

## 5.4 Buckeye Subbasin

### 5.4.1 INTRODUCTION

The Buckeye Subbasin (Buckeye Creek Super Planning Watershed, Calwater 2.2a 113.83) is bounded to the north by the Rockpile Subbasin and to the south by the Wheatfield Subbasin. It encompasses 40.3 square miles of private land used primarily for timber production, grazing, and small vineyards. It contains more moderate terrain compared to the North Fork and Rockpile. There are 90 miles of “blue line” streams, and three major tributaries: Flat Ridge, Grasshopper, and Osser creeks (Figure 5.4-1).

Historic events and the period of record on the various data sets used in the NCWAP assessment are presented in a graphic format in Figure 5.4-2.

### 5.4.2 GEOLOGY

Mélange of the Franciscan Complex underlies oak savanna woodland in the eastern headwaters. Large areas of active earthflows and other forms of landsliding are abundant and contribute sediment to the streams (Figure 5.4-3). Figure 5.4-4 is the relative landslide potential map for the Buckeye Subbasin. The complete maps and explanations for both maps are on Plates 1 and 2.

The steep tributaries in the upper reaches can be characterized as source (>12 percent slope) and transport (4-12 percent slope) reaches.

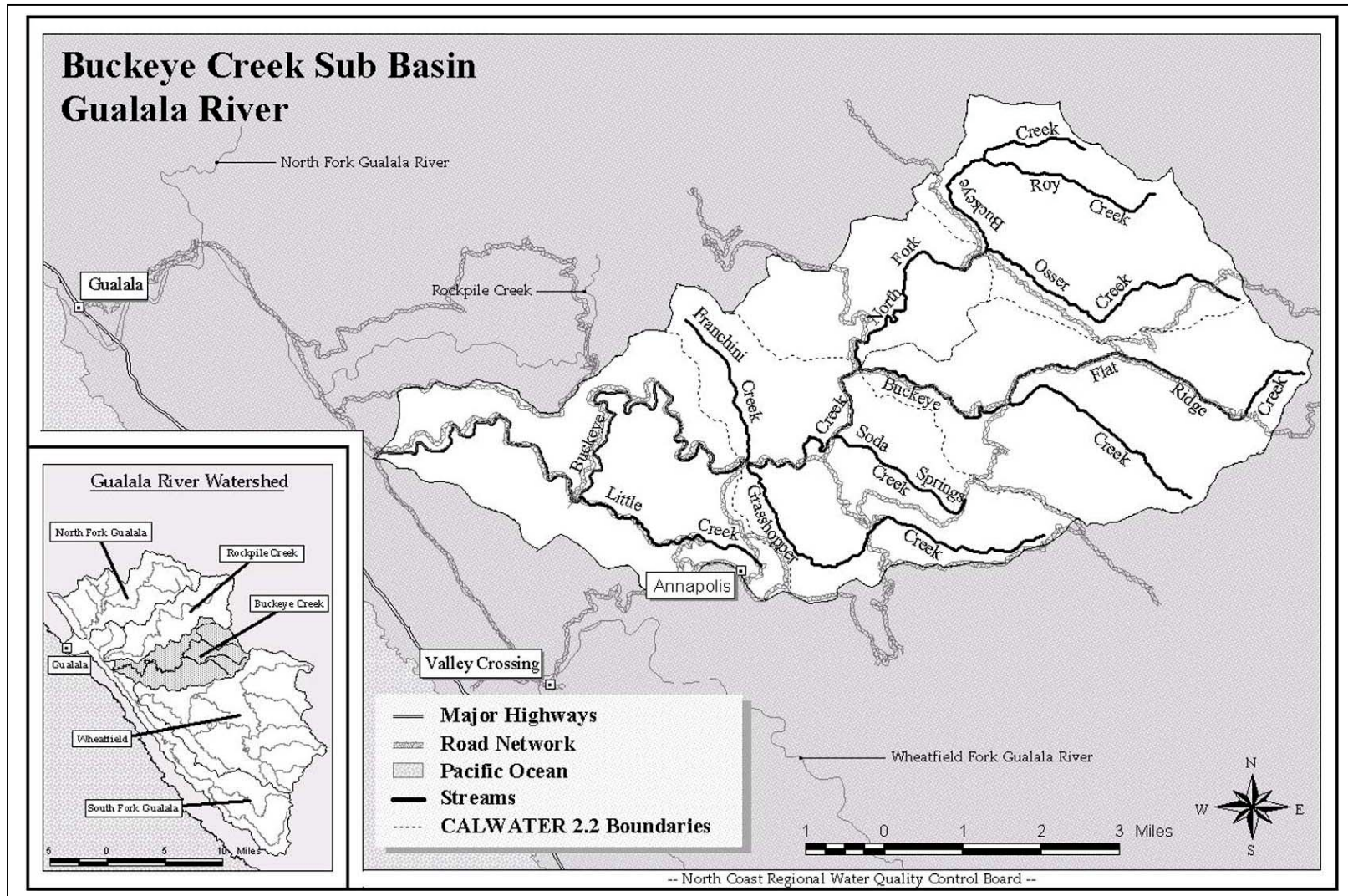
In the lower reaches of the subbasin, streams are mainly bedrock controlled within moderately steep valleys. The narrow floodplain is limited to the lower 1.5 miles.

