7 percent, slightly steeper than Reach B, and supports pool-riffle morphology but lacks extensive riparian vegetation along the channel banks.

Meanders are actively migrating as evident by large-scale bank erosion and actively propagating point bars with some active point bar cut-offs. Depths from the meadow surface down to the channel bed in this reach are in excess of 5 feet high with high-water marks from 2012 peak flow identified well-below the meadow surface, further suggesting incised conditions and/or continued channel adjustments under the current hydrologic regime. Based on limited topography, this reach appears slightly steeper than upstream and downstream areas, possibly a result of localized incision.

SW Tributary is an ephemeral tributary that originates in the western slopes of the watershed and receives overflow from the 'Southwest Pond', a tarn, or glacial cirque lake. Knickpoints or head cuts were observed propagating up the lower segment of the SW tributary and may be the result of increased hydrologic connectivity with runoff originating from portions of Meadow Lake Road.

Reach D is the upper most reach of the Lower Lacey Meadow and is characterized as a single-meandering channel with a similar channel slope to Reach B (0.4 percent). This reach receives discharge from the steeper bedrock controlled and confined valley immediately upstream (Reach E)[4] and therefore exhibits a coarser substrate and supports a robust willow riparian corridor. The absence of an alluvial fan or excessive sedimentation at this transition (the confined valley above to the meadow) may support the hypothesis that excessive sediment, observed in the Upper Lacey Meadow, is regulated by the bedrock control between the upper and Lower Meadow, and does not presently move in significant quantities into the lower meadow.

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[4] Field reconnaissance did not include, Reach E. Findings are based on historical aerial photographs and maps.

3.2.4.3 UPPER LACEY CREEK CHANNEL CONDITIONS

Upper Lacey Creek and tributaries supporting Upper Lacey Meadow exhibit characteristics of excessive sediment supply from both natural and anthropogenic sources. Natural sources are considered to include hillslope erosion, landslides, debris flows and streambed and bank contributions. Anthropogenic sources include streambed and bank erosion associated with road capture, increased runoff from roads, grazing impacts, and channel modifications or diversions. As discussed above, the Upper Meadow is slightly steeper than the Lower Meadow. The Upper Meadow is also smaller and more confined than the Lower Meadow, and is therefore likely more influenced by upland processes. Reach conditions in Upper Lacey Meadow are shown in **Figure 16** and described from downstream (Reach E) to upstream (Reaches J and K)

Reach F is at the downstream end of the Upper Meadow, and is characterized by a single straight channel with pool-riffle morphology and coarse (gravel-cobble) active sediment bars, aligned along the west side of the valley at the base of adjacent upland glacial deposits. The straightness of the channel may be controlled by shallow bedrock, tectonic tilting associated with the inferred fault zone that helped to create the valley or anthropogenic modifications. The channel slope is less than 0.5 percent, and is likely greatly

influenced by valley narrowing, downstream bedrock control, and resultant sediment depositional areas. Shallow bedrock and channel slopes also appear to induce shallow groundwater conditions at this, the lower end of the Upper Meadow. Seeps and springs were observed along this reach and appear to be a source for baseflow, offering support for wet meadow conditions adjacent to the channel.

Reach G consists of two sub-reaches: Reaches a and b. **Reach G(a)** is the current channel and became the dominant channel between 1955 and 1966, while **Reach G(b)** is the historical channel which continues to support streamflow from springs and overflow events. Figure 16 shows the location and alignment of these reaches, and **Figure 21** shows the changes which occurred here. Historical aerial photographs indicated that Lacey Creek meandered across the Upper Meadow as a single meandering channel in the location of Reach G(b). Sometime before 1966, the channel changed course at the head of the meadow, cutting through well-developed soils and forming a straight channel along the forest-meadow transition before rejoining the meadow approximately 2,500 feet downstream. Today, the area in the vicinity of the former channel (Reach G(b)) is relatively dry and exhibits characteristics of a dry meadow.

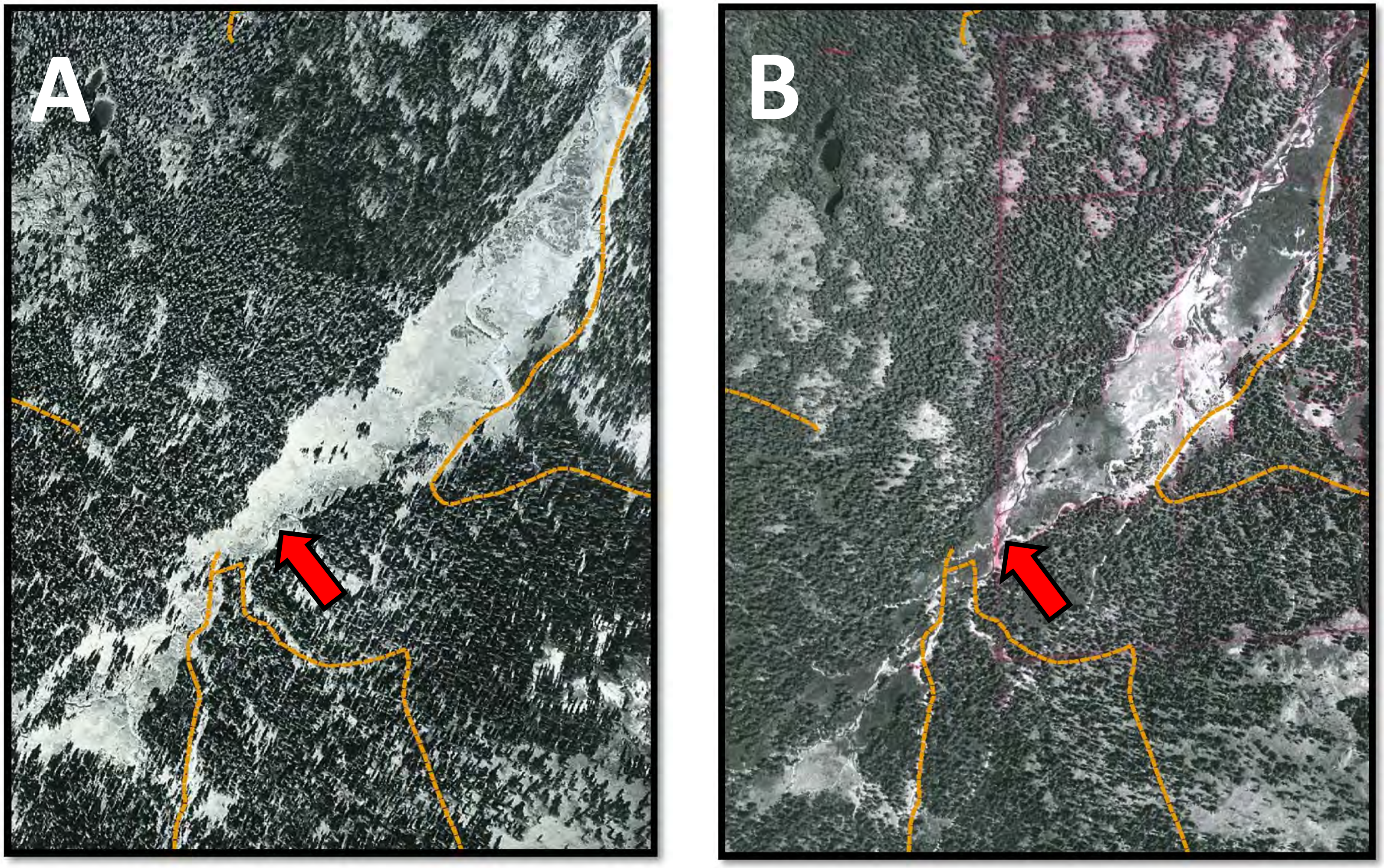

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Figure 21. **Comparison of channel changes, Reach G, A: 1955 and B: 1966, Upper Lacey Creek.** Lacey Creek follows a sinuous path through the Upper Lacey Meadow in 1955. Sometime before 1966, Lacey Creek largely abandons its historic channel (red arrow) and follows a linear path along the western edge of the meadow. Cause of channel change is uncertain but may be associated with a temporary dam.

Three notable floods occurred within the region over this period of time (1955, 1963 and 1964); the 1964 flood was the second largest flood on record. While it may not have been the intention to completely realign the main channel in the Upper Meadow, slight modifications for grazing management or road capture may have altered conditions just enough so that one or several of these large events resulted in wholesale channel modification.

Most of Reach G (a), the active channel, is very straight and passes through upland areas at the base of the moraine on the west side of the valley, while the portion of the channel which crosses the valley is actively widening. An approximate channel slope for this reach approaches 1 percent with plane-bed and pool-riffle morphology and a coarse gravel substrate with many small boulders and cobbles mined from side moraines. The straight alignment of Reach G(a) may be controlled naturally by bedrock, structure (i.e., active fault trace) or simply the presence of an historical remnant channel. Reach G(b) was abandoned, but exhibits channel morphology typical for its position in the watershed and in a montane meadow, so we have identified it as a 'reference reach' for the Upper Lacey Meadow, discussed later in this section.

An historical map (1940) shows at least two roads terminating at a point on Lacey Creek where the channel abruptly adjusted course, and field evidence suggests that significant anthropogenic modifications were made in at this location. Closer inspection of the channel at this location revealed buried boulders in the channel, aligned perpendicular to flow direction. Immediately upstream, cobbles were piled along the channel margins, significantly higher than the active floodplain and adjacent bars, suggesting active modification of the channel, possibly in order to maintain roads or sheep grazing encampments at this point.

There are many examples of forced diversions or dams constructed in other montane meadows to support ranching and grazing objectives. Historically, ranchers relocated or altered entire stretches of channel to dry out meadows, making them more suitable for sheep grazing. In fact, we observed several gravel push-up dams in the abandoned channel, likely attempts at channel modifications or efforts to dewater the meadow. Our anecdotal observations in many Sierra Nevada meadows indicate that this practice was possibly more common in areas grazed by sheep. Sheep are susceptible to hoof rot, a bacterial infection affecting sheep grazed in moist or wet areas, such as montane meadows. Additionally, relocating a stream to the meadow fringe may improve access and more than double the pasture available for grazing and was a typical practice in the Klamath Basin of northern California and Southern Oregon.

Reach H is a transition reach between an alluvial fan and lower gradient meadow and receives additional streamflow and sediment supply from ephemeral tributaries. Reach H is characterized by a relatively wide braided or multi-channel system with a channel slope exceeding 1.5 percent. Extensive sediment deposition in this area appears to contribute to active channel migration and wood recruitment. Large (3-foot diameter) wood was observed buried by coarse (gravel-cobble) sediment, suggesting abundant sediment and wood supply to this reach. Recent and excessive sediment was also observed deposited on meadow surfaces.

Reach I: Similarly to Reach G, Reach I was also bifurcated by an historical event and is divided into Reach I(a) and Reach I(b) (**Figure 22**). Both reaches occupy an alluvial fan surface with slopes near or exceeding 3 percent with expression of pool-riffle and step-pool morphology. Multiple active and abandoned channels exist across the fan surface. Channel substrate is coarse gravels and cobble with small boulders, coarsening in the upstream direction.

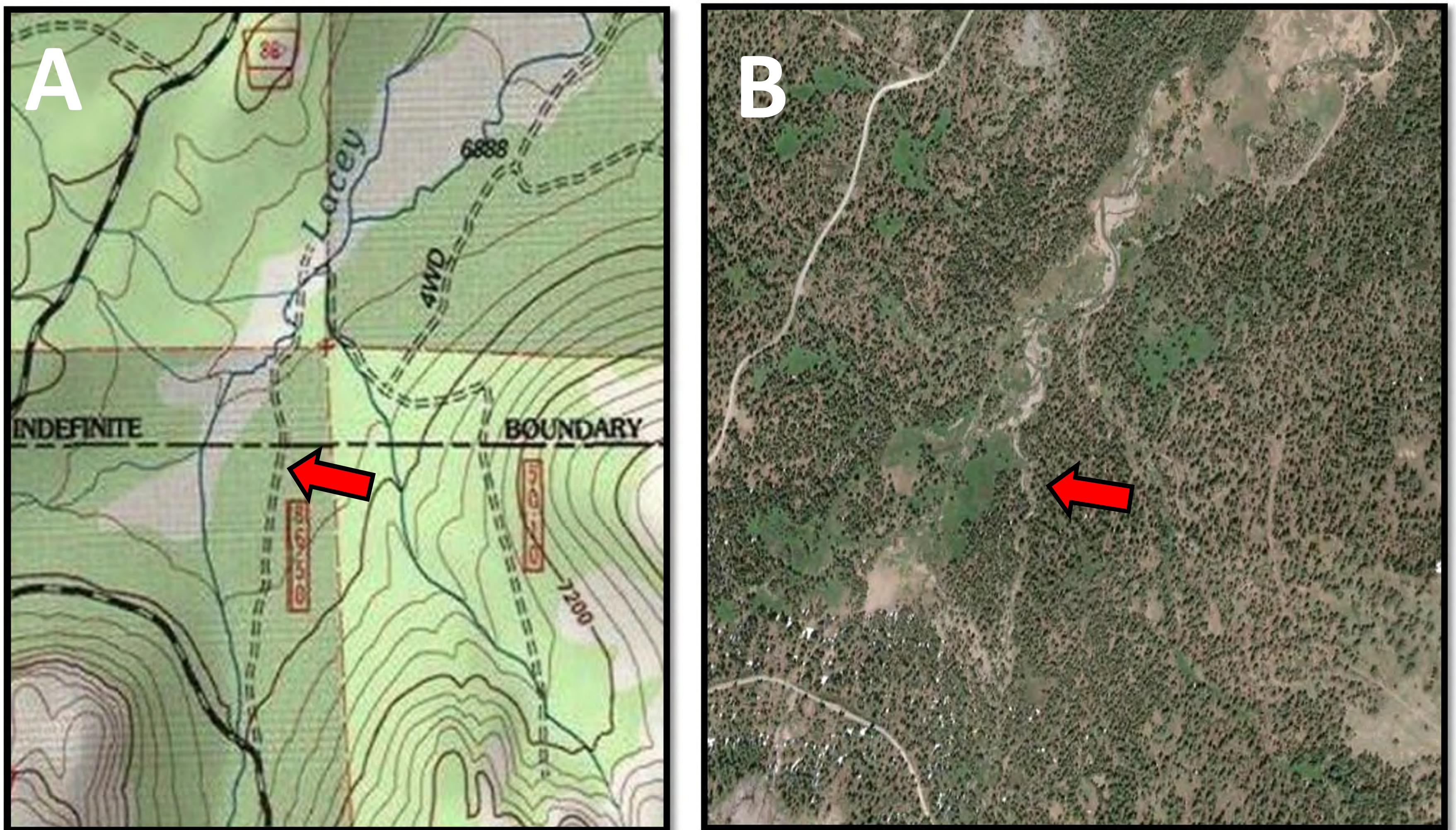

Figure 22. **Comparison of channel changes, Reach I, A: 1940 historical map and B: 2010 aerial photograph, Upper Lacey Creek.** Historically, Lacey Creek followed a path along the east side of the alluvial fan; road construction down the fan surface captured streamflow sometime after 1940 and redirected most of the flow today (red arrow).

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A review of a 1940 historical (USGS) topographic map and field observations suggest that a road captured the natural channel (Reach I(a)) and generated a new channel along the length of the road (Reach I(b)). Today, Reach Ib is maintained as the active channel while Reach I(a) conveys streamflow from springs and discharge slope meadows along the alluvial fan and forested uplands. Reach I(b) exhibits active widening and downcutting and provides a source of excess sediment to the Upper Meadow, largely bypassing the Reach I(a) in many locations. As a result, Reach I(a) is largely intact, having not experienced the same magnitude of runoff as Reach I(b), which receives significant flows from old road alignments.

Reach J is a tributary to Lacey Creek with two branches draining a relatively large portion of the southwestern corner of the watershed. Reaches J(a) and J(b) drain steep forested uplands and form a confluence on an alluvial fan (Reach J(c)). In general, Reach J is characterized by a single step-pool channel above Meadow Lake Road and below the road. As Reach J(b) flows off the steeper slopes, it transitions into a broad swale where it flows over coarse glacial deposits upstream of the meadow. Once encountering the finer meadow soils, the channel becomes deeply incised as it crosses the steeper upper portions of the meadow. These fine-grained soils are mapped as aquolls and borolls in published soils maps (Hanes, 2002), but incision appears to have lowered the water table significantly, such that these portions of the upper meadow now support conifer forests and young pines growing on desiccated meadow soils, especially in proximity to the incised channel. Legacy logging and runoff collected from Meadow Lake Road and directed to the channel may be reasons for channel degradation downstream. Reach J(a) exhibited streamflow well into the late summer while the mainstem of Lacey Creek (Reaches K and I) was dry, and appears to be a primary source of perennial water to the meadow.

Reach K: Lacey Creek originates from a shallow meadow along a saddle on the watershed boundary and quickly drops through a steep, bedrock-controlled cascade and step-pool reach. Channel slope ranges between 5 and 7 percent with colluvium and large wood providing structure. Reach K appears to be actively mining the toe of unconsolidated colluvium and dry ravel, from unstable volcanic cliffs— a presumably natural process that appears to be exacerbated by Meadow Lake Road and its embankment, which reduce the natural channel width in portions of this reach. Furthermore, an in-board ditch collects runoff from steep, ephemeral tributaries and the road surface and conveys flows to the channel via multiple culverts. Active rilling on the road surface and in-board ditch erosion and proximity to Lacey Creek suggests that runoff and sediment are readily generated and delivered directly to the channel. Reach K and adjacent tributaries in this portion of the watershed appear to be a significant source of sediment to the Upper Meadow.

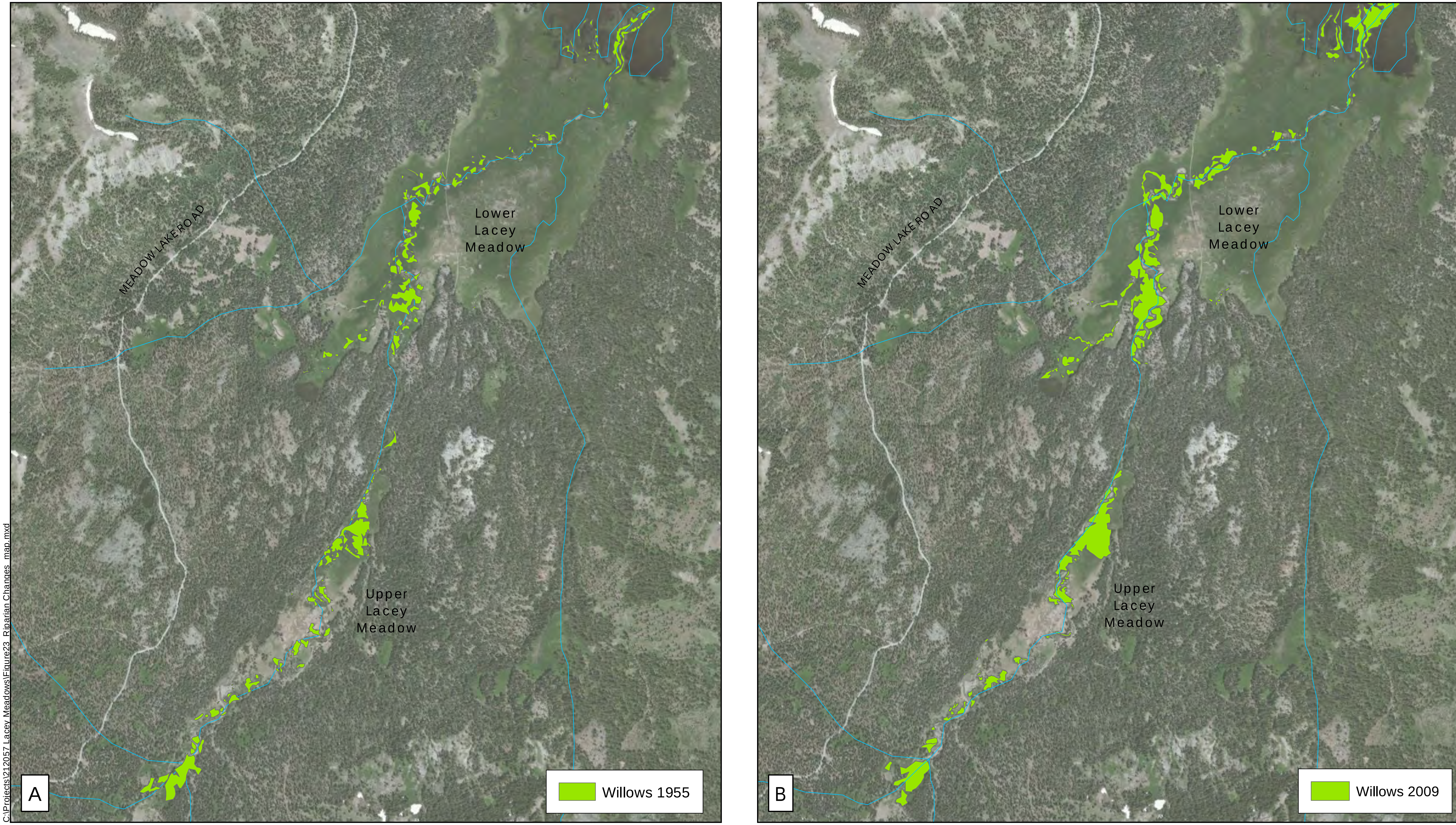
In summary, Lacey Creek has experienced several episodes of degradation in a number of reaches, with sediment delivery, bank instability, and channel incision continuing in those locations today.

3.2.5 CHANGES IN RIPARIAN CORRIDOR ACREAGE

The proportion of willow habitat to meadow size and changes in willow abundance was evaluated from stream walks, comparison of historical aerial photograph for the Lower and Upper Meadow. The 1955 and 2009 aerial photographs provided the best quality images for comparison. Willow cover was delineated in GIS (**Figure 23**), and total area was computed for both years and compared (**see Table 12**).

Willow cover is sparse or absent in many locations, particularly along Reaches G, C, and the SE tributary reach and there was little to no sign of active willow recruitment throughout the areas absent of willow. There are many potential causes for this observed lack of willow recruitment. As discussed previously in Chapter 2, willow germination is most likely to occur under a specific sequence of events that follow inundation of floodplain surfaces (e.g., point bars) and result in areas of moist, bare mineral soil being exposed during the seed release period for willows (Mahoney and Rood, 1998). Therefore, a reasonable explanation for the observed lack of willow recruitment is that changes in watershed conditions have reduced the frequency with which hydrologic conditions conducive to willow germination and persistence occur within Lower Lacey Meadow. It is possible that sheep grazing may also be limiting willow recruitment, either through trampling willow seedlings when watering out of Lacey Creek or through browsing of willow seedlings—as observed during our reconnaissance.

Historical analysis suggests that willow cover is more abundant today (49 acres) than in 1955 (35 acres). However, the



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Balance Hydrologics, Inc.
H. T. HARVEY & ASSOCIATES ECOLOGICAL CONSULTANTS

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Feet

Figure 23. Riparian changes: (A) willow coverage 1955 (B) willow coverage 2009
Lacey Meadows Study Area, Sierra and Nevada Counties, California

Table 12. Changes in meadow size and extent of willow riparian Lacey Meadows, Sierra and Nevada Counties, California

	1955	*2009*	*Change*
	(ac)	*(ac)*	*(ac)*
Lower Meadow area	396	385	*-11*
Upper Meadow area	99	72	*-27*
Total meadow area	495	457	*-38*
Willow Riparian Area (Upper and Lower Meadows)	35	49	14
Willow riparian as percent of meadow area	7.1	10.7	--

Notes:
1. Historical aerial photographs (geo-rectified) were used to compare meadow areas and riparian cover.
2. Areas were calculated using GIS (ArcMap 9.4)

portion of willow habitat is small regardless of the year: willow occupied roughly 7 percent of the Lacey Meadows (Upper and Lower) in 1955 as compared to roughly 11 percent in 2009. The increase in willow acreage between these two years may suggest impacts prior to 1955 or improving conditions after 1955; regardless, the percentage of willow riparian in Lacey Meadows is much lower than other Sierra meadows that exhibit large and robust populations of willow flycatcher, as suggested by current literature. There may be several reasons for this. Willow depend on a high soil moisture regime and a specific sequence of flow-related events for germination and recruitment. Reduced soil moisture may be related to absence of overbank flows in recent years.

It is probable that the observed increase in willow between 1955 and 2009 is related to changes in grazing practices, which have resulted in less livestock use within Lacey Meadows, perhaps allowing for willow growth in localized areas that support willow recruitment and growth. Alternatively, large floods prior to 1955 may have scoured willow communities from the channel edge. The observed increase in riparian scrub habitat during this period represents a net improvement in the ecological functions potentially provided by Lacey Meadows, but it should not mask the equally important observations that, overall, riparian scrub habitat is limited within Lacey Meadows and that recruitment and growth of new shrubs is almost non-existent.

3.2.6 WILDLIFE AND AQUATIC HABITAT RELATIONSHIPS

As described above, some reaches of Lacey Creek are functioning relatively well with stable banks, some degree of floodplain connectivity, extensive vegetation cover and riparian scrub vegetation, and undercut banks and other in-stream habitat features that support fish habitat and macroinvertebrate production. Other reaches show evidence of channel degradation, a lack of floodplain connectivity, limited fish habitat, denuded stream banks, and heavily browsed, or a complete lack of, riparian scrub vegetation. The following sections provide brief assessments of the wildlife and aquatic habitat conditions provided by each reach.

3.2.6.1 WILDLIFE AND AQUATIC HABITAT VALUES

Montane riparian and wetland scrub plant communities provide habitat for many species of migratory songbirds, most importantly species that only nest in riparian scrub habitats such as willow flycatchers and yellow warblers. These plant communities, which are primarily composed of willows within Lacey Meadows, provide abundant refugia and breeding substrate for bird prey (i.e., invertebrates), and they provide nesting, foraging, and thermal cover for the birds themselves. Shrub density and abundance are critical components of habitat quality for many species of birds found in high-elevation Sierra Nevada meadows (Serena, 1982;, Harris and others, 1987 1988; Fowler and others, 1991; Green and others, 2003). For example, Bombay and others (2003) found larger and more robust populations of willow flycatchers in large meadows with a significantly high percentage (60 percent) of shrub [willow] relative to open, grassy meadow areas, and greater nesting success in territories with more willow cover. Willow cover is at its densest, tallest and most contiguous in Lower Lacey Meadow near the lake margin, where it forms almost impenetrable thickets (Reach A). During much of the willow flycatcher study at Lacey Meadows (1998 – 2008) territories and nests were most densely clustered at the northern end of Reach A (Appendix E), where high-quality willow flycatcher habitat and habitat for other migratory songbirds is found.

Upstream of Reach A and through Reach B to the Meadow Lake Road crossing, riparian scrub habitat is confined to a narrow band along the active stream channel and the closest abandoned oxbows. Therefore, nesting habitat for birds is also closely restricted to the stream and oxbow system. Bird habitat quality for within this reach of Lacey Creek generally declines with increasing distance from Webber Lake since the extent of standing water and willow cover within and along the creek also declines with distance from the lake. For example, willow flycatcher territory density is lower along this reach of Lacey Creek, relative to Reach A, but a number of locations are still consistently occupied from year-to-year (Mathewson and others, 2011). As discussed above, willow germination and recruitment is reduced in this area due to livestock, incision and bank instability along Lacey Creek, or some combination of these two factors. Without recruitment of new riparian scrub habitat, bird habitat quality within this reach of Lacey Creek may not be sustainable.

Southwest and upstream of the road crossing, riparian scrub habitat along Reach B becomes more extensive but is drier relative to riparian scrub habitats further downstream. Shrub foliar cover and shrub height also decrease along this reach of Lacey Creek, and the herbaceous understory changes from a sedge-dominated community to grass and forb-dominated community with more open ground. These areas of drier riparian scrub provide less cover for ground nesting birds. Willow flycatchers are typically not found in these drier areas, but yellow warblers are still relatively abundant (Cain and Loffland, unpublished data). These drier willow areas also see an increase in ground squirrels, chipmunks, and edge species such as Douglas squirrels and deer mice, all of which may be potential nest predators for migratory songbirds.

Taller and denser riparian scrub habitat is found at the southwestern edge of Lower Lacey Meadow along Reach C and near the pond. Similarly, areas of discharge slope meadow along Reaches F and J within Upper Lacey Meadow support dense riparian scrub habitat. These areas provide potentially suitable habitat for many species of migratory songbirds, including yellow warblers. Willow flycatchers are occasionally detected in Reach C and near the pond within Lower Lacey Meadow, but the species has not been detected in Upper Lacey Meadow despite the presence of suitable habitat along Reaches F and J. However, Upper Lacey Meadow has not been extensively surveyed for willow flycatchers so intermittent, but undocumented use, by willow flycatchers is possible.

The lack of willow flycatchers within Upper Lacey Meadow may also be at least partially attributed to livestock grazing. Willow flycatchers, and many other species of migratory songbirds, are known to be adversely affected by livestock through direct browsing of riparian scrub vegetation, which can result in hedging (i.e., a lack of shrub growth), foliage removal (which reduces prey production and cover), and a lack of vegetation recruitment (which reduces long-term habitat suitability and habitat suitability for species that prefer early-succession vegetation) (Littlefield, 1989; Sanders and Flett, 1989; Cicero, 1997; Mathewson and others, in press, Green and others, 2003). Similarly, increased brown-headed cowbird (*Molothrus ater*) populations, a songbird brood parasite, are associated with livestock; the presence of cowbirds often leads to reduced nest success for many songbirds, including willow flycatchers and yellow warblers (Purcell and Verner, 1999, Goguen and Mathews, 2001).

In areas where riparian scrub vegetation occurs close to the forest edge, such as along Reaches C, F, and J, this habitat may support a variety of riparian/forest edge species such as northern goshawks, long-eared owls, and great gray owls, in addition to species of migratory songbirds. Additionally, these reaches of Lacey Creek provide high-quality foraging habitat for many mammal species such as American martens, wolverines, Sierra Nevada snowshoe hares, Pacific fishers, Sierra mountain beavers, and Sierra Nevada red foxes, species that prefer linear riparian and meadow habitats with access to adjacent forested cover (as opposed to the vast open areas that characterize the main part of Lower Lacey Meadow, for example).

In addition to riparian scrub vegetation, most reaches of Lacey Creek contain gravel bars. Killdeer and especially spotted sandpipers are abundant in these habitats, which they use for foraging and nesting. Other shore birds such as western sandpiper, American avocet, and greater yellowlegs are occasionally observed on the mudflats along Reach A. Mudflats are not commonly found in many Sierra Nevada meadow and riparian ecosystems; therefore, Lacey Meadows tends to support a much greater diversity of shorebirds and waterfowl relative to many other Sierran meadows.

As previously described, aspens are largely absent from Lacey Meadows and surrounding uplands. Aspens provide high quality habitat for many bird and mammal species (see Shepperd and others, 2006 and references cited therein); thus, increasing aspen cover within riparian scrub habitats along Lacey Creek, particularly within areas of having a pronounced groundwater influence such as Reaches F, J, and I(b) and discharge slope meadows, would greatly enhance the overall wildlife habitat values of the Lacey Meadows Watershed. Aside from increasing aspen cover, an increase in riparian cover would also enhance the wildlife habitat values of riparian scrub communities along Lacey Creek within Lacey Meadows. Considering its size, willow cover is limited within Lacey Meadows, particularly when compared to adjacent meadow ecosystems of a similar size. Increased willow cover along streams and oxbows in Reach B and the SE tributary to Reach B, especially when associated with slow-moving and standing water, would substantially increase habitat for willow flycatcher, yellow warbler, and other species of migratory songbirds (Bombay and others, 2003, Mathewson and others, in press).

3.2.6.2 AQUATIC HABITAT VALUES

Based on observations in summer 2012, the habitat in Lacey Creek appears to satisfy conditions needed to support fish populations. Although many stream banks were actively eroding and deeply incised, some undercut bank features were identified in Lower Lacey Meadow. Undercut banks provide cover for fish and invertebrates and are often an important habitat feature in meadow streams especially where other cover or canopy features are lacking (Myers and Resh, 2000). Riparian scrub vegetation does not appear to be a major cover component in some reaches of Lacey Creek. In reaches where riparian scrub vegetation is present , such as Reaches A, D, F, H, I and sections of Reach B, fish habitat is likely enhanced due to better regulation of water temperatures, increased in-stream habitat complexity, and greater bank stability.

Substrate conditions appeared to be good for spawning and macroinvertebrate production outside of reaches heavily impacted by livestock within Upper Lacey Creek (e.g., Reach G). In some sections of Lacey Creek floodplain connectivity is reduced between the creek and meadow during annual high flow events. When creeks and meadows become hydrologically disconnected from their floodplains, the loss of meadow vegetation due to the lowered water table may result in greater erosion and increased transport of substrates. The result is increased channel incision and progressively greater hydrologic disconnection (see Figure 20) (Schumm, 1999, Purdy and Moyle, 2009). In a disconnected system, during high flows fish are unable to use flooded meadow vegetation as refuge from high velocity currents.

Scouring and incision may also remove macroinvertebrate prey species and transport large volumes of sediment downstream, diminishing water quality. During low flows, in a system with good hydrologic connectivity, riparian vegetation can moderate stream temperatures and provide cover for fish. Nonetheless, even in an apparently disconnected system such as Lacey Creek, the mere presence of fish is considered an indicator of stream condition (Purdy, 2005). Fish, such as the abundant brook trout (a non-native species) observed in Upper Lacey Creek during field surveys, require clean, cold, well oxygenated water and an abundant food supply to thrive (Purdy and Moyle, 2006). During August 2012, stream temperature measurements ranged between 4.8 degrees C. and 20 degrees C with the higher temperatures recorded in the more disturbed reaches (Reach G(a)) of Upper Lacey Meadow. Other non-native and native fish species were observed throughout Lower Lacey Creek during field visits earlier in the summer when flowing water was still present in most of Lower Lacey Creek. Thus, despite obvious signs of degraded fish habitat quality in some reaches, much of Lacey Creek appears to support robust fish populations primarily comprised of non-native, introduced sport fish species.

In contrast, the presence of non-native fish throughout Lacey Creek lowers habitat suitability for most species of amphibians. For example, the decline of mountain yellow-legged frogs in the Sierra Nevada has been correlated with the introduction of predatory, non-native fish (like brook trout and rainbow trout) to formerly fishless portions of the frog's range (Davidson and Knapp, 2007), and removal of introduced, predatory fish has been found to result in increased populations of yellow-legged frogs (Knapp and others, 2007). During reconnaissance surveys of Lacey Creek, several areas of isolated, ponded water were observed within Lacey Creek. Some of these areas appeared to not contain fish. To the extent that these fishless areas of isolated ponding are more or less consistently found from year-to-year, they could provide a reliable source of suitable amphibian breeding habitat; however, due to low snow and rainfall amounts in 2012, it is unknown whether these areas of isolated ponding would be observed in years with average or above average precipitation. In the event that these areas are more frequently connected to other parts of Lacey Creek and accessible to fish throughout the summer, their suitability for amphibian breeding would be greatly reduced. Similarly, the pond at the southwest corner of Lower Lacey Meadows could provide suitable amphibian breeding habitat. It is not known if fish occur in this pond; however, given the fish stocking history of Webber Lake and Lacey Creek, it is assumed that non-native fish exist in the pond and that the suitability of the pond for amphibian breeding is relatively low, similar to Lacey Creek.

3.3 MEADOW ASSESSMENT

Meadows were assessed along with stream and riparian corridors on August 22-23, 2012. Plant community boundaries were initially mapped in ArcGIS 10.1 at a scale of 1:6,000 (1 inch equals 500 feet) using a color aerial image obtained from the U. S. Department of Agriculture National Agricultural Imagery Program (NAIP) (USDA, 2011). NAIP images are true-color aerial images with a 1-m ground resolution that are flown and updated at roughly 2-year intervals. The 2010 NAIP image for Sierra County was used to prepare an initial plant community map. Plant community boundaries were delineated where readily apparent on the aerial image at the specified scale. The initial plant community map was refined in the field during reconnaissance surveys completed from 22 August to 23 August 2012, and a final plant community map was prepared in ArgGIS version 10.1 using information gathered during reconnaissance surveys.

Initial maps of meadow HGM types were prepared from 2010 NAIP imagery using the meadow typology developed by Weixelman and others (2011). These maps were refined during field reconnaissance surveys in August 2012 and calibrated by a selected number of soil samples to examine rooting depth and redoximorphic soil features (which can be used to infer meadow hydrology) as required to differentiate among meadow HGM types. Following fieldwork, false-color infrared imagery from 1992, as obtained from the Tahoe National Forest Sierraville Ranger District, was used to assist in the delineation of boundaries between mesic/wet and dry meadow types, particularly within Lower Lacey Meadow, as these boundaries were difficult to discern in the field with a reconnaissance-level survey effort. This information was used to prepare a final map of meadow HGM types for Lower and Upper Lacey Meadow in ArcGIS 10.1.

A single site, following the protocol described by Weixelman and others (2011) was established in Upper Lacey Meadow in the vicinity of the realigned Reach G and permanently marked in the field to facilitate re-assessment in future years (**Figure 24**). This site was chosen because it superficially appeared to exhibit the attributes of a low-functioning site and would, therefore, be likely to show an improvement in ecological condition in response to changes in grazing management, ecological restoration activities, or other restoration or management activities to Lacey Meadows and the surrounding watershed that may occur at some point in the future.

Four additional assessment sites were located in other parts of Lacey Meadows within locations generally representative (in terms of landscape position, soil moisture regime, and plant community composition) of the surrounding landscape (see **Figure 24**). Due to time constraints, an abbreviated version of the Weixelman methodology was employed at these points. The most common plants at each location and seral status ranking of each plant, based on the USFS Region 5 range plant list (USFWS 2012), were noted at each site, and a single soil sample was collected to examine rooting depth,

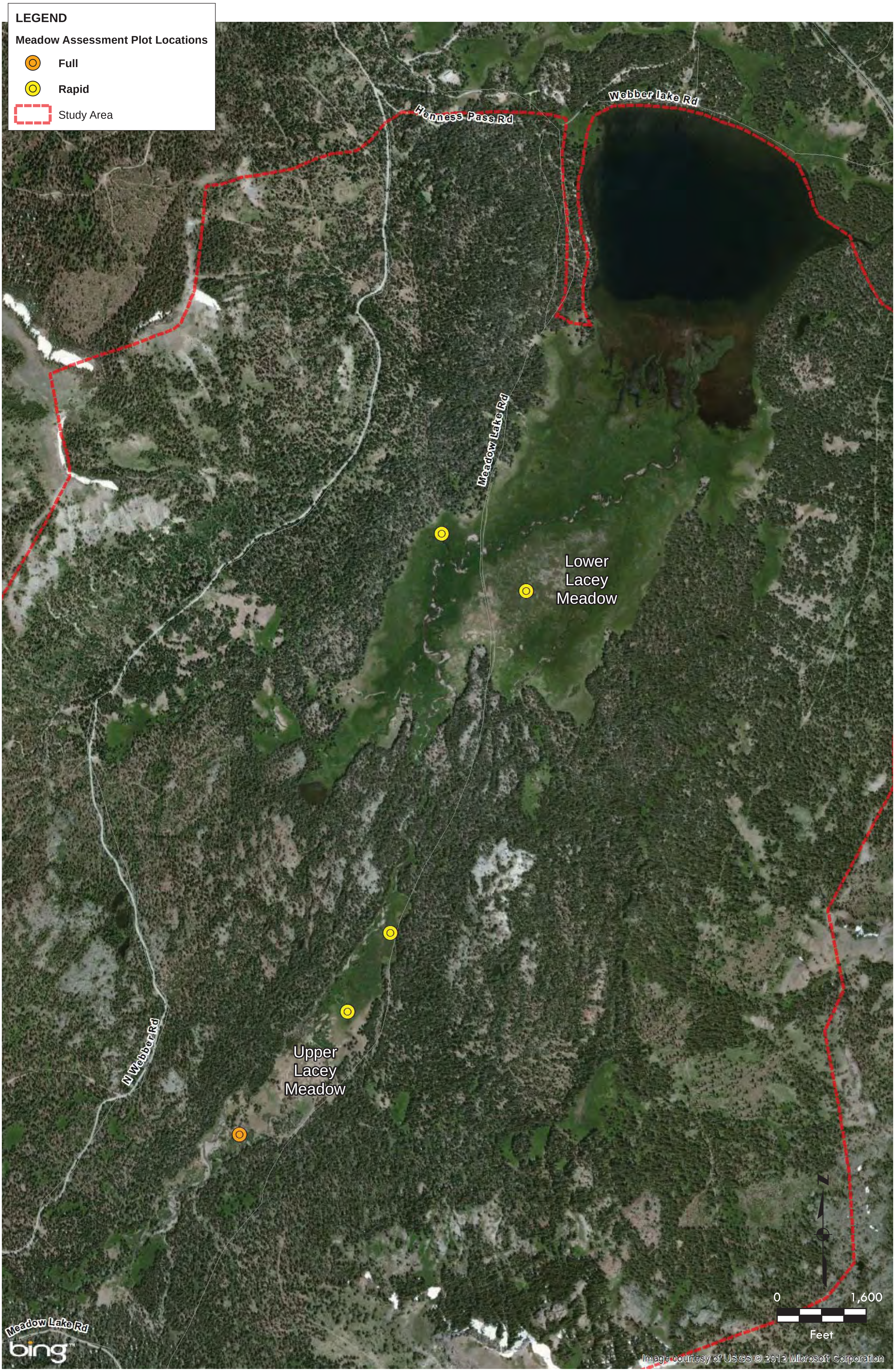

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Figure 24. Lacey Meadows – Meadow Assessment Plot Locations
Sierra and Nevada Counties, California

soil saturation, and the presence or absence and depth of soil mottles to aid in a determination of meadow hydrology. These data were used to derive an estimate of meadow condition at each assessment site.

3.3.1 CURRENT MEADOW CONDITION

Meadow condition assessments are summarized in **Table 13** and described in more *detail below for both Upper Lacey Meadows and Lower Lacey Meadows.*

3.3.1.1 UPPER LACEY MEADOW

Three assessment sites were located in Upper Lacey Meadow. One site, which followed the methodology described by Weixelman and others (2011) was located in the middle portion of Upper Lacey Meadow within a dry meadow that showed obvious signs of moderate to heavy sheep grazing. The chosen site was representative of the surrounding area, which generally corresponded to the length of Reach G of Lacey Creek (see Figure 24). Field data forms from this site are included as **Appendix F**. The five most commonly encountered plants and their seral status rankings (for dry meadows) at this site were: mat muhly (mid seral), an annual knotweed (*Polygonum sawatchense* ssp. *sawatchense*, early seral), Parish's yampah (mid seral), mountain Navarretia (*Navarretia divaricata*, early seral), and marsh cudweed (*Gnaphalium palustre*, early seral). Rooting depth averaged 4 inches and 49 percent of the assessment site was characterized by bare ground. Following the dry meadow scorecard for assessing meadow function (Weixelman and others, 2011), this portion of Upper Lacey Meadow was ranked as low ecological status based on its dominant plants, most of which were ranked as early seral, and the extensive amount of bare soil (low ecological status dry meadow sites are considered to have over 13 percent bare ground). Rooting depth was indicative of high ecological status sites (root depth greater than 3 inches), most likely due to the presence of mat muhly throughout the assessment site; however, the large amount of bare ground and preponderance of early seral status plants drove the overall site ecological status ranking down to low ecological status. It should be noted that many of the areas that exhibit bare ground or encroachment by conifers are mapped as aquolls and borolls—wetland type soils in Hanes (2002) and suggest that these areas are undergoing conversion to dry meadow. Representative photographs of this site are shown in **Appendix G**.

Two additional assessment sites were located in lower portions of Upper Lacey Meadow. One plot was located within the portion of the meadow generally

Table 13. Summary of Lacey Meadows Condition Rankings

Site Id	Scorecard Used	Species Composition	Root Depth	Bare Ground	Overall Ecological Status
LU-1	Dry Montane	Early Seral	High	Low	Low
LU-2	Mesic Montane	Mid Seral	High	Low	Moderate
LU-3	Wet Montane	Late Seral	High	High	High
LL-1	Mesic Montane	Mid Seral	Moderate	High	Moderate
LL-2	Dry Montane	Mid Seral	High	Moderate	Moderate

corresponding to the upper half of Reach F, and the second was located along the lower half of Reach F. A large willow cluster occurs along a tributary to Lacey Creek in this reach and separates an area of riparian middle gradient meadow into two distinct sites. The two sites were assessed separately due to obvious differences in livestock utilization and plant community composition. For the purpose of determining ecological status and selecting the appropriate ecological status scorecard (Weixelman and others, 2011), the upper site was ranked as a mesic meadow based on dominant plants, depth to soil mottles, and depth to soil saturation; the lower site was ranked as a wet meadow based on these same characteristics. It should be noted that both sites would likely be significantly wetter in years with average or above-average precipitation; thus, the hydrologic status and resultant scorecard selected to evaluate ecological status for each site were primarily determined by plant species composition and not the observed depth to soil saturation.

The upper site was dominated by the following plants: Kentucky bluegrass (mid seral), mat muhly (mid seral), primrose monkeyflower (*Mimulus primuloides*, mid seral), longstalk clover (*Trifolium longipes*, mid seral), and Parish's yampah (early seral). Rooting depth was indicative of high ecological status sites (root depth > 7 inches), and the percentage of bare ground was indicative of low ecological status sites (bare ground = approximately 40 percent). The site had been recently grazed by sheep with approximately 50 percent use of Kentucky bluegrass but much heavier use of other species, particularly forbs. Pedestalled plants, soil rills, and other signs of moderate to heavy grazing and resultant soil erosion were commonly observed throughout the site. The site was ranked as moderate to low ecological status based on dominance by mid seral plants, and the large percentage of bare ground observed throughout the site. As indicated above, rooting depth was indicative of high ecological status sites, but other factors reduced the overall ecological status ranking of this site. Representative photographs of this site are shown in Appendix G.

Dominant plants at the lower site include: Nebraska sedge (late seral), mat muhly (early seral) beaked sedge (late seral), tufted hairgrass (*Deschampsia cespitosa*, late seral), and California oatgrass (*Danthonia californica*, mid seral). Rooting depth was over 8 in, which is indicative of high ecological status, and bare ground was less than 4 percent, which also indicates high ecological status. Relatively shallow bedrock was present at approximately 26 in with saturated soil found above this bedrock, despite the relative lack of rainfall and snow throughout the year. Little to no sign of grazing was observed at this site. This site was ranked as high ecological status based on dominance by late seral plants, deep rooting depth, and a lack of bare ground. Representative photographs of this site are shown in Appendix G.

3.3.1.2 LOWER LACEY MEADOW

Two meadow condition assessment sites were located in Lower Lacey Meadow. Despite its larger size, relative to Upper Lacey Meadow, fewer plots were located in Lower Lacey Meadow since the majority of the meadow was relatively consistent in terms of plant community composition, livestock utilization, landscape position and hydrology, and similar factors that could potentially affect meadow condition rankings. For a reconnaissance level assessment, two assessment sites were adequate to characterize the full range of meadow conditions found in Lower Lacey Meadow.

One site was located along the upper half of Reach B within a location that was generally representative of the majority of the riparian low gradient meadow along this reach of Lacey Creek. A second site was located in between Reach B and the SE tributary to Reach B within an area of dry meadow. The sample site at this location was generally representative of the surrounding landscape; however, areas closer to the SE tributary were more similar to the first plot located further upstream along Reach B (i.e., these areas were wetter and dominated by plants seen at the first plot).

Finally, although no assessment sites were located in Lower Lacey Meadow in close proximity to Webber Lake, this area appeared similar in plant community composition and hydrology to the third assessment site in Upper Lacey Meadow (i.e., the area was very wet and primarily dominated by sedges with little to no bare ground). Based on the results of the assessment conducted at the similar site in Upper Lacey Meadow, this area appeared to have all the characteristics of a high ecological function meadow, and a focused assessment of this portion of Lower Lacey Meadow was deemed unnecessary. Likewise, areas at the upper end of Lower Lacey Meadow south and west of Reaches C and D were occasionally characterized by areas that appeared to be intermediate between a riparian low gradient meadow and dry meadow, based on plant community composition, hydrology, and landscape position. The ecological status of these areas were not assessed in any detail due to their small size relative to the larger Lower Lacey Meadow; however, it is acknowledged that neither meadow condition ranking observed at the two Lower Lacey Meadow assessment sites may be representative of conditions found in these locations.

The upper assessment site along Reach B of Lacey Creek was located in a moist meadow representative of the majority of Lower Lacey Meadow. It was dominated by the following plants: Kentucky bluegrass (mid seral), Nebraska sedge (late seral), mat muhly (mid seral), longstalked clover (mid seral). Rooting depth at roughly 6 to 8 inches was indicative of moderate ecological status sites, and the site was characterized by approximately 5 to 10 percent bare ground, which is indicative of moderate to high ecological status sites. There was little to no signs of grazing observed throughout the area, and saturated soils were observed at roughly 28 inches below the ground surface. Overall, these observations are consistent with a moist montane meadow that is at moderate to high ecological status. Representative photographs of this site are included in Appendix G.

It should be noted that small-scale topographic differences, likely correlated with historical Lacey Creek floodplain terraces, were observed throughout the entire area of low gradient riparian meadow that characterizes the majority of Lower Lacey Meadow. Plant communities throughout this area represented a continuum of species with respect to hydrologic regime ranging from sedges and rushes in the lowest and wettest areas (e.g., abandoned oxbows or scour pools) to a mix of sedges, rushes, perennial grasses, and broadleaf plants in mid-terrace locations, to mostly perennial grasses and broadleaf plants in the highest locations with frequent mixing of these species groups in transitional areas. In general, the mixes of species observed at different locations throughout this region of Lower Lacey Meadow are indicative of moderate to high ecological status meadow ecosystems, absent a more thorough investigation of soils and hydrology and considering the observations gathered at the single representative site that was investigated in greater detail.

The lower site in between Reach B and the SE tributary to Reach B was located in a dry meadow. Dominant plants observed at this site were: mat muhly (mid seral), needlegrass (*Achnatherum* sp., late seral), yarrow (early seral), slender wheatgrass (*Elymus trachycaulus*, late seral), and miniature lupine (*Lupinus bicolor*, early seral). Rooting depth was approximately 4 inches, characteristic of high ecological status for dry meadow sites, and the percentage of the site characterized by bare ground was approximately 10 percent, an indicator of moderate ecological status. A soil pit excavated to over 30 inches deep did not find any saturated soil layers; soil mottles (an indicator of soils that experience alternating saturated and dry periods) were first observed at approximately 20 to 24 inches. Signs of light to moderate livestock utilization were observed in the general area; almost none of the grasses had been grazed, but broadleaf plants had been moderately grazed. Other locations in this same general part of Lower Lacey Meadows showed evidence of slightly higher livestock utilization with more bare ground, pedestalled plants and soil rills, and higher utilization of broadleaf plants. Taken as a whole, these observations of vegetation, rooting depth, and bare ground along with an interpretation of livestock utilization, are indicative of moderate ecological status for this site and surrounding dry meadow areas of Lower Lacey Meadow. Representative photographs of this site are included in Appendix G.

In general, most areas observed in Lower Lacey Meadows were higher functioning than areas observed in Upper Lacey Meadow. This is likely due, at least in part, to the fact that Upper Lacey Meadow is drier and appears to have been preferentially grazed by sheep. As previously mentioned, sheep herders tend to avoid wet meadows to minimize the risk of hoof rot within their flocks. Additionally, wet or mesic meadows, such as those in most of Lower Lacey Meadows and parts of Upper Lacey Meadows, are characterized by grasses, sedges, and rushes, plants that are generally not preferred by sheep. Given a choice, sheep tend to prefer broadleaf plants and will preferentially graze broadleaf plants when available. This grazing preference may explain the apparently inconsistent observation of relatively deep rooting depths, an indicator of high ecological status, in locations that otherwise showed signs of moderate or low ecological status in terms of plant community composition and ground cover. In many of these locations it is likely that the presence of grasses, which tend to have deep, fibrous root systems and had not been grazed by sheep, resulted in skewed observations of rooting depth that were inconsistent with other observations of meadow condition.

3.3.2 CHANGES IN HISTORIC MEADOW ACREAGE

Changes in meadow size (acreage) of Lacey Meadows (Upper and Lower) were examined using comparison of historical aerial photographs (1955 and 2009; **Table 12**). Meadows were delineated in GIS as a continuous open area defined by the absence or presence of conifers. Due to fluctuating lake levels in Webber Lake a similar lake fringe (meadow/open water boundary) was identified in both years for comparison purposes. In 1955, the total meadow area was approximately 495 acres, with the Upper Meadow at 99 acres and the Lower Meadow at 396 acres. In comparison, the total meadow area in 2009 was approximately 457 acres: 72 acres in the Upper Meadow and 385 acres in the Lower Meadow. This analysis indicates that total meadow area shrunk by roughly 8 percent (38 acres), with a 3 percent (27 acres) loss in the Upper Meadow.

3.3.2.1 CONIFER ENCROACHMENT

Conifer encroachment, and encroachment of lodgepole pine in particular, has been implicated as one cause of meadow decline across the Sierra Nevada (D'Antonio and others, 2004) and other parts of the western United States. Areas that show conifer encroachment today are underlain by wetland-type soils suggesting a conversion from wet to dry meadow habitat. Conversions of these meadows may result in loss of important ecosystem services, such as habitat and water storage and release, which they provide (Lubetkin, 2011). Jones and others (2005) have suggested that conifer encroachment has also degraded aspen in this region—a keystone species for maintaining biodiversity.

Hypothesized causes of encroachment are numerous and include changes in land-use management and climate. Wildfire suppression is one key change in land and natural resources management. Anderson and Smith (1997) suggest that wildfire was a key factor in controlling encroachment during drier years. USFS and CalFire records indicate the absence of both prescribed and naturally-caused wildfire in the watershed and meadow over the past 50 years or more (see Figure 13). Review of other historical aerial photographs (1966, 1992) suggests that encroachment in some areas may have been recent, in the last 10-15 years, generally a dry period when compared to the historic record (see Figure 3). This is supported by field estimates of tree age where conifers in areas of encroachment ranged between 7 to 15 years old. Similarly, Millar and others (2004) argue that climatic patterns may be a main factor that encourages encroachment such as consecutive dry years and low soil moisture. Local climate data indicate that precipitation (as percent deviation from mean annual precipitation) has been low over the past decade (see Figure 3). It is possible that the low snowpack and dry conditions experienced this past year created ideal conditions for lodgepole germination and seedling growth; lodgepole pine seedlings were commonly observed within the meadow condition assessment plot in Upper Lacey Meadow.

Incised channel conditions observed in Lacey Meadows may also exacerbate encroachment by lowering the local groundwater table—further reducing soil moisture along the fringes of the meadow. Areas where maximum channel incision or realignment was noted tend to correspond to areas where pine stands are being recruited.

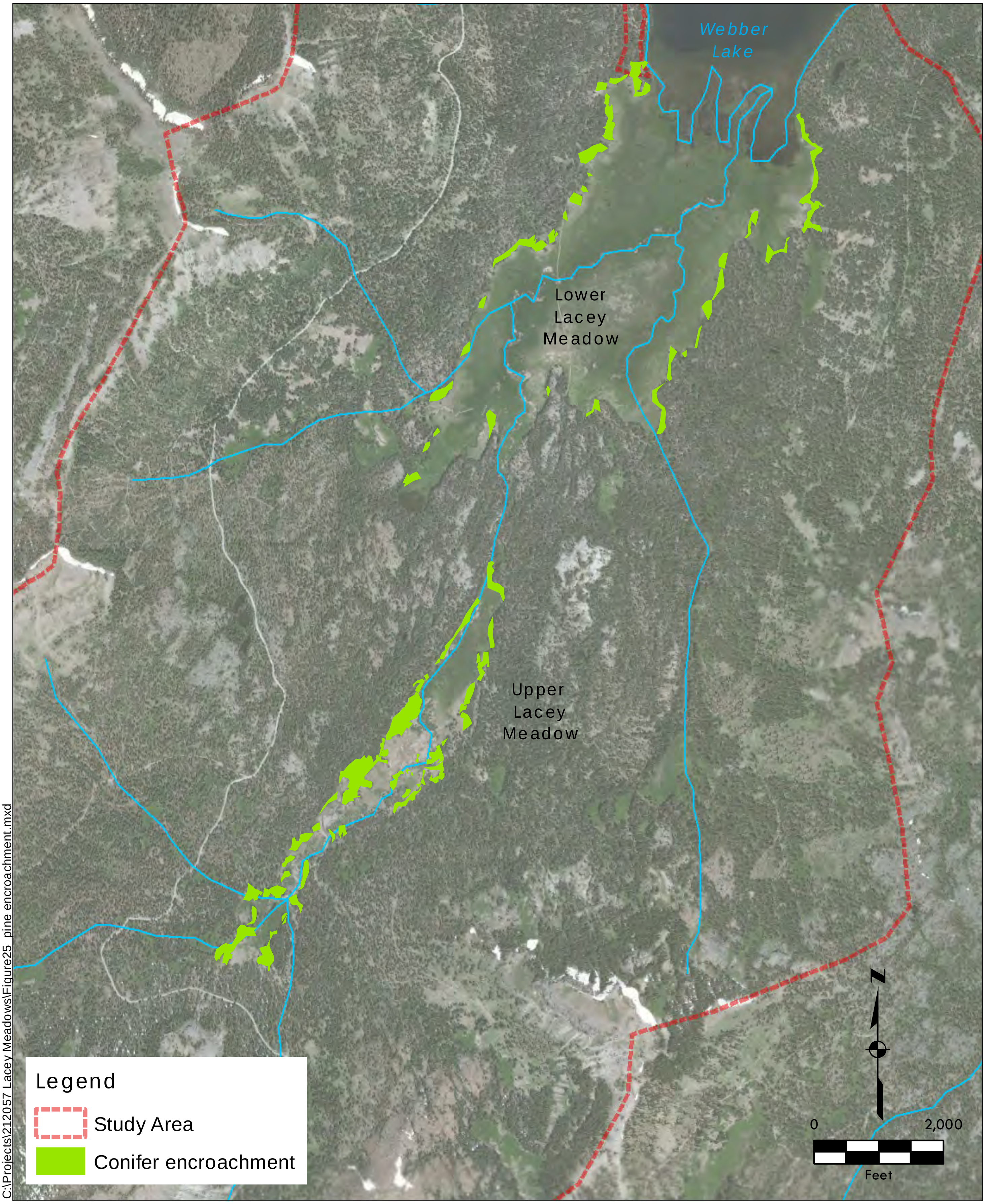

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Figure 25. Conifer encroachment
Lacey Meadows Study Area
Sierra and Nevada Counties, California

3.3.3 WILDLIFE HABITAT VALUES

Aside from riparian scrub habitat, the habitats associated with the greatest diversity of wildlife species and the greatest numbers of special-status species within Lacey Meadows are the moist to wet montane meadows and marshes along Webber Lake and Lacey Creek, particularly within the northern portions of Lower Lacey Meadows. Standing water or saturated soils combined with dense herbaceous vegetation are the keys to attracting several common and special-status wildlife species, including species not commonly seen in other Sierran meadows. Many of these species are associated with the northern end of Lower Lacey Meadows, closest to Webber Lake along Reaches A and B of Lacey Creek.

Moist to wet montane meadows dominated by grasses and sedges provide dense nesting cover necessary for several bird species, including special-status species such as greater sandhill cranes, short-eared owls, and northern harriers. Vole populations, a key prey species for many ground nesting birds in Sierran meadows, are positively associated with meadow vegetation density and cover. Thus, meadows with dense, herbaceous vegetation not only provide enhanced nesting opportunities for many birds but also increase prey production, which can contribute to increases in populations of predatory birds. As moist to wet meadows become drier with less dense vegetation cover and more bare ground either due to changes in hydrology (e.g., due to stream channel degradation) or in response to inappropriate management (e.g., frequent, heavy grazing), nesting habitat quality along with prey abundance declines. Populations of birds and their small mammal prey may decline or shift their territories to wetter, less disturbed areas (Green, 1995). Large ground nesting birds like sandhill cranes, short-eared owls, and northern harriers are especially impacted when both their nesting habitat and the habitat of their primary prey species are adversely affected. These species are also very sensitive to disturbance of their nests and may readily abandon their nests when disturbed by livestock, anglers, and hikers (especially with dogs) (Littlefield and others, 1982).

The highest-quality habitat for these three bird species, and similar species that make their nests in open meadows, presently occurs in the north half of Lower Lacey Meadow, primarily to the east of Reach A and Reach B (below the confluence of the SE tributary). This is the wettest part of Lower Lacey Meadows, and vegetation in this area primarily consists of robust sedge species such as Nebraska sedge, inflated sedge, and beaked sedge. The combination of moist to wet soils and tall herbaceous vegetation creates the best nesting cover and vole production. In addition, sheep grazing is limited in this area to minimize hoof rot (as previously described), which reduces grazing-related impacts and the potential for nest trampling or disturbance. This area also appears to receive less disturbance from anglers and hikers than the upstream sections of Reach B and C.

Aside from moist to wet meadow, which is found throughout Lower Lacey Meadows and in isolated locations within Upper Lacey Meadows, shallowly flooded meadow, or marsh habitat, occurs in several areas within Lower Lacey Meadows, primary to the east and west of Reach A and the lower portion of Reach B and along the boundary between Lower Lacey Meadows and Webber Lake. Bird species that breed in these marsh habitats include: greater sandhill cranes, yellow-headed blackbirds, American white pelicans, and occasionally black terns. Raptors associated with lakes, such as bald eagles and ospreys, are commonly observed in these areas either soaring and hunting above Webber Lake or perched in trees along the northeast side of Lower Lacey Meadow. Additional nesting habitat in these areas is provided by native and, possibly, introduced species of pondweed that form floating mats of vegetation along the margins of Webber Lake and provide suitable nesting habitat for black terns and American white pelicans.

Drier montane meadows, such as those found in the center and edges of Lower Lacey Meadows and along Reaches G and I in Upper Lacey Meadow, do not provide the same nesting habitat values for many species of birds, but these areas do provide valuable foraging habitat for many species of raptors (e.g., bald eagles, northern harriers, Swainson's hawks), as foraging is sometimes easier for these visual hunters when herbaceous cover is less dense (and drier areas can be utilized by small mammals earlier in the spring). Raptor prey such as ground squirrels and gophers thrive in these drier areas where lower soil moisture is more conducive to their burrowing and foraging techniques. Although raptors may benefit from dry meadows via increase foraging opportunities, many other species that nest in meadows or associated riparian areas may be negatively affected by dry meadows, especially when these habitats are located in the interior of large moist to wet meadows like Lower Lacey Meadows. The juxtaposition of large complexes of moist or wet meadows with dry meadows creates opportunities for mammalian predators to access the wet meadow and riparian habitats via the adjacent dry meadows. This increased access can, in turn, render the wet meadow and riparian species more susceptible to mammalian predation (Cain and others, 2003, Mathewson and others, in press).

Meadow habitat quality for raptor species such as bald eagles and great grey owls is greatly enhanced by the presence of dead trees, or snags, along the meadow boundary to provide valuable foraging perches for these species. An assessment of snags and snag abundance was not completed as part of this watershed assessment, but bald eagles were observed perched on a few large snags on the northeast edge of Lower Lacey Meadows during reconnaissance surveys. Abundant standing snags were also observed along the western margin of Lower Lacey Meadows, but few of them had fallen into the adjacent meadow. Great gray owls are strongly associated with downed snags or logs that fall into adjacent moist or wet meadows, thereby providing elevated foraging perches required by this species in close proximity to their preferred nesting and hunting habitat (Winter, 1986; Hull and others, 2010). Habitat quality for both species may currently be limited by the relative lack snags and downed trees within Lower Lacey Meadows.

As discussed above, many species of mammals, particularly larger carnivores such as wolverines, foxes, and martens are more likely to utilize narrower montane meadow and riparian corridors than open montane meadows. Many of these species are likely to traverse through open montane meadows or use them as a source of water and prey, but open meadow habitats are not critical for these species. Similarly, species of amphibians and reptiles such as Sierra tree frogs and western toads as well as Sierra gartersnakes are likely to be found within montane meadows, particularly in areas that are at least seasonally wet, but sensitive species like mountain yellow-legged frogs would primarily breed and forage within perennial streams and ponds. Isolated, historic oxbows and stream channels within Lower Lacey Meadow along Reach A that contain ponded water throughout the summer months, may provide suitable breeding habitat for this species, provided these areas do not support predatory fish.

4. ASSESSMENT CONCLUSIONS

The Lacey Meadows Watershed includes one of few large high-montane meadow systems in this part of the Sierra Nevada. With a diverse land-use history and widespread disturbance, a number of management recommendations and restoration needs were developed as part of this assessment and are provided in Section 5.0. The recommendations and needs were based on an initial review of available information and a limited field assessment and drew on the following conclusions and related considerations:

- Between 2000 and 2012, cumulative precipitation has been below the 80-year average. Even though 2011 was one of the wettest years on record, total runoff and groundwater recharge have likely been below normal over the past decade. Given these conditions, we anticipate that the conditions observed during our assessment are drier than historically, and as compared to those visible on historical aerial photographs from earlier, wetter periods. Drier meadow conditions may stress vegetative, avian, terrestrial, and aquatic habitat resources while promoting conifer encroachment and increased wildfire hazards. Restoration or management strategies should consider these conditions in context for long-term management.
- The Lacey Meadows study area is mostly composed of readily-weathered geology and soils including volcanic, metavolcanic terrains, and glacial outwash and alluvium. Land uses such as logging, road building, grazing, and recreation on these geomorphic terrains and soils can generate excessive erosion and exacerbate existing sediment sources. Road drainage management and decommissioning and grazing exclusion zones are suggested where soils are most prone to erosion.
- The Lacey Meadows study area has likely been experiencing changes from cultural uses as far back as 1,500 years ago during Native American occupation; however, more measureable changes have been documented since the mid-1800s. Most notably, road building from 1846 through the 1980s, logging in the 1950s, 1970s, and possibly as recent as the 1980s, and livestock grazing, primarily sheep, beginning in the 1840s and continuing today (albeit at reduced frequency and intensity). Management strategies are provided to minimize impacts on meadow resources and habitat.
- Hydrology of Lacey Meadows is supported by a snowmelt-dominated hydrology in tributaries. The annual peak flow in Lacey Creek (at Webber Lake) in WY 2012 was estimated to be between 340 cfs and 760 cfs, greater than estimated 2-year discharge; however, field evidence suggests peak flows were largely contained within the active channel—evidence of an incised, or incising channel. Upland, channel and meadow restoration strategies are proposed to enhance channel-floodplain functions.

- Aspens provide high quality habitat for many bird and mammal species, but are largely absent from the study area.
- A hydrogeomorphic evaluation of Lacey Meadows identified six different meadow types. Classification of meadow types provides meadow habitat-focused and location-specific restoration criteria for enhancement or future management actions. For example, slope-discharge meadows are prime candidates for aspen regeneration.
- Biological resources include numerous, special-status plant and wildlife occurrences including many perennial and annual herbs, amphibians, migratory birds (e.g., willow flycatchers, birds of prey, mammals such as California wolverines, Sierra Nevada red foxes, Sierra martens and others. Management recommendations include continued monitoring for special-status species as indicators of meadow health, particularly meadow-obligate breeders such as willow flycatchers.
- Fish are presumed to have been absent from Webber Lake and Lacey Creek prior to 1850 since Webber Falls, located downstream of Webber Lake on the Little Truckee River, is a natural barrier to fish movement from lower reaches of the Truckee River system. Beginning in the 1850s, non-native and predatory fish such as rainbow trout, brown trout, and eastern brook trout were introduced and now occur throughout Webber Lake, Lacey Creek, and their tributaries. The existence of these fish likely limits populations of threatened or endangered amphibians. Future surveys of amphibian populations should be implemented and strategies for habitat enhancement that include identification of fishless isolated water bodies should be pursued.
- Forested uplands were not investigated in detail as part of this assessment; however, based on our limited observations, forested uplands exhibit very dense growth with abundant dry or dead vegetation, particularly along the western margin of Lower Lacey Meadow. Based on data provided by the Sierra Coordinated Resources Management Council (2008), wildfire has been absent in the Lacey Meadows Watershed and adjacent areas since 1880 or earlier. Future forest health assessments and wildfire management will be critical to sustaining existing habitats and meadow health.
- The road network survey found over 21.9 miles of improved and unimproved roads and includes 107 stream crossings using culverts within the study area. Road building in the study area has been documented as far back as 1850 and supported trans-Sierran travel, ranching and logging operations. While many of the roads are in limited use or not used today, the presence of abandoned grades on erosive geology and soils and under the existing climate exacerbates sediment sources and appears to result in some of the largest sediment sources (direct and indirect) to Lacey meadows. Several roads and/or road segments not in use today are recommended for decommissioning to reduce excess runoff and sediment sources to the meadows.
- A geomorphic assessment of streams and riparian corridor found major differences between the Upper and Lower Meadow. Lacey Creek in the

Upper Meadow is much more influenced by sediment sources and channel modifications that occurred between 1955 and 1966. Lacey Creek through Lower Lacey Meadow appears to more resilient to watershed impacts, but does exhibit degradation along the riparian corridor due to historical and possibly on-going land uses in the watershed. Channel instability is evidenced by large-scale bank erosion, channel bed incision, and absence of willow communities along the channel. Channel incision throughout the study area and modification of lake levels in the Lower Meadow may be contributing to lower groundwater levels, and thus, degrading meadow conditions. Suggested restoration actions include: a) reducing anthropogenic sources of runoff and sediment; b) inducing channel aggradation using large wood and in stream structures, and; c) excluding grazing from restored riparian/stream zones.

- Meadow conversion (wet to dry) in Upper Lacey Meadow was likely exacerbated by channel modifications in the late 1950s and early 1960s. The new channel (Reach G(a)) directs streamflow away from the meadow and continues to exhibit instability through both incising and widening. Restoration of flow to abandoned channels (Reach G(b)) is anticipated to restore meadow hydrology and habitat.
- Much of the Upper Lacey Meadow is ranked as low ecological status based on its dominant plants, and likely associated with historical channel modifications and upland disturbances. Based on a limited biological assessment, observations in the Lower Lacey Meadow are consistent with a moist montane meadow that is at moderate to high ecological status. Management strategies should protect areas of moderate to high ecological status and identify process-based restoration solutions for improving areas of low ecological status. The TDLT has stipulated some strict grazing rules under the new grazing lease to protect meadow resources. In the near future, a detailed grazing management plan is recommended to analyze livestock grazing opportunities and constraints within the Webber Lake watershed to develop a range of grazing prescriptions that will contribute to the maintenance and enhancement of ecological and watershed functions.
- The total meadow area in the Lacey Meadows Watershed appears to have been reduced by roughly 38 acres or 8 percent (between 1955 and 2009), with the greatest losses in the Upper Meadow. Meadow area reductions are due to conifer encroachment, which have likely been brought on by the cumulative effects of reduced precipitation, channel incision, and historical and current land-uses. Reducing excessive runoff from the uplands and restoring channel processes should provide conditions (i.e., high water table, wet soils) suitable for meadow re-establishment and/or aspen grove establishment. Tree removal (including conifers from the meadow) and forest thinning may also be required to facilitate aspen regeneration and to reduce wildland fire hazards.
- Willow flycatcher, an endangered species, was identified in Lacey Meadows between 1998 and 2012. With two exceptions, all territories in the Lacey Valley have been documented in the Lower Lacey Meadow directly south of

Webber Lake, primarily in the area between the lake and the Webber Lake road crossing of Lacey Creek. Species of migratory songbirds, including willow flycatcher, find important nesting habitat in riparian scrub. The acreage of willow scrub habitat in the Lacey Meadows study area is well below other large Sierran meadows that support robust populations of migratory songbirds. Willow germination and recruitment may be reduced in this area due to livestock, channel degradation along Lacey Creek, or some combination of these two factors. Reduction of excessive runoff and sediment sources, restoration of channel processes, and grazing exclusion zones are recommended to enhance songbird and willow flycatcher habitat.

- Based on a limited assessment, the aquatic habitat in Lacey Creek appears to satisfy conditions needed to support fish populations. Historical and recent livestock grazing practices are limiting development of typical cover components of meadow streams (i.e. undercut banks, willows) and may have accelerated erosion in certain areas, but substrate conditions appear to be good for spawning and macroinvertebrate production outside of reaches heavily impacted by livestock within Upper Lacey Creek. High-water refuge habitat is lacking due to the incised nature of the channel in many reaches and limited channel-floodplain connectivity. Upland controls of excessive runoff and sediment sources, channel and meadow restoration as well as grazing exclosures are recommended to improve aquatic habitat.
- Webber Lake is controlled by outlet operations and affects water surface levels by 3.0 feet or more in some years. Modification of lake levels has likely altered channel processes, such as sedimentation, in the near-lake environment. These altered processes result in seasonal barriers for fish migrating upstream or downstream to the lake.

5. DISTURBANCE INVENTORY AND RESTORATION OPPORTUNITIES

The Lacey Meadows Watershed includes many restoration and management opportunities which are: a) important as this area is the headwaters of the Little Truckee River; b) important locally to wildlife, and; c) important to the overall enhancement and restoration of Sierran meadows, identified as key ecological units for habitat and ecosystem services. Restoration is particularly achievable in this portion of the greater Little Truckee River watershed because the majority of the watershed is primarily under the ownership of two entities, Truckee-Donner Land Trust and USFS. And these entities have similar management goals and resource objectives. Restoration can take the form of a watershed-scale approach—where restoration can target watershed processes to improve conditions downstream.

Key management actions and/or restoration opportunities that address disturbances or impacts in the watershed are provided in this section. The actions/opportunities are presented as 2-page project sheets. These sheets were developed to assist with information that can be used for acquiring funding or permits. We identify 8 key management actions and restoration opportunities.

Each project sheet includes the following key information needed for project planning, implementation and monitoring:

a) the location and general description of the problem/disturbance;

b) the goal(s), sources of degradation, and objective(s) to achieving stated goal(s);

c) possible effects of degradation on both physical and ecological processes;

d) restoration strategies, approaches, and alternatives (if available);

e) target conditions or success criteria;

f) restoration concepts and the benefits;

g) timeframes for implementation;

h) pre- and post-project monitoring recommendations;

i) if appropriate, recommended phasing or order of implementation, and;

j) possible range of costs for the project.

5.1 WEBBER LAKE MANAGEMENT RECOMMENDATIONS

Operation and maintenance of fish screens at the Webber Lake Dam appears to affect lake levels and associated geomorphology in the lacustrine and estuarine environments. We also understand that Webber Lake was, and may continue to be, stocked with fish for sport fishing and the fish screens were used to minimize loss of these fish to downstream waters. As such, we recommend that a temporary experiment be conducted where the operation of fish screen be discontinued and fish monitoring implemented to evaluate or quantify fish movement over the dam in the absence of screens. If results suggest these numbers are low, operations of the fish screens can be discontinued in perpetuity.

Lacey Meadows Restoration and Management Recommendations, Project #1

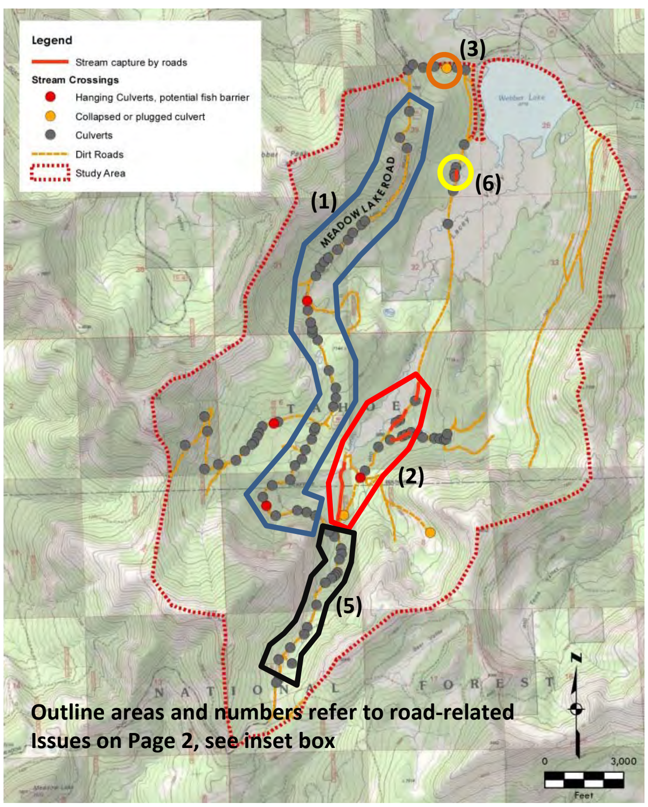
Problem: **Excessive runoff and sediment originating from roads, stream capture by roads**
Project: **Road decommissioning, renaturalizing drainage**
Location: **Throughout study area, mainly above Upper Lacey Meadow**

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
Roads in the watershed directly increase runoff to existing channels with noticeable adverse affects on Upper Lacey Meadow that include altered flood frequency/magnitude, erosion, and excessive sedimentation. Sources of excessive sediment include scour and incision of existing and historical roads and their drainage by stream capture, culvert failures, and streambank erosion generated by increased runoff from roads resulting in aggradation in the mainstem. These processes appear to impair or alter both physical functions and ecological values.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Reduce excessive runoff and sediment delivery to meadow and streams	Stream capture by roads, undersized culverts, poor road drainage and management, channel confinement by roads	Road decommissioning, recontouring, culvert removal or replacement, general drainage improvements on roads planned for continued use.



Road Network Survey, Figure 14 from Lacey Meadows Assessment Report; large yellow circle identifies area of concern.

Possible Effects on Physical and Ecological Processes

Physical:
Excessive runoff from roads with connectivity to streams induces channel scour, bed incision, streambank erosion, increases frequency and magnitude of flooding; secondary effects include lower groundwater table, floodplain disconnection. **Excessive sediment** is generated from stream capture by roads, road erosion, streambank and bed erosion related to excessive runoff, sedimentation of sensitive habitats

Ecological:
Loss of meadow vegetation from channel incision, floodplain disconnection, and lowered groundwater levels. Incised channels reduce high-water refugia for aquatic species, while excessive fine sediment can impair spawning habitat, macroinvertebrate populations and water quality.

**cost estimate includes planning, design, implementation and monitoring.*

Lacey Meadows Restoration and Management Recommendations, Project #1

Restoration or Management Approach:

1) Road drainage can be improved using techniques approved by USFS, local Resource Conservation Districts (RCDs), and/or California Stormwater Quality Association (CASQA) on roads deemed important for forest management, access or recreation. For instance, road outsloping, culvert overflow relief dips, rolling dips, road surfacing, and culvert replacements where existing culverts are undersized.
2) Abandoned roads that are identified as sources of degradation should be decommissioned using techniques approved by USFS or other entity.

Alternatives:

No alternatives identified for this project; road closures without active road management may not address on-going degradation.

Target Conditions/Success Criteria:

1) Natural drainage restored at locations where stream capture occurs
2) Reduced sediment delivery to Meadow
3) Reduced runoff from decommissioned roads

Implementation Timeframe

Design and permitting (6-9 months)
Implementation (2 weeks- 2 months per site)
Monitoring and adaptive management (1 to 10 years)

Post-project monitoring recommendations:

Qualitative survey of roads and drainage
Repeat channel surveys to evaluate sediment changes

Phasing or Order of Implementation:

This project addresses upland degradation and should be implemented prior to meadow restoration or instream channel projects where excessive runoff, sediment or on-going erosion occurs. Because existing roads/trails may be an important component to future forest management or recreation, management plans for these activities should be developed prior to this project

Special Considerations:

Development of a Road Management Plan to address future needs , access, and general road maintenance or repair is highly recommended to minimize future degradation from the watershed's road network.

Descriptions of high-priority road-related issues in Lacey Watershed Study Area (see Figure on Page 1):

1) Meadow Lake road drainage and channel incision downstream of crossings or drainage locations (reportedly addressed under USFS management in 2012, monitoring is recommended).
2) Stream capture: Webber Lake Road in T19N, R14E, Section 29, and T18N, R14E, Section 5; a logging road at the intersection with Webber Lake Road in the same section; and an old unmarked road that leaves Webber Lake Road and heads north to Lacey Creek (T18N, R14E, Sections 6 and 7).
3) Undersized culverts at stream crossings along Henness Pass Road.
4) Four of 107 culverts are hanging culverts and currently generate noticeable scour and erosion and may impede fish passage
5) Construction and maintenance of the Meadow Lake Road above the Upper Lacey Meadows (T18N, R14E, Section 7) has confined Lacey Creek.
6) Webber Lake Road, bisects Lower Lacey Meadow, and is graded below the elevation of the meadow surface which may alter hydrology of the meadow in these sections.

Road decommissioning should be coordinated with adjacent land managers to identify any potential conflicts with through-access .

It has been acknowledged that the USFS completed some road drainage improvements on Meadow Lake Road in 2012.

Lacey Meadows Restoration and Management Recommendations, Project #2

Problem: **Localized overgrazing or browsing of riparian and meadow vegetation; trampling of stream banks**
Project: **Development of a grazing management plan**
Location: **Throughout study area, mainly Upper and Lower Lacey Meadow**

Cost Estimate*:

Cost Estimate
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
The management of livestock grazing within the Webber Lake property is not guided by a formal grazing management plan. Instead, it is based on historic grazing practices that may have unintended adverse effects on Upper and Lower Lacey Meadows and other habitats within the Lacey Creek watershed. Additionally, a formal monitoring program to assess the efficacy of livestock grazing at meeting specific resource management goals and objectives does not exist. The development of a monitoring program, as part of the grazing management plan, would allow the Truckee-Donner Land Trust to identify changes that might be required to adaptively manage livestock grazing in an effort to meet resource management goals.

Project goals	Sources of degradation	Objectives to achieve project goals
Minimize disturbance to streams and sensitive wildlife, browsing of riparian vegetation, and overutilization of meadow vegetation	Trampled stream banks, heavily grazed and browsed meadow vegetation; increased runoff, sediment, and nutrient input to Lacey Creek	Development of livestock grazing approaches to minimize the potential for adverse ecosystem effects or enhance ecosystem function

View of grazing assessment plot in Upper Lacey Meadow showing heavily grazed plants and extensive bare ground.

Possible Effects of Unmanaged Grazing on Physical and Ecological Processes

Physical:
Excessive runoff from compacted soil and reduced infiltration and plant evapotranspiration, which can adversely affect meadow habitat. Bare soils that result from heavy grazing can reduce the amount of topsoil and ***increase sediment*** input into streams. ***Reduced summer baseflows*** due to compacted soils and reduced water infiltration and soil/groundwater support to streams. ***Modified channel morphology*** resulting from hydrologic alteration (e.g., timing, duration, and magnitude of runoff) and physical disturbance to stream beds and banks.

Ecological:
Transition from perennial plants to annual plants, reduced ability to cycle and store soil nutrients, alteration of wildlife habitat values, reduction of fish habitat quality, reduced water quality, increased water temperature, altered macroinvertebrate communities.

**cost estimate includes planning, design, implementation and monitoring; potential costs for implementation variable based on types of grazing facilities included in plan.*

Lacey Meadows Restoration and Management Recommendations, Project #2

Restoration or Management Approach

A detailed grazing management plan should be developed to describe goals and objectives for livestock grazing on the Webber Lake property; approaches to grazing management that are compatible with these goals and objectives (including required range improvements such as water developments and fencing); monitoring approaches to assess whether current approaches to grazing management are achieving defined goals and objectives, and adaptive management thresholds that, if met, will necessitate a change in grazing management to better meet defined goals and objectives.

Alternatives

No action: continued livestock grazing without development of a grazing management plan may not address potentially adverse effects from grazing or positively contribute to goals and objectives for management of the Webber Lake property

Target Conditions/Success Criteria

1) Vegetation communities and soil surface conditions indicative of high-functioning riparian and meadow ecosystems
2) Economically viable grazing program

Implementation Timeframe

Plan development (3 – 6 months)
Implementation (6 - 12 months)
Monitoring and adaptive management (In perpetuity)

Post-project Monitoring Recommendations

1) Annual grazing readiness and utilization monitoring
2) Periodic condition and trend monitoring
3) Other monitoring as proposed in grazing management plan

Phasing or Order of Implementation

Project could be implemented at any point but should be Implemented prior to or in conjunction with projects intended to restore or enhance Lacey Creek, Upper Lacey Meadow or Lower Lacey Meadow (see Projects #6, #7).

Special Considerations

Grazing is currently conducted according to the terms of lease between the Truckee-Donner Land Trust and its grazing lessee. This lease could require modification following development of the grazing management plan.

Descriptions of specific grazing-related issues in Lacey Meadows Watershed Study Area:

1) Portions of Upper Lacey Meadow are characterized by plants and soil conditions indicative of low-function meadow ecosystems .
2) Willows have been heavily browsed in Upper Lacey Meadow. Willows provide habitat for the willow flycatcher and other terrestrial species and as well as shade, in-stream habitat complexity, and other aquatic habitat benefits.
3) Bare ground and trampled stream banks, which likely contribute excessive sediment to Lacey Creek are common along Lacey Creek in Upper Lacey Meadow .
4) Trampled banks are occasionally found along the inlets to Webber Lake in Lower Lacey Meadow; bank trampling may contribute to stream widening, incision and headcutting of Lower Lacey Meadow.
5) Limited to no off-stream water sources occur within the Webber Lake property, forcing livestock to use streams and lakes for water.
6) Brown-headed cowbirds are associated with livestock and have been documented parasitizing endangered willow flycatchers in Lower Lacey Meadow.

The Webber Lake property is part of the Webber Lake grazing allotment within the Tahoe National Forest. Modification of grazing on the Webber Lake property should be coordinated with Tahoe National Forest grazing program. Substantial modification of the Webber Lake allotment management plan, if required to be consistent with the terms and conditions of the Webber Lake grazing management plan, could trigger U.S. Forest Service review of its Webber Lake allotment under the National Environmental Policy Act.Pursuant to California law, development of the grazing management plan must be overseen by a Certified Rangeland Manager (see http://casrm.rangelands.org/HTML/certified.html).

Lacey Meadows Restoration and Management Recommendations, Project #3

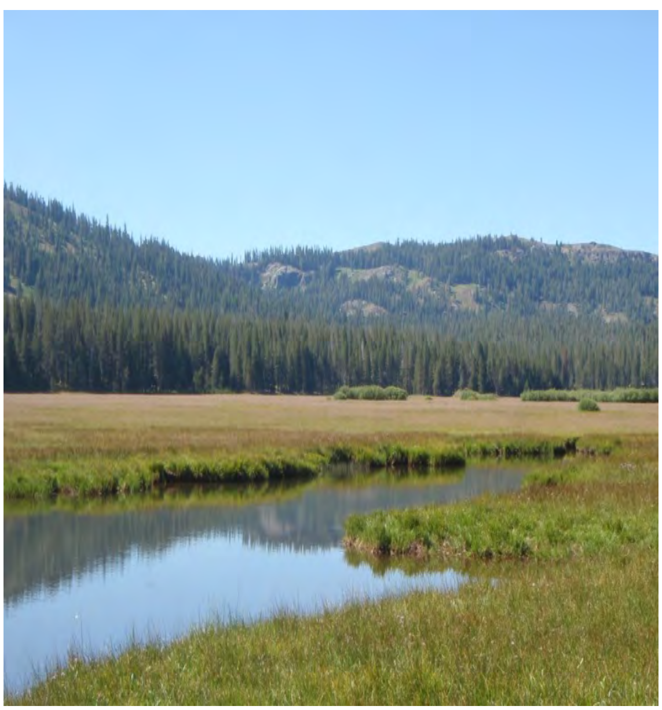
Problem: **Introduction of invasive species, conflicts with sensitive wildlife, and adverse effects on physical processes**
Project: **Development of a recreation management plan**
Location: **Throughout study area, mainly Upper and Lower Lacey Meadows**

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
The Webber Lake property has historically been used as a private recreational property, and access was strictly limited. Recreational use of the property is expected to increase with its transfer from private to Truckee-Donner Land Trust ownership. Increased recreational use, including boating, fishing, hiking, mountain biking, horse riding, off-road vehicle use, and camping has the potential to result in the introduction and spread of invasive species, conflicts with sensitive wildlife, such as nesting greater sandhill cranes, and the creation of or increased use of trails that if not properly sited and maintained, could lead to erosion, hydrologic alteration to Lacey Creek, and similar adverse effects.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Prevent or limit conflicts between recreational use and wildlife habitat; limit adverse effects of recreational activities on watershed functions	Introduced invasive species, harassment of sensitive species, habitat alteration, increased trail erosion, ongoing construction and use of unauthorized trails by horses, bikers, and off-road vehicles	Management of recreational activities to avoid or minimize the potential for adverse ecosystem effects



View of inlet to Webber Lake in Lower Lacey Meadow within area of potential greater sandhill crane breeding habitat

Possible Effects of Unmanaged Recreation Use on Physical and Ecological Processes

Physical:
Increased runoff and sediment that may result from bare soil associated with ongoing, unmanaged road/trail construction and use.

Ecological:
Potential for introduction and spread of ***invasive species***, particularly aquatic invasive species through watercraft and fishing gear. ***Possible conflicts with sensitive wildlife***, particularly during nesting periods when these species are particularly sensitive to the presence of people and dogs. ***Increased refuse***, which may encourage the presence of crows, ravens, brown-headed cowbirds, and other potential predators or parasites on native wildlife.

**cost estimate includes planning, design, implementation and monitoring; potential costs for implementation variable based on types of recreational facilities included in plan.*

Lacey Meadows Restoration and Management Recommendations, Project #3

Restoration or Management Approach

A detailed recreation management plan should be developed to describe goals and objectives for recreation management on the Webber Lake property; the types of recreational activities that are compatible with these goals and objectives (including required recreational facilities and infrastructure such as signage or trails); specific policies that will govern recreational use of the property (including areas that are closed to recreational use at certain times of the year, methods for preventing the introduction and spread of invasive species); and methods or techniques that will be used to monitor and maintain recreational facilities.

Alternatives

No action: The property is likely to experience increased recreational use in the future, there is an increased potential for adverse effects on ecological and physical processes if a recreation management plan is not developed.

Target Conditions/Success Criteria

Accommodation of recreation use without introduction or spread of invasive species, disturbance to native wildlife, increased erosion, and other adverse effects

Implementation Timeframe

Plan development (6 – 12 months)
Implementation (12 months or longer, depending on scope of projects included in plan and available funding)
Monitoring and maintenance (in perpetuity)

Post-project Monitoring Recommendations

1) Condition and maintenance needs for trails, signage, gates, and other recreational facilities
2) Other monitoring as proposed in recreation management plan

Phasing or Order of Implementation

Project should be implemented prior to allowing increased public recreational use of Webber Lake property. Once developed, restoration plans can Incorporate elements of the Recreation Management Plan.

Special Considerations

The Webber Lake property supports extensive breeding habitat for sensitive species of birds that could be adversely affected by increased recreational use; the Recreation management plan should incorporate avoidance measures to protect these sensitive species.

Descriptions of specific recreation-related issues in Lacey Meadows Watershed Study Area:

Since recreational use of the property has been strictly limited, there are few, existing recreation-related issues. Future issues that may occur with increased public use of the property include the following.

1) Conflicts with sensitive wildlife in Lower Lacey Meadow, which supports breeding habitat for greater sandhill cranes, willow flycatchers, yellow warblers, and other sensitive species that can be adversely affected by human disturbance.
2) Opportunistic road/trail construction by off-road vehicles, mountain bikers and other trail user groups that would increase erosion and modify watershed hydrology (e.g., by capturing and channelizing runoff along trail alignments)
3) Introduction of invasive species by fishermen and other visitors to the property, particularly aquatic invasive species such as New Zealand mud snails and species of non-native, freshwater clams and mussels.
4) Increased trash and refuse, which may encourage predators on native wildlife.

New Zealand mud snails, an aggressive aquatic invasive species, were recently found in the Truckee River. Protective measures to prevent the introduction of this species and other aquatic invasive species to Webber Lake and Lacey Creek should be incorporated into the recreation management plan.

Lacey Meadows Restoration and Management Recommendations, Project #4

Problem: Potential for catastrophic wildfire, encroachment of conifers into meadows
Project: Development and Implementation of a forest management plan
Location: Throughout study area

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
There has not been a significant wildfire on the Webber Lake property since at least the 1950s, and fire history records indicate that the property has likely not experienced a wildfire since the 1910s or earlier, which has resulted in the growth of dense stands of conifers interspersed with numerous dead trees that increases the risk of a catastrophic wildfire. Lodgepole pine encroachment has been encouraged by a prolonged lack of wildfire, changes to meadow hydrology resulting from disturbances such as road construction and historic grazing practices, and a period of below average precipitation beginning around 2000.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Thin conifer stands that pose a significant wildfire risk; Restore groundwater recharge functions and remove conifers that have encroached into meadows;	Accumulation of fuels that increase risk of catastrophic wildfire; encroaching conifers that modify meadow ecosystem functions.	Reduce wildfire risk; Manage forests to reduce conifer encroachment

Dense lodgepole pine stand with numerous dead trees along western margin of Lower Lacey Meadow

Possible Effects on Physical and Ecological Processes

Physical:
Excessive runoff, sediment input, and changes to channel morphology of Lacey Creek. A large wildfire would reduce rainfall interception by the canopy, expose bare soil to erosion, decrease infiltration, and increase runoff. These changes could further destabilize Lacey Creek, tributaries and meadows, and increase sediment inputs to Webber Lake.

Ecological:
Potential for introduction and spread of ***invasive species*** following wildfire. ***Transition of forest cover*** from conifers to dense shrubs (e.g., tobacco brush), small trees, and grasses/bare ground, which would temporarily (i.e., decades) lower habitat values for forest-dependent species. Ongoing conifer encroachment leads to reduced meadow habitat and ecological value.

**cost estimate includes planning, design, implementation and monitoring; potential costs for implementation variable based on extent of forest management included in plan.*

Lacey Meadows Restoration and Management Recommendations, Project #4

Restoration or Management Approach

A detailed forest management plan should be developed to describe goals and objectives for forest management on the Webber Lake property. The plan should discourage additional encroachment through surface-groundwater management/restoration options and identify areas of tree removal from the Upper and Lower Lacey Meadows. Additionally, the plan should model forest stand development and potential wildfire behavior and wildfire effects given current and potential future stand conditions and fuel loads. Stands should be identified and prioritized for treatment to strategically reduce fuel loads, reduce the potential for catastrophic wildfire, improve overall stand health and condition, and to enhance wildlife habitat values. A range of treatment techniques should be described along with appropriate implementation guidelines for each technique (See USFS publications: North and others, 2009 [GTR-PSW-220], North, 2012 [GTR-PSW-237].

Alternatives

1) No action: Since the property is likely to experience continued conifer encroachment and increased wildfire risk, there is a high probability of future degradation to wildlife habitat values, other ecological processes, and physical/hydrologic processes without active forest management.
2) Implementation without a management plan.

Target Conditions/Success Criteria

Target conditions for reduced forest fuels should be consistent with USFS guidelines [GTR-PSW-220]
Increased meadow conditions or ecological value

Implementation Timeframe

Plan development (6 – 12 months)
Implementation (12 months or longer, depending on scope of actions included in plan and available funding)

Post-project Monitoring Recommendations

Ongoing monitoring of fuels and stand conditions as recommended by forest management plan

Phasing or Order of Implementation

Project should be implemented in conjunction with other restoration projects in Upper or Lower Lacey Meadows (i.e., projects #6 and #7) since removal of encroaching conifers within meadows would contribute to meadow restoration. Conifer logs and root wads could also provide a source of wood for in-stream habitat enhancement projects within Lacey Creek.

Descriptions of specific forestry-related issues in Lacey Watershed Study Area:

Although the scope of the watershed assessment did not include a detailed assessment of forested areas surrounding Upper and Lower Lacey Meadows, the following general issues were observed.

1) Conifer encroachment in Upper Lacey Meadow and to a lesser degree in Lower Lacey Meadow that modifies meadow habitat conditions and can modify meadow hydrology
2) Dead and dying lodgepole pine along Lower Lacey Meadow that increase fuel loading and increase the probability of wildfire
3) Dense stands of conifers that increase the risk of a catastrophic wildfire and reduce habitat values for some forest-dependent species

Special Considerations

Habitat needs for sensitive forest-dependent species, such as black backed woodpeckers, great grey owls, California spotted owls, northern goshawks, Sierra Nevada red foxes, Sierra martens, Pacific fishers, and California wolverines should be considered in development of the forest management plan.

Development of the forest management plan should be coordinated with the Tahoe National Forest and any fuels or forest treatments should consider the surrounding lands managed by the Tahoe National Forest.