### 5.4.3 VEGETATION

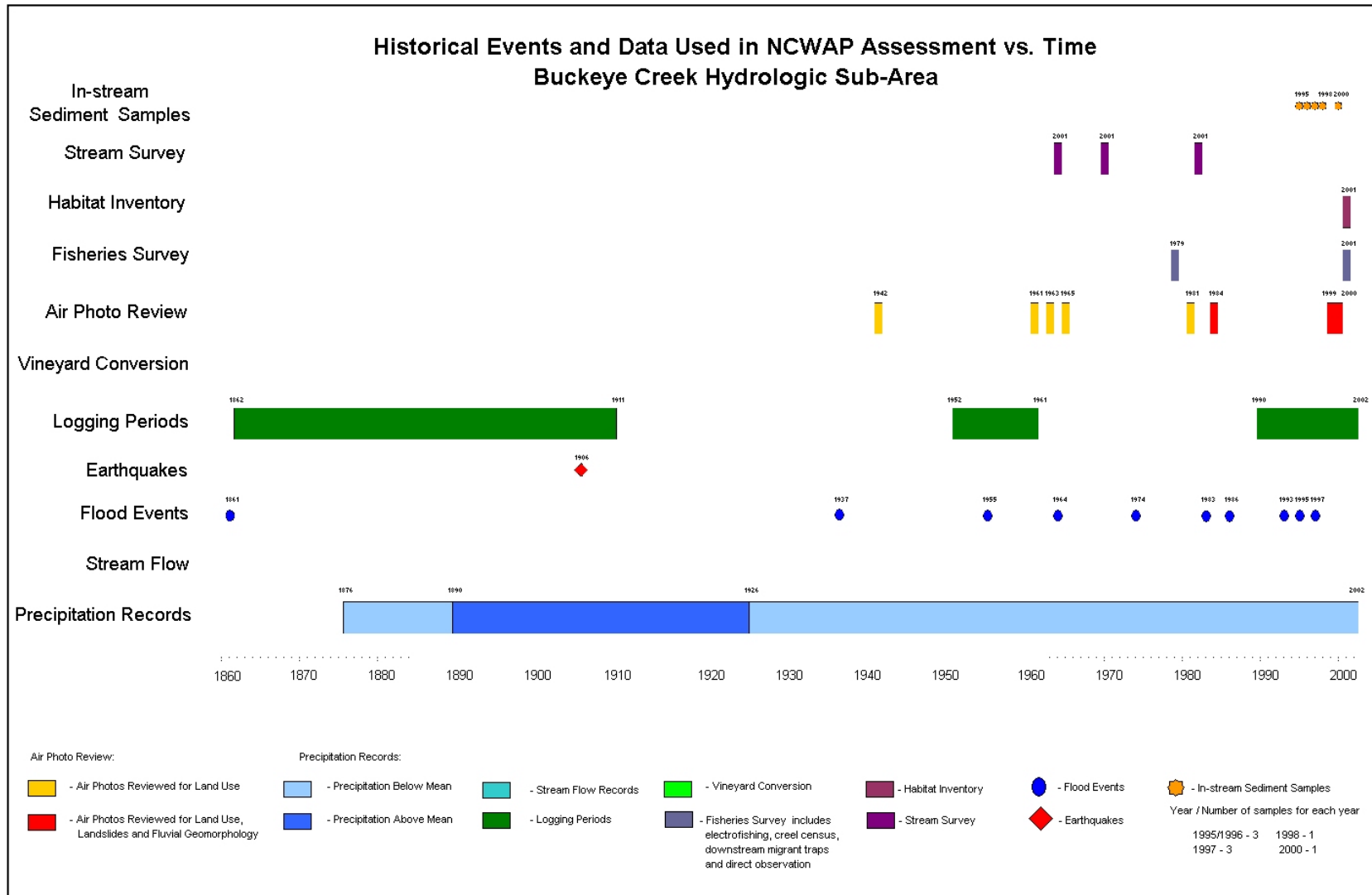
The wider Buckeye Subbasin contains high site redwood ground in the lowest reaches. Further inland, Douglas fir and then mixed conifer-hardwood predominates. Oak and prairie grassland is the dominant vegetation type east of Osser and Flat Ridge creeks. As in Rockpile Creek, the 1942 photos show mature coniferous shade canopy cover over all primary streams. Only in the lowest reaches near the confluence with the South Fork is the main channel of Buckeye Creek wide enough to result in bank-to-bank exposure (Figure 5.4-5).

### 5.4.4 LAND USE

Mid-20th-century pre-1973 tractor method harvesting was the dominant land use period in the Buckeye Subbasin. These operations removed old growth conifer stands to comprise approximately 70 percent of the total subbasin area harvested by 1968. Original turn of the century steam donkey operations were limited to the lowest reaches of the subbasin due to limited rail access from the South Fork.

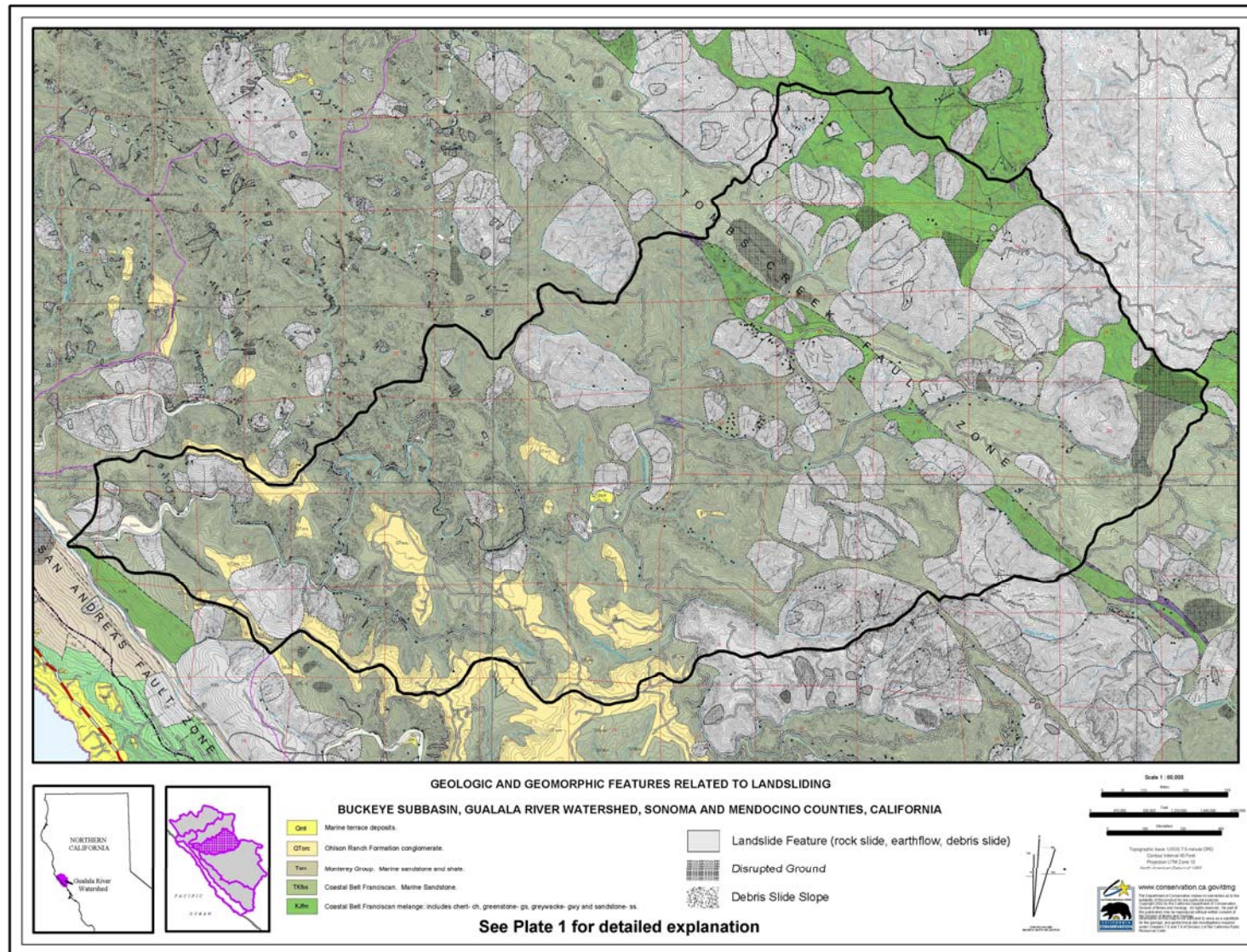


**Figure 5.4-1**  
Buckeye Subbasin



**Figure 5.4-2**  
Historic Events and Data Used in