Lacey Meadows Restoration and Management Recommendations, Project #5

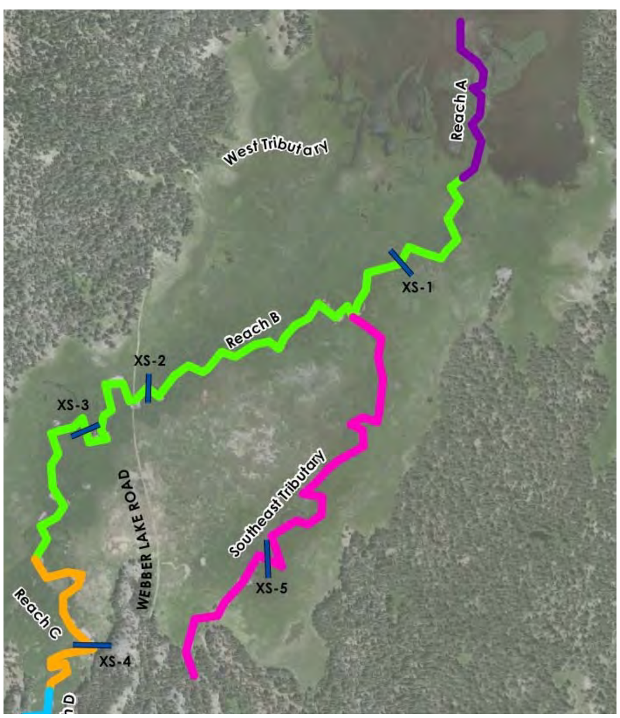
Problem: **Webber Lake water-level fluctuations and its effects on meadow and fish passage**
Project: **Webber Lake water-level management and mitigation**
Location: **Webber Lake and Lower Lacey Meadow**

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
Webber Lake has historically been used for private recreation with water levels changing seasonally by as much as 3 feet due to dam and seasonal screen operations. Unnatural base-level changes can directly affect channel morphology, meadow condition, and meadow and aquatic habitats. When Webber Lake is at its maximum water- surface level, the lake propagates upstream more than 0.4 miles from the lake's lowest level. The timing of the maximum water-surface levels coincides with high streamflows and sediment transport. The higher base-level promotes sediment deposition well upstream of the late-summer mouth of Lacey Creek. Subsequently, when fish screens are removed in the mid summer, lake level falls rapidly, transferring the location of sediment deposition 0.4 miles downstream when streamflow may not be sufficient to transport the sediment that was deposited upstream. Field observations suggest that these deposits become a barrier for fish passage as flows become intermittent in Reach A. In addition, a fluctuating lake level influences the groundwater table within the lower portions of the meadow and results in the cyclical wetting and drying of the finer soils, which in turn triggers bank collapse, sloughing and knickpoint erosion, as documented in the field.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Restore stream processes at the Webber Lake inlet; mitigate existing headcuts and minimize future knickpoint erosion	Artificial water-level fluctuations	Evaluate current operations of fish screens and Webber Lake Dam; assess alternatives to reduce artificial changes in lake levels



Channel Reach Map, showing Reach A, Lower Meadow, Figure 15 from Lacey Meadows Assessment Report.

Possible Effects on Physical and Ecological Processes

Physical:
Fluctuating base-levels in a hydrologic system results in changes in ***surface-groundwater connectivity*** as well as ***sedimentation***, ***bank erosion*** and ***knickpoint creation and propagation***.

Ecological:
Lower groundwater tables reduces one of three critical elements that comprise a wet meadow, soil water; as a result, vegetation communities become dominated by plants that provide ***reduced ecological functions***. Meadow drying may also contribute to ***conifer encroachment***. Excessive sedimentation from a fluctuating lake base-level appears to ***inhibit fish passage*** in the late summer and early fall between the lake and upstream habitat. Most of the ***sensitive species*** documented in the Lacey Meadows watershed utilize the transitional zone between lucustrine (lake) and fluvial (stream) habitats; to date, it is not known how lake level management has affected these species and their habitats. There is a need for data on how lake-levels may affect fish habitat.

**cost estimate includes baseline and post-project monitoring, Possible fish screen alteration or replacement; potential costs for implementation may depend on elements of Recreation Management Plan—which is also a separate cost.*

Lacey Meadows Restoration and Management Recommendations, Project #5

Restoration or Management Approach:
1) Identify time periods to avoid artificial changes in lake levels to restore channel processes at lake inlet
2) Arrest existing knickpoints and headcutting using bioengineering solutions
3) Develop a fish screen management approach that minimizes rapid fluctuations in lake levels

Alternatives:
Permanent removal of fish screens or revaluate operation of fish screens that minimize effects on lake-levels.
No Project Alternative: maintain current operations of Webber Lake dam/fish screens, but mitigate for knickpoint erosion in secondary channels. Alternative does not address channel sedimentation, fish passage, groundwater or meadow conditions.

Target Conditions/Success Criteria:
1) Continuous surface flow between fluvial and lucustrine environments during average and wet years
2) Reduced unnatural fluctuations in groundwater levels
3) Reduced knickpoint formation and propagation
4) Improved fish passage (spatial and temporal)
5) Increased ecological value in meadow condition

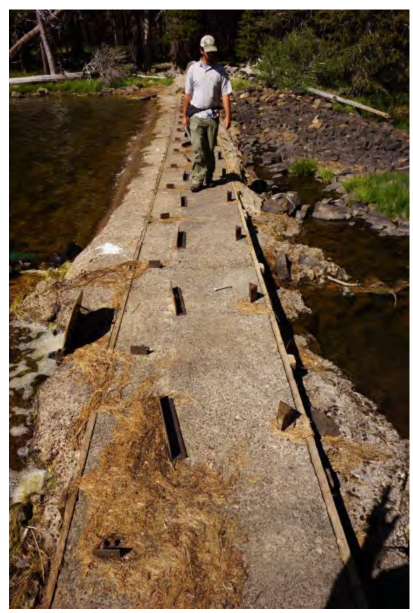
Benefits of Webber Lake Management:

1) Restored surface water and groundwater connectivity
2) Increased meadow ecological value
3) Enhanced avian and aquatic habitat**
4) Reduced erosion
5) Improved fish passage

Implementation Timeframe
Dam and fish screen removal or modification (6-12 months)
Knickpoint and sediment mitigation (4- 12 weeks)
Monitoring and adaptive management (1-5 years)

Pre- and Post-project monitoring recommendations:
1) Channel morphology (repeat surveys) to document changes in sedimentation before and after management
2) Repeat vegetation surveys and meadow assessments
3) Limited stream/sediment gaging (to evaluate critical flow and sediment transport periods through Reach A)
4) Limited groundwater monitoring (4-6 piezometers)

Phasing or Order of Implementation:
A) Upland degradation and roads management should be implemented where excessive runoff, sediment originate
B) This project or elements of should be considered during development of Lower Meadow restoration approaches.



Webber Lake Dam

***there is a need for data on the relationships between lake Level changes and ecosystem response.*

Lacey Meadows Restoration and Management Recommendations, Project #6

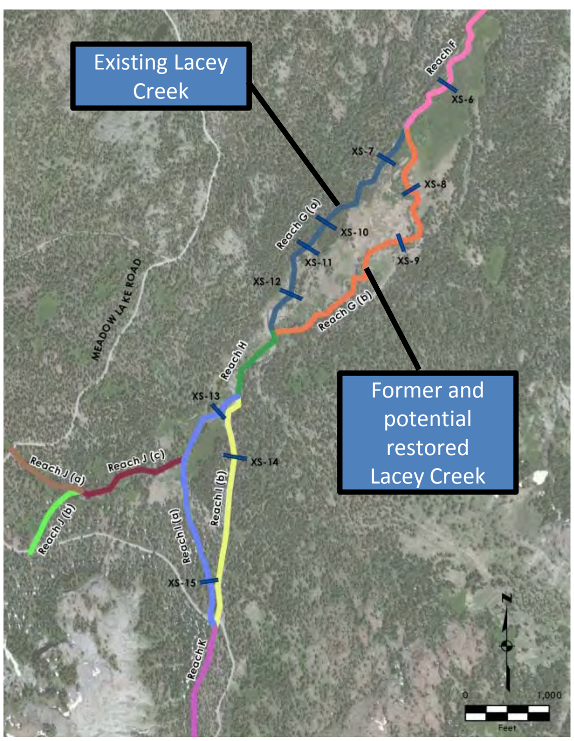
Problem: **Channel modification and impaired channel-meadow processes**
Project: **Stream and meadow restoration; aspen planting/regeneration**
Location: **Upper Lacey Meadow**

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
Upper Lacey Meadows experiences abundant sediment supply from both natural (e.g., hillslope erosion, landslides, debris flows) and anthropogenic sources~~.~~ (e.g., streambed and bank erosion associated with increased hydrologic connectivity from roads, grazing impacts, and channel modifications or diversions). Historical aerial photographs suggest that Lacey Creek transitioned from a multi-threaded system on an alluvial fan to a meandering channel across the Upper Meadow (Reach Gb) prior to 1966. The channel was modified at the head of the meadow and diverted to a straight channel along the northwest meadow edge before rejoining the meadow approximately 2,500 feet downstream (Reach Ga). Today, the area in the vicinity of the former channel is relatively dry and is characterized by dry upland vegetation, while the newer channel is straight and incised with ongoing conifer encroachment. Restoration of the pre-1966 channel will provide benefits to meadow health and both meadow and aquatic habitats.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Renaturalize channel and restore channel and meadow/floodplain connectivity and dynamic alluvial fan processes	Upland excessive runoff and sediment sources; channel modification in the 1950s-1960s; grazing impacts	Address upland sources of excessive sediment (see project #1); renaturalize former channel system through meadow



Channel Reach Map, Figure 16 from Lacey Meadows Assessment Report.

Possible Effects on Physical and Ecological Processes

Physical:
Degradation of Lacey Creek through Upper Lacey Meadow is associated with cumulative impacts from ***channel modifications*** and ***excessive runoff and sediment*** from high road connectivity, stream capture by roads, channel scour, bed incision, streambank erosion; secondary effects include impaired meadow and floodplain functions and lower groundwater levels.

Ecological:
Loss of meadow vegetation and habitat from channel diversion, incision, channel-floodplain disconnectivity, and lower groundwater levels. Incised channels reduce high-water refugia for aquatic species, while excessive sediment can impair spawning habitat, macroinvertebrate populations and water quality. ***Conifer encroachment*** due to hydrologic modification and ***lack of aspen stands*** within groundwater-fed areas.

**cost estimate includes planning, design, implementation and monitoring.*

Lacey Meadows Restoration and Management Recommendations, Project #6

Restoration or Management Approach:
1) Develop a restoration plan and baseline monitoring strategy and implement ~~them~~ both
2) Implement upland restoration practices that reduce excessive sediment/runoff to meadow (see project #1)
3) Develop and implement restoration designs for channel renaturalization that are geomorphically-appropriate

Alternatives:
Passive Management of Channel and Meadow: Implement pilot upland management and grazing exclosures to evaluate channel response in the absence of channel renaturalization; will require a monitoring plan to evaluate effectiveness of passive management. Some active restoration elements may be necessary and may include bed aggradation elements to encourage floodplain/meadow reconnectivity and channel migration

Benefits of channel-meadow restoration in Upper Lacey Meadow:

1) Restored channel-floodplain functions
2) Restored meadow vegetation and increased quantity, quality, and diversity of wildlife habitats
3) Reduced erosion
4) Enhanced in-stream aquatic habitat
5) Improved water quality

Target Conditions/Success Criteria:
1) Restored channel planform and morphology
2) Increased wet meadow vegetation/habitat including aspen stands
3) Restored channel-floodplain connectivity
4) Reduced streambank and bed erosion

Restoration concepts
1) Encourage streamflow to occupy former channel using bio-engineering elements
2) Stabilize slopes along existing channel
3) Introduce large wood to dissipate streamflow velocities, encourage overbank flow, and enhance in-stream habitat
4) Implement grazing exclosures
5) Selectively plant riparian vegetation (e.g., aspen)

Meadow loss due to channel aggradation and widening, Upper Lacey Meadow

Implementation Timeframe
Design and permitting (9-12 months)
Implementation (4-8 weeks)
Monitoring and adaptive management (5+ years)

Pre- and Post-project monitoring recommendations:
1) Channel morphology (repeat surveys)
2) Vegetation/meadow condition surveys
3) Observations of channel conditions
4) Groundwater monitoring
5) Fish surveys

Phasing or Order of Implementation:
Upland degradation and roads management should be implemented prior to any meadow restoration design or instream channel projects

Bank trampling and erosion, Upper Lacey Meadow

Lacey Meadows Restoration and Management Recommendations, Project #7

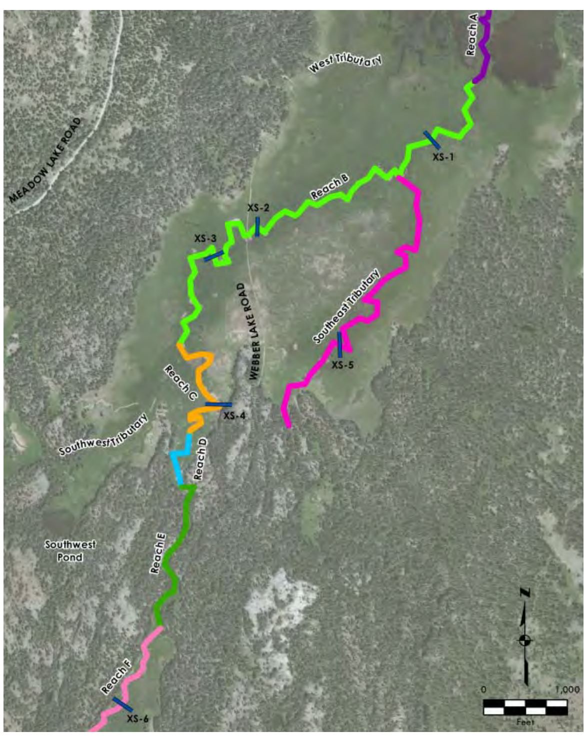
Problem: Impaired channel-meadow processes and functions
Project: Stream and meadow restoration, Reaches B and C
Location: Lower Lacey Meadow

Cost Estimate*:

Cost Estimate
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

General Description of problem:
Lower Lacey Meadow supports habitat for one of the few remaining populations of the endangered willow flycatcher. Lower Lacey Meadow also provides important habitat for several other sensitive wildlife species, and it supports populations of native and non-native, sport fish. Some reaches of Lacey Creek within Lower Lacey Meadow show signs of degradation. These degraded reaches of Lacey Creek reduce the habitat functions and values of the surrounding meadow and may be contributing to a lack of riparian habitat recruitment, plant community conversion, and other ecological effects. Active management and restoration of Lower Lacey Meadow may be required to avoid further meadow degradation and to prevent loss of critical habitat for avian, terrestrial, and aquatic species.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Restore channel and floodplain connectivity, enhance ecological value of meadow , improve aquatic habitat	Upland sources of excessive runoff and sediment (including roads), channel widening /incision, grazing within riparian zone, conifer encroachment	Address upland sources of excessive runoff and sediment, restore channel through Upper Lacey Meadow, discourage channel incision and encourage overbank flows



Channel Reach Map, Lower Meadow, Figure 15 from Lacey Meadows Assessment Report.

Possible Effects on Physical and Ecological Processes

Physical:
Channel incision adversely affects channel and floodplain functions. The loss of floodplain connectivity results in loss of groundwater recharge, overbank sedimentation, increased flood velocities, and generates further bed and bank instability. These conditions promote excessive sediment to downstream habitat including Webber Lake. As the channel incises, the groundwater table follows the incision downward which has many ecological effects.
Ecological:
Lower groundwater tables reduces one of three critical elements that comprise a wet meadow, soil water; as a result, vegetation conversion from wet to dry species occurs, and promotes conifer encroachment. Separately, excessive sediment from bed and bank erosion degrades water quality and aquatic habitat. Flood flows confined to an incised channel, absent of a floodplain, limit high-water refuge for fish while scouring spawning habitat and macroinvertebrate communities.

**cost estimate includes planning, design, implementation and monitoring.*

Lacey Meadows Restoration and Management Recommendations, Project #7

Restoration or Management Approach:
1) Develop a restoration plan and implement baseline monitoring
2) Reduce road (Webber Lake Road) impacts to meadow (i.e., stream capture, meadow dissection)
3) Protect areas of high ecological status (using grazing management plan and recreation plan)
4) Develop and implement restoration designs to restore channel-floodplain connectivity and enhance aquatic habitat

Alternatives:
Passive Management of Channel and Meadow: Implement upland restoration (see Project #1) and temporary (3-5 year) grazing exclusion for the Lower Meadow and Lacey Creek to evaluate channel/meadow response. Some active restoration elements may be necessary to encourage bed aggradation and floodplain reconnectivity.

Target Conditions/Success Criteria:
1) Meadow inundation after an 1- to 2-year flood
2) Improved meadow ecological functions and increased acreage of riparian habitat
3) Increased channel width/depth ratios
4) Higher annual-mean groundwater levels
5) Reduced streambank and bed erosion
6) Reduced conifer encroachment

Benefits of channel-meadow restoration in Lower Lacey Meadow:

1) Restored channel-floodplain functions
2) Increased meadow ecological value
3) Enhanced avian and aquatic habitat
4) Reduced erosion
5) Enhanced in-stream aquatic habitat
6) Improved water quality

Restoration concepts
1) Conduct a geomorphic study to evaluate channel evolution (is the channel still incising?)
2) Introduce instream wood to encourage sediment deposition, and reduce flood velocities
3) Encourage or re-occupy secondary channels across the meadow to dissipate flow velocities, erosion, and enhance re-wetting of distal portions of the meadow
4) Layback banks and plant (willow recruitment) in select locations to encourage slope stability and reduce excessive erosion
5) Construct temporary grazing exclosures

Implementation Timeframe
Design and permitting (6-9 months)
Implementation (4-6 weeks)
Monitoring and adaptive management (5-10 years)

Pre- and Post-project monitoring recommendations:
1) Channel morphology (repeat surveys) and detailed mapping
1) Repeat vegetation surveys and meadow assessments
2) Stream gaging (to evaluate flood frequency)
3) Groundwater monitoring (4-6 piezometers)


Lacey Creek (Reach C), Lower Lacey Meadow

Phasing or Order of Implementation:
1) Upland restoration and roads management should be implemented or considered prior to meadow and channel restoration projects.
2) This project, or element of, should be considered in tandem with water-level management of Webber Lake to avoid knickpoint erosion from fluctuating Webber Lake water-levels in the meadow.

Lacey Meadows Restoration and Management Recommendations, Project #8

<u>Problem:</u> Localized overgrazing or browsing of riparian and meadow vegetation; trampling of stream banks
<u>Project:</u> Short-term grazing exclosures and alternative watering sources
<u>Location:</u> Upper and Lower Lacey Meadows

<u>General Description of problem:</u>
The management of livestock grazing within the Webber Lake property is currently not guided by a formal grazing management plan (see Project #7); however, an annual lease with restrictions is in place. Restrictions are identified as limiting grazing to 1,500 head of sheep with some exclusion zones around drinking water source for the campground and the current residence. In the interim, some sensitive areas have been identified that would also likely benefit from additional temporary grazing exclosures. These area include riparian corridors, much of the Upper Meadow, due to its current limited cover, and willow flycatacher habitat in the both the Upper and Lower Meadows. As such, alternative watering sources may need to be identified.

Cost Estimate*:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Project goals	Degradation	Objectives to achieve project goals
Minimize disturbance to streams and sensitive wildlife habitat	Trampled stream banks, increased runoff, sediment, and nutrient input to Lacey Creek	Temporary exclosures established along channel and riparian corridors and other sensitive habitat, alternative watering sources established


Bank trampling from sheep, Lacey Creek, Upper Lacey Meadow


Example of low-cost, temporary exclosure fencing for sensitive habitat.

**cost estimate includes planning, design, implementation and monitoring; potential costs for implementation will vary based on types of grazing facilities included in plan.*

Lacey Meadows Restoration and Management Recommendations, Project #8

Restoration or Management Approach

Temporary livestock fencing (electric) on the Webber Lake property, focused on excluding livestock from the active stream channels, riparian zones and other sensitive habitat without restricting access to the meadows. Willow flycatcher nesting habitat in the upper and lower meadows should be protected with short term exlosures until August 15 of each year. A long term management plan should be implemented to address grazing impacts in the meadows. Alternative watering sources may include solar powered pumps to pump water from Lacey Creek or groundwater to off-stream areas.

Alternatives

No action: continued livestock grazing without exclusion zones would likely contribute to effects on habitat, in contrast with management goals and objectives.

Target Conditions/Success Criteria

1) Vegetation communities and soil surface conditions indicative of high-functioning riparian and channel conditions
2) Sustained or increased density of willows that support flycatcher habitat
3) Alternative watering sources are sustainable in the short-term

Implementation Timeframe

Summer 2014

Phasing or Order of Implementation

Immediate (2014) implementation could serve as a pilot project for developing a more formal grazing management plan.

Special Considerations

Grazing is currently conducted according to the terms of lease between the Truckee-Donner Land Trust and its grazing lessee. The Webber Lake property is part of the Webber Lake grazing allotment within the Tahoe National Forest. Modification of grazing on the Webber Lake property should be coordinated with Tahoe National Forest grazing program. Substantial modification of the Webber Lake allotment management plan, if required to be consistent with the terms and conditions of the Webber Lake grazing management plan, could trigger U.S. Forest Service review of its Webber Lake allotment under the National Environmental Policy Act. Pursuant to California law, development of the grazing management plan must be overseen by a Certified Rangeland Manager (see http://casrm.rangelands.org/HTML/certified.html).

Descriptions of specific grazing-impacted areas in Lacey Meadows Watershed Study Area:

1) Willows have been heavily browsed in Upper Lacey Meadow. Willows provide habitat for the willow flycatcher and other terrestrial species and as well as shade, in-stream habitat complexity, and other aquatic habitat benefits.
2) Bare ground and trampled stream banks, which likely contribute excessive sediment to Lacey Creek are common along Lacey Creek in Upper Lacey Meadow .
3) Trampled banks are occasionally found along the inlets to Webber Lake in Lower Lacey Meadow; bank trampling may contribute to stream widening, incision and headcutting of Lower Lacey Meadow.

6. LIMITATIONS

As stated in the introduction to the report, the objectives of this study are to provide the Truckee River Watershed Council with a characterization of the hydrologic and geomorphic processes that support habitat in the Lacey Meadow Watershed. This is a reconnaissance report, intended to bracket likely historical and potential future conditions, to identify certain hydrologic or geomorphic factors which must be better known, and to help guide initial planning. This report should not be used to assess, site or design individual enhancement or restoration projects without further site-specific investigations. Similarly, it is not intended to serve as a basis for flood management or detailed floodplain planning, both of which are conducted by well-defined and separate procedures, and which frequently require multiple lines of evidence. Use of these results for purposes other than those identified above can lead to significant environmental, public-safety or property losses. Balance Hydrologics should be contacted for consultation prior to considering use of this analysis for any purposes other than the reconnaissance, watershed-scale analysis specified above in this paragraph.

The application of geomorphic history to inferring future channel and corridor change has a long and respected record in the earth sciences. As with all historical or archival analysis, the better the record is known and understood, the more relevant and predictive the analysis can be. We do encourage those who have knowledge of other events or processes which may have affected the site or channel system to let us know at the first available opportunity.

It should be noted that the hydrologic study and associated field measurements were conducted during a two-month period of a single water year and therefore, reflect a snapshot of conditions dependent on the local weather patterns present during July and August 2012, an extremely dry period and dry year. Conditions on the site are likely very different during relatively wet years.

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PERSONAL OBSERVATIONS

Dave Johnson, H. T. Harvey & Associates bat biologist, Personal observation of bat species encountered during field surveys near U. C. Sagehen Field Station.

Helen Loffland, Institute for Bird Populations ornithologist, Personal observations of species encountered in Lacey Meadows during field surveys.

Appendix A

Appendix A. Summarhy of historical aerial photographs and maps, Lacey Meadows Assessment, 1!

Year	Month	Day	Source	color or B/W	Type	Scale	Area Covered	Major Flood Dates	Climate trend	Notes
Aerial Photographs										
1939	June	23	USFS	b/w	**aerial**	unknown	90% of watershed	n/a	dry year; follows 3 wet years	Quality is fair
1955	Oct	22	USFS	b/w	**aerial**	unknown	100% of watershed	**November 20, 1950**	Two consecutive dry years	Still shows original channel alignment in upper Meadow
1966	July	17	USFS	b/w	**aerial**	unknown	90% of watershed	**December 23, 1955, February 1, 1963**; **December 23, 1964**	dry year, follows a wet years	quality is fair (dark photos); after 1963 flood, peak flow of period of record, shows new channel alignment in upper meadow
1969	Dec	31	Google Earth	b/w	**aerial**	unknown	30% (southeastern corner)		wet year	
1983	Sept	5	USDA	color	**aerial**	unknown	60% of watershed	**January 13, 1980, December 20, 1981**	follows wettest year on record (1982)	active channel (unvegetated bars)
1992	July	30	USDA	color infrared	**aerial**	1:24,000	100% of watershed	**March 8, 1986**	drought (1987-1994)	Facilitates identification of groundwater discharge zones and wet meadow complex
1992	Aug	3	USDA	color	**aerial**	unknown	100% coverage		drought (1987-1994)	
2000	July	9	USDA	color	**aerial**	unknown	60% coverage	**January 2, 1997**	dry year following a wet period	Noteable for 1997 flood damage on Truckee River
2011	June	14	Google Earth	color	**aerial**	unknown	75% coverage	**December 31, 2005**	Record snowpack (since 1971)	Peak snowmelt June 29, 2012
Maps										
1889/1895	--	--	USGS	b/w	topo	1:125000	100% of watershed	--	--	Good quality map
1940	--	--	USGS	b/w	topo	1:125000	100% of watershed	--	--	Pre-dates Meadow Lake Road
1981	--	--	USGS	b/w	topo	1:125001	100% of watershed	--	--	Pre-dates multiple logging roads found today

Appendix B

LACEY MEADOW/WEBBER LAKE WORK BOOK

A CONTEXTUAL OVERVIEW OF HUMAN LAND USE

AND

ENVIRONMENTAL CONDITIONS

prepared by

Susan Lindström, Ph.D.

Consulting Archaeologist

Truckee, California

prepared for

Balance Hydrologics, Inc.

Berkeley, California

on behalf of

Truckee River Watershed Council

Truckee, California

July 2012

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LACEY MEADOW/WEBBER LAKE WORK BOOK: A CONTEXTUAL OVERVIEW OF HUMAN LAND USE AND ENVIRONMENTAL CONDITIONS

by Susan G. Lindström, July 25, 2012

INTRODUCTION

The Lacey Meadow watershed assessment study area comprises Webber Lake, Lake of the Woods, Lacey Creek and a number of unnamed tributaries which drain into the Little Truckee River above the Little Truckee River Falls (about 6,650 acres). The study focuses on Webber Lake (at the head of the Little Truckee River) and about 3.5 miles of Lacey Creek and 1,900 acres of Lacey Meadow. Watershed restoration efforts can benefit from an understanding of the long-term ecological role of aboriginal peoples and historical Euroamerican populations in the dynamics of wild plant and animal populations and alterations of the physical environment. As such, a brief contextual history of pre-modern conditions within the watershed is presented in order to document human disturbances and set a baseline of reference conditions from which to assess the contemporary environment. This contextual discussion draws upon the existing literature, supplemented by personal notes and experience. Study results have been organized into a "work book" format -- as a work in progress -- in anticipation that follow-up research in future stages of watershed restoration will augment these preliminary findings. Hence, the topics covered here are not necessarily comprehensive, but target human disturbances that have relevance to immediate watershed restoration issues.

METHODS

Archival and oral history research was conducted by Susan Lindström, Ph.D. Lindström meets the Secretary of Interior's Professional Qualifications Standards. She has 38 years of professional experience in regional prehistory and history, holds a doctoral degree in anthropology/archaeology and has maintained certification by the Register of Professional Archaeologists (former Society of Professional Archaeologists) since 1982.

RECORDS SEARCH

A records search of U.S. Forest Service (USFS), Tahoe National Forest (TNF), Sierraville Ranger District (SRD) heritage files was conducted on June 12, 2012. District Archaeologist, Michael Baldrica, was most helpful in this effort. Files reviewed include:

- archaeological reports and cultural resource atlas of known archaeological sites
- cutting plats and index to cutting plats (ca. 1906-1940s)
- grazing allotment maps
- Sierraville District Land and Corner Atlas
- GLO plats and field notes

- Ranger Carl Scholberg's Notebook ca. 1951 (he was SRD Ranger ca. 1957-1970s)
- 1954 Sierra Booster Map

Other historic maps (on file in Lindström's personal library) and secondary literature sources consulted are listed in the accompanying references cited section.

ORAL HISTORIES

The present resort managers and several long-term clients were interviewed on July 13 and July 24, 2012 at Webber Lake Ranch. Follow-up phone calls and correspondence continued after that time. Interviewees included:

- Ken (KB) and Joan (JB) Bretthauer - managers of Webber Lake Ranch since 1999
- Larry (LB) and Pat (PB) Bullivant - clients for 60 consecutive years since 1947; LB worked as the maintenance man for the resort for many of those years
- Marylou (MM) and Joe (JM) Moeckel -Al and Mary Giddings, MM's parents were also clients since 1947; MM began coming to the resort ca. 1960 when she was 7 years old; JM has been coming to the resort since 1976
- Bob Carnevale (BC) and friend - BC is LB and PB's son-in-law; BC's friend was a close friend of Kathy, LB's and PB's only daughter who passed away last year
- Pat and Patty Meyers (PM) - clients of the resort for about 30-40 years
- Gene Corporon (GC) - client of the resort for about 30-40 years
- Pat [last name?] (P) - client of the resort for about 30 years

NATIVE AMERICAN CONSULTATION

Prior ethnographic studies indicate that the Washoe Tribe is the applicable tribal authority for lands encompassing the project area. In order to incorporate the Tribe's opinions, knowledge and sentiments regarding any potential concerns specific to the project area, Darrel Cruz, Washoe Tribal Historic Preservation Officer (THPO), was contacted. A project description and project maps were emailed to Mr. Cruz on July 25, 2012 and he concurred with study findings and recommendations (see attached correspondence).

PRIOR ARCHAEOLOGICAL RESEARCH AND KNOWN ARCHAEOLOGICAL SITES

A limited archaeological records search indicates that only a fraction of the watershed has been subject to archaeological study. The list of sites and surveys within the watershed (see below) may not be complete. At some point in the future, proposed watershed restoration sites and known archaeological resources should be surveyed and resort standing structures should be subject to an architectural inventory. The TDLT might also consider developing an interpretive plan regarding the historic resort.

Archaeological Surveys within the Watershed

- Payen 1976: land exchangeT19N/R14E/32 (320 acres)
- Flaws 1976, Kent 1976: Lacey Timber Sale

Recorded Sites within the Watershed

- FS-05-17-56-38 = ruin of a log cabin; most likely a "homestead" cabin established for the purpose of livestock grazing on the adjacent meadows (Payen 1976:16)
- CA-SIE-166/FS-05-17-56-39 = petroglyphs, shallow bedrock mortars with cobble pestles, scatter of basalt artifacts situated on elevated ground just above the meadow and a swampy pond (Payen 1976)
- FS-05-17-56-40 = isolated bedrock mortar feature (Payen 1976)
- Henness Pass Road; Mackey et al. (1993:60) and Dixon and Hardesty (2000) recommended the nomination of a Henness Pass Historic National Register District, to include way stations along its route as contributing elements of the district; E. Clampus Vitus installed a granite monument to commemorate Henness-Zumwalt in 1983 near the old Webber Lake Hotel
- FS-05-17-56-75 = isolated milling slab (Flaws 1976)
- FS-05-17-56-76 = bedrock mortar/cupule/milling slick feature and lithic scatter (Flaws 1976)
- FS-05-17-56-80 = notched log bear trap (Flaws 1976); "This part of the forest is a noted bear haunt, and a log trap is built here for Bruin's inspection." [Lemmon 1877]
- Dr. Webber's Monument: "Another short trip is by boat across the lake to a dense part of the forest, where are hidden, but a few rods from the lakeshore, Dr. Webber's Monument, a dome of white granite rising through the trees; and just beyond Lover's lake, green with reflections of the overhanging trees." [Lemmon 1877] [It is uncertain if this "monument" is the prominent granite outcrop on the southeast side of Lacey Meadow, designated as "bluff of barren rocks" on the 1872 GLO Plat or it this is some kind of fabricated monument.]
- Webber Lake Ranger Station (shown on TNF 1921, 1926, 1930) in SW 1/4 Section 32
- Webber Lake Hotel; E. Clampus Vitus set a commemorative plaque on the old hotel
- miscellaneous buildings from Webber Lake resort, including the office, cabins, apartment house, ice house, etc. (see below)

Recorded Sites in Proximity to the Watershed (relevant historic themes)

- CA-SIE-144/05-17-56-71/05-17-57-691:Sierra Nevada Wood and Lumber Company/Hobart Estate Company Railroad Grade System (Sprowl 1986)

- FS-05-17-56-601: Little Truckee River Ditch; precursor alignment to the existing operating Sierra Valley Mutual Water Company Ditch; original ditch built 1871-1878 to provide irrigation water for Sierra Valley agriculture (Francis 2012; also see Sutherland 1995)

- FS-05-17-56-483: Davis Station (Dixon and Hardesty 2000); Davis Station is located about five miles east of Webber Lake; Dixon and Hardesty (2000) recommended the nomination of a Henness Pass Historic National Register District and FS-05-17-56-483 was recommended eligible as a contributing element of the district

- CA-SIE-41: Moore's Station (Mackey et al 1993); Moore's Station is located two miles east of Davis Station; Mackey et al. (1993) recommended the nomination of a Henness Pass Historic National Register District, although CA-SIE-41 was recommended ineligible

Note: The historic complex at Webber Lake ("Webber's Station") fits the documentary model of historic way stations, with the added focus on lake-based recreation. These complexes typically included two-story lodging or public house, stables, blacksmith/repair facilities, facilities for the maintenance of livestock, equipment and a small residence staff (Mackey et al. 1993:53). As the only surviving standing building way station on the Henness Pass Road, Webber's Station would seem to qualify as a contributing element to such a district, were it ever to be nominated. It retains its physical integrity and integrity of setting.

Other Buildings in the Watershed

- Old Dairy was 1/4 mile south of the lake along the old "county" road [road from Meadow Lake]; just in the trees; remains of the old dairy are still there (LB personal communication 2012)

- Vern Johnson's Cabin in meadow area; rockwork still remains (LB personal communication 2012)

- W,H. ("Papa") Johnson's house on west side of meadow; burned down (LB personal communication 2012)

- Cliff Johnson's house near Webber Lake; still there (LB personal communication 2012)

- Three "teacher's cabins" were along county road south of Webber Lake; they were moved back into the trees; Doug Garton (former resort manager) had LB tear them down so as not to pay taxes; several buildings within the main resort complex were also torn down for this same reason (LB personal communication 2012)

- Log Cabin in upper meadows; LB metal-detected the area and found nothing but a canteen (LB personal communication 2012)

PREHISTORY AND WASHOE HISTORY

A large view divides the prehistory of the Sierra Nevada and adjoining regions into intervals marked by changes in adaptive strategies that represent major stages of cultural evolution (Elston 1982, 1986). In broadest terms, the archaeological signature of the Truckee Basin marks a trend from hunting-based societies in earlier times to populations that were increasingly reliant upon diverse resources by the time of historic contact (Elston et al. 1977, 1994, 1995). The shift in lifeways may be attributed partially to factors involving paleoclimate, a shifting subsistence base, and demographic change. Two distinct prehistoric lifeways are believed to have once characterized the area's early occupants (Heizer and Elsasser 1953). Subsequent studies have further refined the culture history of the region (Elston 1971; Elston et al. 1977). Pre-Archaic remains suggest initial occupation of the region by about 9,000 years ago (Tahoe Reach Phase). Subsequent Pre-Archaic to Early Archaic occupation dates from about 7,000 years ago (Spooner Phase). The most intensive period of occupation may have occurred at varying intervals between 4,000 and 500 years ago (Martis Phases during the Early and Middle Archaic and Early Kings Beach Phase during the Late Archaic). The protohistoric ancestors of the Washoe (Late Kings Beach Phase), also of Late Archaic Times, may date roughly from 500 years ago to historic contact.

The Washoe regard all prehistoric remains and sites within the Truckee Basin as associated with their own history. Although it is clear that the Truckee Basin, including Lacey Valley, falls within the Washoe homeland, with primary use by the northern Washoe or *Wa She Shu* (D'Azevedo 1986; Downs 1966; Jacobsen 1966; Nevers 1976), the western side of nearby Sierra Valley was the territory of the Northeastern Maidu. Given the close proximity, it is possible that Maidu made forays into the Webber Lake vicinity. They are part of an ancient Hokan-speaking population, which has been subsequently surrounded by Numic-speaking and Penutian-speaking incomers such as the Northern Paiute and Northeastern Maidu, respectively. Accordingly, the Washoe once embodied a blend of Great Basin and California in their geographical position and cultural attributes.

HORTICULTURAL PRACTICES

The ethnographic record suggests that during the mild season, small groups traveled through high mountain valleys collecting edible and medicinal roots, seeds and marsh plants. Many hundreds of montane plants were regarded as significant to Native Americans (Lindström et al. 2000:38). Women systematically shook mature seeds from the flower heads as they gathered whole plants. Certain targeted species, especially bulbs, were planted. Stands of plants were pruned, culled and weeded, and the ground surface was cleaned and restored after digging to encourage new growth and maintain beds. The same logic applied to fisheries and wildlife. In the higher elevations, men hunted large game (mountain sheep, deer) and trapped smaller mammals. The Truckee River and tributaries such as the Little Truckee River were important fisheries year-round.

FISHING

"Truckee River abounds with prettier, larger, hardier trout, than we ever saw elsewhere. Some are about two feet long. Washoe Indians harpoon them, and sell them to white people at two bits apiece. As many as they catch more than are demanded fresh, are split and spread, smoked, dried, and packed in baskets for Winter. The baskets are made by squaws, on a long round grass found in the meadows. Some of these baskets are made so tight as to hold water; and in all respects they are neatly and mechanically put up." [*Sierra Democrat* 6/2/1860]

FIRE

California vegetation evolved with fire, not only to tolerate it but some species even require it. This relationship may have, in part, been influenced by millennia of micro-burning by Native Americans. There is some evidence that Washoe people deliberately set fires in the forest or valley (Lindström et al. 2000:40-41), such that native burning extended the range, increased the frequency and altered the timing of the natural fire regime. Localized micro-burning concentrated around camps and inside prime meadow resource catchments.

> When the Indians had sole use of the [Sierra] valley, they used to round up the antelope every Fall and kill their winter's meat supply. As an aid to the round-up they burned off all of the tall dry feed. This kept the sage down..." [Strang 1969 in Sinnott 1976:88]
>
> The Indians, by starting fires in the hills around the [Sierra] valley, are giving us a smoky, hazy atmosphere, and a taste of Indian Summer. [*Mountain Messenger* 11/2/1867]

The degree to which Washoe horticultural and fire practices influenced the structure and composition of various habitats in Lacey Meadow is unknown.

ARCHAEOLOGICAL REMAINS

The Washoe have a tradition of making long treks across the Sierra passes for the purpose of hunting, trading and gathering acorns. These aboriginal trek routes, patterned after game trails, are often the precursors of our historic and modern road systems. Petroglyphs may be an archaeological signature marking these ancient travelways.

Archaeological evidence of these traditional subsistence activities are found along the mountain flanks as temporary small hunting camps containing flakes of stone and broken tools. In the high valleys more permanent base camps are represented by stone flakes, tools, milling implements, and house depressions. Milling implements such as portable slabs and grinding features such as bedrock mortars have been recorded in Lacey Meadow. Ethnographic records indicate a broad spectrum of uses for milling tools including the processing of roots, tubers, herbs, meat, bone, dried fish, rodents, insects, medicines, pigments, and hides. Washoe categories of ground stone are based on the dichotomy of an ownable portable tool (such as a milling slab or handstone), which symbolize mobility and flexibility. In contrast, a communal permanent place for work (such as the bedrock mortar) symbolizes "home" and a stationary, domestic space that may represent a long and unbroken chain of occupation associated with a specific landscape and plant resource management area. Each camp might be "claimed" by the construction and maintenance of a bedrock or immovable boulder milling stations, although women from different camps might gather at a communal bedrock mill (Rucks 1995). The presence of portable milling implements and permanent milling features in Lacey Meadow furthers our understanding of human lifeways in terms of concepts of place, ownership, permanence, and mobility.

Throughout prehistory and even into the 21st Century, the Washoe have maintained contact with their traditional lands. The contemporary Washoe have developed a Comprehensive Land Use Plan (Washoe Tribal Council 1994) that includes goals of reestablishing a presence within the Tahoe Sierra and re-vitalizing Washoe heritage and cultural knowledge, including the harvest and care of traditional plant resources and the protection of traditional properties within the cultural landscape (Rucks 1996:3).

TRANSPORTATION

PRIMARY ROADS (*maps attached)

Henness Pass Road

Old Emigrant Road

In 1844 Caleb Greenwood guided the Stevens, Murphy Towsend Party (the first emigrant party to cross the Sierra by wagon) from present-day Verdi up the more difficult route through the Truckee River Canyon. By 1845 Greenwood and sons charted an easier route and precursor to the eastern section of the Henness Pass Road -- starting in Verdi, traversing above Dog Valley over First and Second summits to the Little Truckee River and then veering south to Prosser Creek (Jackson 1967: 1-6). Through the 1850s the road remained an undeveloped emigrant trail between Virginia City, Nevada and Marysville, California (Howard 1998: 69). With the discovery of gold in 1848-1849 on the sierran west slope, the Comstock Lode in 1859, the boom-and-bust gold strike at Meadow Lake in 1866, and the development of agriculture in Sierra Valley in support of the mines, the need arose to develop a connecting trans-sierran route(s).

Henness Pass Turnpike and Toll Road

Henness Pass at 6,842 feet marks the headwaters of Pass Creek, a tributary of the Middle Fork of the Yuba River. Due east of the pass is Webber Lake, the headwaters of the Little Truckee River. Henness Pass is a remarkably easy crossing of the divide between the Great Basin and the Pacific slope (Howard 1998: 69). The Henness Pass Turnpike and Toll Road is actually a system of roads, with a single route leading from the east. It proceeded from Verdi, or perhaps as far east as Reno (Stock 1982:71), traversed through Dog Valley and over First and Second summits, crossed the edge of Sardine Valley, followed along Davies Creek and down the Little Truckee River to the northern edge of Webber Lake. It then trended westerly over Henness Pass and down through Jackson's Meadows where it split into three branches with termini at Marysville, Nevada City and Dutch Flat. Descending the western slope additional sub-branches spread out widely to various gold camps (Duncan 2001:np; Goodwin 1960:8; Howard 1998:69, 159-161; Jackson 1967:22-23, 27; Jackson et al. 1982). Thus the Henness Pass Road was a consolidated thoroughfare from Verdi west across the Dog Valley grade and through Sardine Valley, but beyond that point it had many branches going to Loyalton, Sierraville and Downieville to the north and Marysville, Nevada City and Dutch Flat to the west.

The Henness Pass route was pioneered by Joseph Zumwalt on his way westward to the North Yuba diggings in 1850 (Mackey et al 1993:10). The name Henness is allegedly derived from Patrick Henness who with a partner named Jackson, supplied hay from Jackson Meadows to spread on the road and compacted to improve it (Mackey et al. 1993:11). While affiliation to Henness Pass Road is somewhat in doubt, it is accepted that Henness is credited with naming the 6,700 foot pass that bears his name. Joseph Zumwalt is credited with actually charting the route of the Henness Pass Road.

The route was formally surveyed in 1855. The road was described as being 15 to 18 feet wide, banked with ditches for drainage, and a grade not steeper than six feet in 100 (Howard 1998:160). Regular stage and mail service was established soon after and the first stage trip from Marysville to Virginia City was made in July 1862 in 25 hours and 28 minutes (Howard 1998:70; Sinnott 1976:33). The 1860s saw the heyday of travel along the Henness Pass Road. Traffic became so brisk that arrangements were made to have the freight teams travel during the day and the passenger stages at night because of the small number of turnouts and hence difficulty in passing (Sinnott 1976 I :76). Daily fairs on the Truckee Turnpike were projected to be 75¢ for a two-horse wagon on the up trip and 50¢ on the down trip; for a four-horse wagon, $1.25 on the up trip and 75¢ on the down trip; for a six-horse wagon, $2 and $1; and for an eight-horse wagon $2.50 and $125. Various lesser tolls were charged for horsemen and loose stock. The rationale for the price difference between up trips and down trips was that the former usually carried heavier loads of mining equipment and gear bound for Virginia City (Howard 1998:161). Trans-sierran traffic dropped dramatically and was reduced to local travel with the construction of the Central Pacific Railroad over Donner Pass. As such Henness Pass routes did not survive into the auto age when paved highways across the Sierra -- apart from the paved section between Webber Lake and Jackson Meadows (Howard 1998:161; Jackson 1967:26-27).

Historic Accounts

1861 "This is the first point where the dust-covered traveler enter[s] Sierra County on his way from Washoe by the Henness Pass. Here you can find refreshments dealt out by a former townsman of yours, Dr. Webber. We commence descending through a beautiful valley on a splendidly graded road. 3 miles brings us to Fenn's Ranch [shown on the 1872 GLO plat], another host whom travelers love to patronize. We continue on our winding way, and 5 miles brings us in front of Richard Rofferd's place (formerly known as Jackson's Ranch). It is about completing one of the finest 3 story buildings you can find outside of the towns." [*Sierra Democrat* 9/11/1861 in Mackey et al 1993:19]

1863 "At calculation we must have passed 2 or 3 hundred teams. Every wagon was heavily freighted, some with merchandise, others with iron castings for the mills, and quite a goodly number with families, fruit, whiskey, and furniture. There were horse teams, mule teams and ox teams. I never before saw so many teams on one road. No wonder the dust was so deep!" [Browne 1863:24 in Mackay et al. 1993:9]

1878 "...[page 22] In the winter of '60 I moved up on the Henness Pass where I lived for six years. The winter after I moved to the Henness Pass I made fourteen trips over the Sierras on snow-shoes often carrying sixty pounds on my back. I piloted many parties over the Sierras on their way to the silver mines. In the fall of '59 before moving to Truckee Meadows I blazed out the road from Eureka South (in Nevada County) to Jackson's Ranch... [page 23] During the spring of 1860 I began building up the place known as Moore's Station on the Henness Pass. This spring I also discovered a very beautiful lake three miles long and half a mile wide [Independence Lake]. This lake up to that time had remained unknown. It is surrounded by high mountains and timber and so situated that it cannot be seen until nearly approached. The lake is full of mountain trout and the scenery is of the wildest description. It is about four thousand feet above tide water and will someday be a favorite place of resort. On the fourth of July 1862 I again visited the lake with a party of friends and had a trout dinner. As I had discovered the lake my friends proposed that I [page 24] should also name it. I did so calling it Independence Lake...[page 27] I lived on my place on the Henness Pass until the Central Pacific Railroad was so far advanced that the hotel business was destroyed on the road. My place on the Henness Pass was about ten miles from the summit of the Sierras. I was the fourth settler on that great high-way over the Sierras. To Mr. Henness belongs the credit of the discovery of this pass and the opening of it to emigrant travel in 1849 and Dr. David Gould Webber was the [page 28] first settler upon it. Jackson Ranch was next settled...and the fourth was myself at Moore's Station. I took part in the first efforts to get the road open for mule trains in 1860. I acted as pilot for the first train that tried to break through the snow in March of that year. The Pass attracted the attention of Messers. Freeman and Wood and they built the road from Forest City to Jackson Ranch. Another company built the road from Eureka South to Jackson where they came together and from there it was built by both companies. The road was opened sufficiently for travel in 1860. In the winter of 1862 two lines of stages, the California Stage Company and James McCues [spelling?] ran over the road and it required a great deal of work to keep it open during the storms. It was kept open by ox teams which had to be kept running all the time during the storms. I kept seven miles open by contract with the road company. [page 29] When winter broke in 1863 the roads in some places were almost impassable. The stages often stuck fast in the mud and had to be pulled out by ox teams and the passengers were often several miles in advance of the stage. Here was some old fashioned California staging. A passenger was not considered a good one unless he would go on foot and carry a rail on their shoulder to pry the stage out of the mud. The residence of Dr. Webber is on the Henness Pass at Webber Lake and on the summit of the Sierras. The Dr. is one of the old pioneers and still resides there. He has a most beautiful and romantic place and favorite place of resort. The Dr. has a large warm heart and all old pioneers hold him in high esteem. He has had some reverses of fortune but like pure gold always comes out purer and brighter from every ordeal. He has been more active than most Pioneers, has done a great deal to develop the resources of the state and deserves a bright record in her annals." [memoires of Agustus Moore1878]

Map Data

- "Henness Pass Road (*Map of Sierra County 1867)
- "Henness Pass Road/Old Emigrant road" shown north of Webber Lake (*GLO Plat T19N/R14E 1872)
- "Old Emigrant road" (GLO Field Notes T19N/R14E 1872:36)
- "Henness Pass Wagon Road" shown north of Webber Lake (*GLO Plat T19N/R14E 1872)

- Hennes pass wagon road (GLO Field Notes T19N/R14E 1872:25)

- "Hennis [sic] Pass Wagon Road" (GLO Field Notes T19N/R14E 1872:27)

- "Hennis [sic] pass wagon road...note at this point the wagon road passes over a low summit of the Sierra Nevada mountains through the Hennes pass the passage is so low and gradual that a person would scarcely discover that they had made the pass until they noticed the water of the springs in this vicinity running in opposite directions." (GLO Field Notes T19N/R14E 1872:36)

- route of Henness Pass Road shown north of Webber Lake on the following maps: Sierra County Map (*1867); Howard (*1998:140); GLO T19N/R14E (*1872); Truckee Sheet (*1889); Truckee Quad (*1897); TNF (*1915, *1921, *1926); USGS Sierraville 15' Quad (*1955) shown as an "unimproved dirt road" disconnected from Henness Pass Road east of Webber Lake in Section 28 and as an "unimproved dirt road" west of the lake with a short segment paralleling it to the north into Coppins Meadow; TNF (*1962) shown as a "main motor road east of Webber Lake and as a "poor motor road FS 19N03" west of Webber Lake, with a short segment paralleling it to the north into Coppins Meadow; TNF (*1977) shown as an "unimproved road" east of Webber Lake and west of the lake until it becomes the Fibreboard Road (Section 20), Fibreboard Road is now a "light-duty road improved surface"; TNF (*1983) shown as an "unimproved road" east of Webber Lake and west of the lake until it becomes the Fibreboard Road (Section 20); Fibreboard Road is now a "secondary highway"

- Henness Pass Road and way stations along its route (including Webber Lake) shown on sketch map by Sinnott (*1976)

Road from Cisco (Meadow Lake) to Webber Lake

This road passes through upper and lower Lacey Meadow. The road was a main thoroughfare and repairs and improvements were likely necessary over the years. Portions of the present-day road contain a gravel surface and it is uncertain where this material was quarried. According to KB (personal communication 2012), the Johnsons never engaged in gravel quarrying activities on the property and he has no knowledge of road surfacing with these materials. KB maintains that the Johnsons never imported any foreign rock or soil onto the property.