the NCWAP Assessment for the Buckeye Subbasin

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**Figure 5.4-3**

Geologic and Geomorphic Features Related to Landsliding - Buckeye Subbasin

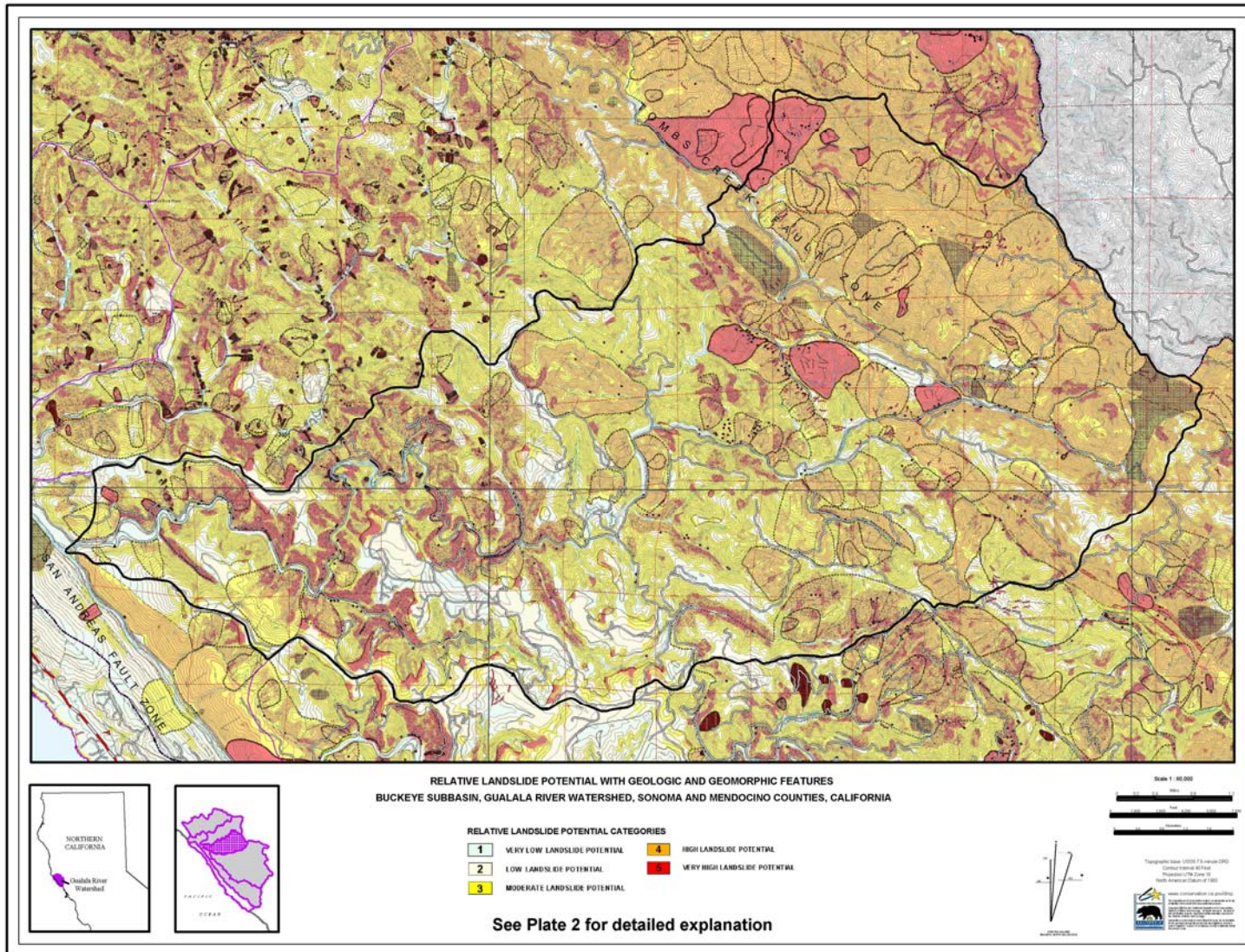
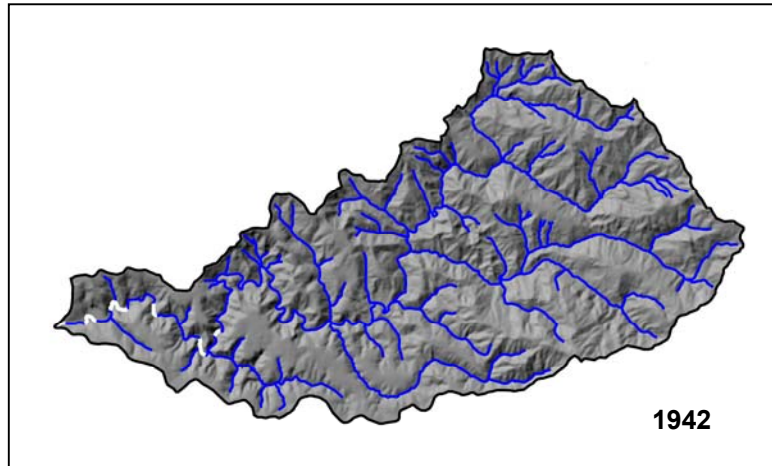