Map Data

- "Road from Meadow lake to Webber lake" (GLO Field Notes T19N/R14E 1872:43, 51)

- shown on GLO for T19N/R14E (*1872) and T18N/R14E (*1861/1872); Truckee Sheet (*1889); Truckee Quad (*1897); TNF (*1915); TNF (*1921) shown as "road fair or good"; TNF (*1926) shown as "road minor or very poor" with "trail" from White Rock Lake entering from the southeast and intersecting in Section 5; TNF (*1930) shown as "good motor road" with "trail" from White Rock Lake entering from the southeast and intersecting in Section 5; Truckee Quad (*1940 edition; 1951 reprint) shown as double hatched-line road (i.e., main dirt thoroughfare); USGS Donner Pass and Sierraville 15' Quads (*1955) shown as "unimproved dirt road;" TNF (*1962) shown as "main motor road FS 19N11"; the main road accessing Meadow Lake, along the Henness Pass Road east of Webber Lake, paralleling the Fibreboard Road ("good motor road" to the north, and ending at Little Truckee Summit; TNF (*1977, *1983) road not shown

SECONDARY ROADS (*maps attached)

Trail from Webber Lake (North) to Sierra Valley

Map Data

- "Trail from Sierra Valley to Webber Lake" (GLO Field Notes T19N/R14E 1872:25)
- shown on GLO T19N/R14E (*1872); Truckee Sheet (*1889); Truckee Quadrangle (*1897); TNF (*1915); TNF (*1921) not shown; TNF (*1926,*1930) and Truckee Quad (*1940 edition; 1951 reprint) road merges with road to Bear Valley before turning north in Section 21; USGS Sierraville 15' Quad (*1955) disconnected from Webber Lake and not appearing until the north half of Section 21; TNF (*1962) shown as "trail" extending northward from the north edge of Section 21 as a "jeep trail"; TNF (*1977) shown as "trail" extending northward from Webber Lake; TNF (*1983) shown as a "unimproved dirt road" north of Webber Lake to the Fibreboard Road where it is incorporated as a "gravel road" ending at the Section 21 north line

Trail from Webber Lake (Northeast) to Bear Valley

Map Data

- shown on Truckee Sheet (*1889) and Truckee Quadrangle (*1897); TNF (*1915) not shown; TNF (*1921) not shown; TNF (*1926) incorporated into road through Rice Canyon to Bear Valley; Truckee Quad (*1940 edition; 1951 reprint); USGS Sierraville 15' Quad (*1955) shown as ending at "new" Henness Pass Road; TNF (*1962; *1977; *1983

Road Encircling Webber Lake

Map Data

- "Dr. Webber has also built a good road circling the lake." [Edwards 1883:54] [Note: such a road would have had to cross the Webber Lake outlet either at low water or on a bridge or crossed downstream from the outlet; a road along the east side of Webber Lake is shown on the USGS Quad (*1940 editi9on 1951 reprint).]
- road along east shore Webber Lake shown on Truckee Quad (*1940 edition 1951 reprint)

Branch Road from Henness Pass Road to Coppins Meadow (Sections 20-21)

Map Data

- shown on Truckee Quad (*1940 edition 1951 reprint)

-Road through Coppins Meadow now part of Fibreboard Road but still subsidiary to Henness Pass east of lake on TNF (*1962); now main Fibreboard Road with Henness Pass east and west of lake as secondary as shown on TNF (*1977; *1983)

Road to Lake of the Woods

Map Data

- shown as double hatched road on TNF (*1962)
- shown as completely new road with switchback on TNF (*1977)

Fibreboard Road (Road to Jackson Meadows Reservoir)

Map Data

- USGS Sierraville 15' Quad (*1955) shown as "unimproved dirt road"
- TNF (*1962) shown as "good motor road 19N07" to Webber Lake and "poor motor road" west of Webber Lake
- TNF (*1977) shown as "light duty road improved surface" SR 89 to Jackson Meadows Reservoir
- TNF (*1983) shown as "secondary highway"
- LB personal communication: original Henness Pass road went south (in front) of the hotel before it was detoured to an existing logging road to the north [i.e., Fibreboard Road] ca. early 1960s

Section 16-17 Road to Haypress Valley

Map Data

TNF (*1977) shown as "unimproved road" branching northwest off of Fibreboard Road

TNF (*1983) show as "gravel road" branching northwest off of Fibreboard Road

WEBBER LAKE

DR. WEBBER'S HOUSE/WEBBER'S STATION

A variety of way stations (wayside camps, watering stations, boarding houses, and hotels) emerged to serve this great traffic on the Henness Pass Road. Nineteenth century way stations in the American West were typically characterized by buildings and other facilities to maintain livestock, equipment, and a small resident staff, usually comprising a two-story lodging or public house, stables, and blacksmith/repair facilities. Way stations differed according to size, diversity of activities, and household composition and organization, depending upon their status as a terminal station, a home station or an intermittent `swing' station (Mackey et al 1993:49). In 1852 David Gould Webber located all the land around "Little Trucky Lake" (now known as Webber Lake) for a stock range (Fariss and Smith 1882:26; Hoover et al. 1966:360). During and after completion of Dr. Webber's Hotel in 1860 other way stations sprang up along the Henness Pass route. The 1865 Sierra County Assessor Rolls lists the way stations on the Henness Pass Toll Road in geographical order and gives the distances among them.

Map Data

- His place of residence is mentioned as "Webber's Station" in Brewer's Notes, November 1861 (Hoover et al. 1966:360)
- "Dr. Webber's house" (GLO Field Notes T19N/R17E 1872:25)
- It then became known as "Webber's Station" but that was changed to "'Webber Lake" two years later (Lutes and Scholberg 2006:3).

Historic Accounts

1869 "About Webber Lake. In about 1852 Dr. D.G. Webber, who had the year previous owned and lived on Oak Ranch on upper Goodyears Creek, acquired the meadow and a lake on the Henness Pass road, which he at once resolved to stock with fish. The lake, called by the aborigines, Truckee, is situated seven miles south of the head of Sierra Valley, and twenty-eight miles from Truckee, and lies beside the once well-traveled road from Sierra Valley to the mining town of Summit City [Meadow Lake], at the point where the old emigrant road through the Henness Pass crosses it. The Doctor built a station there and for a time coined money.." [*Mountain Messenger* 4/10/1869]

1877 "...with the boom-and-bust of the gold strike at Meadow Lake after 1862 and with the progress of the railroad over Donner Pass and completion in 1868, travel on the Henness Pass Road lessened and gradually the Webber premises assumed the character of a health and pleasure summer resort rather than a way station along a major trans-sierran thoroughfare." [Lemmon 1877:364]

1949 "But the proprietor had no intention of running a wayside inn. He had other and more quixotic plans." [Hinkle and Hinkle 1949:227]

WEBBER LAKE RESORT

Webber Lake resort was one of the earliest recreational resorts in Sierra County and was the first attempt to capitalize on the attractions of the Sierra Lakes region and the natural landscapes. Dr. Webber built the hotel in 1860. Open from June until November, the resort was easily accessible by stage from all points. He stocked the lake with fish, mapped horse trails to the uplands and built bridle paths through the woods. He added a sanitarium for tubercular patients and a solarium for their sun baths. He established a school for their children in the 1870s during the summer months (*Mountain Messenger* 4/10/1869; 9/9/1876). He was not interested in making money as his resort rates were "the cheapest pleasure resort in California" (Lemmon 1877:364 quoting The Sacramento *Bee*). If the people could pay for the service, that was good;

if not, it was forgotten. He continued to take in on credit a steady procession of ailing and insolvent people. His many interests and his open handedness set the tone of his resort (Lemmon 1877:364; Lutes and Scholberg 2006:4; Sinnott 1976:8). Webber was a man of unblemished charity. There is no accurate count of the number of children adopted or financially staked by Webber, but it must have been well over fifty...By 1860 all of them had found useful niches in life -- in trade, farming, law, or medicine (Hinkle and Hinkle 1949:227). During his lifetime he was a student, a laborer, a drug clerk, stock dealer, gold miner, building contractor, horse breeder, school superintendent, rancher, resort owner, medical doctor and philanthropist (Lutes and Scholberg (2006:1). Webber died in 1882 at his ranch near Loyalton (Lutes and Scholberg 2006:4).

Historic Accounts

<u>1877</u> "Of all the popular resorts found on these passes the highest and prettiest, and that which proves the most satisfactory because most beneficial and cheaply enjoyed, is the noted mountain gem of Webber lake, a snow-formed, crystal sheet of water reposing in a gently sloping, basin-shaped, forest-clothed valley, occupying the highest part of the well-known Henness pass through the high Sierra. Webber lake is nearly circular in shape, about a mile in diameter, and nearly 7,000 feet above sea level in Lat. 391/2° north by Long. 129 1/2 ° west, hence the region is sub-alpine, the scenery peculiarly grand, the flora rare, often new to science, the fishing and hunting unexcelled, the climate cool and health-giving, the waters pure and delicious, added to all which the entertainment or medical assistance furnished by the proprietor, Dr. D.G. Webber, at his spacious hotel and sanitarium is of the most satisfactory kind, for he is a genial, efficient, liberal-hearted gentleman, and one of the most skillful, sympathetic, benevolent and successful physicians in California." [Lemmon 1877:353]

<u>1909</u> An advertisement for Webber Lake ca. 1909 touted the resort as a place: "*For Rest - For Health - For Recreation*;" as the "the Queen of Mountain Lakes for fly fishing" and further making the claim of: "*No Poison Oak. No Rattlesnakes. No Mosquitoes*." The ad was sponsored by the Webber Lake Hotel Company and distributed by the Peck-Judah Company with offices at the Southern Pacific Railroad in Truckee, permanent address in Stockton, California, and summer address in Hobart Mills. At that time hotel rates were $12.50/week and upwards. The hotel was opening under new management with new improvements and regular access by stage. Amenities included: Assembly Hall; Club House; boats; baths; free amusements; and side trips on foot, horseback and by wagon for hunting, fishing, and recreation.

Map Data

- Truckee Sheet (*1889) and Truckee Quadrangle (*1897) two buildings are shown
- TNF (*1915) three buildings shown on

WEBBER LAKE CLUB

Map Data

- "Webber Lake Club", one building shown on TNF (*1926) as one building

- LB (personal communication 2012) Bohemian Club members stayed at Webber Lake

WEBBER LAKE RANCH

Map Data

- Truckee Quad (*1940 edition reprint 1951) and TNF (*1962) four to five buildings shown on five buildings shown
- TNF (*1977) campground and three buildings shown north of lake and two buildings on west shore

Oral History Accounts

W.H. ("Old Man" or "Papa") Johnson; W.H. Johnson bought resort in 1941; he owned meadows to the south; sons were Vern and Clifford (LB personal communication 2012)

Vern and Betty Johnson were involved with the resort ca. 1940s-1959); Betty committed suicide after Vern died (ca. 1959); Clifford was involved in grazing cattle and sheep; he died and his wife Barbara now owns the resort

Doug Garton was the resort manager ca. 1950s until current managers Ken and Joan Bretthauer took over in 1999

Resort Building Complex

The hotel and the front half of office was built in 1864; LB built the back of office ca. 1950s (LB and KB/JB personal communication 2012). Present resort buildings include: Big Buckhorn Cabin, Little Buckhorn Cabin, Carson Cabin (former garage); garage; Polka Dot Cabin; Cherry Cabin; Uncle Tom's Cabin; Palace Cabin; Peterson Cabin; Ice House; Twin Sisters Cabin; three of the cabins were moved to Webber Lake resort from Sardine Valley. Former resort buildings include: Glass House and Cook Shack (Garton had LB tear them down). The old buildings were still standing in 1956 when John W. Hinckley visited Webber Lake. He wrote that carpenters were repairing the old hotel, that the old sanitarium and solarium were still standing, and that numerous campers were enjoying the beautiful, secluded lake. "I walked about the old buildings, took color pictures of the grounds, the lake and towering mountains, and made mental eulogies on the singular philanthropist." [Lutes and Scholberg 2006:4]

Clients take pride in maintaining the grounds around their respective cabins and camp areas. They respect vehicle closures in Lacey Meadow and cooperate in monitoring the activities of unauthorized visitors those who don't (KB/JB personal communication 2012).

Other

"In 1884 James O'Neal was convicted of the murder of John Woodward, a dairyman at Webber Lake. Although there was a great deal of hunting, the murder weapon was never found. In 1985 while Doug Garton was caretaker at Webber Lake, he found an old pistol in the well. Lee Adams, Sierra County Sheriff said it could very well be the "missing murder weapon" (Lutes and Scholberg 2006:5). Actually LB found the weapon and gave it to Garton (LB personal communication 2012).

LOGGING

The Hobart enterprise of the Sierra Nevada Wood and Lumber Company (SNWLC) owned much of the public land in the project vicinity until 1936 when lands were exchanged into USFS jurisdiction. Leaving exhausted timber supplies on 20,000 acres above Lake Tahoe's northeast shore in 1895, the SNWLC moved its base of operations from Incline to Overton (Hobart Mills), located 6½ miles north of Truckee (Myrick 1962:439; *Pacific Coast Wood and Iron* 8/1896; Trespel and Drake 1991:50). Here, the SNWLC set up operations on 5,000 acres of land acquired in a land exchange with the Truckee Lumber Company. By 1898 timber holdings numbered 75,000 acres; acreage rose to 85,000 in the mid 1920s (Knowles 1942; Trespel and Drake 1991:50-51; Wilson 1992). The SNWLC was dissolved in 1917, with properties transferred to the Hobart Estate Company (Myrick 1962:441) and operations were expanded. Timber depletion and declining lumber orders in 1931 forced overall downscaling. In 1936 the company shut down their plant at Hobart Mills (Trespel and Drake 1991:46).

Like other contemporary mill operations, logging was centered around the development of a complex network of narrow gauge railroads. However, historic railroad logging by the company did not extend into the project area watershed. The last recognizable vestiges of the SNWLC railroad along the Little Truckee River are in Sections 14, 15 and 22, T19N/R15E (Michael Baldrica personal communication 2012; Myrick 1962:440; USFS Map 2011-2012). It is unlikely that the Fibreboard Road or any of its branching roads within the watershed could be one of these railroad grades because the 1939 aerial photograph does not show a grade or road in those locations (Francis ASR 2012:3).

On 1866-1873 GLO Survey plats, timber stands around Webber Lake are characterized as "Heavy Growth of Tamarack, Red & White Fir, Yellow Pitch Pine Timber and some Cedar." "Timber Tamarack Fir & Pine" or "Timber Tamarack Scattering" is mentioned numerous times in field notes describing the area now contained by the project (GLO Field Notes T19N/R14E 1872). Since the targeted species of historic logging was pine, the SNWLC may not have found it profitable to harvest areas surrounding Webber Lake given the relatively high density of tamarack (lodgepole pine) and red and white fir. With the advent of the pulp and paper industry after 1900, some stands were re-entered to harvest fir, provided that some means of timber transport was in place. The market demand for fir products is relatively recent.

USFS-SRD cut plats dating from about 1906 into the 1940s show very little cutting within the watershed study area. A record of later cuts are limited to T19N/R14E, Section 17 (cut in 1971), Section 20 (1958), and Section 21 (1952, 1958), and harvesting in Section 5, T18N//R14E in 1971 (TNF n.d.). Land in sections 5 and 17 were owned by Fibreboard Products, Inc.

GRAZING

The period 1846-1868 saw considerable wagon traffic along the Old Emigrant Road/Henness Pass Road in the vicinity of Webber Lake. Adjacent meadows received intermittent grazing use from the trail herds and wagon and stage teams travelling with emigrant parties in the

1840s and early 1850s, and again in the 1860s by travelers along the Henness Pass/Dutch Flat Roads. Way stations and various logging camps undoubtedly made use of the adjacent range lands during this period (Goodwin 1960:8, 10, 133). By the 1870s ranchers were using the mountain meadows for summer pasture and stockmen centered herds around Sierra Valley by the 1880s (Jackson et al 1982:113-114; Sinnott 1976). The development of resorts in high elevation pastures during the 20th century and increased use of the automobile to access these resorts, created competition for grazing lands.

An undated 19th Century advertisement for the "Webber Lake Hotel" (when rates were just $3 per day) shows cattle grazing above the shores of the lake. William H. Johnson (a subsequent owner of the Webber Lake resort ca. 1941) was a well-known sheep man. He had originally been a cattleman, like the rest, and according to LB (personal communication 2012), W.H. Johnson grazed cattle and had a dairy about 1/4 miles south of Webber Lake along the old "Road from Cisco (Meadow Lake) to Webber Lake." His shift to sheep made him something of an "outsider" in the community. He ran flocks in the west end of Sardine Valley in an area described as "on the way to Tucker Valley (Jackson 1967:43). His son Clifford grazed sheep on his land in the upper Lacey meadow. Stock were wintered in Roseville on the home ranch. Clifford did his own herding and did not need to hire outside help. However MM (personal communication 2012) remembers her dad referring to Basques who ran sheep for Clifford and lived in small trailers while on the range. An old small trailer is currently stored outside the entrance to the Webber Ranch Complex. While Basque sheepherders are documented in nearby Perazzo Meadows (Michael Baldrica, personal communication 2012; Mallea-Olaetxe 2000; Smith and Baldrica 1993) downstream on the Little Truckee River, their presence in Lacey Meadow is uncertain.

Before U.S. Government controls were implemented on public lands beginning in 1905, early-season entry into rangelands, excessive over-grazing, and the practice of persistent small fires (ignited to improve forage) may have exterminated native browse species in many areas, increased erosion, slowed forest regeneration, and altered forest stand structure. Such practices produced lasting changes in communities of grasses, forbs and shrubs (McKelvey and Johnston 1992). Sheep were thought to be more destructive than cattle. The Washoe Indians were especially affected by the impacts of livestock grazing, which altered the composition and vigor of native plants (Elliott-Fisk et al. 1996). According to KB (personal communication 2012), Clifford Johnson grazed his stock responsibility. He kept his sheep moving and they grazed only for about 1 1/2 months during the summer. Clifford may have developed some sense of stewardship, in part because he owned the land that he grazed, and he wanted grazing to be sustained for generations to come. Sheep grazing continues under the ownership of Barbara Johnson, Clifford's wife (KB personal communication 2012).

Map Data

- Lacey Meadows referenced as "Webber lake valley" (GLO Field Notes T19N/R14E 1872:35, 50)

- within the Lacey watershed, a cattle allotment and a sheep allotment are shown (*TNF 1915 map)

- due east of the watershed a cattle allotment shown (*TNF map 1939)

HYDROLOGY AND WATER MANAGEMENT

WEBBER LAKE

"It was geography as well as settlement that made the northern lakes the earliest resort sites in the Sierra. North of the difficult and ill-fated Donner Pass there were no less than seven well-worn routes over the mountains, all of them crossing at comparatively low elevations...Truckee Lake, a small, round body about a mile in diameter, lay on the south side of the road (Henness Pass Road) and near the summit of the pass. As the source of the Little Truckee, it bore the name throughout the fifties [1850s] and was even designated as Truckee Lake on many maps of the sixties [1860s]." [Hinkle and Hinkle 1949:222]

Map Data

- "Webber Lake a body of deep clear water" (GLO Field Notes T19N/R17E 1872:25)
- "...the average depth being about 85 feet." (Edwards 1883:54)
- "land around this lake [Weber] is good rich soil, banks from 4 to 6 feet high except on the southern part where the land is level and wet. Timber Tamarack Scattering" (GLO Field Notes T19N/R17E 1872:27)
- 1889 USGS planned to enlarge Webber Lake [and Independence Lake] as a reservoir; pool would extend throughout Lacey Valley into sections 32 and 33 with a maximum capacity of 11,152 acre feet; maximum height of the dam is 29 feet and the length of the crest is 812 feet (USGS 1889)
- Webber Lake does not appear on an 1867 schematic Map of Sierra County and some confusing landmarks are depicted. A large "lake" is shown on the east side of the road to Sierraville (modern SR 89) and in the vicinity of modern Stampede Reservoir and where there was no lake. Also, a the map shows a large lake "Truckee Lake" in the vicinity of modern Jackson Meadows Reservoir where there was no lake. Webber Lake was initially known as "Truckee Lake."
- The lakeshore at the head of Webber Lake is shown with rounded banks on maps dating from1872, 1877, 1889, 1889/1897, 1915, 1921, and 1926. This shoreline becomes bifurcated on maps dating from 1930, 1940/1951, 1955, 1962, 1977, 1983, and onward.
- Two main tributaries to Webber Lake are shown on the 1866/1872 GLO Survey Plat of T18N/R14E (Section 5) with a "prairie" listed in between the two channels. The easternmost stream appears to bypass Webber Lake to the southeast [?].
- Two main tributaries feed Webber Lake (Truckee Sheet 1889; Truckee Quad 1889/1897; TNF 1915).
- One main tributary feeds Webber Lake (TNF 1921, 1926, 1930; Truckee Quad 1940/1951; Sierraville 15' Quad (1955); TNF 1962, 1977, 1983). [This may be due to rising lake levels after construction of the Webber Lake dam ca. 1914.]

- In ca. 1914 the Bohemian Club (Flycasters) built a rock dam (augmented by concrete) at the outlet of Webber Lake. Ca. 1980 Clifford Johnson upgraded this dam and pumped more concrete around its edges. The height of the rock/concrete dam was not changed. Johnson added a metal fish weir ca.1985. This structure was controversial and Johnson was taken to court (ca. 10/15/1990). The court ruled in favor of Johnson to keep and maintain his dam/weir improvements (KB personal communication 2012).

- A small pond named "$30 Lake" is located near the Webber Lake outlet and it also has a dam. This was built prior to Johnson ownership of the property. [$30 Lake may be one of the ponds Dr. Webber planned to construct ca. 1880s in order to rear fish. See following fisheries discussion.]

DITCHES

Limited research has identified no ditch irrigation system within the Lacey watershed. However, considerable effort was expended to augment irrigation in the Sierra Valley using water from the Little Truckee River. In late 1871 work was in progress by William Himes and others on the construction of a ditch to bring water from the Little Truckee River, which would enter the valley at or near Randolph, for the purpose of supplying water for irrigation (*Mountain Messenger* 7/19/1873; Sinnott 1978:152).

One of the first major attempts to bring more water into Sierra Valley began in 1878, when a joint stock company known as the Sierra Valley Irrigation and Water Company was incorporated in Virginia City, Nevada. The company's aim was to cut a canal from the Little Truckee River, below the falls, to the valley. Three miles of the canal were completed and water was being delivered when construction was halted because of court actions brought by the Boca Mill and Ice Company and Dr. D.G. Webber. The injunctions were a crippling blow to the water company..." (Copren 1971:27-28). The project was a long time in process, with the work in abeyance for rather long periods of time. "The canal is expected to have the water into the Valley this year. Most of the water of Cold Creek, which flows into Sierra Valley at Randolph, is a diversion from the Little Truckee River. The creek divides at Randolph...one branch leading into the western end of the Valley near Sattley, and the other passing through Sierraville...and to within four miles of Loyalton. Waters of both branches are used for irrigation." [*Mountain Messenger* May 1878]

"In July of 1913 a company, known as the Sierra Valley Water Company, was formed with A.S. Nichols, W.E. Miller, F.E. Humphrey, John McNair, and James McHair as stockholders, and an application was made for permission to issue 25,000 shares of stock. The Company proposed to build a dam at Webber Lake to control the flow of the Little Truckee River which issues from it, and to construct a ditch system that would provide water both for irrigation and domestic purposes in Nevada and Plumas counties as well as in Sierra. The Company planned to increase the flow of Cold Creek by bringing water to it from the Little Truckee River by means of the old Himes Ditch. The original ditch had been surveyed and built by Alf Himes. It is said that difficulties arose with Himes and his ditch for when the water was turned into it was found that for part of its length the ditch ran uphill. It was thought that either some practical joker or someone in opposition to the construction of the ditch, altered the surveying instrument so that sightings gave a slight up-grade rather than down-grade to the ditch. It is said that a very practical-minded citizen of Sierraville resolved the problem by simply having his suggestion adopted that the water be turned in and the ditch re-dug to the depth required to effect a continuous flow of the water by just following the water" Sinnott 1976:209: "

Along the north side of the river, a water ditch now owned by the Sierra Valley Mutual Water Company, was constructed between 1871-1878 to deliver water from a diversion dam about one-half mile upstream on the Little Truckee to deliver water to the Sierra Valley (Sinnott 1978:152; Steidl 1997:3). Remnants of this ditch are located in Section 15, T19N/R15E (Francis 2012;) and have been recorded as site FS-05-17-56-601. The ditch currently crosses under Old Fibreboard Road near its junction with Jackson Meadows Road (Forest Road 7). It appears there were successive parallel alignments that contoured the base of the unnamed hill north of the project to a point near Little Truckee Summit where the water flowed downhill in a deep ravine called the Big Ditch to Onion Valley and into Cold Stream, finally entering Sierra Valley at its southwestern side (Francis 2012:4).

KB (personal communication 2012) has no recollection that any of the Johnson's dug ditches to either irrigate or de-water or open and/or block Lacey Creek. There was no need to.

FISHERIES

Below are excerpts from a doctoral dissertation regarding the prehistoric fishery of the Truckee River Drainage system (Lindström 1992, 1996). While the focus was on Lake Tahoe and the main stem of the Truckee River, the summary discussion on the structure of the native fishery and its subsequent decline may have some application to fisheries issues in the Lacey Meadow watershed assessment.

STRUCTURE OF THE TRUCKEE RIVER NATIVE FISHERY

Species native to the Truckee River include: Lahontan cutthroat trout (Salmo clarki henshawi), cui-ui (Chasmistes cujus), Tahoe sucker (Catostomus tahoensis), mountain sucker (C. platyrhynchus), mountain whitefish (Prosopium williamsoni), tui chub (Gila bicolor), Lahontan redside (Richardsonius egregius), Paiute sculpin (Cottus beldingi), and speckled dace (Rhinichthys osculus) . A comprehensive discussion of the native fish fauna of the Lahontan Basin system and their life histories has been given by Cope (1883), Gerstung (1986), La Rivers (1962), Moyle (1976), Rostlund (1952), Sigler and Sigler 1987, Snyder (1917), and the Tahoe Regional Planning Agency (1971), as quoted in Lindström (1992, 1996).

The collective life histories, spawning cycles and habitat of these native Lahontan fish form a composite of the structure of the Truckee River fishery. Drainage wide, these native fish populations occupied a variety of habitats. The hardiness and resiliency of these fish populations was bred out of the need to adapt to the severe long and short-term climatic fluctuations characteristic of the interior basins where they are most common. Their long life span (up to 18 years for white fish, 35 years for tui-chub, and 40 years for cui-ui) afforded them further reproductive advantage to survive prolonged droughts when spawning was impossible. Stream spawning could have taken place throughout the Truckee River watershed during most of the year, with the exception of a short period during late summer-early fall. Historically, spawning migrations within the middle and lower reaches of the watershed lasted from October until May; runs in the uplands were usually of shorter duration during the summer.

Ecological variation in the structure of the fishery are closely linked to cultural diversity and central to understanding both archaeological and ethnographic variability (Rostlund 1952; Schalk 1977 as quoted in Lindström 1992, 1996). The duration and season of availability and the congruency of fish with other resources determines the degree to which fish were exploited by humans, regardless of abundance. Fish resources of the Truckee River (as elsewhere) are characterized as clumped, predictable, and stable, with temporary super-abundances. Although most native species were strongly keyed to spring spawning (the cui-ui and smaller species), the most substantial runs (consisting of the large cutthroat trout and whitefish) occurred throughout the winter-early spring, when valuable terrestrial foods were least available to humans. Prehistoric populations, migrating throughout the drainage basin, could have subsisted on spawning fish for most of the year with minimal scheduling conflicts involving the procurement of terrestrial resources.

FISH STOCKING

Historic Accounts

1854 "In 1854 Dr. Webber stocked the Webber Lake with trout, there having been previously no fish in it because of the falls a mile below (Fariss and Smith 1882:267; Lutes and Scholberg 2006:3).

1858 "The river [Little Truckee River] at this place [below the falls] is about the size of the East Fork of the North Yuba. It runs clear, and is full of trout. Truckee Lake (Webber Lake), however, is devoid of the finny tribe, with the exception of a small stock started there some four years ago by Dr. Webber. The falls in the river have been impassable to trout, situation so far interior as they are, away from steamtugs, stationary engines, and the like. The fish of the river are large salmon trout." [*Sierra Democrat* 7/24/1858]

1869 "Dr. Webber with the assistance of Mrs. Lipscomb and others of the Sierra Valley, planted a large number of minnows secured from the streams of the valley into the lake. [This may be a means whereby other species native to the Truckee River drainage, e.g., speckled dace, Lahontan redside, Paiute sculpin, mountain sucker, may have entered the Webber Lake system.] In five years the fish became so numerous as to be frequently caught for the table. From that time to present, trout fishing has become a standing recreation for persons in the vicinity, as also for parties from a distance who come and spend the Summer amidst the varied attractions of Webber Lake and its picturesque surroundings." [*Mountain Messenger* 4/10/1869]

1877 "There were no trout in the lake when first discovered, manifestly prevented from entering it by reason of the high cataract off 110 feet." [Lemmon 1877:364]

1877 "In '60 the doctor began introducing trout of two varieties, silver-sides and red-flesh. Four years after he was enabled to set this delicious fish before his guests as desired. Subsequently other parties proposed to lay claim to stocking the lake, and others still declared that it was always filled with trout, but the doctor proving his claim to the satisfaction of the Fish Commissioners and complying with legal provisions, has acquired possession of the fish, pays taxes upon them, and, assisted by the law, carefully guards against their being caught out during the spawning season, which would diminish one of the most enjoyable pastimes of summer tourists, as well as cut off one of the most appetizing items in the bill of fare." [Lemmon 1877:364]

ca. 1880s "Webber and Independence lakes were popular places for camp outings and fishing expeditions or a vacation stay at the resorts established there. In the late 1880s Dr. D.G. Webber had prepared five ponds at Webber Lake in which he raised trout and carp. In 1889 he planned to increase the number of ponds and stock some of them with white fish from the Truckee River." [Sinnott 1976:266]

1906 Lake of the Woods had brook trout in 1906 (LB personal communication 2012).

1949 "Half a mile from the eastern shore, the lake's outlet, the Little Truckee, plunged more than a hundred feet in a superb double cataract...Because of the falls, there were no fish in the lake when Webber staked out his claim. In 1860 he stocked the waters with two varieties of trout." [Hinkle and Hinkle 1949:228, 230]

HISTORIC CATCH RECORDS

Fish were abundant in sufficient numbers to support a commercial fishery in the main-stem Truckee River from about 1860 until 1917. Fish supplied booming Comstock populations and great quantities were exported westward to San Francisco and as far east as Ogden and Chicago. The sport fishery in Lake Tahoe and its tributary lakes and streams was characterized as a "piscatorial bonanza" in the period press . While these historic accounts assist in gaining an appreciation of the quality of a now-diminished fishery, they may be biased in that many date between the 1870s and the 1920s, a time when the age and aggregation of the species catch was unbalanced by the obstruction of spawning runs. This resulted in abnormal concentrations of fish, with an overrepresentation of old and large adults relative to smaller juvenile populations. These circumstances characterized the Truckee River and Lake Tahoe but may be less applicable to Webber Lake, Lacey Creek and the Little Truckee River above the falls -- a closed basin that may have been subject to frequent, recreation-driven plantings of non-native species since the 1850s.

Historic Accounts

1860 "Truckee River abounds with prettier, larger, hardier trout, than we ever saw elsewhere. Some are about two feet long. Washoe Indians harpoon them, and sell them to white people at two bits apiece. As many as they catch more than are demanded fresh, are split and spread, smoked, dried, and packed in baskets for Winter. The baskets are made by squaws, oN a long round grass found in the meadows. Some of these baskets are made so tight as to hold water; and in all respects they are neatly and mechanically put up." [*Sierra Democrat* 6/2/1860]

1869 "A TYPICAL DAY AT THE LAKE: About eight o'clock in the morning the children are rowed across part of the lake to the school. A little later, when the breeze springs up, the anglers, with flowing sail or health-giving oar, proceed to the inlets or the deep water center of the lake, in pursuit of trout, and as many as four hundred large fish have been taken in a few hours. At night the glaring pitch-pine light is seen gliding over the still waters, and revealing to the expert where the fleeing occupants of the weedy bowers of the deep may be implaced upon his spear." [*Mountain Messenger* 4/10/1869]

1877 "....trout fishing with rods...over to the inlet, deeply bordered with willows...In the deep holes of this inlet, extending like a chain for 100 rods up the stream, is often found the best fishing...As many as 400 fish have been taken by one boat-party in an hour." [(Lemmon 1877:364]

1883 "The Water [Webber Lake] abounds with trout, which are famous as being the most gamey of any of the lakes...The fish are what is known as the Feather river trout, and range from one to three pounds in weight, and are gamey, vicious little beauties." [Edwards 1883:54]

LB (personal communication 2012) first visited Webber Lake in 1947 specifically because it was renowned for fishing. His personal photo album contains many images of trophy-sized trout he and his wife caught in the lake. The resort used to plant rainbows, brooks and browns. Now Department of Fish and Game allow them to only plant rainbows (a genetically modified "triploid"). These fish typically feed deeper rather than on surface bugs so the fishing has declined (KB personal communication 2012).

HISTORIC DECLINE OF THE FISHERY

The modern Truckee River fishery is sustained primarily by an extensive program of planting non-native species. Major prehistoric food fish are now either extinct or endangered. The enormously productive fishery of the Truckee River drainage was once blithely regarded as inexhaustible. From the 1860s, the superabundant fish resource was pillaged by commercial over-fishing and annihilated by pollution, by the construction of dams obstructing spawning runs, and by the introduction of non-native sport fishery (Behnke 1979; Coffin 1983; Fisher 1949; Juday 1906; La Rivers 1962; Moyle 1976; Scott 1957, 1972; Snyder 1917; Sumner 1940; Townley 1980 quoted in Lindström 1992, 1996). By 1929 neither cutthroat trout nor cui-ui could migrate up the Truckee River and by 1938 the Tahoe and Pyramid strains of cutthroat trout were extinct and the cui-ui was an endangered species. Modern fish production is a shadow of its former great abundance. Parallels in the productivity and demise of the Truckee River fishery are found at other remnant Great Basin lakes (Behnke 1979:82; Carter 1969; Janetski 1983 quoted in Lindström 1992, 1996); however, the enormous scale of events in the Truckee River are unmatched.

Commercial fishermen were active during the last half of the 19th century on many Sierra Nevada lakes, including Tahoe, Donner, Webber, Independence (State Board of Fish Commissioners 1886:7 quoted in Jackson et al. 1982:122). The Commissioners noted in 1893-94 that "a considerable number of trout are annually caught by market fishermen on Donner and Independence lakes and the Truckee River and are shipped to the San Francisco market," enough that the annual spawn was threatened (State Board of Fish Commissioners 1894:31 quoted in Jackson et al. 1982:122).

FLORA AND FOREST COMPOSITION

Dr. Webber became acquainted with John Gill Lemmon, the well-known botanist of Sierra Valley and helped collect plants for him. J.G. Lemmon named two plants in his honor: *ivesia webberi* and *astragalus webberi*. Lemmon made collections around Webber Lake and in the winter he read and sorted plants on the table at the Webber Lake Hotel (Lutes and Scholberg 2006:4). Lemmon's comments on local botany are quoted below.

Historic Accounts

<u>1866</u> On 1866-1873 GLO Survey plats, timber stands around Webber Lake are characterized as "Heavy Growth of Tamarack, Red & White Fir, Yellow Pitch Pine Timber and some Cedar." "Timber Tamarack Fir & Pine" or "Timber Tamarack Scattering" is mentioned numerous times in field notes describing the area now contained by the project (GLO Field Notes T19N/R14E 1872).

<u>1877</u> "The forest immediately surrounding the lake is composed exclusively of the graceful *Pinus contortus* or California tamarack, clustered into gravel floored, flower-carpeted groves, affording cool but not gloomy shades and most romantic drives. Outside the groves, investing the bases of the mountains, is a denser growth of the several Sierra pines, decorated on its upper edge by a fringe of the dark green trees of the two rare and exquisite California firs, *Picea grandia* or white silver fir, and very rarely, *Picea amabilis* or red silver fir; the latter only found in limited alpine regions of California and by all observers admitted to be the most lovely evergreen in the world. So beautiful and desirable is it...that its seed sells in London for its weight in gold, and agents of the Prussian and other European governments have been sent here to obtain seed for renewing their forests...Another beautiful and rare tree, *Abies Pattoniani* or silver spruce, is found clinging to the sides of the highest peaks." [Lemmon 1877:353]

"This enclosing forest is broken at two points on the north side of the lake by small meadows, lined with willows. Between and nearly enclosed by them extends a symmetrical grove of the tamaracks described, forming a natural site and a fortunate sun-shield for the hotel and accessory buildings, cottages for tourists, etc., located in a line skirting the lake and but a few feet from its shallow, gravel-bottomed shore." [Lemmon 1877:353]

"This beautiful grove, for several rods back from, and for a mile along the lake shore, has lately been cleared of hundreds of fallen and uprooted trees, the vestiges of a terrific storm which tore through the valley from south to north several winters ago." [(Lemmon 1877:353]

"Across the lake at the south end a larger break in the forest is occupied by a broad meadow, extending four miles up the valley and comprising several hundred acres of pasturage annually cropped by thousands of sheep. This meadow, like the floor of the groves, is smooth-laid gravel, affording excellent travel in any direction. Through its center winds a silvery streamlet fresh from snow-banks in sight the year round." [Lemmon 1877:353]

"...the north one [pass] threaded by a trail precipitous at a few places, leads over through a grove of *Picea amabilis* described, and down eight miles to Sierraville...The high south pass leads up by a good wagon road, through a grove of silver spruce, eight miles south and west to Meadow lake and the once populous town of Summit City." [Lemmon 1877:353]

" ...Botany meadow on the west side of the lake...The meadow is variegated with colors, showing where grow rare and interesting flowers, among them four species of *Gentian*, one a new species; a new *Ranunculus Lemmoni*; a new *Silene montana*; the little *Sagina Linnceii* [sp.?] and a one-flowered clover; the violet-like *Parterella carnosula*, etc., with hosts of more familiar flowers and a near grove of *Picea amabilis*." [Lemmon 1877:364]

<u>1949</u> "Although the lake lay at an elevation of nearly seven thousand feet, its environment was spacious and hospitable. It occupied a broad, gently sloping basin encircled by low hills, with

the background of high peaks sufficiently distant to give an enchanting perspective. The northern end of the basin was dotted by patches of willow-enclosed greensward, [?] and beyond the southern shore of the little lake extended a long and level stretch of rich meadowland. Elsewhere the shore line was backed by groves of the close-grained *pinus murrayana*, or tamarack. These noble trees grew far apart, and the gnarled boles of their mottled gray-and-brown trunks bore no low-hanging branches to impede the solitary walker." [Hinkle and Hinkle 1949:227]

"It was full of allure for the amateur botanist. Three species of gentian, a rare ranunculus, phlox, wood violets, one-flowered clover, and *pentstemon* grew everywhere, and on the rocks and lava of the surrounding peaks were strange species of heather, dwarf arctic willow, and purple *primula*." [Hinkle and Hinkle 1949:228]

FAUNA

"Another short trip is by boat across the lake to a dense part of the forest...This part of the forest is a noted bear haunt, and a log trap is built here for Bruin's inspection." [Lemmon 1877]

"Mountain game is still in abundance, and it is no uncommon thing to sit down to mine [?] host Webber's table, and enjoy a bear steak, a venison haunch, a spitted hare, a broiled quail or a roasted grouse." [Edwards 1883:55].

"The region abounded in deer and bear, with quail in the coverts and grouse in the high places. [Hinkle and Hinkle 1949:228]

Beaver

Below are excerpts from an archaeological and ethnographic study conducted along the Upper Truckee River, Lake Tahoe Basin (Lindström and Rucks 2003) that may have some application to the issue of beavers in the Lacey Meadow watershed assessment. Part of the scope of the Upper Truckee River restoration project entailed the development of a beaver management plan. To address this issue from a cultural standpoint, the journals of early Euroamerican trappers and explorers and accounts of early Washoe ethnographers, linguists and folklorists were reviewed and contemporary Washoe elders were consulted. An overriding issue remains as to whether or not beaver (*Castor canadensis*) is a native of the Lake Tahoe and Truckee basins. *C. canadensis*, a true beaver that attains weights upwards of 50 pounds and builds dams, is not to be confused with the Mountain Beaver (*Aplodontia rufa*), a native to the Lake Tahoe region that does not build dams, being a small and tailless rodent weighing about two pounds.

Summary

The successful survival of true beaver in the Lake Tahoe Basin (*Castor canadensis*) -- not to be confused with the native mountain beaver (*Aplodontia rufa*) -- and the prolific numbers of true beaver in certain areas of the Upper Truckee River watershed have led to a series of problems that were initially recognized by ranching interests who claimed that beavers negatively altered the hydrology of streams and adjoining wetlands and hindered efforts to restore the fishery. A central question to these events remains whether or not beaver (*C. canadensis*) are native to the Lake Tahoe Basin. Resolution of this issue remains inconclusive, even after a survey of the journals of early Euroamerican trappers and explorers and a study of accounts by early Washoe ethnographers, linguists and folklorists and interviews with Washoe elders and descendants of pioneer families in Lake Valley. Findings disclosed:

(1) the absence of a historic fur trade in the Lake Tahoe Basin;
(2) limited documentation of trapping in the Truckee River watershed;
(3) the lack of beaver in Washoe tradition, subsistence and technology; and
(4) concordant statements by long-term local residents regarding the introduction of beaver ca. 1920s-1940s.

The lack of historic fur trade in the Lake Tahoe Basin, the limited documentation of trapping in the Truckee River watershed, the absence of beaver in Washoe tradition, subsistence and technology, and the emphatic statements by descendents of pioneer families tentatively suggest that beaver (*C. Canadensis*) are not native to this area. However, it is possible that beaver may have gone without mention in Washoe and non-Washoe recollections because they occurred in such low numbers. Resolution of this questions remains inconclusive.

Distribution

Traders and trappers in pursuit of beaver pelts are credited with much of the early exploration of California and the Great Basin. As Hall notes (1995:482 quoted in Lindström and Rucks 2003): "the exploration of North America by white men was incidental to their quest for beaver." International competition for controlling the trade led to expeditions such as those sponsored by the Hudson Bay Company, whose intent was to exterminate beaver populations with a scorched-stream policy that was meant to discourage American enterprise and secure the west for Britain. Intensive and persistent trapping soon led to the near demise of the animal. No special effort was made to protect the beaver in California prior to 1911 (Tappe 1942:11). After that time, a rapid increase in the beaver population followed, destroying protective reclamation works in the Sacramento Valley. Wholesale trapping by 1925 led once again to their threatened extinction (Tappe 1942:12). Because of the beaver's alleged value as a fur resource and as an aid in water conservation, control of soil erosion, and enhanced biodiversity in ponds and meadows created by beavers, agencies made attempts to re-introduce them in many of the western states where they had become extinct or where they survived in declining numbers (Tappe 1942:41). In 1934 attention was focused on parts of California and the Sierra Nevada (Tappe 1942:6). The meadows and streams in the Sierra Nevada, where native beavers were never known to occur, were targeted as the most extensive habitat for beaver introduction in California, as their introduction into the forested uplands did not interfere with agriculture interests. However, the successful survival of beaver in the Lake Tahoe Basin and their prolific numbers in certain subwatersheds created considerable problems for Sierran ranchers who claim that beavers have altered the hydrology of streams and adjoining wetlands in a negative way (Tappe 1942:54).

Tappe's (1942:8) comments on the distribution of beaver are partly in support of this claim.

> "...beavers were common on the San Joaquin River and its tributaries north of the Kings River, and on the Sacramento River and its tributaries almost as far north as the present

town of Redding. However, as far as could be learned, these animals confined themselves to the parts of these streams below the 1,000-foot level."

He (Tappe 1942:13-14) further concluded: "there are no known records of beavers ever having occurred in the Sierra Nevada, except where these mammals have been recently introduced there by man." However, Tappe qualified this observation, based upon an account by Roy Mighels who, in about 1886-1892, reported sighting beaver cuttings in the upper Carson River and its tributaries in Alpine County. Mighels never mentioned seeing beaver, only their cuttings. As Craven (personal correspondence to Lindström 2003) pointed out: "If they were willow cuttings it could well have been work of Washoe Indian basket weavers cutting selecting and drying willows. My grandmother said the Indian women really made a mess cutting and stripping willows."

Historic Accounts

Probably the most compelling evidence that beavers are not native to the Truckee River drainage is the lack of historic fur trade in the watershed. Jedediah Smith, Peter Ogden, and Joseph Walker passed through the western Great Basin, finding little reason to linger in the Sierra. A review of general county histories dating from the 1880s and reprints of journals from early explorers, such as James H. Simpson in 1859 and William H. Brewer in 1863, disclosed no mention of beaver. One exception is a citation found in the History of Amador County (Thompson and West 1881:58). The passage indicates that trappers of the American Fur Company and the Hudson Bay Company were the first visitors to the region and that Stephen H. Meek, a celebrated trapper, claimed to have been the first white man to gaze upon the Truckee River, where he set his traps in 1833 (Thompson and West 1881:58).

- Bill Craven has lived in the Fallen Leaf Lake area throughout his life and is a keen observer of beaver activity. He is the grandson of William Whiteman Price, who visited the Fallen Leaf Lake area during the mid 1890s and established Fallen Leaf Lake Resort in 1906. Trained as a mining engineer, Bill Craven has developed hydrological models of beaver impacts on Glen Alpine Creek sub-watershed. According to Craven (personal communication 2003 quoted in Lindström and Rucks 2003) beaver damage in the Glen Alpine Creek drainage and Lily Lake and Grass Lake is severe. Failed beaver dams amplify natural flooding, as flash floods created by the additional water their dams impound, scour stream channels and destroy fish spawning gravels, strip thin soils, and negatively alter the surrounding meadowlands. Craven contends that the true beaver, "Montana flat tail" (*Castor canadensis*) is not native to the region. He claimed that the first pair of beaver was introduced into the Upper Truckee River in 1937. These animals did not survive due to a severe winter. Beaver were again introduced into the Upper Truckee River ca. 1942 (Tappe 1942). Craven (personal communication 2003) believed that beaver were introduced at this time (during the post-Depression era) partly to stimulate a fur bearing economy. During the Depression and post-Depression years, fur animals such as pine marten were trapped in the Tahoe Basin, especially by resort caretakers. Another two pairs of beaver were introduced into Lily Lake (near Fallen Leaf Lake) in 1944. Beaver bred prolifically (Taylor, personal communication 2003 quoted in

Lindström and Rucks 2003). By the late 1960s they were established in Taylor Creek and around Lake Tahoe. Populations migrated down the Truckee River to Reno and were the cause of a *giardia* outbreak in the Reno water supply. By the mid 1950s the USFS realized the problem and began trapping beaver to eliminate them. The federal program suffered in terms of public relations (Craven, personal communication 2003; USFS 1980 quoted in Lindström and Rucks 2003).

- Knox Johnson (personal communication 2003 quoted in Lindström and Rucks 2003), whose family settled Trout, Cold and Heavenly creeks, also maintained that beaver are not native to the Tahoe Basin and that they were introduced into the area ca. 1940s.

- Shirley Taylor, great granddaughter of Amelia Celio who was the daughter of Carlo Guisseppi Celio, also contended that no true beaver existed in the Upper Truckee River prior to ca. 1920s and they became a problem in the 1940s after breeding for 20 years. She believed that beaver have contributed to the demise of the river system. Her early childhood recollections do not include beaver and she characterized the Upper Truckee River as a deep and narrow channel, affording few crossings for cattle. Since the beaver introduction, however, the family has lost feet of bank land due to beaver denuding foliage and willows. Beaver have also altered the ecosystem of Grass Lake (near Luther Pass); "it was once a puddle, now it is a lake" (Taylor, personal communication 2003 quoted in Lindström and Rucks 2003).

- Since ca. 1968, when Cass Amacher purchased ranchlands near the confluence of Angora Creek and Upper Trucke River, beaver have not interfered with his operations at the Amacher Ranch (C. Amacher, personal communication 2003 quoted in Lindström and Rucks 2003).

- Elsewhere in the Tahoe Basin, problems with beaver were also reported in Spooner Meadows and North Canyon (Lindström and Leach-Palm 2002 quoted in Lindström and Rucks 2003). Here, grazing interests were hindered during the 1920s; so much so, that ranchers hired a caretaker specifically to exterminate beaver in the upper meadows.

Native American Accounts

Beaver trapping was devastating to the aboriginal lifeway wherever it occurred and groups with access to the Humboldt River were particularly impacted. Crum (1994:13 quoted in Lindström and Rucks 2003) stated that beaver robes and footwear had been common winter gear in the Great Basin and ethnographer, Mary Rusco (1976 quoted in Lindströ and Rucks 2003), has even suggested that the emphasis placed on rabbit skin robes in the Great Basin areas affected by the beaver trade may have increased in response to lack of beaver pelts. By 1833 Walker noted there were no beavers in the Humboldt River and that some Indians were demanding food and horses in exchange for safe-passage along this corridor (Crum 1994:13 quoted in Lindström and Rucks 2003).

One goal of this study was to document Washoe tradition and knowledge about beaver (*C. canadensis*), especially on the Upper Truckee River, as an independent line of inquiry to determine whether beaver are native to the area. When Washoe elders were asked if they had ever heard accounts of their ancestors eating beaver, using pelts, or if beaver had figured in any of their traditional stories, without exception each replied "no" or "I can't think of any." Others were hesitant to comment since they weren't sure. Most of the Washoe-speakers thought there was a term for beaver, but they could not remember it or had not heard it much, or at least not recently. Washoe consultants stopped short of saying beaver had not been in Washoe country, since there is a term for it. However Wes Barber (personal communication 2003 quoted in Lindströ and Rucks 2003) stated that this alone was not evidence that beavers are native to Lake Tahoe or any part of Washoe traditional territory, since they also have a word for buffalo and elk. Nevertheless, it is clear that beaver did not play any kind of dominant role in Washoe subsistence, trade or oral tradition.

- Wes Barber stated that his grandfather, Tom Barber, had told him that the California Department of Fish and Game introduced beaver in the 1920's to create better habitat for fish to spawn; but, until the 1920s, "beaver have never been part of this country." On a tour of the project area, Barber further observed how "overgrown and marshy" the Upper Truckee River crossing of South Upper Truckee Road had become, much more so than during his young adulthood when the water was a defined channel "like a river." Barber pointed to beaver dams as the cause for these changes. Barber also recalled that in his youth, the Celio family ran cattle here and that grazing prevented overgrown vegetation. These changes in the landscape have now made it difficult for Barber to spot traditional Washoe camps, even with their hallmark bedrock milling features.

- Steven James (personal communication 2003 quoted in Lindström and Rucks 2003) couldn't recall any stories about beaver, either referring to the use of their fur or as characters in traditional stories. On the topic of mountain beaver (*A. rufa*), James said that his father told him *cim el el* (beaver) was once plentiful but they had begun to disappear. James heard that the "ones we have today" have been reintroduced.

- JoAnn Martinez, an elder from Dresslerville with extensive knowledge of Washoe culture, initially stated that she had not heard anything about beaver from elders. She later recalled a term given by Marvin Dressler (a deceased tribal member who taught Washoe language classes) as being the same or very similar to the term, *cim el el*, given by James.

There is little reference to beaver in the Washoe literature and only Fowler (1986:80 quoted in Lindström and Rucks 2003) listed *C. canadensis* as one of the common edible mammals in the Great Basin for the Washoe, as well as the Northern Paiute, the Western Shoshone and others. Without further comment, d'Azevedo (1986: 478 quoted in Lindström and Rucks 2003) mentioned that: "Porcupine and beaver were sought for their succulent flesh." Elsewhere, d'Azevedo (1984:67 quoted in Lindström and Rucks 2003) provided the term □*imehé:el*, essentially the same word for beaver as that given by James (*cim el el*). None of the other sources consulted mentioned beaver in any connection to Washoe economic, social, or mythic culture, with two important exceptions.

- In the epic tale of the "The Weasel Brothers" (Tale 11 in Lowie 1939:343-344 quoted in Lindströ and Rucks 2003), "beaver" (*tsim:ehel*, Lowie 1963:23 quoted in Lindström and

Rucks 2003) is the second animal that the younger weasel brother encountered in the beginning of the story that lists many of the animals hunted by the Washoe. In this same tale, published in Dangberg's (1927:408-411 quoted in Lindström and Rucks 2003) *Washo Texts,* with Washoe translation and literal translation, the term for beaver is given as *tsim:ehel*, again the same term given by Lowie, d'Azevedo, Jo Ann Nevers, and Steven James ("*ts*" is equivalent to "*c*" by James).

- Melba Rakow (personal communication 2003 quoted in Lindström and Rucks 2003), another Washoe speaker, is acquainted with many traditional stories that she learned from her parents, Ray and Mabel Fillmore. She contributed the term *Shoe.máll-leh*, for the beaver character in the weasel brothers story. Rakow stated that she had never seen the flat-tailed beaver in the years she lived at Lake Tahoe.

- In Dangberg's (1968:21-24 quoted in Lindström and Rucks 2003) analysis of the weasel story, the "beaver," referenced in these tales is: "no-doubt the so-called mountain beaver, living principally on the small streams tributary to Lake Tahoe but also found on the east of the Sierra Nevada in the southern end of Carson Valley, where one was killed in 1953." A news article in the *Record Courier* (1953 quoted in Lindström and Rucks 2003) refers to a mountain beaver killed on the Dressler Ranch in Carson Valley and identified as *A. rufa*.

- While none of the actions undertaken by beaver (*tsim:ehel*) in the stories related in Lowie (1939, 1963 quoted in Lindström and Rucks 2003) and by Dangberg (1927, 1968 quoted in Lindström and Rucks 2003) preclude the character being *C. canadensis*, none reference obvious characteristics of *C.* spp., such as their lodges, tree-felling, their flat tails, or beavers slapping the water. In fact, in the Washoe story, none of the actions takes place in the water, although the riparian setting is clearly implied when the younger weasel brother asks *tsim:ehel* for "a weed" to rub on his sore knee (Dangberg 1968:61; 1927: 408-410 quoted in Lindström and Rucks 2003). This weed can be identified from the Washoe language text as *g'omho* (or *k'ómho*), or cow parsnip (*Heracleum lanatum*), a plant highly valued by the Washoe that grows in the mountains "in moist and shady places below 9000'" (Weeden 1986 quoted in Lindström and Rucks 2003), the same environment in which the mountain beaver lives. In fact, several of the riparian plants mountain beavers have been reported to gather, dry, and store (Hall 1995; Orr 1949; Sleeper 1997; Wallis 1946 quoted in Lindström and Rucks 2003) are valued by the Washoe for medicinal and other purposes, strongly suggesting that the beaver character referenced would have been *A. rufa* rather than *C. canadensis*.

- C. Hart Merriam worked with Washoe speakers at Lake Tahoe, Carson Valley, Sierra Valley, and Reno in 1903, 1904 and 1935. While none of his respondents contributed terms for beaver – the entry was left blank on his checklist -- he did collect the term *tsim-m□-hel'* for "water badger", a word he handwrote on the list after raccoon. Other similar Washoe terms that he collected embed the Washoe word for "spring + badger."

- Jacobsen's (n.d. quoted in Lindström and Rucks 2003) word list of "Animals Used as Foods by the Washo Indians"(n.d), collected in the 1950s, lists □*simehél* as the word for "beaver", according to Roy James and Frank Morgan. Bertha Holbrook described it as "a water-dwelling animal that went in the mud under water and underground." Johnnie Wegar described it as "an animal similar to a coon who lives around water." Jacobsen added a note that the animal was apparently rather rare and identified it as mountain beaver (*A. rufa*). Jacobsen identified the various words for beaver, as reported by Merriam, Dangberg, Roy James, and Steven James, as variations of the same term.

There is little doubt that the term recognized by Washoe speakers today for *C. canadensis* once applied to *A. rufa*. Accordingly, this is very compelling evidence that *C. canadensis* was never an important part of Washoe Indian life or of their traditional environment.

Since there was little or no mention of beaver (*C. canadensis)* in the Washoe ethnographic literature (e.g., Fowler 1986; d'Azevedo 1986 quoted in Lindström and Rucks 2003), several Northern Paiute and Western Shoshone ethnographic sources were reviewed in order to gauge how traditions about *C. canadensis* might have been retained in the ethnographic record of Great Basin groups known to have had historical access (via the Humboldt River) to populations closest to Lake Tahoe. According to Hall (1995:486-487 quoted in Lindström and Rucks 2003), *C. canadensis* was distributed along the Humboldt River as far west as the Lovelock area. It has only recently been reported in the Carson River. It is not reported in the Truckee or Walker Rivers. Evidence that *C. canadensis* was historically important to Northern Paiute groups having access to the Humboldt River is provided by Willard Park (in Fowler 1989:25). Park reports that beaver (*kohi'i*) was eaten around Lovelock, being trapped and hunted with bow and arrow. Wuzzi George, interviewed in Fowler (1992:70 quoted in Lindström and Rucks 2003), also stated that beavers were eaten, but that they were rare, if not absent, in the Stillwater Marsh and in the Carson River until more recent historic times. She noted that her father had seen and caught a few in the Carson River, but that beaver had not been part of her diet as a youth. Finally, about half of Stewart's (1941:372 quoted in Lindström and Rucks 2003) Northern Paiute respondents stated that *kohi'i* was eaten. However, his Washoe respondents, Charlie and Susie Rube, who also worked extensively with Siskin (n.d. quoted in Lindström and Rucks 2003) and summered every year at Bijou at Lake Tahoe, replied that beaver was not eaten.

CONCLUSIONS

The pending land transaction between Truckee Donner Land Trust (TDLT) and the Johnson family (private landowners of the historic Webber Lake Ranch) carries with it important social and historical components that may not be so straightforward in addressing as the biological and hydrological issues. Webber Lake and adjoining lands within its watershed have been prehistorically managed in the optimization of plant and animal resources and aboriginal occupation is marked by milling features, flaked and ground stone artifacts and remarkable petroglyph (i.e., "rock art") panels. In historic times the human focus was on recreation, fisheries and livestock production and since the 1850s Webber Lake has been operated as a "resort." This resort complex and associated out buildings, both along the lake and in Lacey Meadow, are potentially significant historic resources that will require careful management. Prior acquisitions by the TDLT have typically involved lands containing biological and archaeological resources, but the Lacey Meadow/Webber Lake parcels chart a new dimension for the Land Trust with the annexation of a historic resort that is still in operation. The TDLT needs to be fully aware of the new responsibilities it is assuming in regards to heritage matters. Within the inevitable constraints of time and money, the TDLT is urged to engage the interests and invite the help of local historical societies and seek professional advice that archaeologists/historians may volunteer to offer, in order to be fully aware of the new responsibilities and constraints involving heritage resources that the Land Trust is assuming, as well as the opportunities that lie ahead for the conservation and interpretation of these resources.

LEGACY OF WASHOE LAND USE

The Lacey Meadow watershed assumes Native American cultural significance and holds interest to modern Washoe people. Included as part of the Washoe Tribe's comprehensive land-use plan (Washoe Tribal Council 1994) are goals for harvesting and caring for traditional plant resources in the Truckee-Tahoe basins (Rucks 1996:3). The plan aims to reintroduce traditional plant gathering practices and collect oral histories relevant to traditional land and resource use and management. Accordingly, the tribe should be periodically contacted as stakeholders throughout the future decision-making process. If revegetation projects are planned, coordination between project botanists and Washoe plant specialists is encouraged, in the event that plants of traditional ethnobotanic relevance to the Washoe might be reestablished into the project area. The conversion of these private lands into public lands will open access to Washoe traditionalists to plant resources that have historically been closed.

LEGACY OF HISTORIC LAND USE

Webber Lake Ranch

By all historical accounts, Dr. Webber might be portrayed as a renaissance man with vision in advance of his time.

> "This [Webber Lake resort] was probably the earliest attempt to capitalize upon the attractions of the Sierra lakes and to cater exclusively to a touring and vacationing public. Webber's venture pointed to one of the most interesting phenomena in Western history. There was no better evidence of the sweeping social changes of the fifties [1850s] than the developing consciousness of picturesque surroundings...people only a decade removed from the chaos and perils of the gold rush had become sensitive to the charms of landscape and fascinated by curiosities of natural history. ..ladies and gentlemen who could still remember the thin whine of Indian arrows or the lurching of wagons across the barren sage flats now escaped what they called 'civilization' by arduous journeys back into the mountains which they had once crossed at so much hazard. There the ladies sensibly shed their traveling pelisses for calico 'wrappers,' and cooked dinners alfresco; there the gentlemen, unshaved and 'hideous' in old hats and 'wicked and villainous' shirts and trousers, led horseback parties to some 10,000-foot peak to admire a 'majestic vista,' or track down 'old Bruin' or speared the 'finny denizens of the deep' while the ladies botanized. Dr. Webber was one of them, and he know what they wanted." [Hinkle and Hinkle 1949:213-214]

> "...Webber had classified and made known to botany two Sierra plants, *ivesia webberi* and *astragalus webberi*...and had helped to replenish Prussian and other European forests

> with the seeds of the great silver spruce, *picea amabilis*, which flourished so magnificently in his domain...He had made himself a pioneer in the conservation of fish and installed a flotilla of boats. He built a solarium, mapped out horse trails to the high pinnacles, and constructed bridle paths through the woods. By 1863 'good Doctor Webber' had become completely identified with his sylvan paradise, and little Truckee Lake became Webber Lake." "Webber's 'fairyland' ... Webber's idea of recreation seemed so incongruous, in view of the march of progress of the sixties [1860s]...[visitors] ...looked forward to the visit as an 'old fashioned trip." [Hinkle and Hinkle 1949:230-231]

Webber Lake Ranch has retained this "old fashioned" mode. In contrast to the modern resort model, this approach is characterized by relative continuity in proprietorship and the dedication of its loyal and steady clientele. Families remain the focus and multi-generations have made Webber Lake their annual vacation destination, with unbroken and recurrent visits of up to 30, 40 and even 60 years. This continuity has fostered a remarkable sense of community at Webber Ranch that is unusual in modern times. The overall ambience in 2012 is consistent with observations of a writer for the Sacramento *Union* back in 1877.

> 'Webber lake's resources, unlike those of Donner and Tahoe, cannot be exhausted by a visit of a day or two, for it is the exact center of more attractions than can be even enumerated in a long paragraph. Stay one day only at Webber, and perhaps you will pronounce it dull. Stay a week, and you will wish to prolong your visit a month. Stay a month, and you will certainly do as I have done, pass the heated term there season after season." [Lemmon 1877:364]

Over the past century and a half, the resort has maintained its reputation as a good economic value. The Virginia *Enterprise* remarked:

> "We see several in town who have just returned from the usual summer tour of the Sierra lakes. They look fresh and fat and are loud in their praise of Webber lake. They declare that while each has peculiar attractions, Webber lake combines more for the same money than any other, besides affording by the presence there of a skillful physician, the good Doctor W., a sure relief for invalids." [Lemmon 1877:364]

> "The proprietor himself made very little profit from all this. Although his miscellaneous charities had left him at low ebb, his rates were absurdly cheap, and he persisted in taking in on credit a steady procession of the ailing and insolvent...His hobbies and his open-handedness set the tone of his resort. His guests merely paid modestly for board and lodging in order to enjoy its marvels, which were free. Even now, in a chromium-plated civilization, the lake has never lost its character, and in the tamarack groves the spirit of the benevolent enthusiast still lingers." [Hinkle and Hinkle 1949:231]

In considering the historical circumstance of the Weber Lake resort, the TDLT is urged to make as few changes as necessary in order to maintain the social *status quo* and search for "common ground' solutions to creative contemporary land management. As one example, if the annual lease arrangements that are currently in place must be terminated, for those individuals who wish to continue their long-term tenure, perhaps a program of multiple and revolving camp hosts might be implemented. The enduring patronage of resort clients has fostered a sense of investment and stewardship that may ultimately assist the Land Trust to manage the land in the future -- in contrast to the overall transitory atmosphere of a conventional public campground ("here today gone tomorrow"), which tends not to engender the same sense of lasting commitment to environmental integrity.

Grazing

Webber Ranch currently grazes sheep in and around Lacey Meadow and owner Barbara Johnson has made it clear that she wants the historic legacy of grazing to continue (KB personal communication 2012). Grazing can bring many environmental benefits and it affords some of the state's healthiest watersheds -- grazing keeps invasive species in check, it provides habitat for animals and plants, etc. -- but there are problems when land is over-grazed (Nelson 2012:18, 20). Conditions vary from ranch to ranch and land managers can search for a range of methods to find a scientific and social balance: e.g., strategic fencing; providing water and feed in spots away from watercourses; timing grazing in critical watershed areas; giving pastures a rest after grazing before irrigation; managing vegetative buffer zones to protect the soil; vigilant monitoring, etc. (Nelson 2012:20).

In the late 1980s grazing was already being blamed -- wrongly, in some cases -- for any number of environmental and wildlife conservation issues (Nelson 2012:19). As such, conservation and ranching have often been cast as conflicting interests, and for decades that was mostly true. But over the years, science has shown it's no accident that California's annual grazing lands can also encompass the state's richest plant and wildlife biodiversity (Nelson 2012:20). In its task of watershed restoration, the TDLT is encouraged to also consider protecting the economic viability of private rangelands and encourage sound land and habitat stewardship. Lacey Meadow is a part of the region's historic stock-rearing past and it may be possible to keep the ranching tradition alive in ways that are consistent with the chosen watershed restoration alternative.

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1939 Tahoe National Forest cattle and sheep allotments and areas closed to grazing (after Jackson et al. 1982:164)

1951 U.S. Geological Survey Truckee Quad (edition of 1940/reprinted 1951)

1955 U.S. Geological Survey Donner Pass 15' Quad and Sierraville 15' Quad

1962 Lumbering Roads of the Truckee River Area (after Myrick 1962:440)

1962 Tahoe National Forest Truckee Ranger District

1962 Tahoe National Forest Sierraville Ranger District

1977 Tahoe National Forest

1983 Tahoe National Forest

1998 Trans-Sierra Routes North of Lake Tahoe (after Howard 1998:140)

2011-2012 Extent of Railroad Grade System and Heritage Resources Inventory Sierra Nevada Wood and Lumber Company/Hobart Estate Company FS Number 05-17--56-71/05-17-57-691, Site Number CA-SIE-144H/A-NEV-000[?]. On file USDA Forest Service, Tahoe National Forest. Sierraville, California

Newspapers

Mountain Messenger: 11-2-1867, 4-10-1869, 9-9-1876, 7-19-1873, May 1878

Sacramento Union: 1877

Sierra Democrat: 7-24-1858, 6-2-1860, 9-11-1861

Virginia Enterprise: n.d.

CORRESPONDENCE

Susan Lindström, Ph.D.
Consulting Archaeologist

P.O. Box 3324
Truckee CA 96160
530-587-7072 voice
530-587-7083 fax
slindstrom@cebridge.net

DATE: July 24, 2012

TO: Darrel Cruz, Tribal Historic Preservation Officer
Washoe Tribe of Nevada and California
919 Hwy 395 South, Gardnerville, NV 89460
775-888-0936 (775-546-3421 cell); darrelcruz@washoetribe.us

RE: Lacey Meadow Watershed Assessment
Truckee Donner Land Trust/Truckee River Watershed Council

The Truckee Donner Land Trust (TDLT) and the Truckee River Watershed Council (TRWC) are undertaking a study involving the Lacey Creek drainage and Webber Lake at the headwaters of the Little Truckee River in Sierra County (see attached map). The TDLT is in the process of acquiring this property from private ownership and open it to the general public. Both the TDLT and the TRWC believe that there is a significant opportunity for restoration work that will result in real gains in water quality, habitat and watershed function and the goal is to provide the science and policy information needed to direct restoration and protection projects within the watershed.

The TDLT and TRWC have contracted with Balance Hydrologics, Inc. to prepare the necessary environmental documentation to initiate these restoration and protection projects. In turn, I am subcontracted with Balance Hydrologics to prepare contextual background regarding the human history of the watershed. As I understand, this watershed falls within Washoe traditional territory. As such, I invite the Tribe's opinions, knowledge and sentiments regarding any potential concerns for traditional Native American lands within the watershed. Although there has been no formal archaeological survey of the watershed area, a few Native American sites have been recorded in the vicinity of Lacey Creek, including some bedrock milling features, flaked and ground stone scatters and several petroglyph panels.

Although we are at the very earliest stages of planning, I have recommended that any future restoration areas be subject to an archaeological survey prior to any ground disturbance activities and that the Washoe Tribe be contacted. I'll keep you posted as project plans proceed. I look forward to hearing from you if you have any additional information. I am also interested to know whether or not you concur with my findings and recommendations and I would appreciate your formal response in a brief memo/letter regarding the project. Thank you very much.

FIGURES

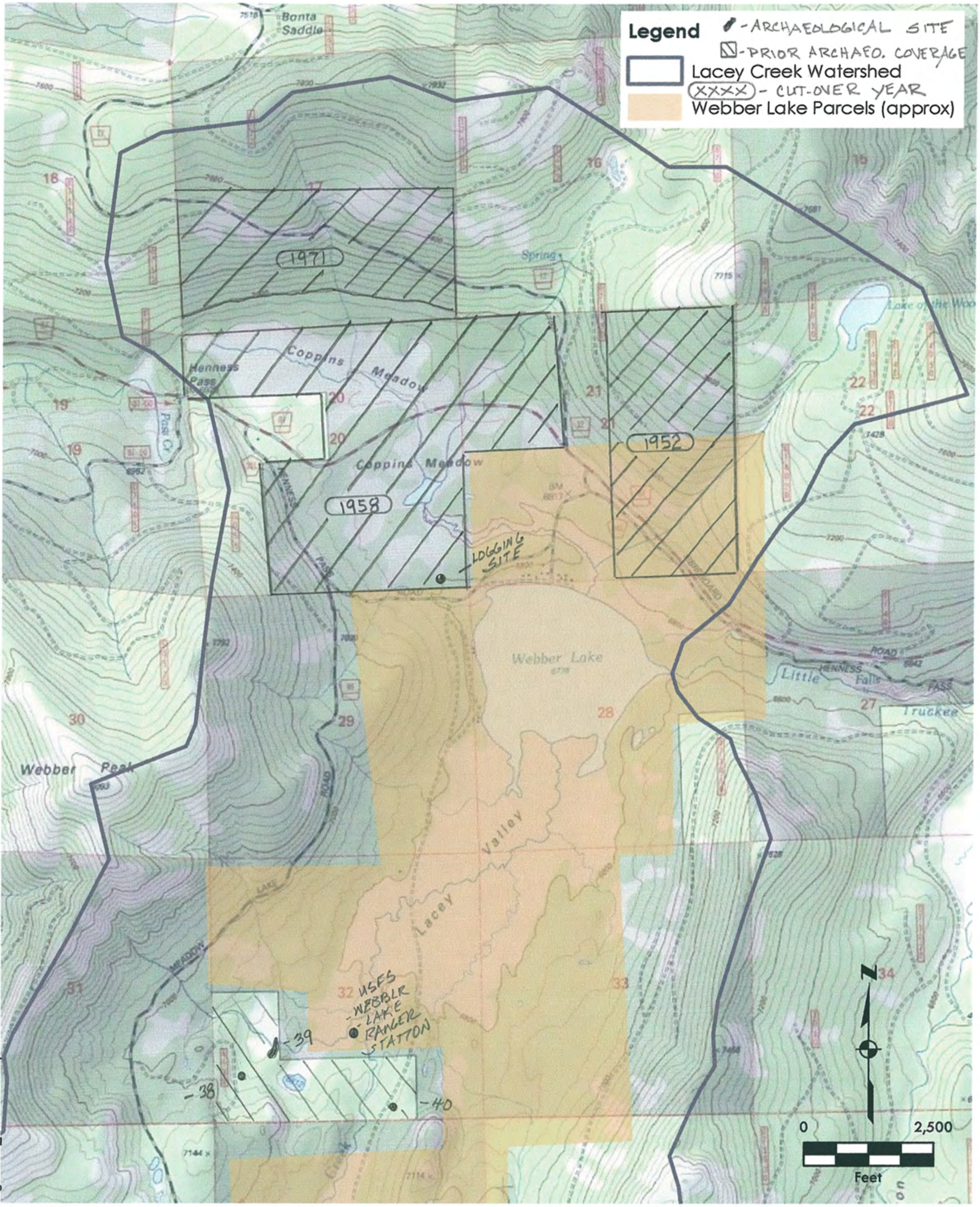
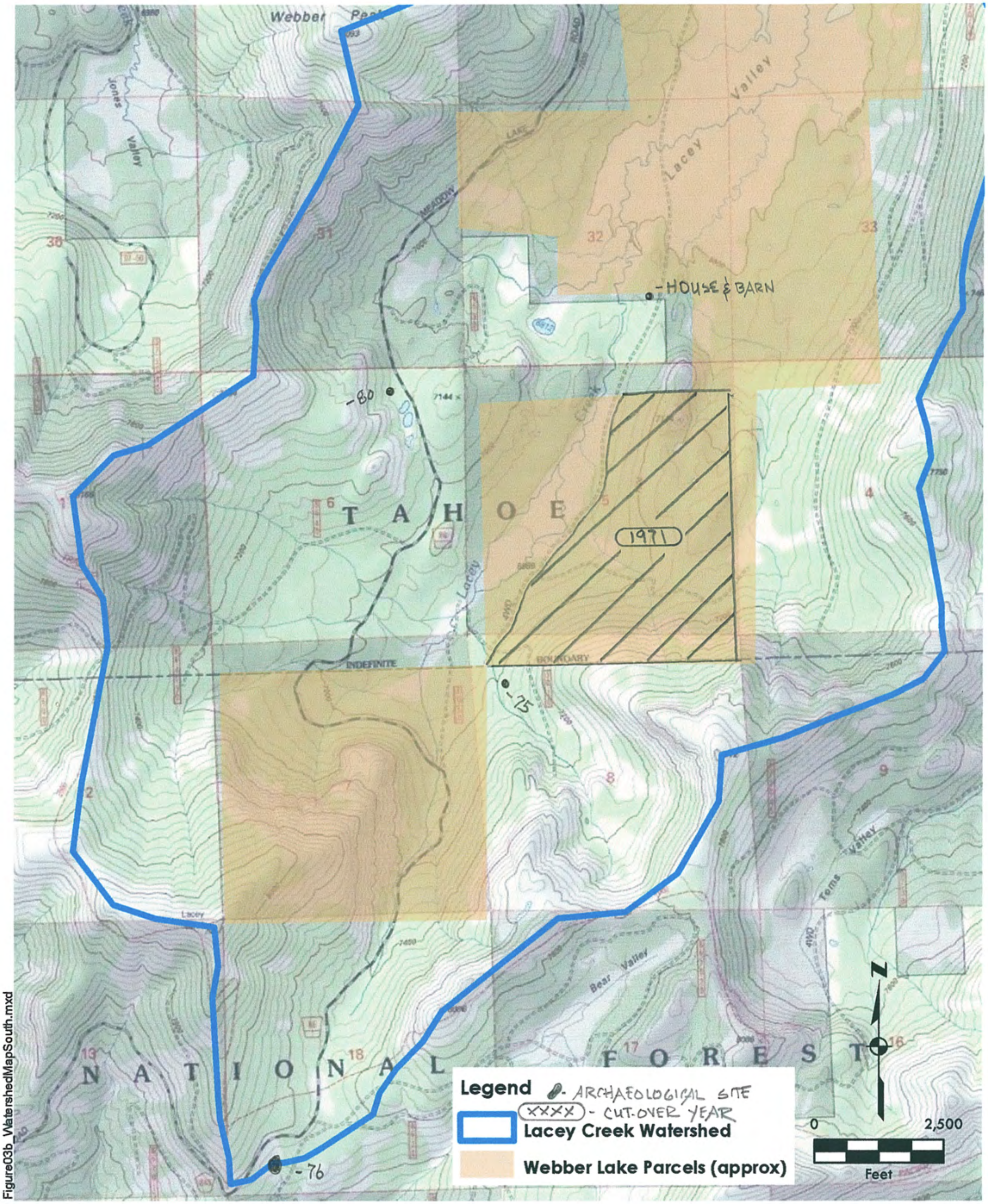


Figure03a_WatershedMapNorth.mxd

Balance Hydrologics, Inc.

Figure 3a. Lacey Meadows Watershed (northern)
Sierra County, California



Balance Hydrologics, Inc.

Figure 3b. Lacey Meadows Watershed (southern)
Sierra County, California

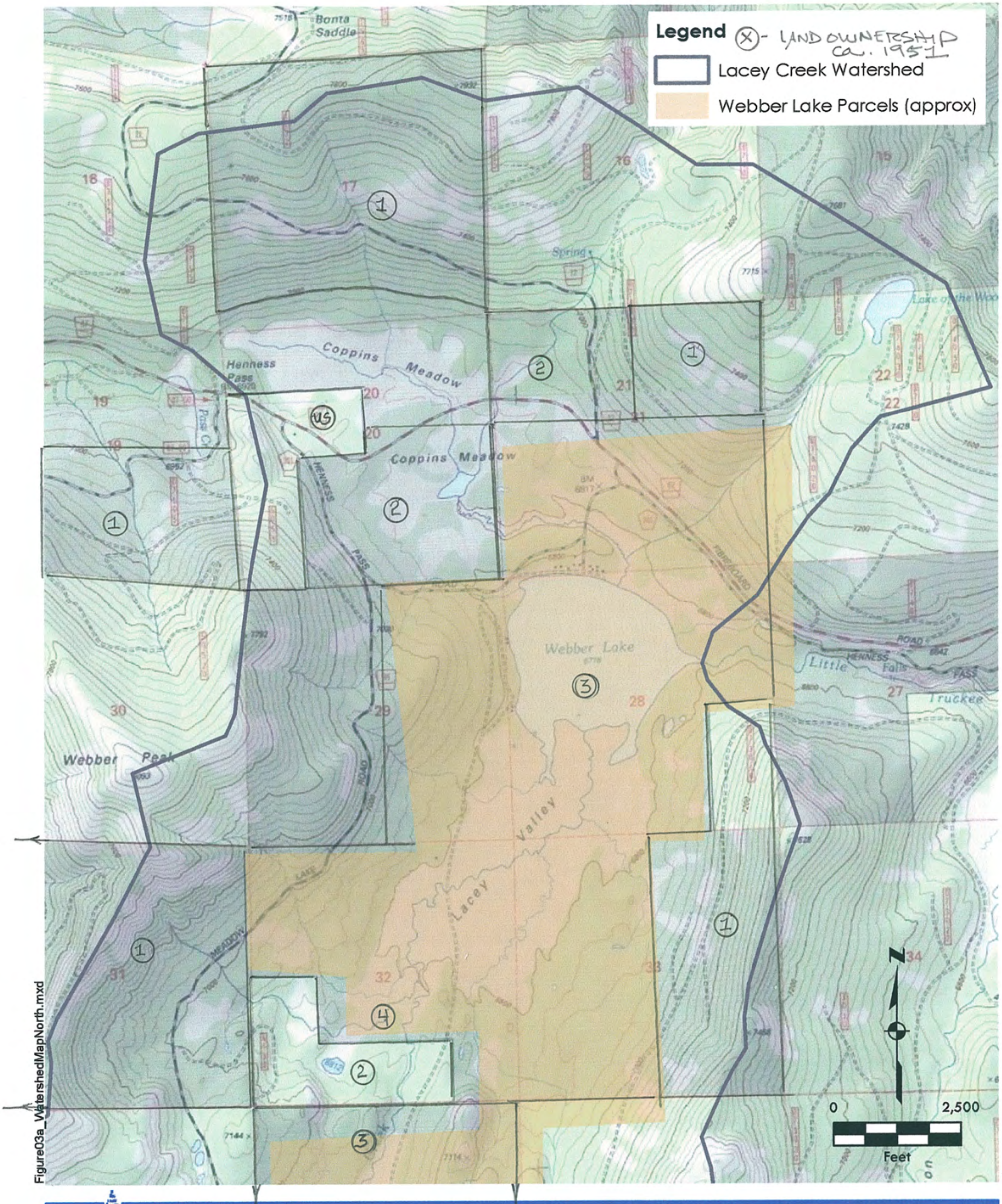


Figure03a_WatershedMapNorth.mxd

Balance Hydrologics, Inc.

Figure 3a. Lacey Meadows Watershed (northern)
Sierra County, California

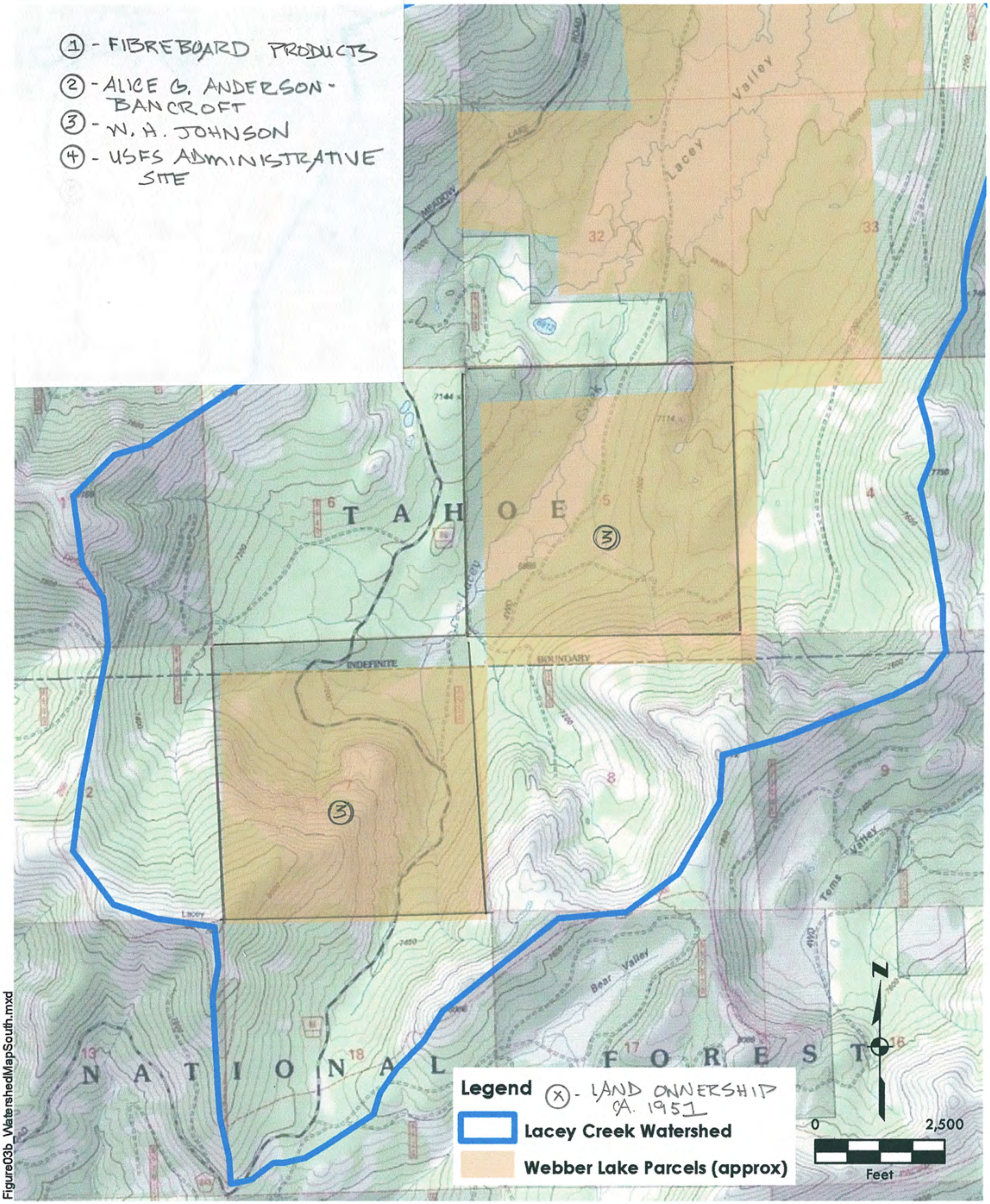
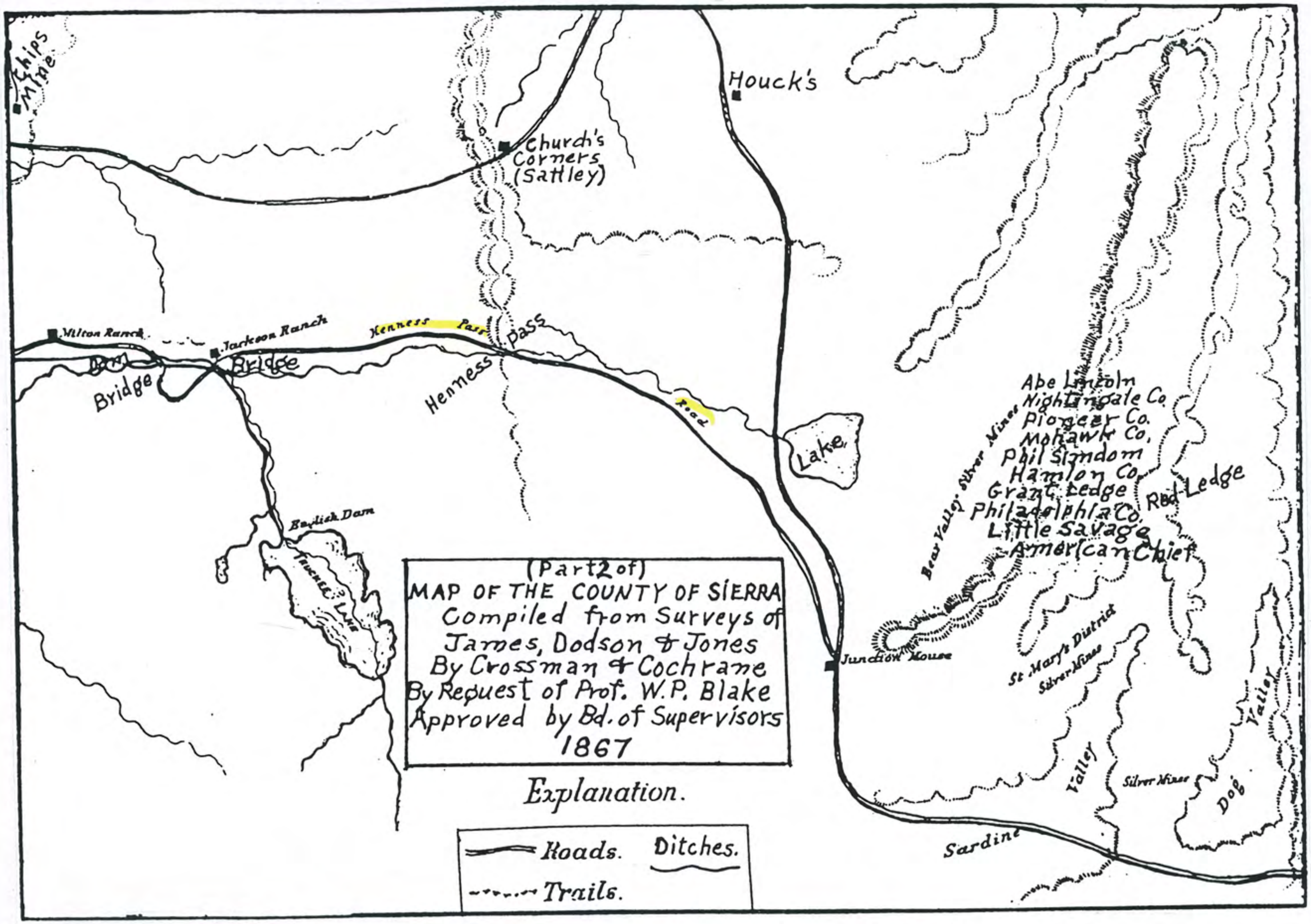


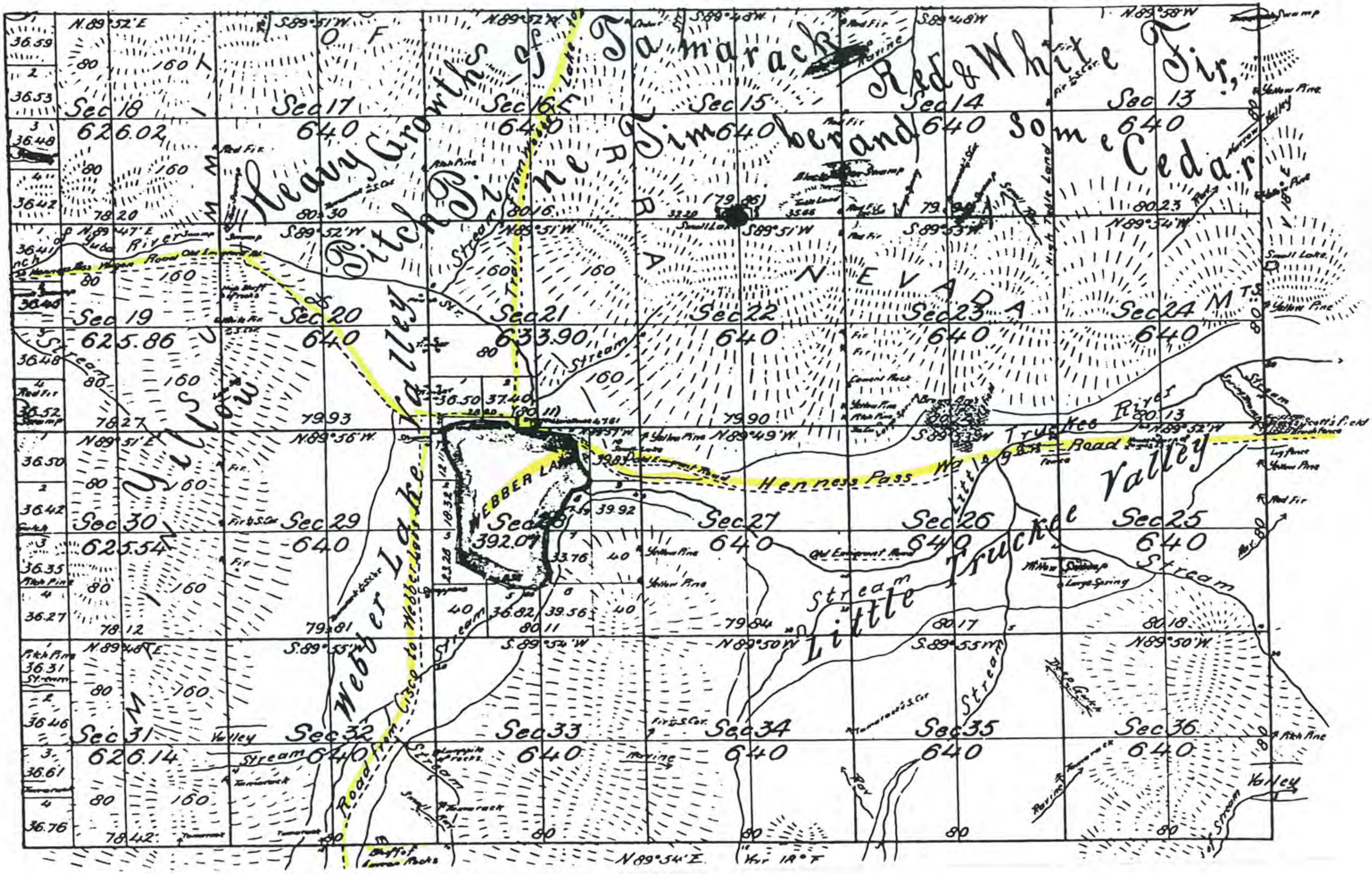
Figure03b_WatershedMapSouth.mxd

Balance Hydrologics, Inc.