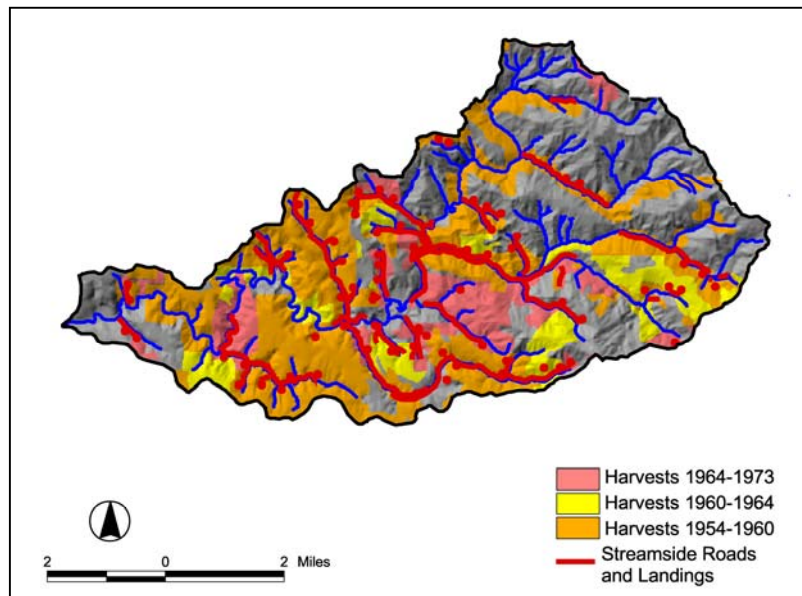
Figure 5.4-4

Relative Landslide Potential with Geologic and Geomorphic Features - Buckeye Subbasin



**Figure 5.4-5**  
Bank-to-Bank Stream Exposure (White) and Partial to Entire Cover (Dark Blue) in 1942

In the late 1950s, the Franchini Creek watershed and surrounding area formed the south portion of the large multi-basin harvest complex area bounded by the upper North Fork and the mainstem Buckeye Creek. This unit followed a large mid-1950s operation that extended south from the mainstem Buckeye Creek through the lower Wheatfield Subbasin to lower Fuller Creek. In the middle 1950s, downslope Douglas fir trees lining a narrow riparian corridor were removed from both Roy and Osser creeks. The Grasshopper Creek Planning Watershed (PWS) was logged by 1964 (Figure 5.4-7). Downslope areas of Douglas fir were logged throughout Soda Springs and Flatridge creeks by 1964. Between 1952 and 1964, 61.5 percent of the subbasin had been tractor harvested prior to the 1964 storms (Table 5.4-1). Streamside roads and landings were concentrated throughout: (1) Franchini Creek, (2) Grasshopper Creek, and (3) the North Fork Buckeye including Osser Creek (Figure 5.4-6). By the end of the tractor era in 1968, 69.5 percent of the subbasin had been harvested (Figure 5.4-8 and Table 5.4-1).



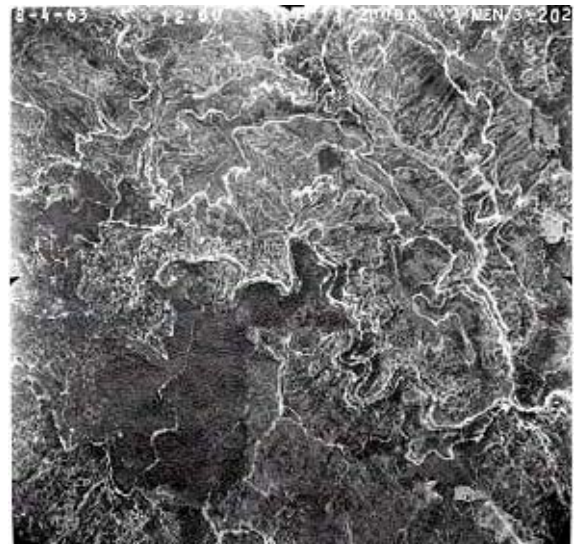
**Figure 5.4-6**  
Mid-20th-Century Tractor Operations in the Buckeye Subbasin and Streamside Roads and Landings  
(Red lines show where road fill has been pushed into the creek over the streambank)



**Figure 5.4-7**  
Tractor yarding was active in the Grasshopper Creek Subbasin in the mid 60s, leaving logs and wood debris piled over the stream channel. During the 1964 flood, this debris floated down to a low road crossing of Grasshopper Creek (left), creating a jam. The resulting dam breached at the south road approach, diverting onto the west road approach, which collapsed into the creek



1960



1963

**Figure 5.4-8**  
Middle reaches of Buckeye Creek 1960, and same area (right) by 1963 showing a high rate of old growth harvesting in a three-year time period. Franchini Creek is in the center right of each photo. Note entire bank-to-bank stream exposure as a result of these operations.