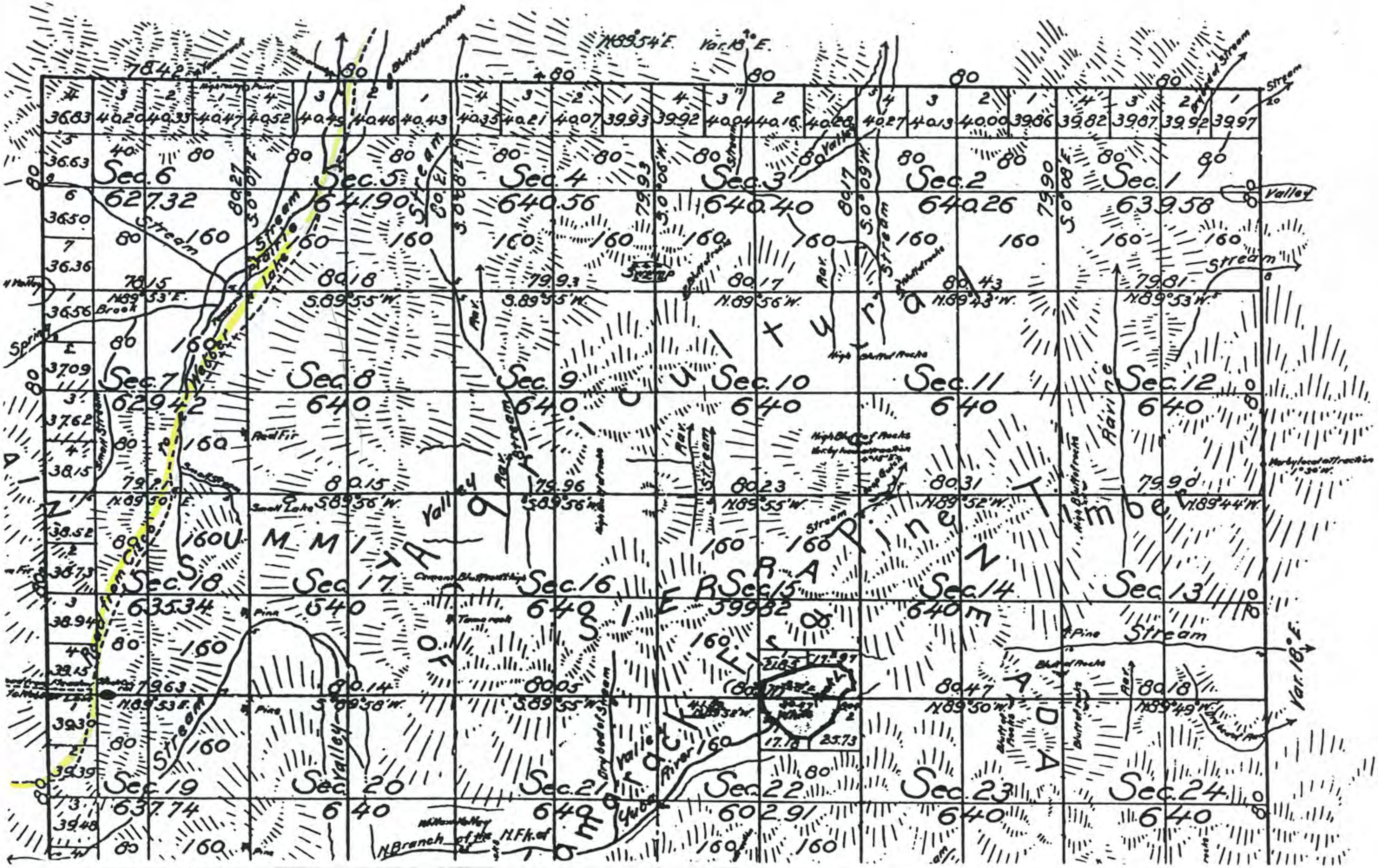
Figure 3b. Lacey Meadows Watershed (southern)
Sierra County, California



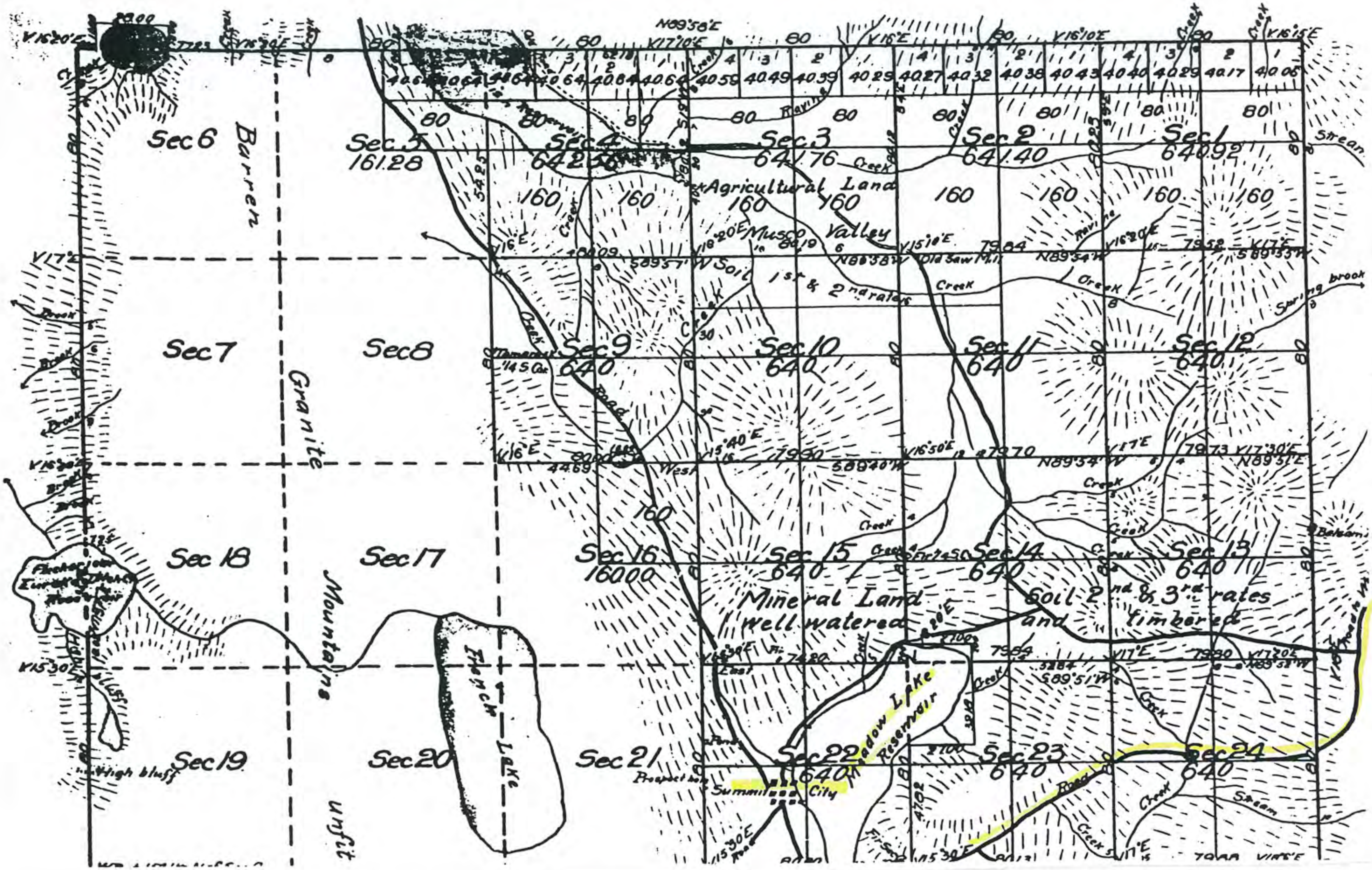
Map of the County of Sierra compiled from surveys of James, Dodson and Jones, 1867; note mining claims in the vicinity of Bear Valley (after Sinnot 1972:11).



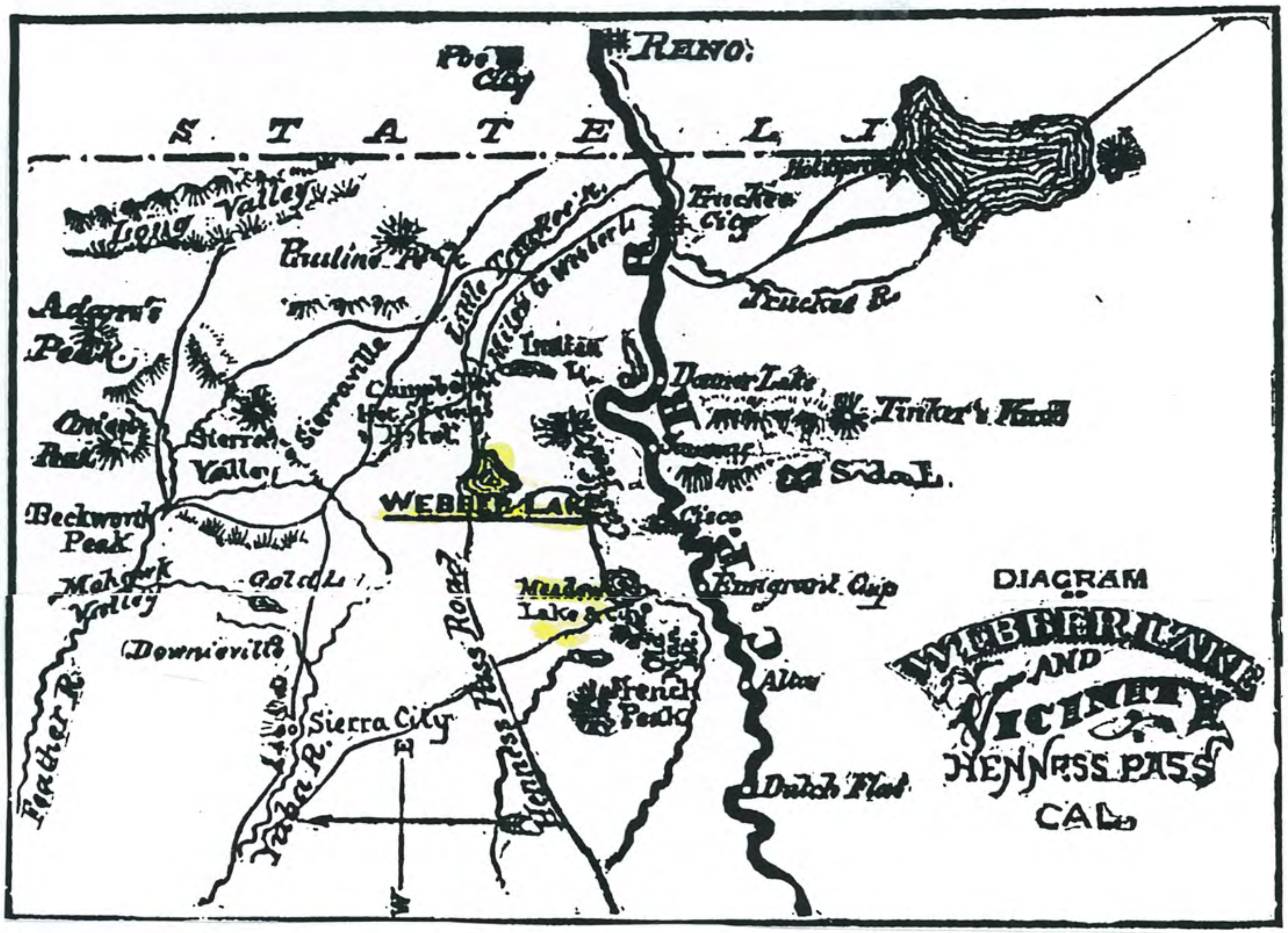
GLO SURVEY PLAT T19N/R14E (1872)



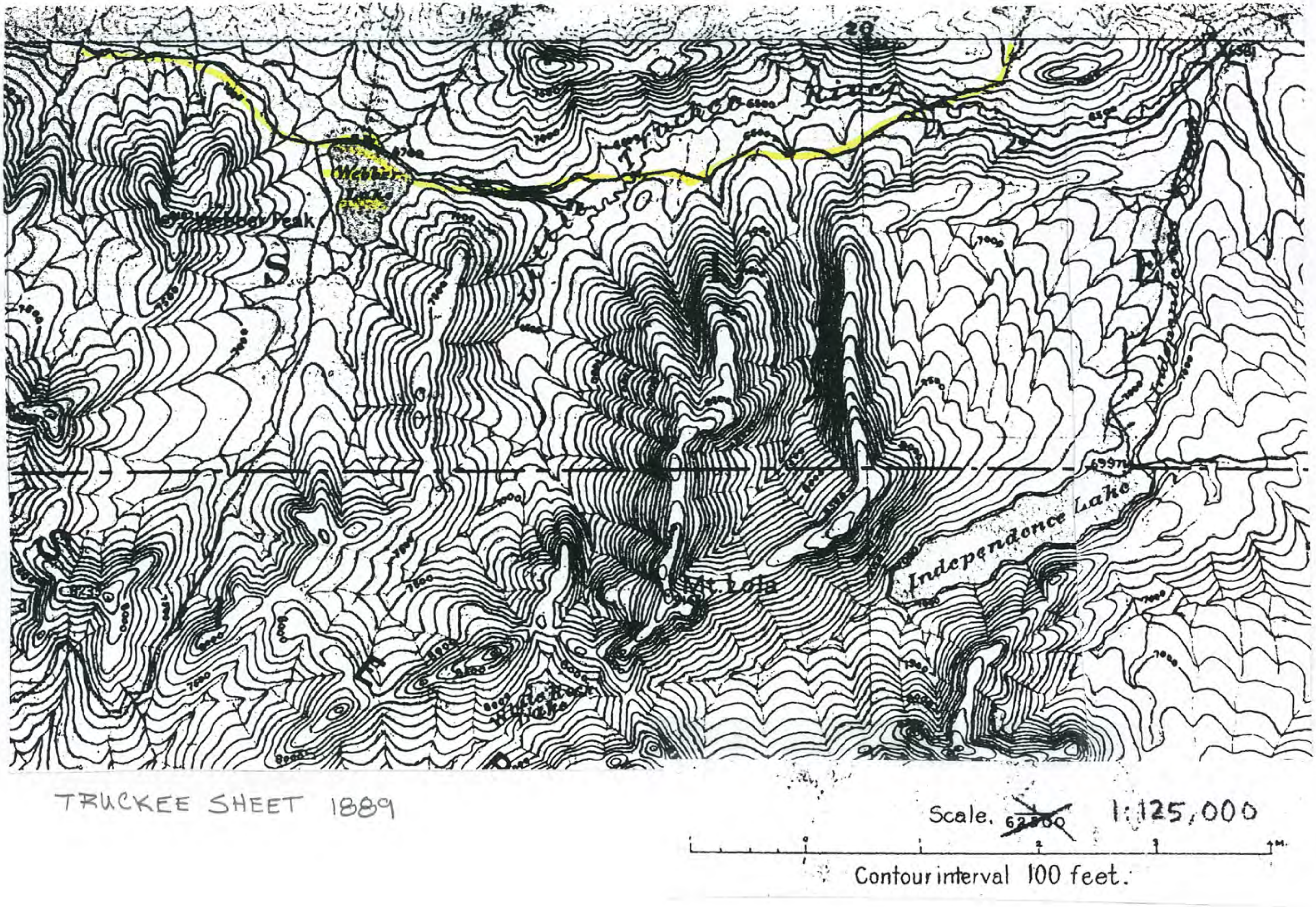
GLO SURVEY PLAT T18N/R14E (1866, 1872)



GLO SURVEY PLAT T18N/R13E (1866, 1872, 1873)



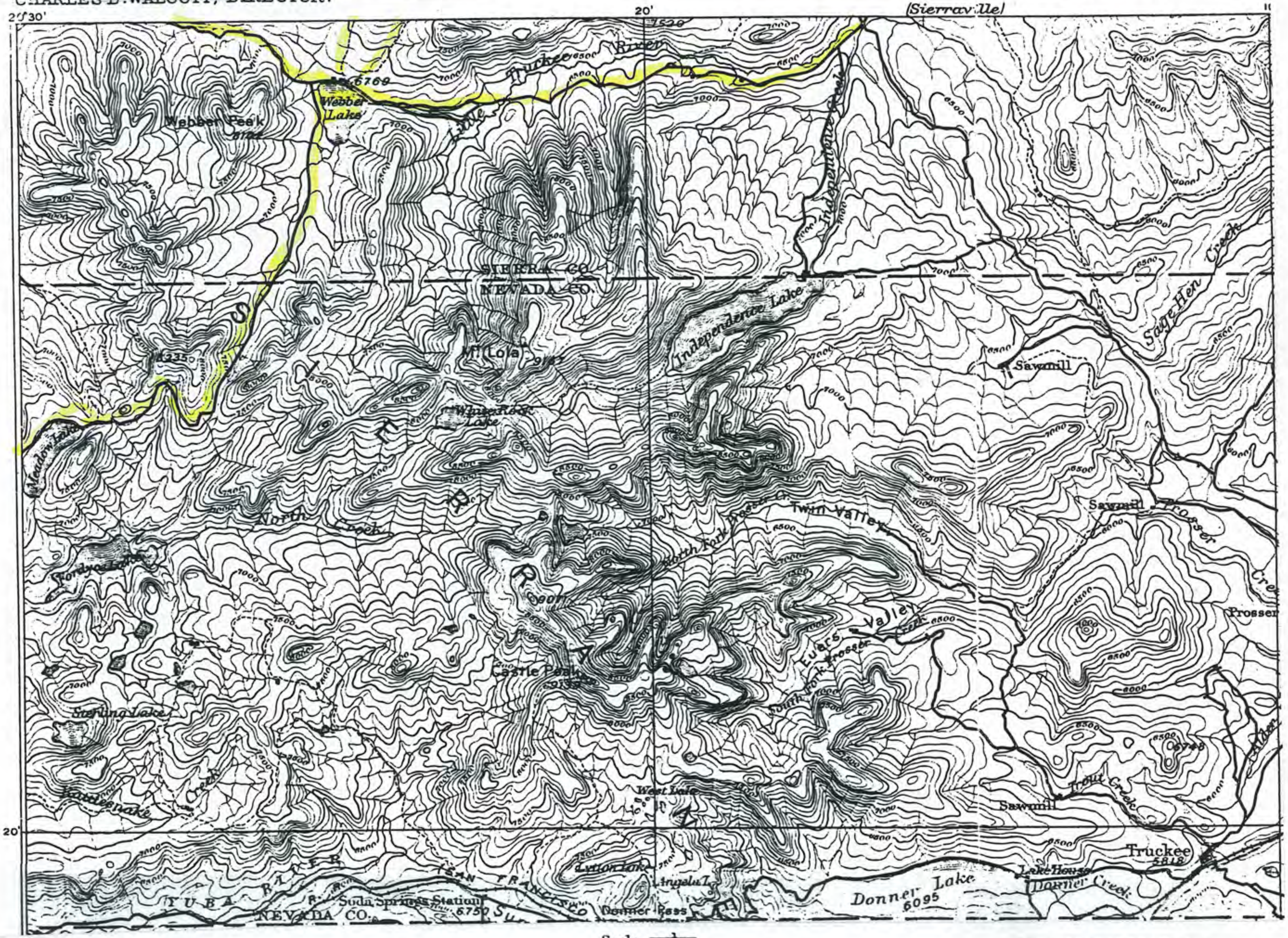
(AFTER LEMMON 1877: 364)



TRUCKEE SHEET 1889

U.S. GEOLOGICAL SURVEY.
CHARLES D. WALCOTT, DIRECTOR.

TOPOGRAPHIC SHEET



Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

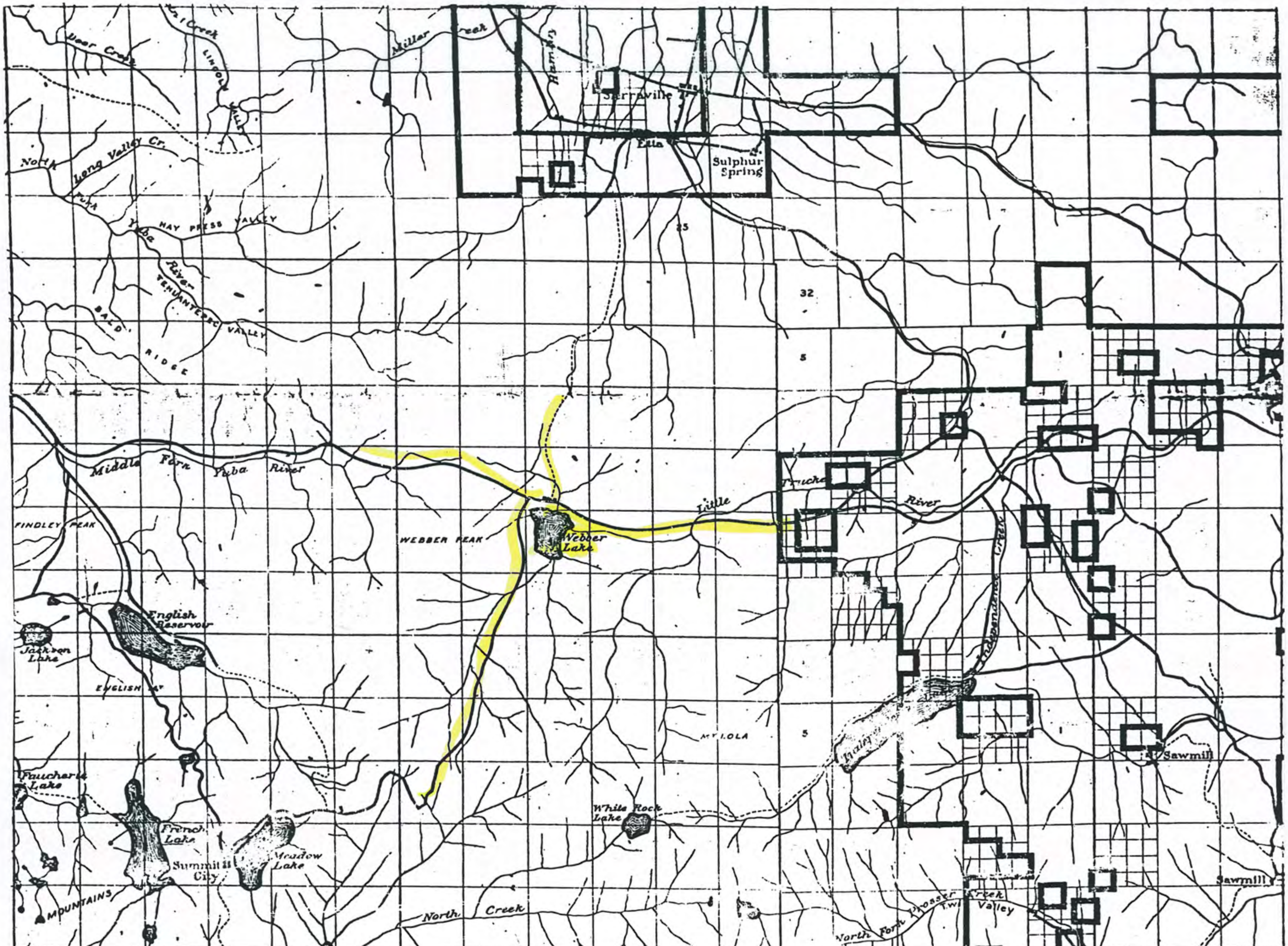
Contour Interval 100 feet

Datum is mean Sea level

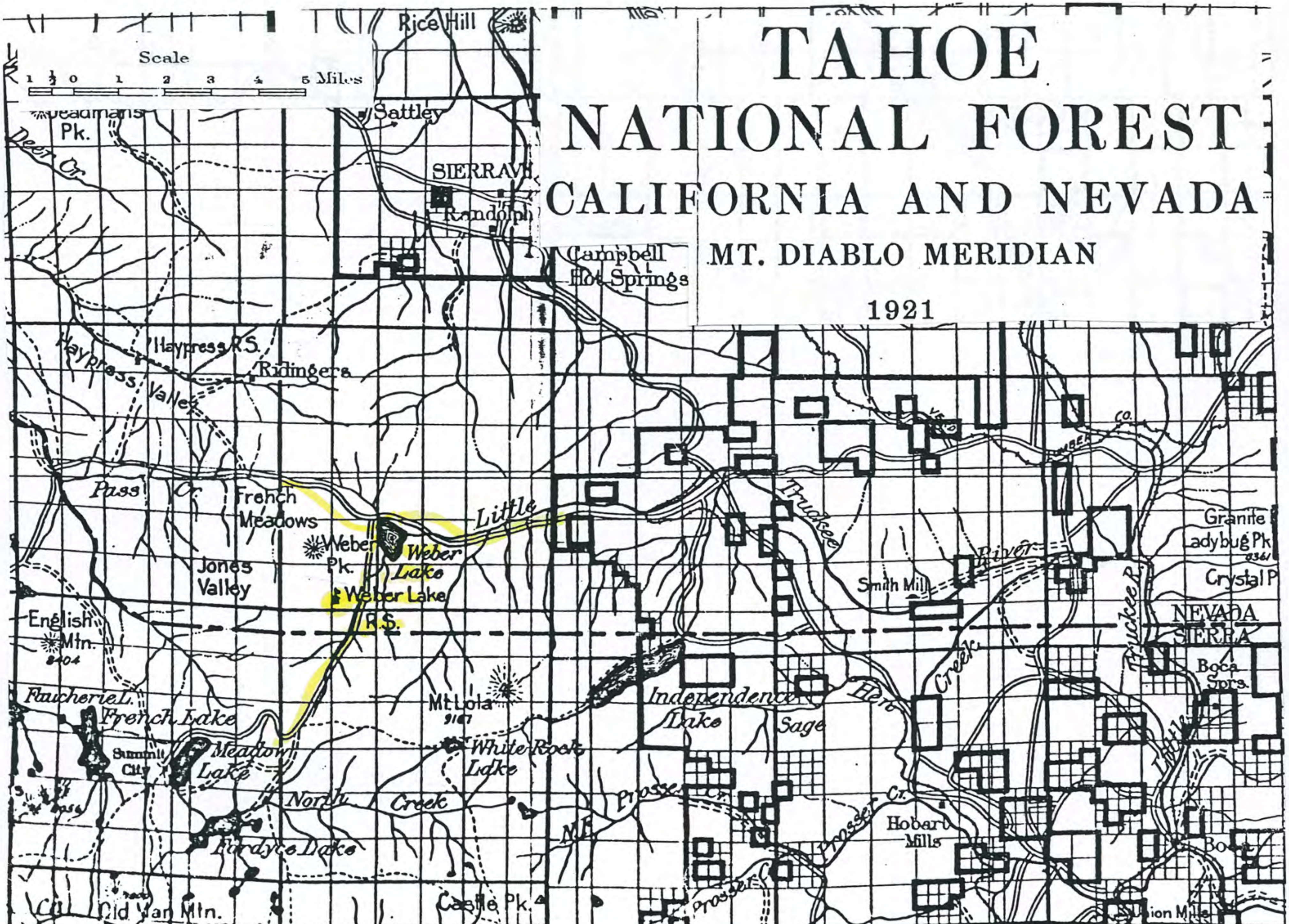
Edition of May 1897.

A. H. Thompson, Geographer.
E. M. Douglas, Topographer in charge.
Triangulation by H. E. C. Feusier.
Topography by A. F. Dunnington.
Surveyed in 1889

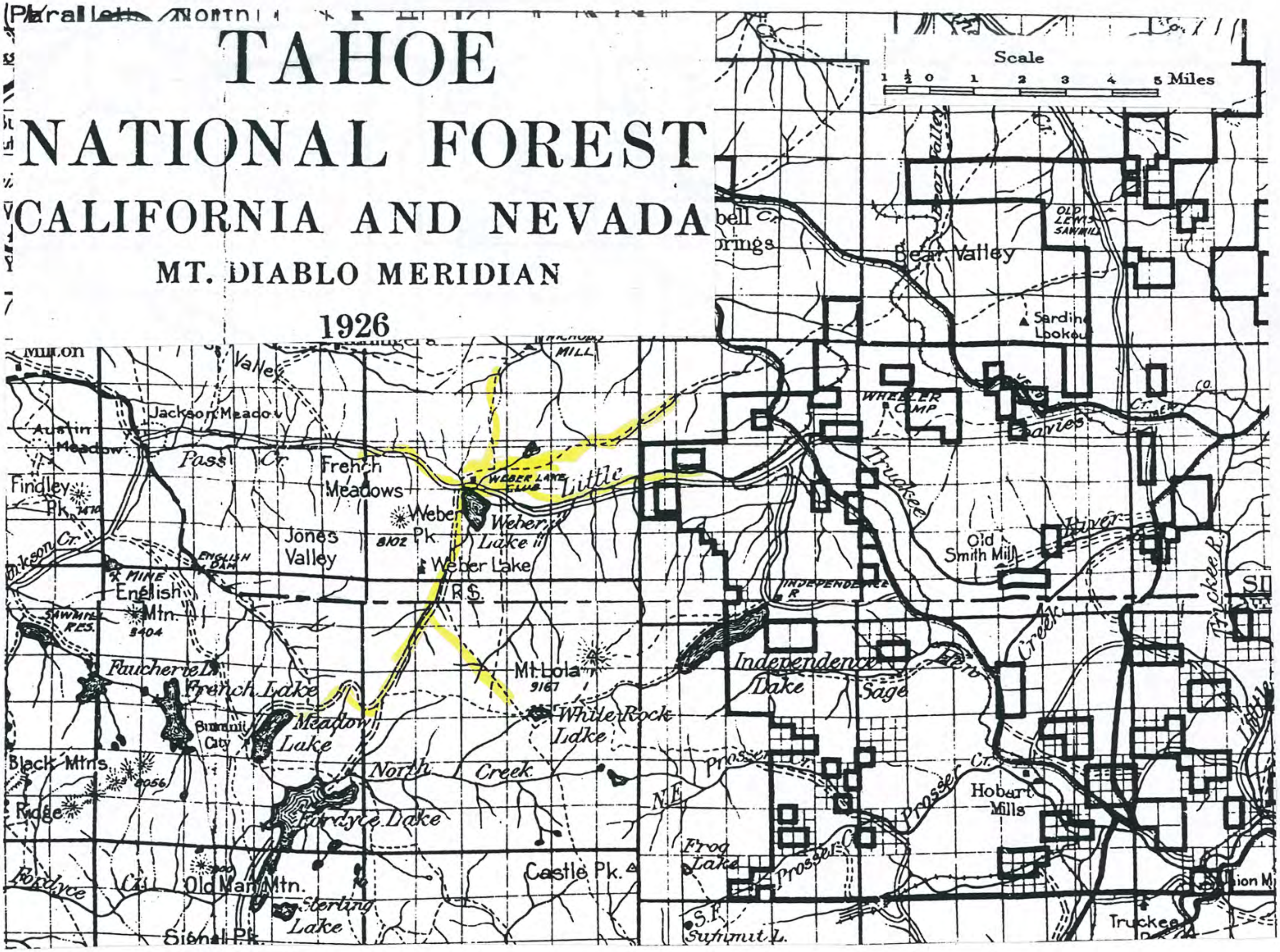
CALIFORNIA
TRUCKEE QUADRANGLE

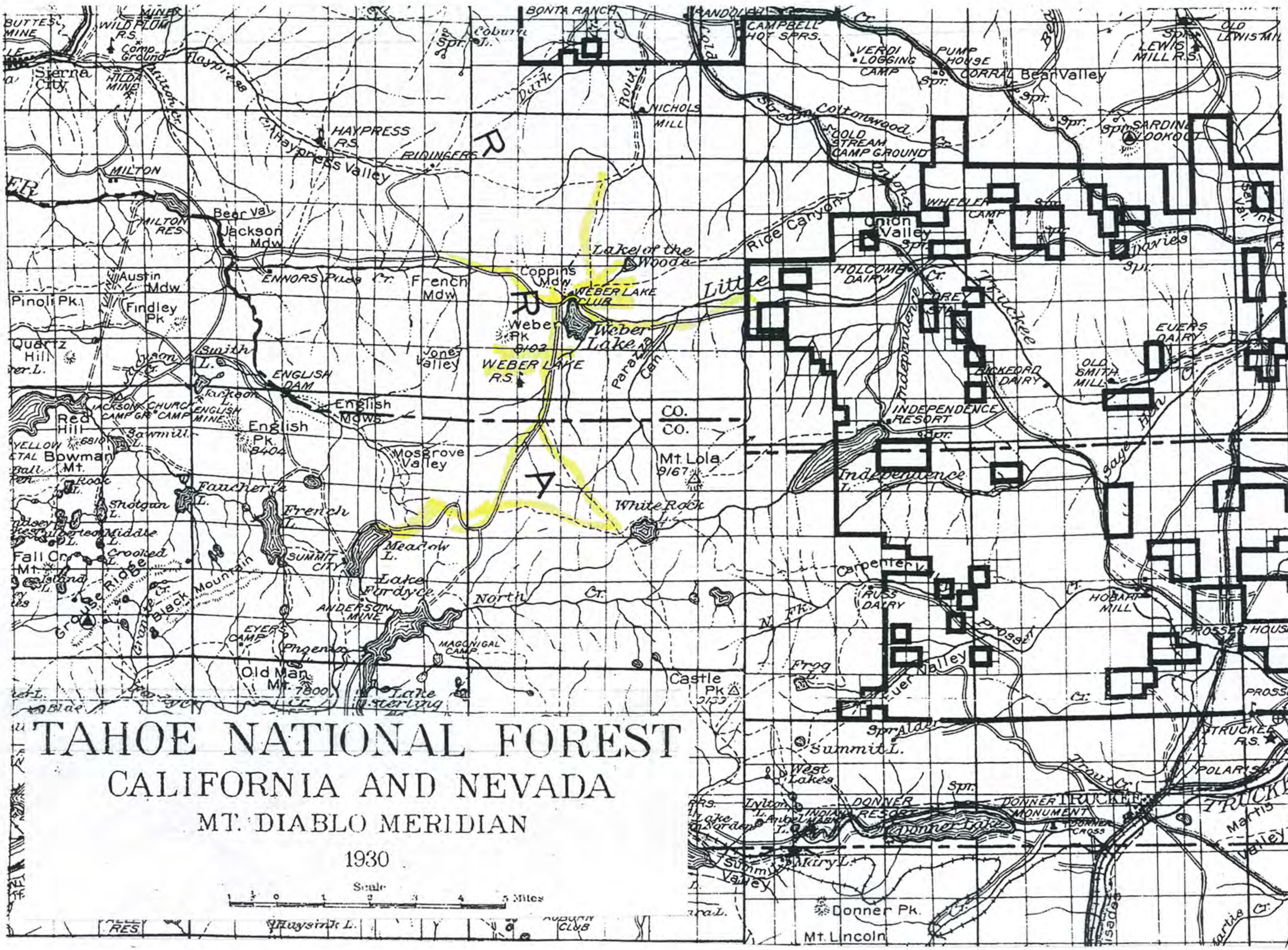


TAHOE NATIONAL FOREST 1915

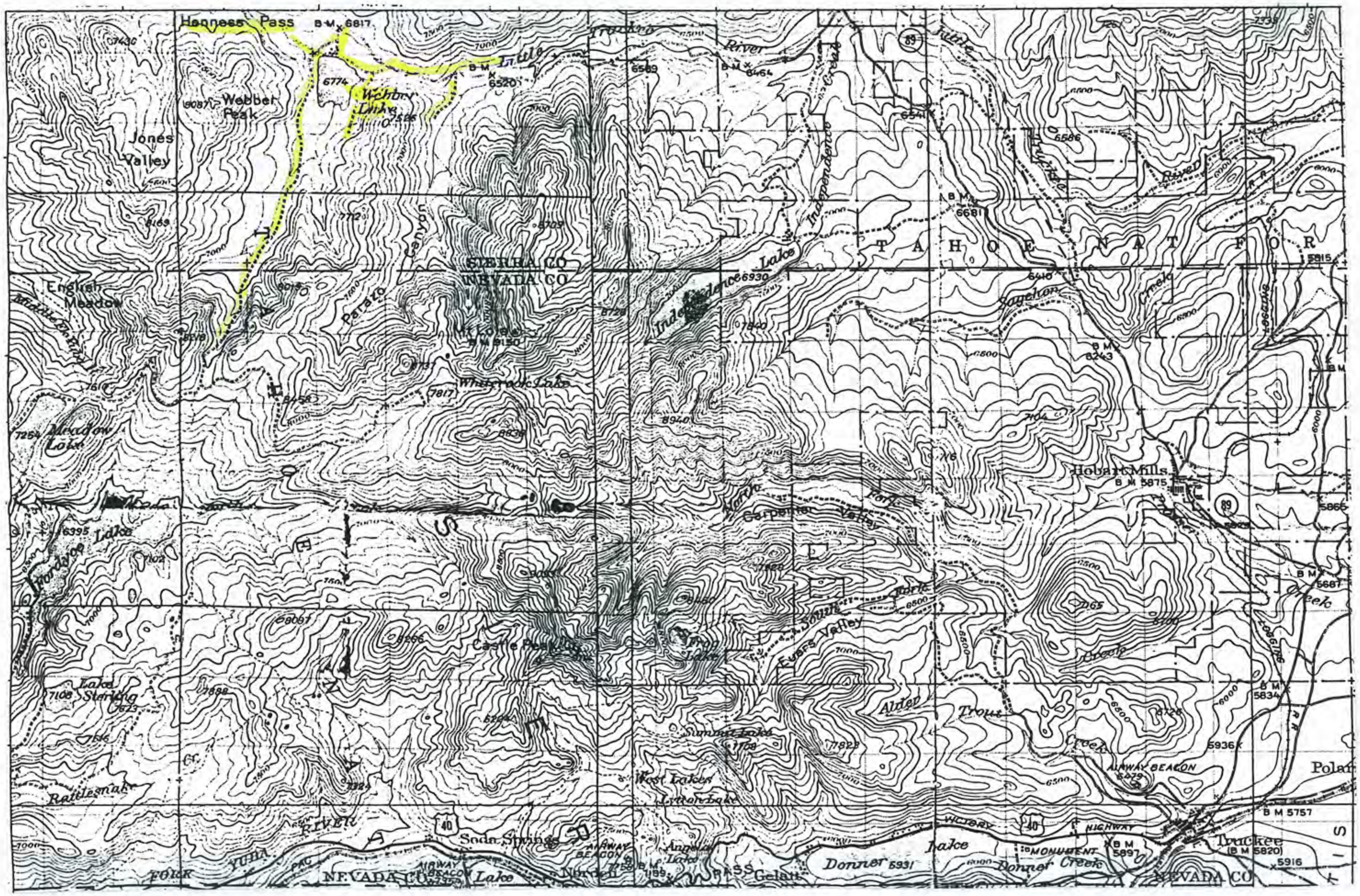


TAHOE
NATIONAL FOREST
CALIFORNIA AND NEVADA
MT. DIABLO MERIDIAN
1921
Scale
5 Miles
Rice Hill
Sattley
SIERRAVILLE
Randolph
Campbell Hot Springs
Pk.
Deer Cr.
Haypress R.S.
Ridingers
Haypress Valley
Pass Cr.
French Meadows
Little
Truckee
Weber Pk.
Weber Lake
Weber Lake R.S.
Jones Valley
English Mtn.
8404
Faucherie L.
French Lake
Summit City
Meadow Lake
North Creek
Fordyce Lake
Mt. Lola
9167
White Rock Lake
Independence Lake
Sage
Hen
Creek
Prosser Cr.
Hobart Mills
Smith Mill
River
Granite
Ladybug Pk.
Crystal P
Truckee R.
NEVADA
SIERRA
Boca
Sprs.
Castle Pk.
Old Man Mtn.


TAHOE
NATIONAL FOREST
CALIFORNIA AND NEVADA
MT. DIABLO MERIDIAN
1926
Scale
5 Miles
Bear Valley
Sardine Lookout
Old Lewis Sawmill
Wheeler Camp
Davies
Truckee
River
Old Smith Mill
Independence Lake
Sage
Prosser Cr.
Hobart Mills
Frog Lake
S.P. Summit L.
Truckee
Castle Pk.
White Rock Lake
Mt. Lola
9167
North Creek
Fordyce Lake
Meadow Lake
French Lake
Faucherie L.
Summit City
Black Mtns.
Ridge
Old Man Mtn.
Sterling Lake
Signal Pk.
English Mtn.
8404
English Dam
Sawmill Res.
Jones Valley
Weber Pk.
8102
Weber Lake
R.S.
Weber Lake Camp
Little
French Meadows
Pass Cr.
Jackson Meadow
Austin Meadow
Findley Pk.
Jackson Cr.
Valley
Mill
Milton
Fordyce



TAHOE NATIONAL FOREST
CALIFORNIA AND NEVADA
MT. DIABLO MERIDIAN
1930
Scale
5 Miles
Sierra City
HAYPRESS R.S.
Haypress Valley
MILTON
Jackson Mdw
French Mdw
Coppins Mdw
WEBER LAKE CLUB
Weber Lake
Weber Pk 8102
WEBER LAKE R.S.
Lake of the Woods
Little
English Pk. 8404
Bowman Mt.
Mosgrove Valley
Mt. Lola 9167
White Rock
Meadow L.
Lake Fordyce
North
Cr.
Castle Pk
Old Man Mt. 7800
Lake Sterling
Independence L.
INDEPENDENCE RESORT
HOLCOMB DAIRY
Union Valley
Rice Canyon
BICKFORD DAIRY
OLD SMITH MILL
EUERS DAIRY
HOBART MILL
PROSSER HOUSE
TRUCKEE R.S.
TRUCKEE
DONNER MONUMENT
Donner Lake
DONNER RESORT
Summit L.
West Lakes
Donner Pk.
Mt. Lincoln
CAMPBELL HOT SPRS.
VERDI LOGGING CAMP
PUMP HOUSE
CORRAL
Bear Valley
SARDINE LOOKOUT
OLD LEWIS MILL
LEWIS MILL R.S.
BONTA RANCH
NICHOLS MILL
COLD STREAM CAMP GROUND
Cottonwood
WHEELER CAMP
Davies
CO.
CO.
R
A



Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 6 7 8 9 Miles

3000 1500 0 3000 6000 9000 12000 Yards

5000 0 5000 10000 15000 20000 25000 Feet

1 0 1 2 3 4 5 6 Kilometers

Contour interval 100 feet

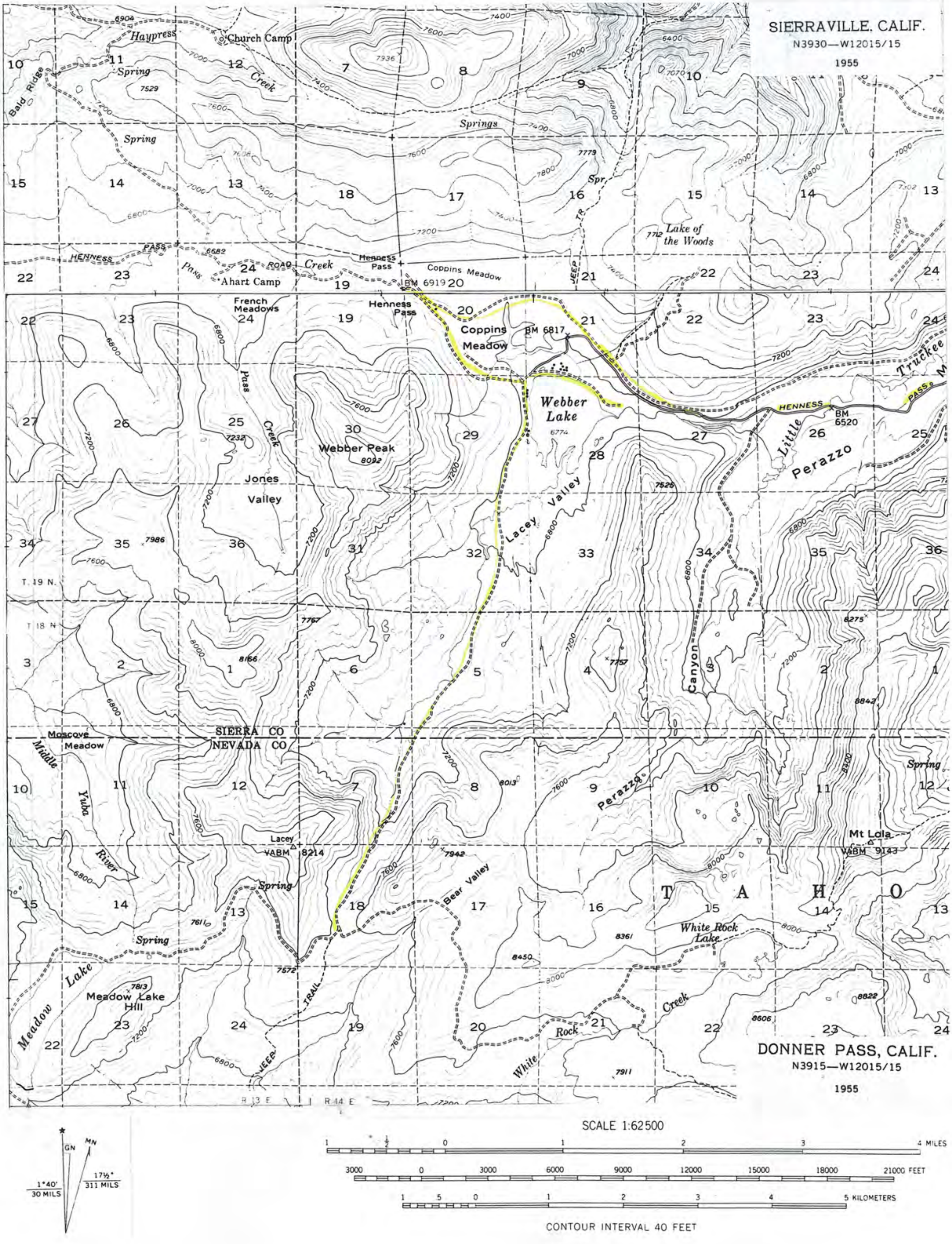
TRUE NORTH

MAGNETIC NORTH

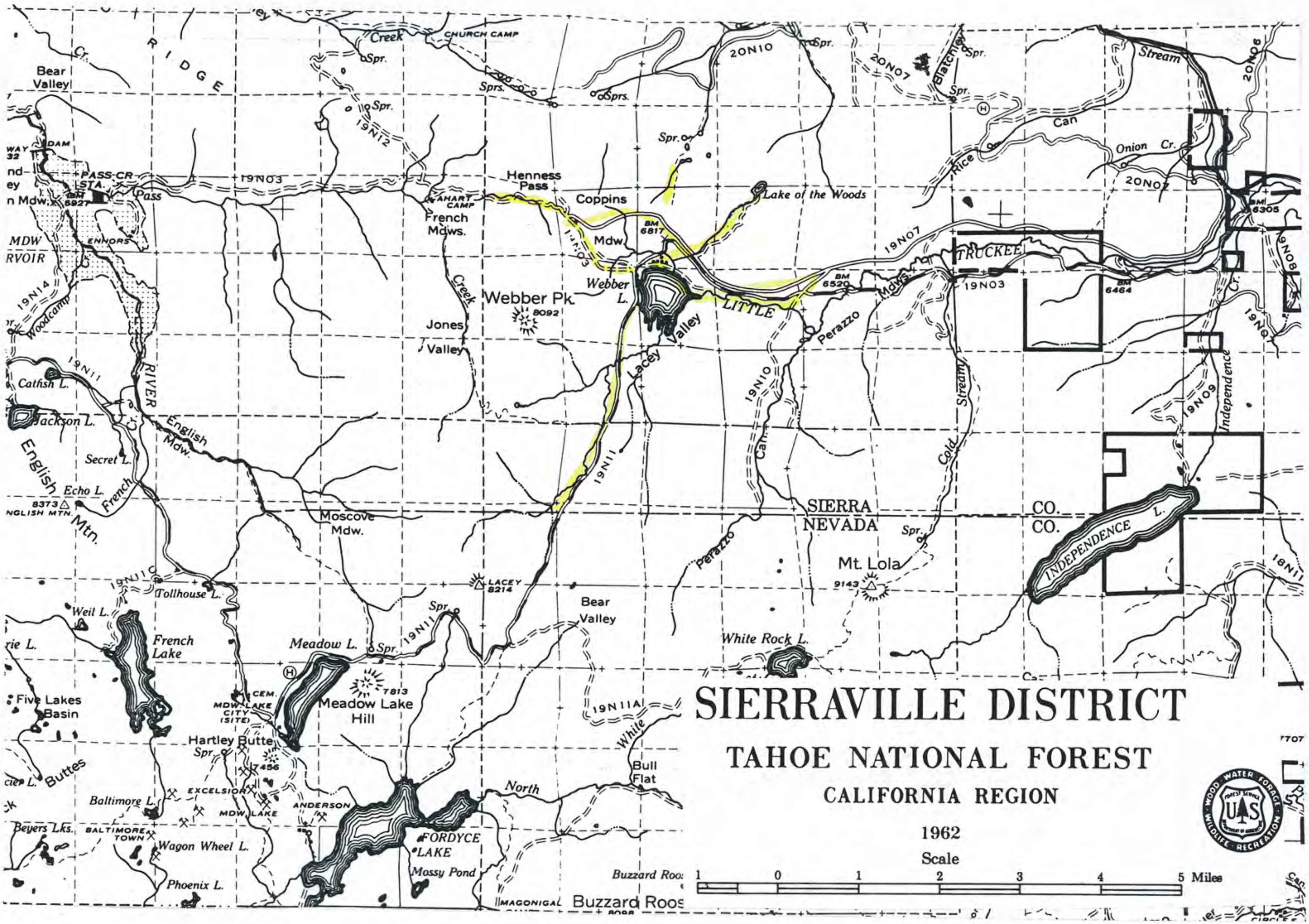
17°

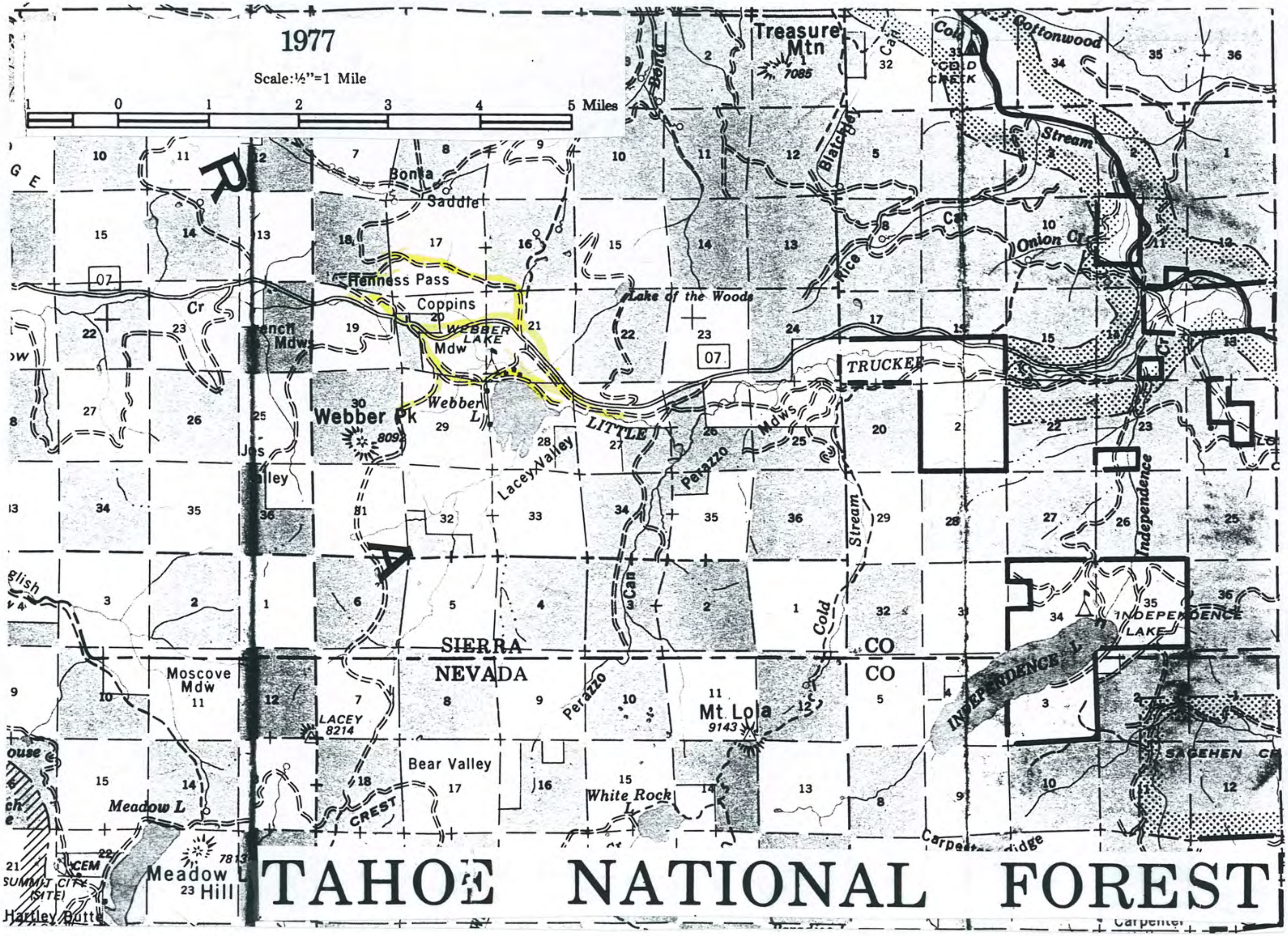
APPROXIMATE MEAN DECLINATION, 1932

TRUCKEE, CALIF.-NEV.
Edition of 1940
reprinted 1951
N3900-W12000/30

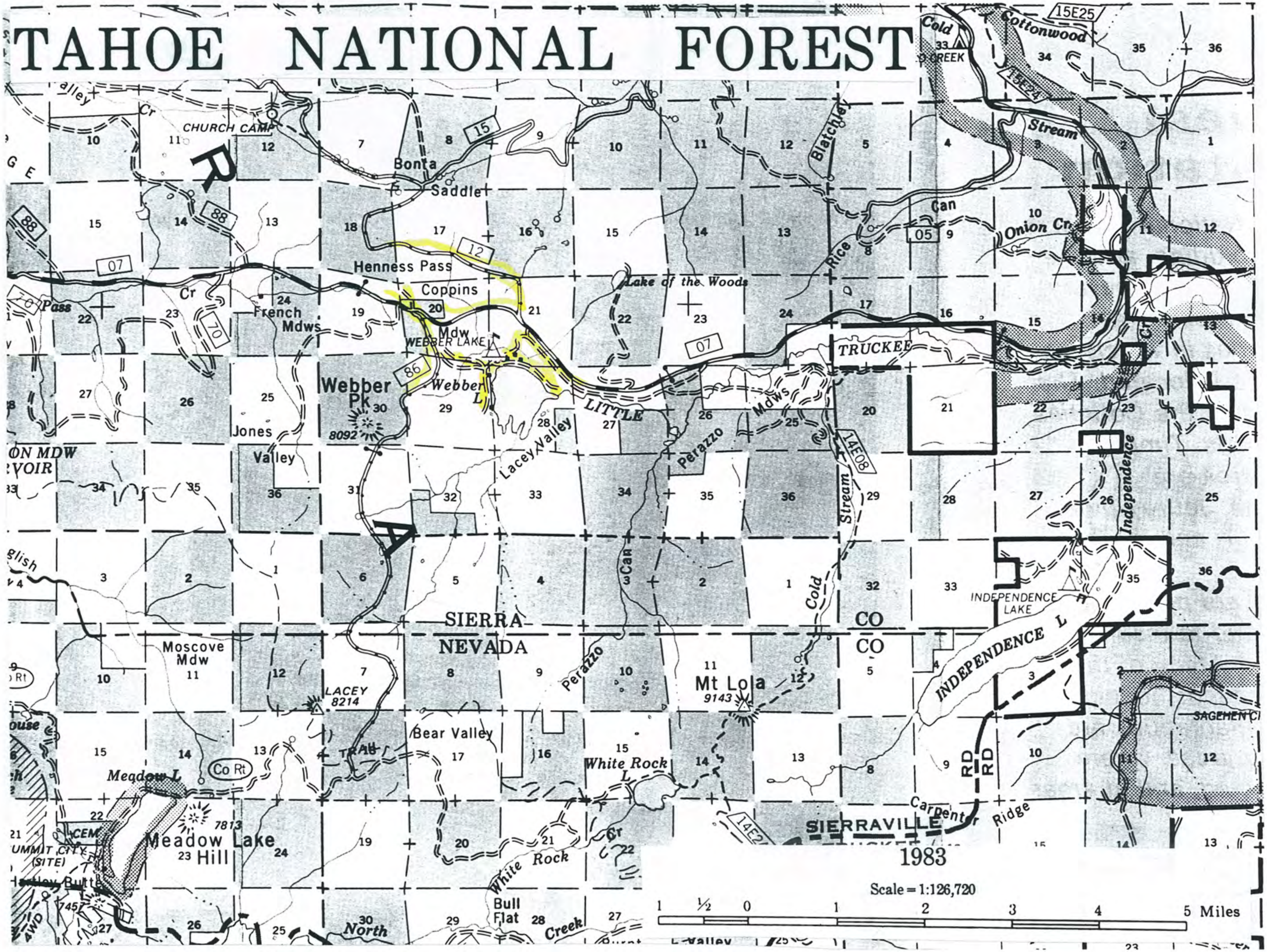


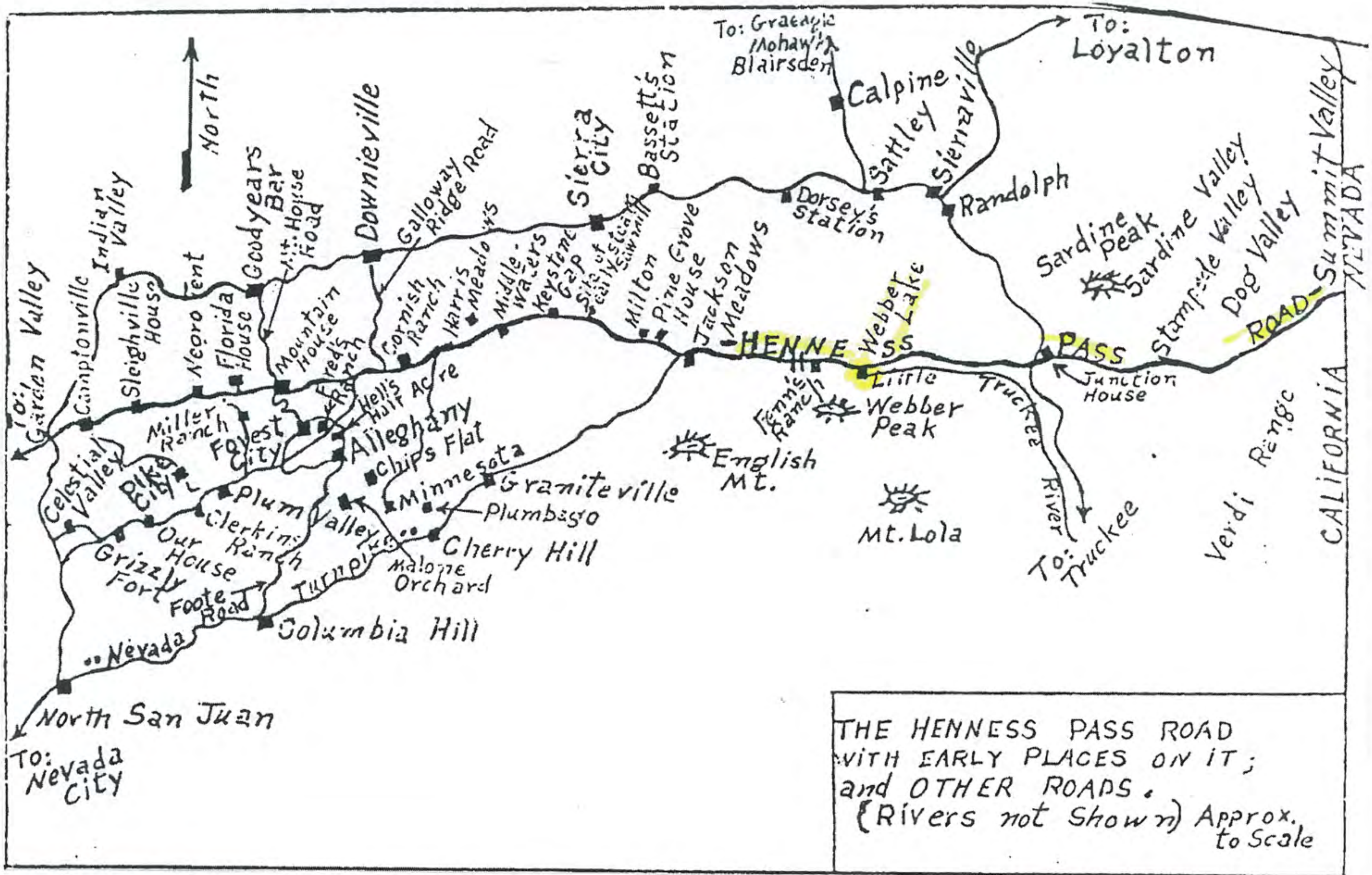
SIERRAVILLE, CALIF.
N3930—W12015/15
1955
Haypress
Church Camp
Bald Ridge
Spring
Creek
Springs
Spr.
Lake of the Woods
HENNESS PASS ROAD
Pass
Ahart Camp
Creek
Henness Pass
BM 6919
Coppins Meadow
JEEP TR
French Meadows
Henness Pass
Coppins Meadow
BM 6817
Webber Lake
6774
Pass Creek
Webber Peak
8092
Jones Valley
Lacey Valley
HENNESS
BM 6520
Little Truckee
Perazzo
PASS
Canyon
T. 19 N.
T 18 N
SIERRA CO
NEVADA CO
Moscove Meadow
Middle Yuba River
Perazzo
Lacey VABM 8214
Spring
Bear Valley
Mt Lola
VABM 9143
T A H O
White Rock Lake
Spring
Meadow Lake
Meadow Lake Hill
TRAIL
JEEP
White Rock Creek
DONNER PASS, CALIF.
N3915—W12015/15
1955
R 13 E
R 14 E
GN
MN
1°40′
30 MILS
17½°
311 MILS
SCALE 1:62500
1 ½ 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS
CONTOUR INTERVAL 40 FEET


SIERRAVILLE DISTRICT
TAHOE NATIONAL FOREST
CALIFORNIA REGION
1962
Scale
1 0 1 2 3 4 5 Miles
Bear Valley
RIDGE
Creek
CHURCH CAMP
Henness Pass
Coppins Mdw
Lake of the Woods
French Mdws.
Webber Pk. 8092
Webber L.
Jones Valley
LITTLE TRUCKEE
Lacey Valley
Perazzo Mdws.
Cold Stream
Independence L.
SIERRA CO.
NEVADA CO.
Mt. Lola 9143
White Rock L.
Bear Valley
LACEY 8214
Moscove Mdw.
Meadow L.
Meadow Lake Hill 7813
Hartley Butte
FORDYCE LAKE
Mossy Pond
Bull Flat
North
English Mdw.
RIVER
French Lake
Tollhouse L.
Weil L.
Five Lakes Basin
Buttes
Baltimore L.
BALTIMORE TOWN
Wagon Wheel L.
Phoenix L.
Beyers Lks.
Catfish L.
Jackson L.
Secret L.
Echo L.
English Mtn.
8373
PASS-CR STA.
Pass
Woodcamp
MDW RVOIR
Buzzard Roost
MAGONIGAL
CEM.
MDW LAKE CITY (SITE)
EXCELSIOR
ANDERSON
Onion Cr.
Stream
Rice Can
Blatchley Spr.
19N03
19N07
19N10
19N11
19N11A
19N12
19N14
20N06
20N07
20N10
19N09
18N11
BM 6817
BM 6520
BM 6464
BM 6305
BM 5927
Spr.
Sprs.


1977
Scale:½"=1 Mile
1 0 1 2 3 4 5 Miles
Treasure Mtn
7085
COLD CREEK
Cottonwood
Stream
Bonta
Saddle
Blatchley
Rice
Onion Cr
Henness Pass
Coppins
WEBBER LAKE
Mdw
Webber L
Webber Pk
8092
Lake of the Woods
07
TRUCKEE
LITTLE
Mdws
Perazzo
Lacey Valley
Independence
INDEPENDENCE LAKE
INDEPENDENCE L
SIERRA
NEVADA
CO
CO
Cold Stream
Moscove Mdw
LACEY
8214
Mt. Lola
9143
Bear Valley
CREST
White Rock L
Meadow L
Meadow Hill
CEM
SUMMIT CITY (SITE)
Hartley Butte
SAGEHEN
Carpenter Ridge
TAHOE NATIONAL FOREST

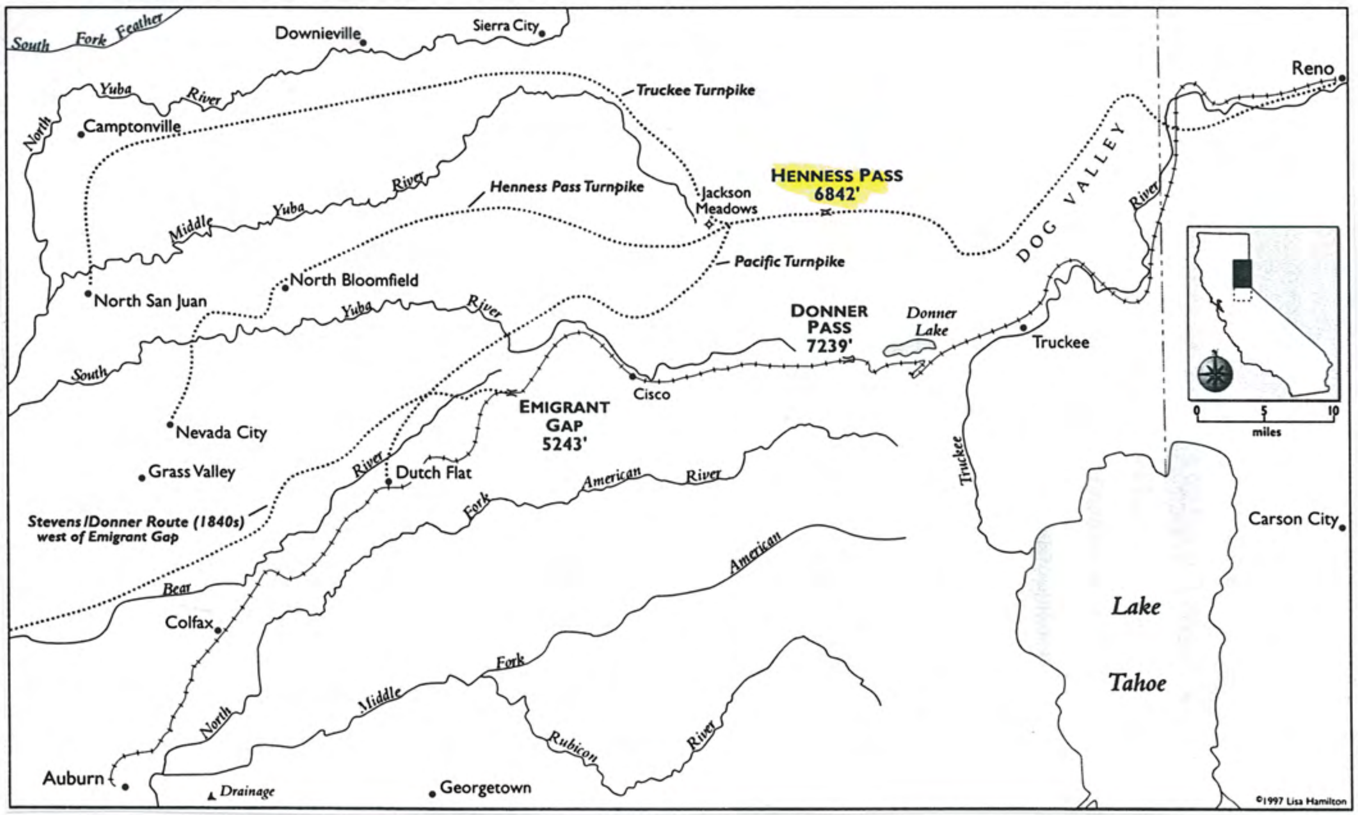
TAHOE NATIONAL FOREST



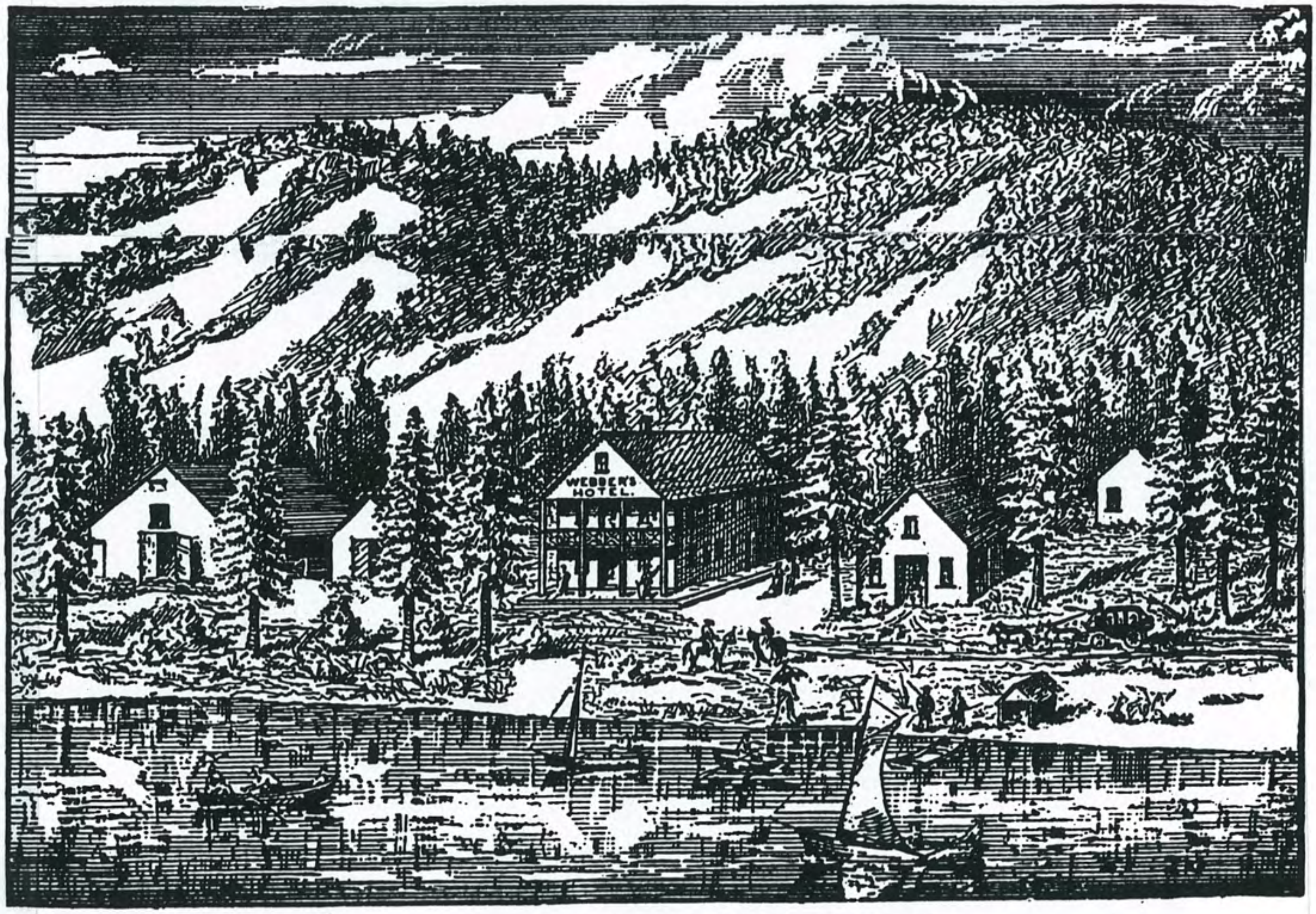


THE HENNESS PASS ROAD WITH EARLY PLACES ON IT; and OTHER ROADS. (Rivers not Shown) Approx. to Scale

(AFTER SINNOTT 1976)



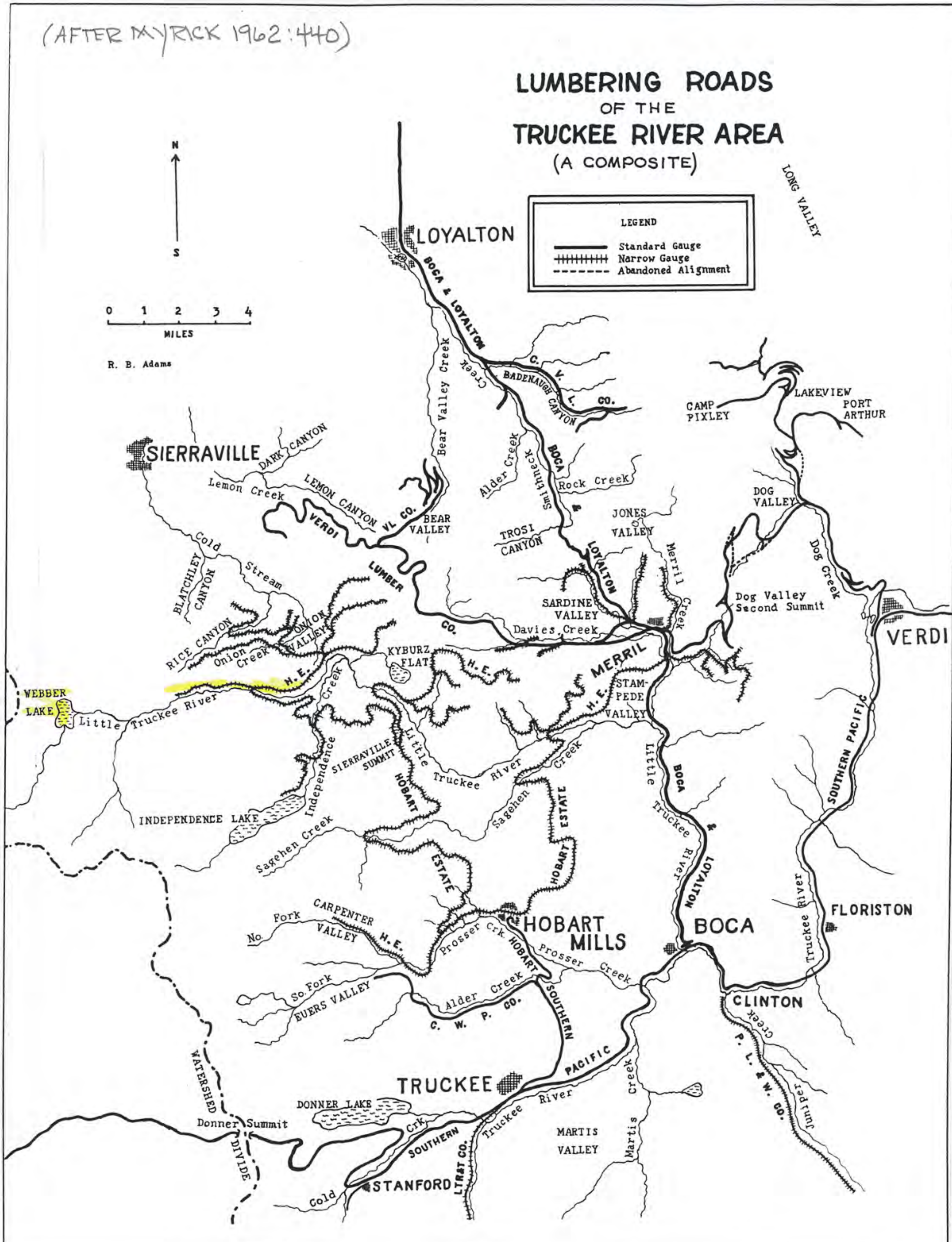
(AFTER HOWARD 1998: 140)

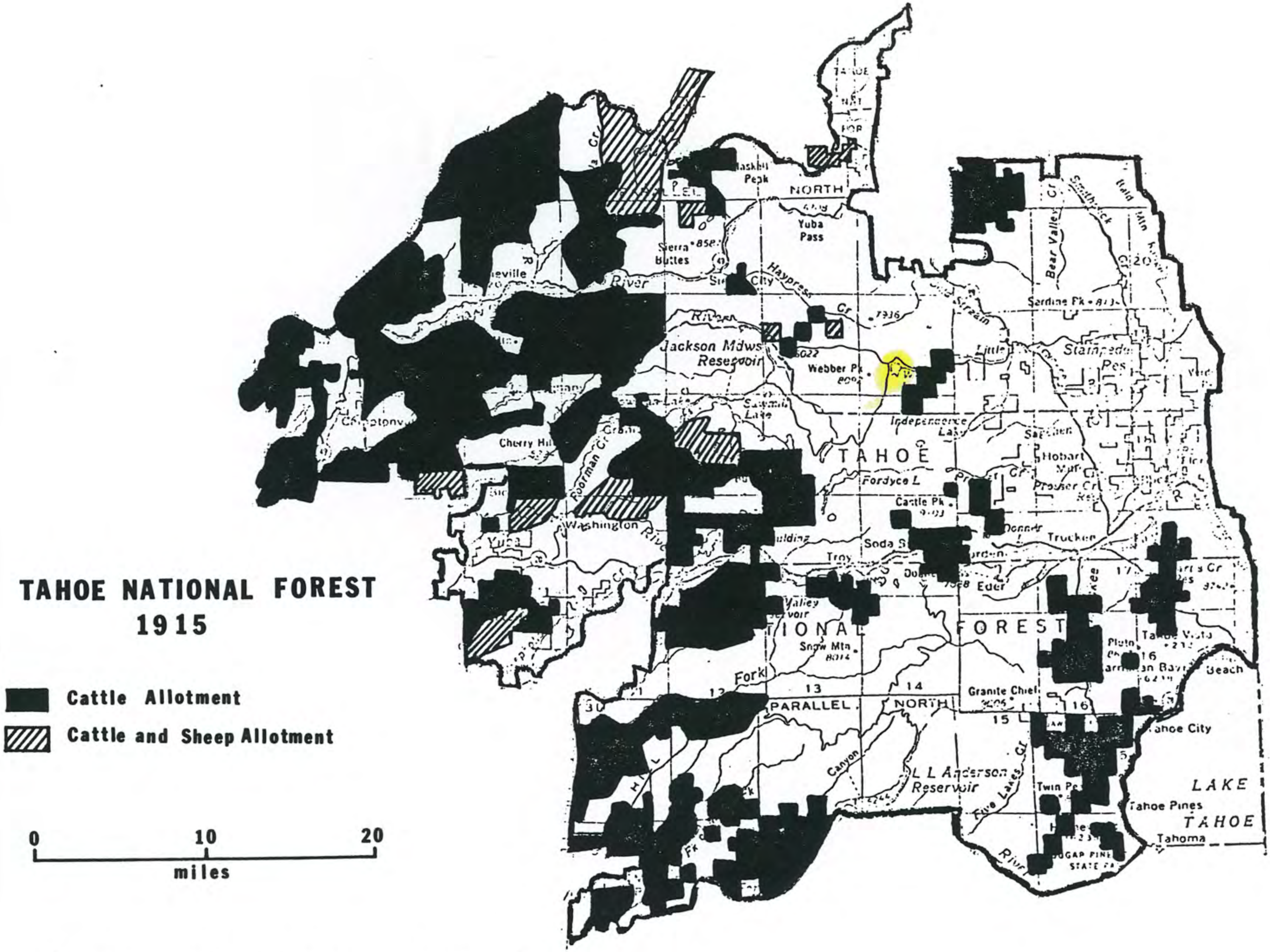


A RAMBLING SKETCH OF WEBBER LAKE.

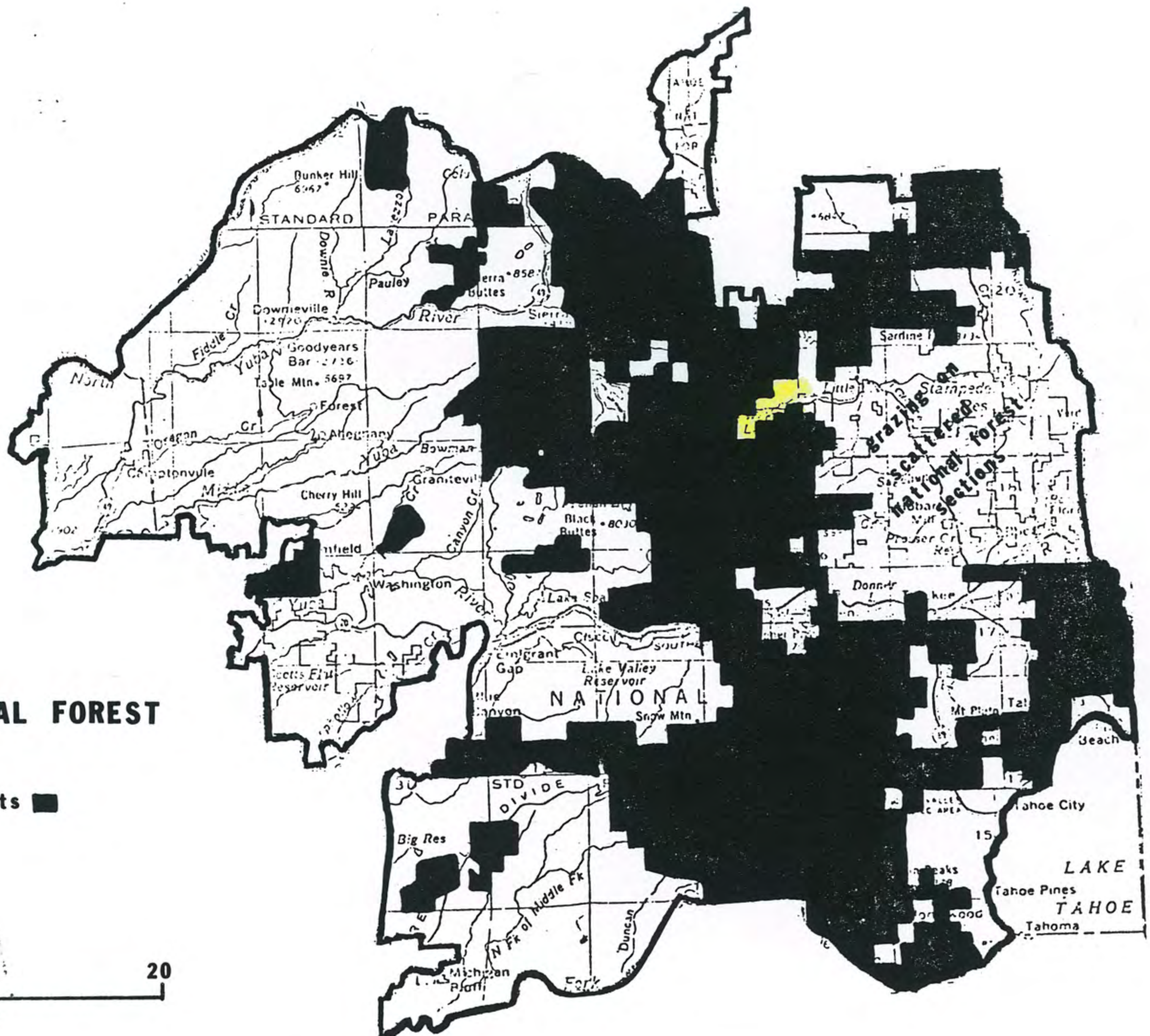
(AFTER PACIFIC RURAL PRESS - LEMMON 1877)

(AFTER MYRICK 1962:440)





(AFTER JACKSON ET AL. 1982:162)

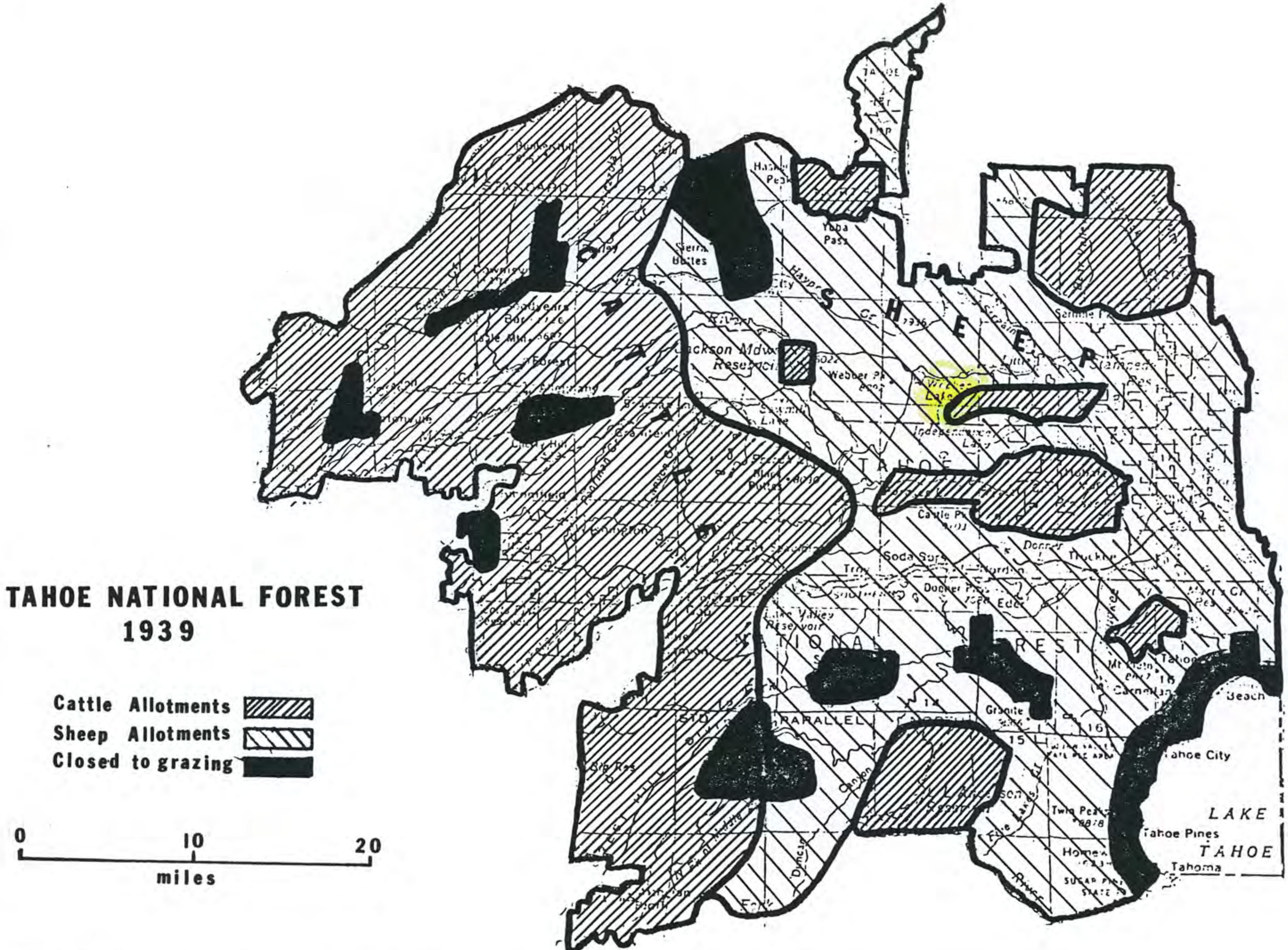


TAHOE NATIONAL FOREST
1915

Sheep Allotments

0 10 20
miles

(AFTER JACKSON ET AL. 1982: 163)



(AFTER JACKSON ET AL. 1982: 164)

LAHONTAN BASIN

PRELIMINARY PLAT

WEBBER LAKE RESERVOIR SITE.

Wm. Ham. Hall, Superv.g Engr.
Lyman Bridges, Engineer

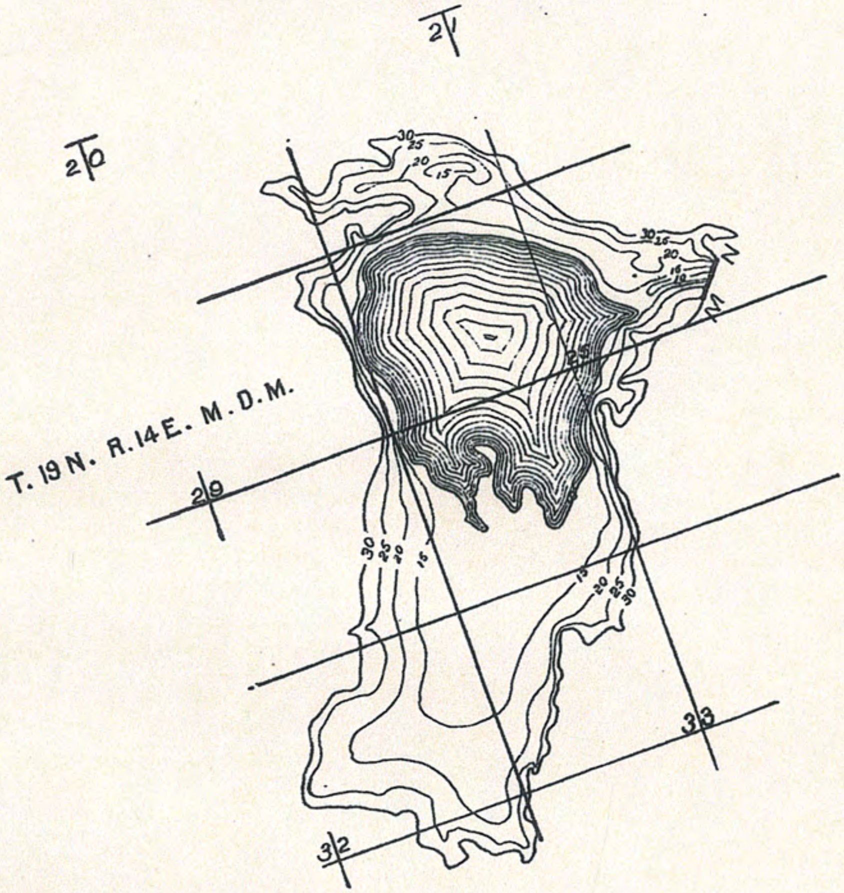
Maximum Capacity 11152 Acre Ft.

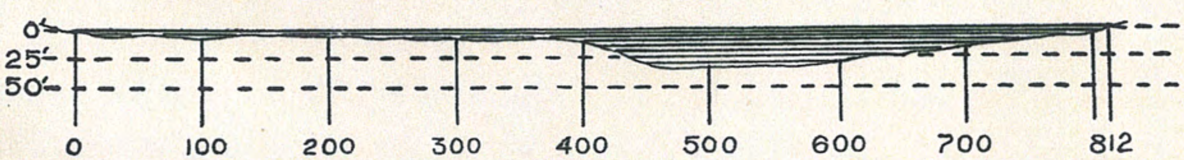
SCALE: 2 INCHES = 1 MILE.

1 3/4 1/2 1/4 0 1 MILE.

Contour Interval 5 feet.

1889





PROFILE OF DAM SITE.

Maximum Height 29 Ft.

Length of Crest 812 Feet.

NATURAL SCALE: 150 FEET = 1 INCH.

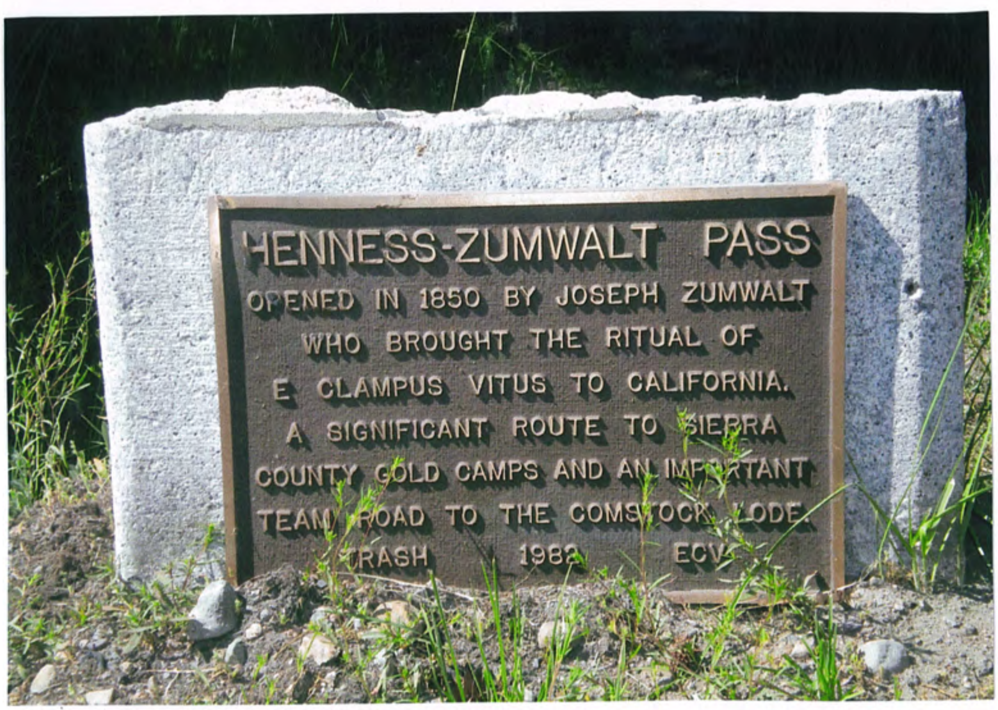
150 100 50 0 150 FT.

PHOTOGRAPHS

WEBBER LAKE 2012

Card To Ma - Pa 1963


WEBBER LAKE HOTEL.
SIERRA COUNTY, CALIFORNIA.
A. JAY ANDERSON.
TERMS, $3.00 PER DAY.


HENNESS-ZUMWALT PASS
OPENED IN 1850 BY JOSEPH ZUMWALT
WHO BROUGHT THE RITUAL OF
E CLAMPUS VITUS TO CALIFORNIA.
A SIGNIFICANT ROUTE TO SIERRA
COUNTY GOLD CAMPS AND AN IMPORTANT
TEAM ROAD TO THE COMSTOCK LODE
TRASH 1982 ECV

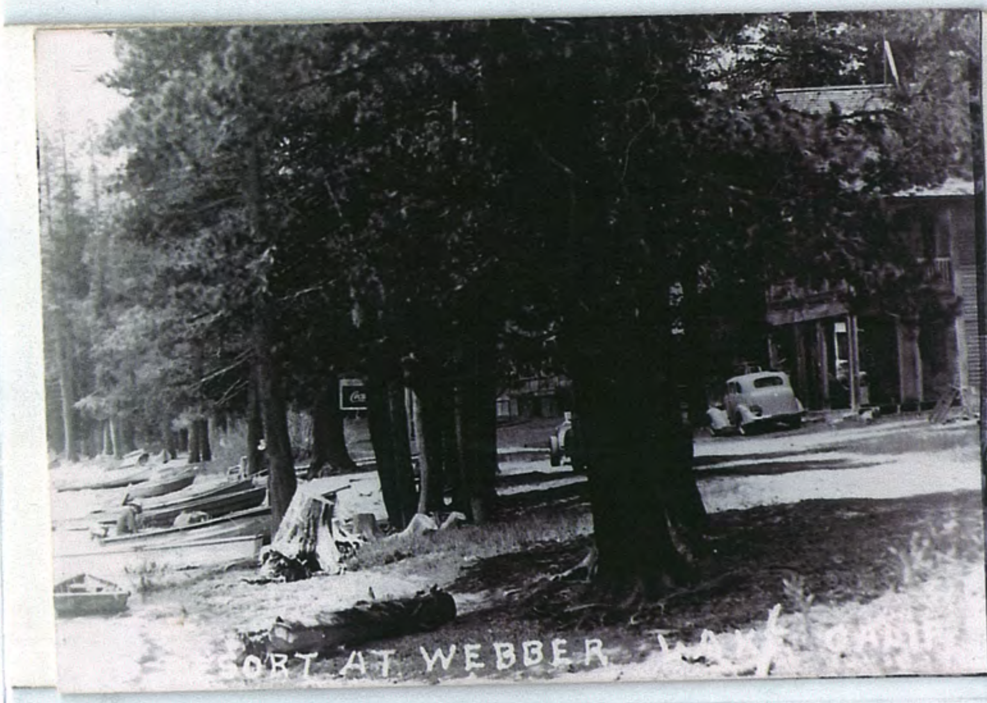

WEBBER LAKE HOTEL
BUILT IN 1860 BY DR. DAVID GOULD WEBBER
THE LAST OF 30 HOSTELRIES ALONG THE
HISTORIC HENNESS PASS ROAD
MARKER PLACED BY
WM M. STEWART CHAP. OF E. CLAMPUS VITUS

Approx 1945 or 1942

Approx 1946

Card To Ma-Pa 1963


RESORT AT WEBBER LAKE CALIF.

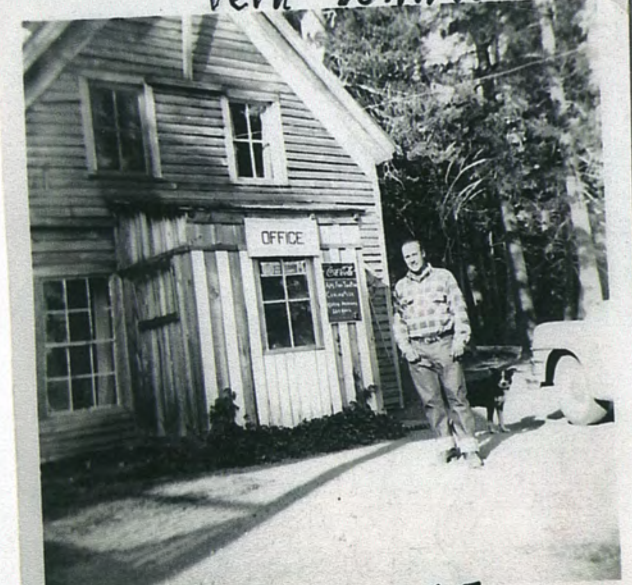

SORT AT WEBBER LAKE CALIF.


Webber Lake Resort

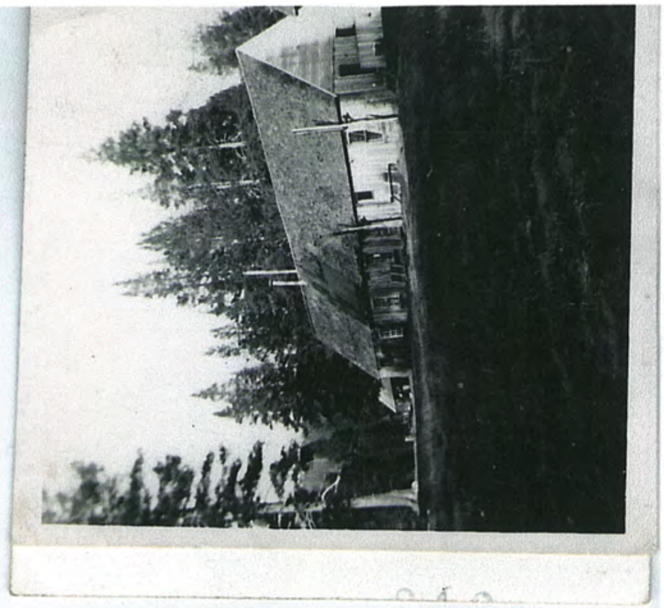

BOATS WEBBER LAKE CABINS
CAMPING · PICNICING 50¢ PER CAR
REGISTER AT OFFICE
HUNTING · FISHING INFORMATION
FISHING TACKLE
AKE RESORT CALIF

0711

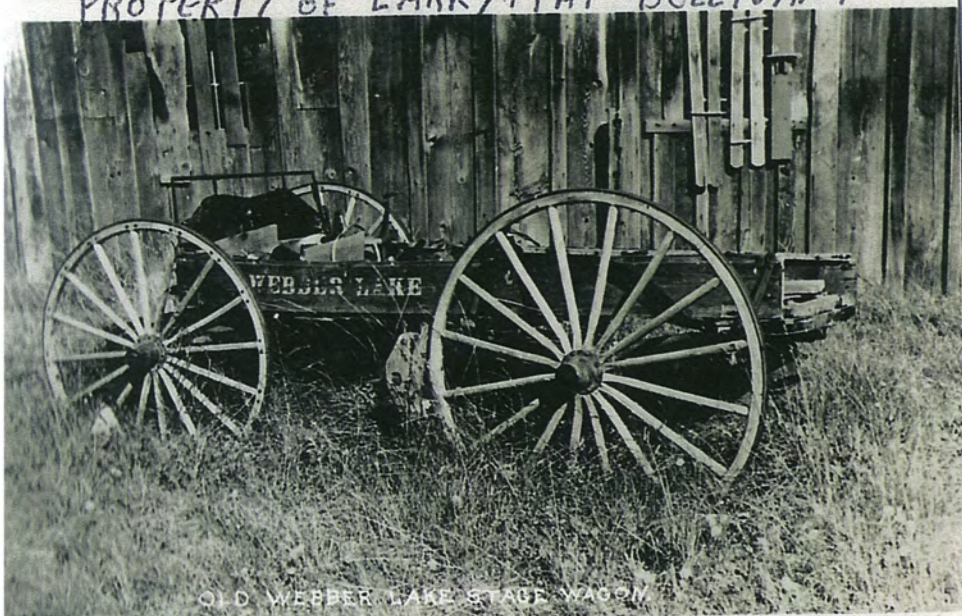
Vern Johnson

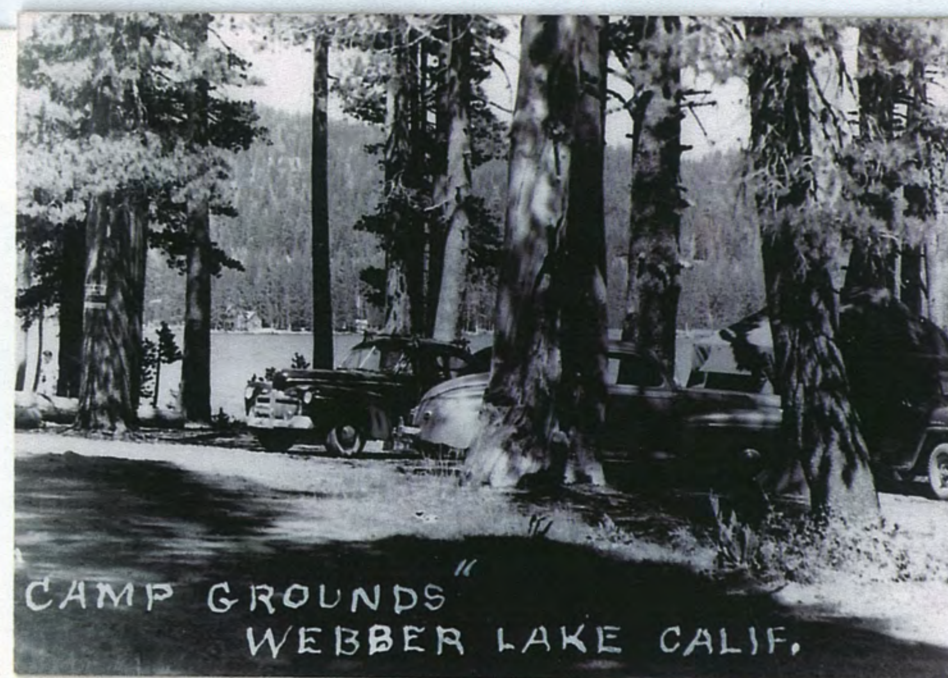


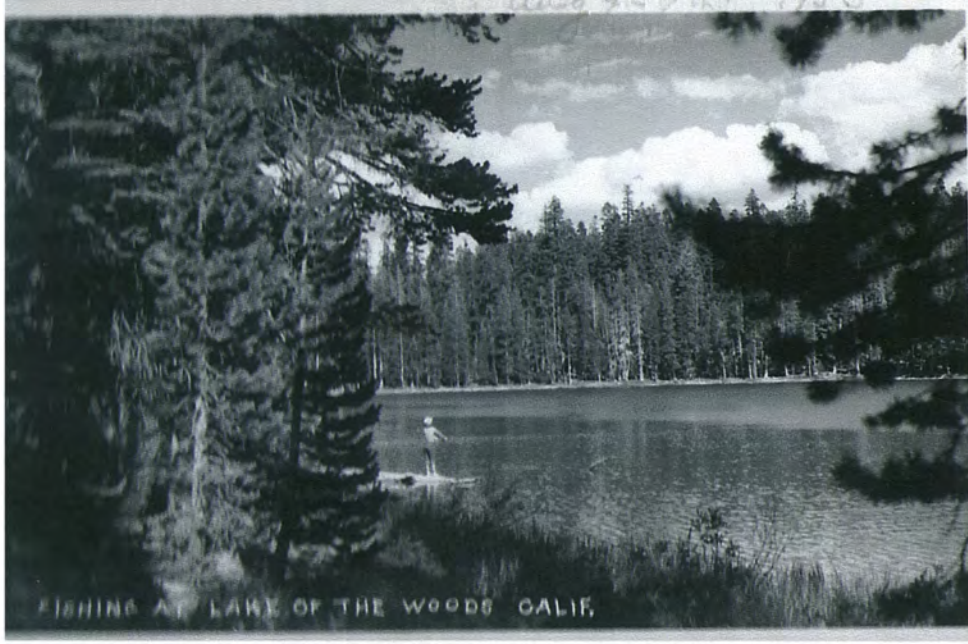
Approx 1945



PROPERTY OF LARRY + PAT BULLIVANT



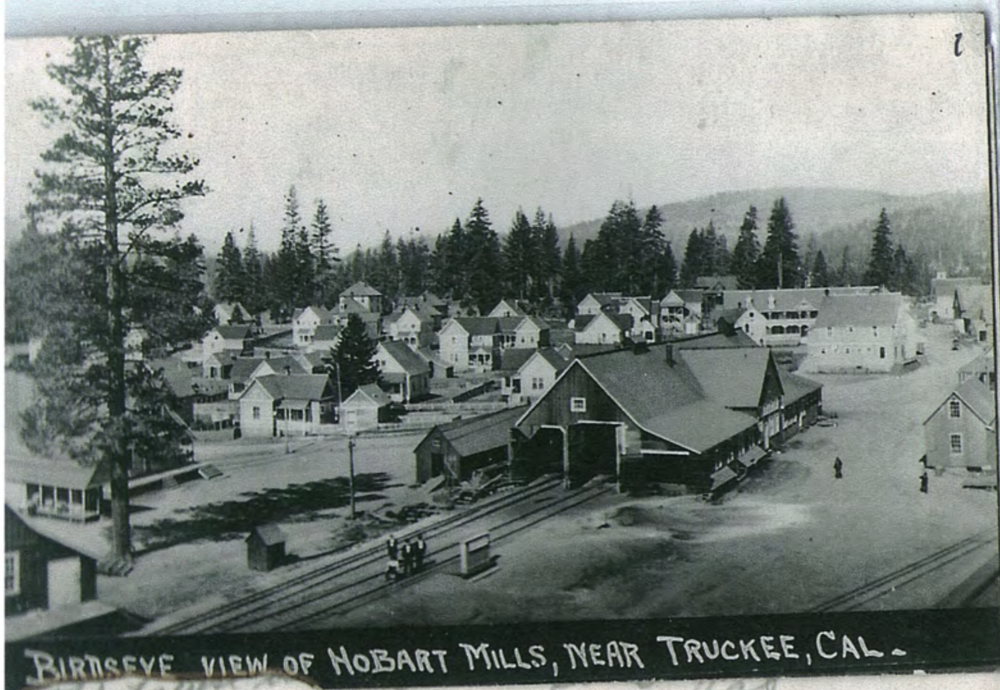


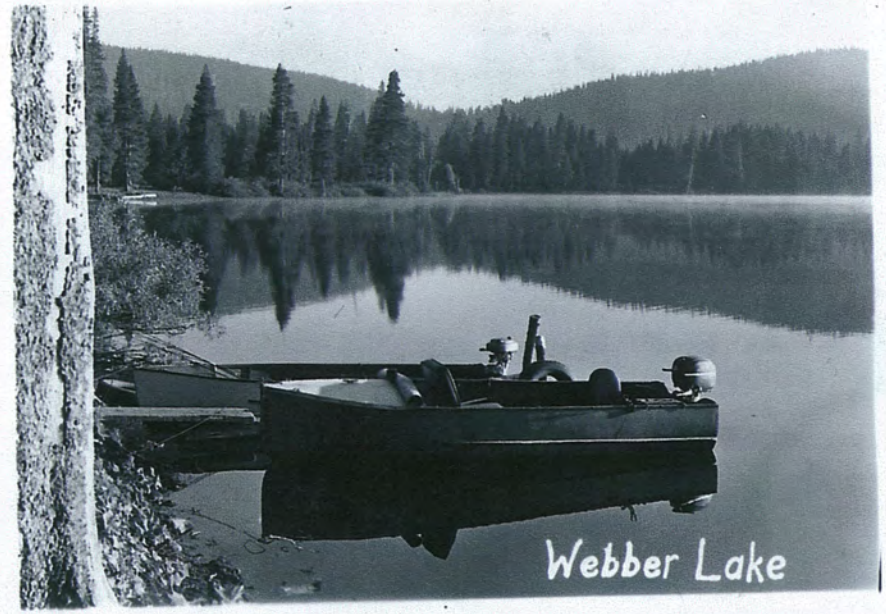



1947
WEBBER LAKE CAMP
WEBBER LAKE CALIF.

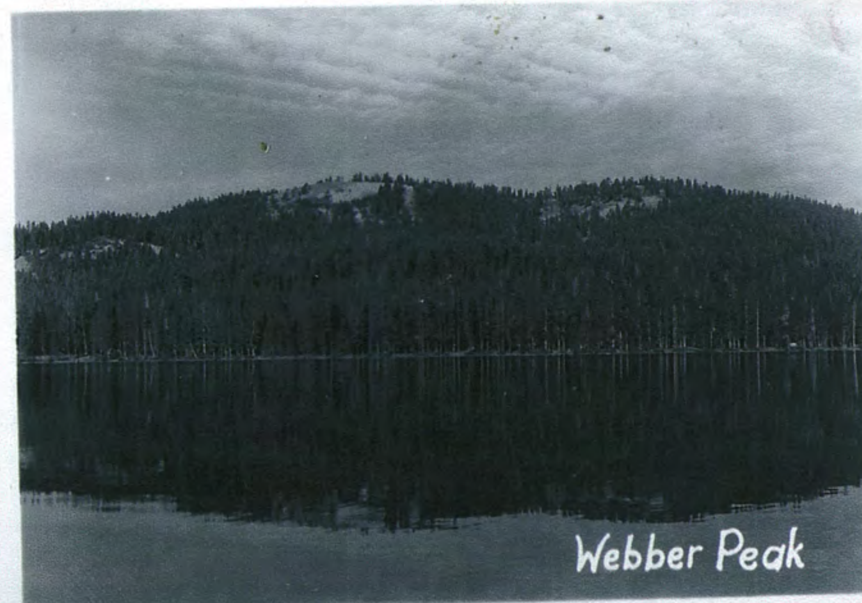

Webber Lake
Torn Down
1971


Webber Lake Campground





American Railway Express Co.



RATES

Cabin for two people ....

With private boat ....

Extra person 50c each

Checking out time, 2:00 p.m.

BOAT RENTAL

Boat $1.50 per day. An extra day's rental will be charged for boats not returned the same day.

CAMP RULES

Dogs must be kept on leagh at all times.

Do not keep gasoline in or near buildings.

Put ashes from stove in designated places.

NOTICE

THIS HOTEL will not be responsible for money, jewelry or other valuables unless deposited in the Front Office safe.

When leaving room please turn out the lights and leave key at office.

Rates of this room:

1 Person $.......... 2 Persons $..........

3 Persons $.......... 4 Persons $..........

IMPORTANT: Check-out time is .... P.M.

Guest desiring to occupy room after that time will please notify the management otherwise charge will be made for an additional day.

If you wish mail forwarded, leave your address at office.

American Hotel Register Co., 226-232 W. Ontario St., Chicago 10, Ill. Form 119

1947

1950

1954

• AUG • 55

1955

JUL • 60

1960

1966

5


MCR'S
AUG 1966
4 1/2

Appendix C

Appendix C. Bird Species Detected at Lacey Valley

Bird Species Name	A Gaither Report	B Willow Flycatcher Surveys 1998-2006	C IBP Monitoring 2012	D Loffland & White 2012
Canada Goose		x	x	x
Gadwall			x	
Mallard	x	x	x	x
Northern Pintail				x
Green-winged Teal		x	x	x
Ring-necked Duck		x		
Bufflehead	x	x	x	x
Common Merganser	x	x	x	x
Mountain Quail	x	x	x	
Pied-billed Grebe	x			x
American White Pelican	x	x	x	x
Great Blue Heron	x			
Great Egret	x			
Black-crowned Night Heron	x	x	x	x
White-faced Ibis				x
Turkey Vulture	x			x
Osprey	x		x	x
Bald Eagle	x	x	x	x
Northern Harrier	x	x		x
Sharp-shinned Hawk				x
Cooper's Hawk	x	x		
Red-shouldered Hawk	x			
Red-tailed Hawk	x			x
American Kestrel	x			
Virginia Rail	x			x
Sora		x		
American Coot	x	x		
Sandhill Crane	x	x	x	x
Semipalmated Plover	x			
Killdeer	x	x	x	x
American Avocet	x			
Spotted Sandpiper	x	x	x	x
Greater Yellowlegs	x			
Western Sandpiper	x			

Appendix C. Bird Species Detected at Lacey Valley

Bird Species Name	A Gaither Report	B Willow Flycatcher Surveys 1998-2006	C IBP Monitoring 2012	D Loffland & White 2012
Wilson's Snipe	x	x	x	x
Wilson's Phalarope	x		x	x
California Gull		x	x	
Black Tern		x		
Mourning Dove	x		x	
Short-eared Owl		x		
Common Nighthawk	x		x	x
Vaux's Swift	x			
Anna's Hummingbird	x			
Calliope Hummingbird		x		x
Rufous Hummingbird		x		x
Williamson's Sapsucker	x			x
Red-breasted Sapsucker			x	x
Downy Woodpecker				x
Hairy Woodpecker	x		x	
Northern Flicker	x	x	x	x
Pileated Woodpecker				x
Olive-sided Flycatcher				x
Western Wood-Pewee	x	x	x	x
Willow Flycatcher	x	x	x	x
Hammond's Flycatcher			x	
Dusky Flycatcher		x	x	x
Cassin's Vireo	x			x
Warbling Vireo		x	x	
Steller's Jay	x		x	x
Clark's Nutcracker		x		x
American Crow				x
Common Raven			x	
Horned Lark		x	x	
Tree Swallow	x	x	x	
Cliff Swallow				
Barn Swallow	x			
Mountain Chickadee	x	x	x	x
Red-breasted Nuthatch	x		x	x

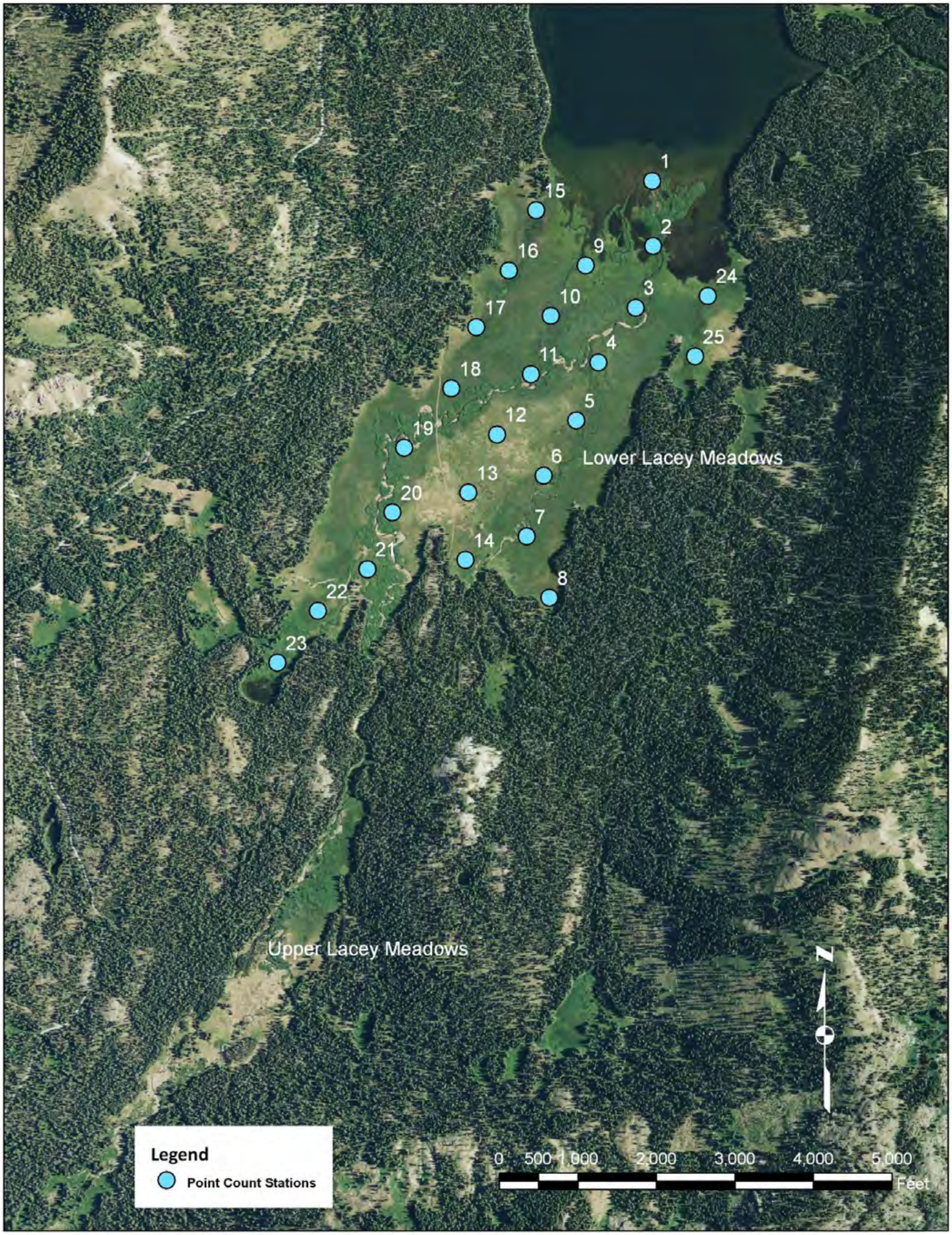
Appendix C. Bird Species Detected at Lacey Valley

Bird Species Name	A Gaither Report	B Willow Flycatcher Surveys 1998-2006	C IBP Monitoring 2012	D Loffland & White 2012
Pygmy Nuthatch			x	
Brown Creeper	x	x	x	x
House Wren				x
Marsh Wren		x		x
Ruby-crowned Kinglet				x
Mountain Bluebird				x
Townsend's Solitaire			x	
Hermit Thrush			x	x
American Robin	x	x	x	x
European Starling		x		
Orange-crowned Warbler	x		x	x
Yellow Warbler	x	x	x	x
Yellow-rumped Warbler	x	x	x	x
Hermit Warbler	x		x	
Wilson's Warbler	x	x	x	x
Western Tanager			x	x
Spotted Towhee				x
Chipping Sparrow	x	x	x	
Vesper Sparrow				x
Savannah Sparrow	x	x	x	x
Fox Sparrow		x	x	
Song Sparrow	x	x		x
Lincoln's Sparrow			x	x
White-crowned Sparrow		x	x	x
Dark-eyed Junco	x	x	x	x
Black-headed Grosbeak			x	
Lazuli Bunting	x			
Red-winged Blackbird	x	x	x	
Yellow-headed Blackbird	x	x		
Brewer's Blackbird	x	x	x	x
Brown-headed Cowbird		x	x	
Pine Grosbeak	x			x
Purple Finch		x		x
Cassin's Finch	x	x	x	x

Appendix C. Bird Species Detected at Lacey Valley

Bird Species Name	A Gaither Report	B Willow Flycatcher Surveys 1998-2006	C IBP Monitoring 2012	D Loffland & White 2012
Red Crossbill				x
Pine Siskin			x	x
Lesser Goldfinch			x	x
Evening Grosbeak			x	

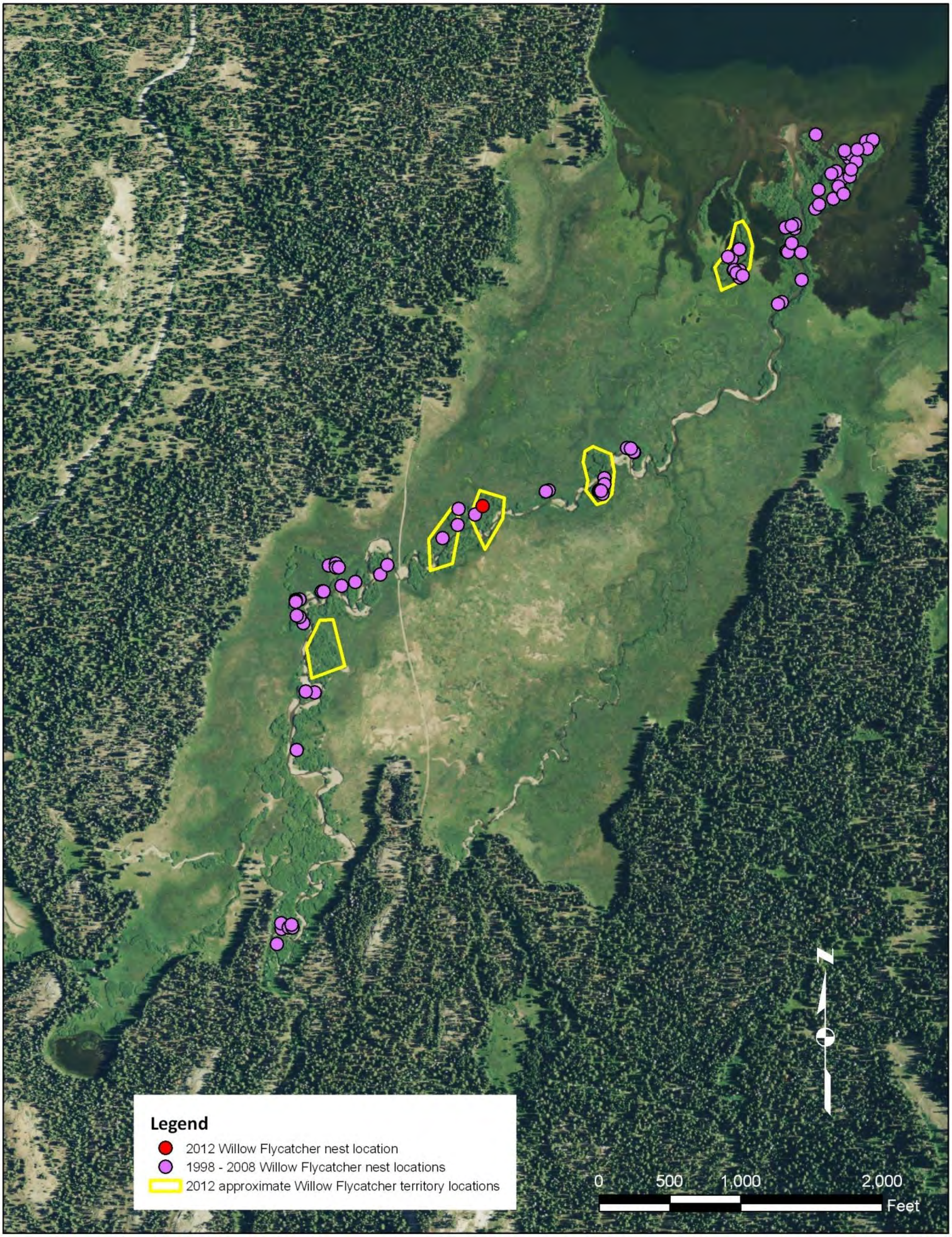
Appendix D



Balance Hydrologics, Inc.® H. T. HARVEY & ASSOCIATES ECOLOGICAL CONSULTANTS THE INSTITUTE FOR BIRD POPULATIONS

Appendix D. Locations of point count stations used for multi-species bird monitoring in Lower Lacey Meadows.
Sierra and Nevada Counties, California

Appendix E



Appendix E. Willow Flycatcher locations in Lower Lacey Meadows
Sierra and Nevada Counties, California

Appendix F

Appendix F. Meadow condition assessment field data forms (August 2012)

USFS Long Term Range Monitoring 05-03-01

Plot Code LU - 01 Plot Name: Lacey upper 1

Date: 8/22/12 Established By: M. Wacker ; H. White

Forest — Allotment: —

Elevation 6800 ft. Slope 1-2 % Aspect flt. degrees T.N.

USGS quadrangle:
Township ____ Range ____ Section ____ ¼ ____

GPS field reading of witness post:
Latitude: ____ deg. ____ min. ____ sec.
Longitude: ____ deg. ____ min. ____ sec.

Distance and bearing between witness post and the beginning of first transect:
Distance — m Bearing at post degrees T.N.
Bearing of 1st transect line N-NW degrees T.N.
Transect length 25 m Sampling interval along transect 1 m
Distance between transects 5 m Frame size 20 cm

Ecological type:
Soil data:
Soil texture: SiL Depth mottles (cm): 20 Depth saturation (cm) >30

Root depth (cm)

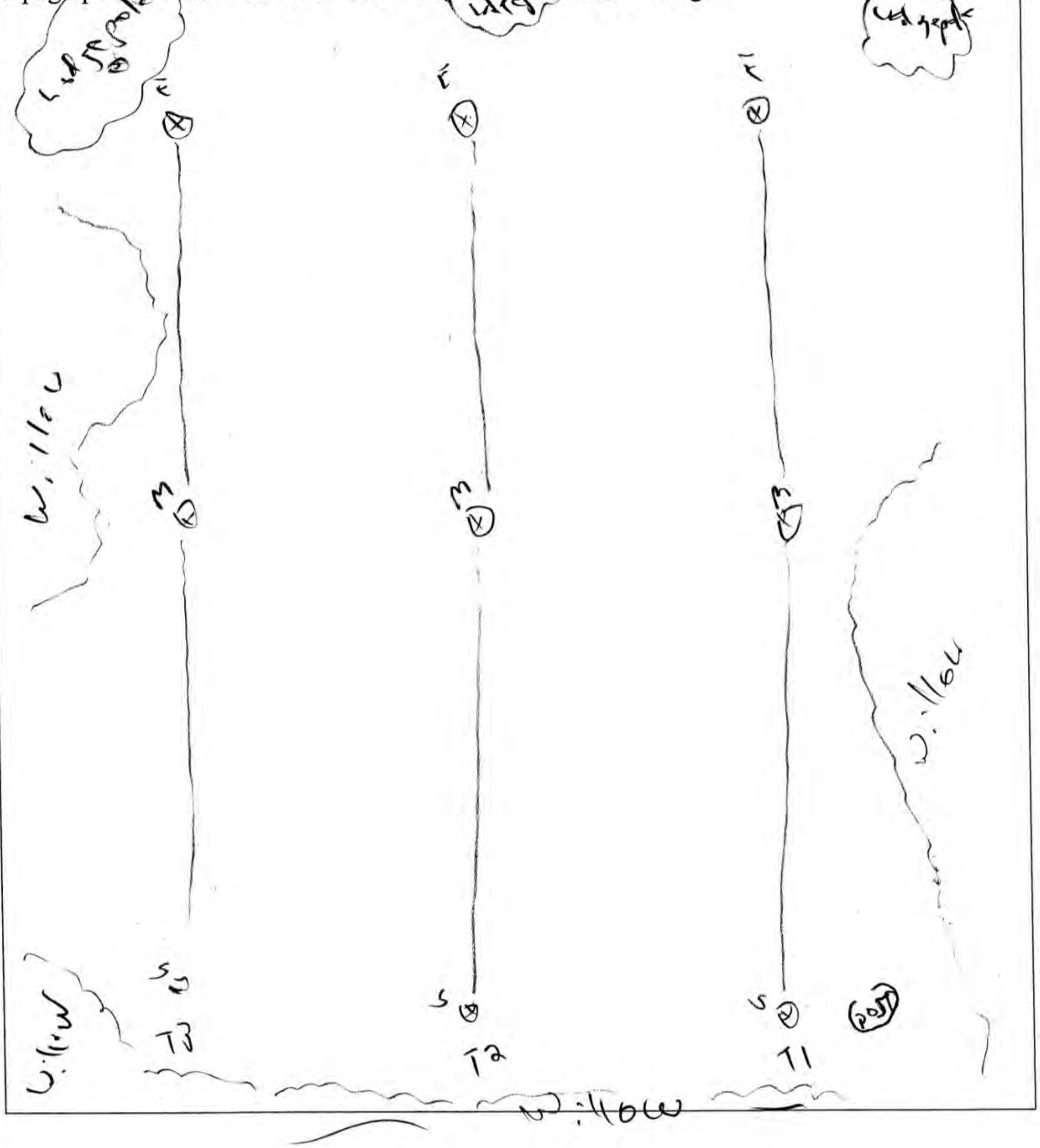
Transect 1. 10 Transect 2. 10 Transect 3. 15

Notes: mod-heavy sheep use; low ecological status

Location Map

Plot code LU-1 Plot name Lucky Upper Plot 1

The purpose of this map is to make easier the relocation of the macroplot for remeasurement. Make a sketch of the physical features of the site and the location of the macroplot within. Indicate North direction. Use compass bearings and distances to witness post and well-known topographic or cultural features. Show how the transects are arranged.



Frequency

Plot Code: L4 - 1	Date: 8/22/12	Examiners: M. Wacker ; H. White	Allotment Name: –
Transect Location: –		Number of Quadrats: 60	Frame Size: 20 cm

Plant Code	Species Name		Total
MYRI	Muhlenbergia richard.	M	52
GNPA	Gnaphalium palustre	E	13
PODOJ2	Podagrum sawatchii (?)	E	43
POSE	Poa secunda	L	6
DEEL	Deschampsia elongata	E	8
PEPA	Perideridia parishii	M	26
NADI	Navarretia divaricata	E	20
POT	Potentilla sp.	E	10
LUBI	Lupinus bicolor	E	10
PICO	Pinus contorta	L	6
LEHA	Leptosiphon harknessii	E	2
MI__	Mimulus douglasii	E	2
BRO	Bromus sp.	H	1

Ground Cover Summary

Vegetation (Basal)	Litter	Bare Ground	Gravel (< 3/4 inch)	Rock (>3/4 inch)	Cryptogams
T1)					
T2)					
T3)					
Hits 9 % Cover 4	Hits 81 % Cover 35	Hits 115 % Cover 49	Hits 23 % Cover 10	Hits 6 % Cover 3	Hits % Cover

	Total	%
Species Ind~~icating High Similarity to PNC~~ Late Seral	21	11
Species Ind~~idating Moderate Similarity to PNC~~ Mid Seral	76	40
~~Species Indicating~~ L~~ow Similarity to PNC~~ Early	95	49
Seral	192	

Remarks: Bare = 49%.
Veg = Low from condition triangle, Seral =
= Low Ecological Status =

Draft rev 05/01/01

Appendix G

APPENDIX G: PHOTOGRAPHS AND GPS LOCATION COORDINATES

GPS WP#508
120°26'24.345"W 39°26'31.542"N

Seepage entering channel from left bank,
SC = 51 @ 4.8degC
SC = 82 @ 25deg C
Potential aspen habitat, but no aspen. Main channel is cobbles, some sand and gravel
Channel width ~10-12', depth ~3-4'
D50 ~ 90mm
D90 ~270mm
D10 ~8mm
Multiple channels incising into alluvial fan surface
Aggradation in channel is close to road, no cobbles in adjacent, lower gully, incised 6-7'

Photos 1,2

GPS WP#509
120°26'24.208"W 39°26'33.008"N

Terraced wet meadow
Alternate channel in photo, wetland soils, limited sediment accumulation
Glacial erratics present


Photos 3,4

GPS WP#510
120°26'22.414"W 39°26'36.993"N

Active alluvial fan, wooded
Well graded substrate, mostly coarse, dry upland soils

Photos 5,6

GPS WP#511
120°26'26.115"W 39°26'37.203"N

Channel becomes dry (flow goes subsurface) in sandy substrate

GPS WP#512
120°26'27.889"W 39°26'40.5"N
Major headcut and 6' incision in silty sandy soil.
Young conifers seem to be encroaching into meadow
Silty sand at depth—very different than material (gravel and cobble) being deposited on surface

Photos 6,7,8,9,10,11

GPS WP#513
120°26'29.177"W 39°26'43.595"N

Dry meadow, appears to have been converted by incision in channel

GPS WP#514
120°26'33.332"W 39°26'40.364"N

Potential reference swale at toe of moraine, limited incision, adjacent to incised channel at u/s limit of meadow

Photos 12,13

GPS WP#515
120°26'36.035"W 39°26'38.571"N

Transition from step-pool on moraine to incised channel in lower gradient meadow, just downstream from road crossing

516
Relatively intact channel/swale

GPS WP#517
120°26'37.167"W 39°26'41.407"N

Incised channel with healthy riparian woodland and inset floodplain
Failing banks with apparently encroaching conifers at upper terrace
Qest ~ 0.1 cfs
Lots of 6-10" fish in channel
Trees on floodplain are ~30-40 yrs old
Photos 14,15 (cut bank with encroaching lodgepole)
Cobble and gravel substrate
D50 ~ 32mm
D90 ~ 90mm
D10 ~ 11mm
SC = 46.2 @ 11.9degC
SC = 61.7 @ 25

GPS WP#518
120°26'27.89"W 39°26'44.972"N
Wetland (wet) soils perched on terrace

GPS WP#519
Flow in channel resurfaces, perhaps due to clayey soils?
Adjacent wetland appears to have clay pockets
SCT = 43 @ 6.6 degC
SCT = 67.4 @ 25

GPS WP#520
Willow growing on terrace surface (dry)
Cobble channel on top of meadow surface

GPS WY#521
SEEP adjacent to thriving willow / wetland community

SCT = 39 @ 7.0 degC
SCT = 59.3 @ 25

GPS WP#522
120°26'19.31"W 39°26'52.002"N

Tremendous amount of coarse sediment delivery from channel near Webber Lake Rd
Cobble deposits results in widening, results in erosion of wet meadow soils
Flow discontinuous in pools
Photos 17,18 show cobble in banks, roughly as large as active deposits, suggesting banks as sediment source

Photos 15,16,17,18

GPS WP#523
120°26'15.399"W 39°26'57.538"N

Cobble-boulder channel entering from right, with coarser substrate than channel and main channel banks
Increasing flow

Photos 19,20

GPS WP#524
120°26'11.231"W 39°26'49.844"N

Failed culvert on tributary
Near base of moraine, as indicated by angular large boulders

Photos 21,22

GPS WP#525
New culvert on road xing

GPS WP#526
Willow/rush meadow in forest, appears to be perched behind low till/moraine crest

GPS WP#527
120°26'5.866"W 39°26'55.035"N
Seep/spring feeding discharge slope wetland
Small channel (1'x1') flows down over moraine/till crest, toward meadow
Qest ~ 0.1 gpm

Photos 22,23,24,25,26,27

528
End of surface flow from spring, converts to dry meadow (deep) soils

529
Broad cobbly channel at edge of meadow

Summary of observations and interpretations:

- Upstream of the upper meadow, Webber Lake Rd (historical alignment) captured drainage, and is now conveying sediment directly to the meadow. The road was subsequently relocated to its current location, but impacts of the former alignment remain
- Secondary or interim roads appear to have also captured drainage upstream of the meadow and also convey coarse material to the meadow
- Significant sediment deposition in the main channel has disturbed the meadow surface (see WP522)
- Channels crossing the meadow have incised, especially at the upstream end, perhaps due to baselevel changes on the W Branch, which has perennial water and lots of fish with an apparently functional inset floodplain
- Groundwater supported channels entered from the south, but have incised into the meadow, apparently resulting in conifer encroachment
- Groundwater discharge is currently supporting willow/riparian areas
- Groundwater discharge in upland forested areas is supporting wetland vegetation, but not aspen communities
- Road drainage management should be a key restoration strategy

GPS WP#530
120°26'7.246"W 39°27'8.407"N

Conifer encroachment

Photos 27-28

GPS WP#531
XS5

GPS WP#532
120°26'4.446"W 39°27'13.349"N
XS6
Straight channel in forest


Photos 29-32

GPS WP#533
Sheep hammering on widening channel bank
Encroaching (young) conifers
This is a transition from continuous flow to intermittent flow between pools, Still lots of 6-10” fish in disconnected pools.
Photos 32,33,34,35

GPS WP#534
120°25'59.328"W 39°27'17.731"N
Tall cut bank where stream is forced into hillside, still discontinuous Q

Photos 35,36,37,38,39,40

GPS WP#535
120°25'57.344"W 39°27'18.268"N
2.4-ft of coarse alluvium overlying coarse 'weathered sandstone'
Sandstone subsoil appears to be saturated, perching water to some degree

GPS WP#536
120°25'55.013"W 39°27'20.609"N
XS7
Inset floodplain beginning to develop
Q=0, dry
Evidence of grazing here
Young conifers on rt bank
Active widening, willows beginning to grow on floodplain
Photos 41,42 (upstream) 43,44 (downstream)

GPS WP#537
Rt bank willow forest begins, appears to be associated with confluence with abandoned channel

GPS WP#538
120°25'45.582"W 39°27'30.334"N
Channel slope seems to decrease toward downstream end of meadow,
water table becomes shallower
channel may be aggrading here
sand and gravel bar deposits appear to be covering adjacenet meadow surface

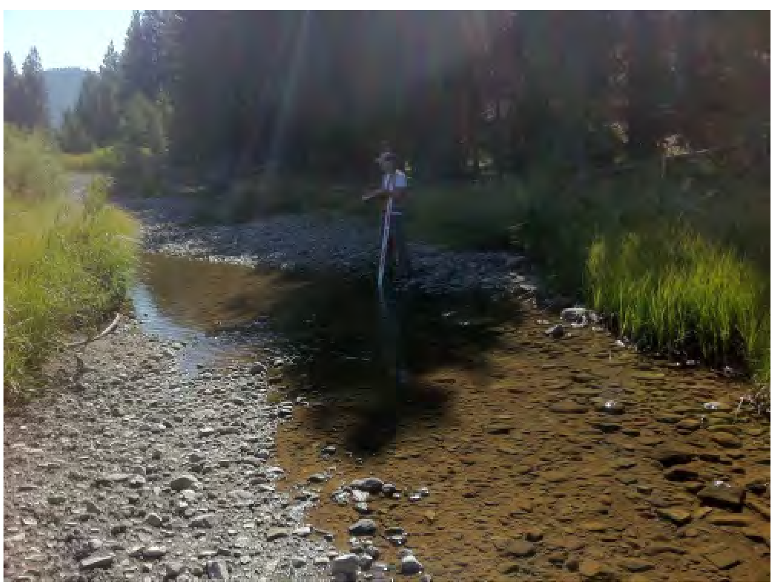

Photos 45,46,47,48

GPS WP#539
120°25'42.482"W 39°27'35.776"N
Bedrock control

GPS WP#540

Headcut in alternate (secondary) channel, 1.5' high (see BKH photos)
Headcut exposes deep meadow soils—silty clayey sand sand, with gravel deposited on top.
Water appears to be perched on top of meadow soils in places

GPS WP#541
120°25'46.53"W 39°27'29.992"N
XS8



GPS WP#542
120°25'52.823"W 39°27'16.572"N
XS9
Remnant channel, abandoned between 1955 and 1965
Some disturbance roughly 600’ upstream
Inset floodplain is surrounded by a drier terrace upland
See also BKH notes


Photos 49,50,51,52

GPS WP#543
Channel running parallel to meadow, possibly captured by old road?

GPS WP#544
120°25'55.254"W 39°27'6.402"N
Channel capture by road, incising onto adjacent terrace


GPS WP#545
Stream capture by road, flows down swale onto terrace, then recaptured again at WP544

GPS WP#546
Swale capture by road

GPS WP#547
Painted rock (yellow dot)

GPS WP#396
120°25'37.312"W 39°26'27.699"N
Gully formation in volcanic-derived soils and former logging areas

120°25'41.861"W 39°26'27.72"N
Gullying in erosive soils in areas formerly logged, Section 8

GPS WP#416
Hanging culvert on stream crossing, Webber Lake Road
120°26'10.582"W 39°26'49.093"N

GPS WP#446
120°26'38.432"W 39°26'56.765"N
Culvert stream crossing with fish ladder, Meadow Lake Road, tributary from Peak 8,166’

GPS WP#441
120°26'56.784"W 39°26'39.743"N
Hanging culvert, 36”D culvert on tributary draining northside of Lacey Peak (8,216 ft)

GPS WP#445
120°26'42.156"W 39°26'54.414"N
Channel erosion downstream of stream crossing (Meadow Lake Road), tributary to Peak 8,166

GPS WP#401
120°25'54.397"W 39°27'7.748"N
Stream capture by old logging road

GPS WP#399
120°25'50.468"W 39°27'10.384"N
Hanging culvert, Webber Lake Road (Upper Lacey Meadow)

120°26'33.157"W 39°26'1.777"N
Rilling and Gulling on steep exposed volcanic terrain, Upper Lacey Creek, Section 7

GPS WP#428
120°26'37.93"W 39°25'53.382"N
Lacey Creek crossing (d/s), Section 18

GPS WP#397
120°25'23.989"W 39°28'23.494"N
Webber Lake Road crossing, Lower Lacey Creek

120°25'23.636"W 39°28'16.56"N
Webber Lake Road, dissecting Lower Lacey Meadow

GPS WP#450
120°26'49.289"W 39°27'11.393"N
Hanging culvert, Tributary to Peak 8,166' on access road to PCT

120°24'49.602"W 39°28'41.619"N
Reach A

120°25'13.036"W 39°28'28.603"N
Reach B

120°25'34.223"W 39°28'10.341"N
Reach C

120°25'35.968"W 39°27'56.055"N
Reach D

120°25'14.33"W 39°28'10.057"N
SE Tributary

120°24'59.009"W 39°28'28.921"N

120°25'53.981"W 39°27'52.203"N
SW Pond

120°25'42.125"W 39°28'5.321"N
SW Tributary

120°25'0.712"W 39°28'43.283"N
West Tributary near Webber Lake

GPS WP#496
120°25'20.143"W 39°28'45.131"N
West Tributary at Webber Lake Road crossing

120°25'39.226"W 39°27'39.284"N
Reach E

120°25'40.935"W 39°27'36.992"N
Reach F

120°26'12.35"W 39°26'59.908"N
Reach G(a),

120°26'11.784"W 39°27'2.036"N
Reach G(a), bank erosion

120°26'4.756"W 39°27'12.081"N
Reach G(a)

120°26'0.763"W 39°27'14.638"N
Reach G(a)

120°25'56.725"W 39°27'18.452"N
Reach G(a) impacts of grazing on streambanks

120°25'54.04"W 39°27'20.785"N
Reach G(a)

120°25'51.322"W 39°27'15.185"N
Reach G(b)

120°26'1.662"W 39°27'3.45"N
Reach G(b)

120°26'6.085"W 39°27'2.414"N
Reach G(b), push-up gravel bar

120°26'13.615"W 39°26'56.41"N
Reach H

120°26'19.049"W 39°26'54.389"N
Reach H, 3-ft diameter tree buried in alluvium

120°26'13.119"W 39°26'56.65"N
Reach H, high stand alluvium deposit (center-back), possible evidence of a dam (sediment is higher than floodplain and point bars in channel)

120°26'19.748"W 39°26'44.204"N
Reach I(b), former road—stream capture

GPS WP#400
120°25'52.346"W 39°27'9.414"N
Stream capture by Webber Lake Road, Upper Lacey Meadow

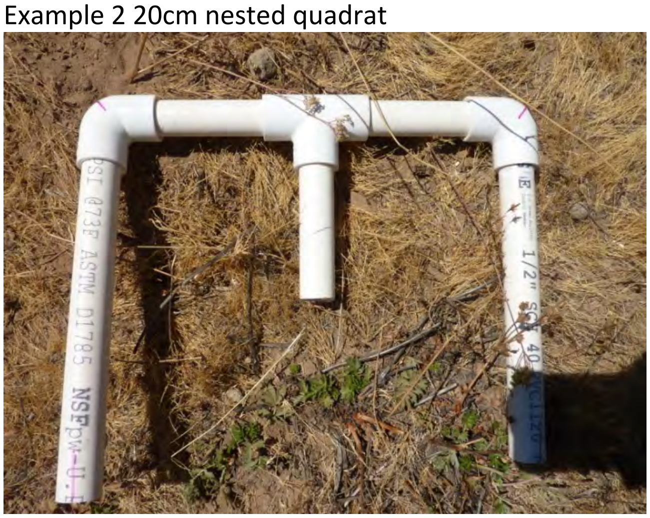
120°24'19.126"W 39°29'6.975"N
Webber Lake Dam

Meadow Assessment Plot LU-1

120º 26’ 7.459”W 39º 27’ 4.222”

Example 1 20cm nested quadrat

Example 2 20cm nested quadrat



Example 3 20cm nested quadrat

Landscape view of assessment plot

Transect 1

Transect 2

Transect 3

Rapid meadow condition assessment Plot 2

120^{o} 25' 40.771"W 39^{o} 27' 31.728"E

Landscape photo looking north; note dominance by sedges and little to no bare ground, indicators of high ecological status; also note limited to no browsing of willow by sheep along riparian corridor

Landscape photo looking west

Landscape photo looking north

Rapid meadow condition assessment plot 3

120º 25' 48.406"W 39º 27' 20.967"E

Landscape photo looking west; note dominance by Kentucky bluegrass, a plant general considered to be indicative of moderate ecological condition in mesic to wet Sierra Nevada meadows that increases in dominance in response to disturbance; significant amount of bare ground also noted

Landscape photo looking east

Landscape photo looking south; note lightly grazed Kentucky bluegrass clumps with much heavier grazing of broadleaf plants in between grass clumps and bare ground

Landscape photo looking north

Rapid meadow condition assessment Plot 4

120^{o} 25' 31.733"W 39^{o} 28' 26.218"E
Landscape photo looking east; note dominance by Kentucky blue grass

Landscape photo looking north

Landscape photo looking south

Landscape photo looking west, note dense stand of lodgepole with many dead trees at meadow edge

Rapid meadow condition assessment plot 5

120º 25' 16.759"W 39º 28' 18.378"E

Landscape photo looking east; plot dominated by Kentucky blue grass and forbs with more bare ground relative to Plot 4

Landscape photo looking north

Landscape photo looking south; sheepherder trailer can be seen in distance at edge of forest

Landscape photo looking west; note presence of forbs and bare ground indicative of higher sheep use, drier conditions, and lower ecological condition; also note significant presence of dead lodgepole at western meadow margin, similar to conditions observed in Plot 4

Miscellaneous photos

120^{o} 25’ 56.682”W 39 27’ 08.481”N

Heavily chisled and steep stream bank along sheep watering area

120^{o} 25’ 56.476”W 39^{o} 27’ 13.242”N

Area of heavy sheep use with little to no vegetation, significant amounts of bare ground and highlined willows from sheep browsing along riparian corridor

Detail view of sheep browsing shown in photo above

120 24’ 41.271” 39 28’ 39.040” N

Pair of sandhill crane foraging with young on the edge of marsh area (July 24, 2012)