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Major sediment inputs from tractor logging areas by mid-20th-century storms are documented (see bullet points in Land Use Documentation, page 5.4-11 through 5.4-14). This coincided with indications of a more shallow pool structure from the early 1970s to present, although actual habitat survey methods and sampling procedures varied between survey years. Historic stream surveys in the Buckeye Subbasin are the most complete in the watershed.

The 1965 photos show extreme stream channel aggradation in Grasshopper Creek (Figure 5.4-7). The sinuous stream channel patterns through the logged areas show either (1) channel meandering through wide, flat areas of sediment fans in low gradient steps, or (2) stream deflections around fresh debris slides.

The 1989 Geological Review of Timber Harvesting Plan (THP) 89-091 SON stated “The Buckeye Creek watershed has been severely impacted by tractor logging between World War II and 1973. Skid trails were constructed in streams and draws, watercourses were filled, and surface flows were concentrated and diverted. As a result, Buckeye Creek is severely aggraded, filling most pools” (Geological Review 89-091 SON, T. Spittler).

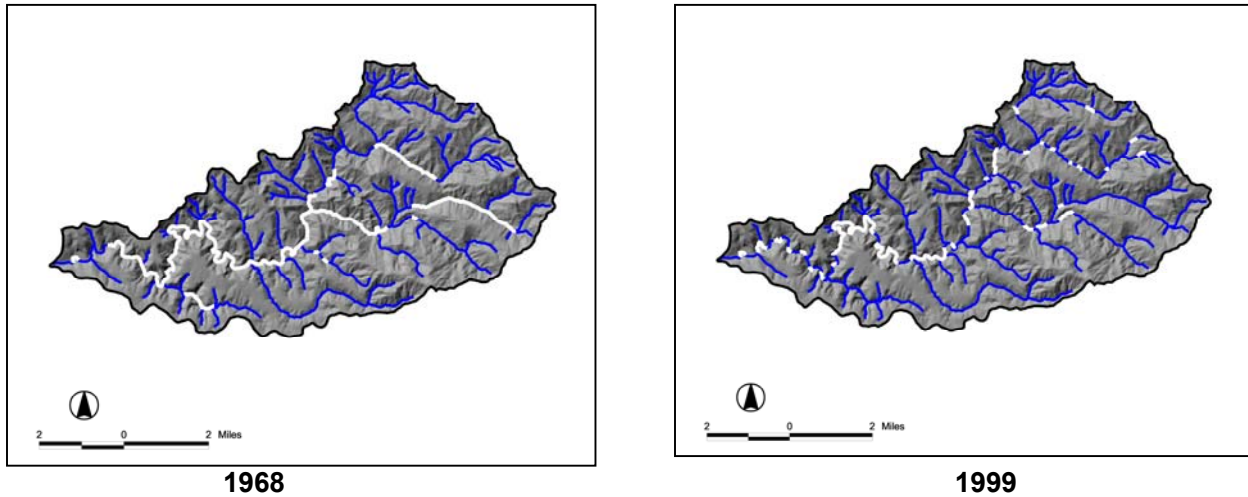
Pre-2001 damage is still contributing substantial quantities of sediment to streams. Large amounts of stored sediments are still present in these watercourses. During storm events, this material moves downstream filling pools, scouring channels, and silting spawning beds. Old woody debris pushed into the channel now rots out losing support strength among the soil matrix. This causes more stream channel failures and entry of soils and fine sediment into watercourses (THP 1-95-114).

A no-harvest provision within Class I riparian zones (in the middle reaches on Coastal Forest Lands [CFL] lands and vicinity) followed a four year standard of added protection for Buckeye Creek. “The landowners and agencies agree that Buckeye Creek has a temperature problem and needs additional time to develop the shade and pools to improve fish habitat. The pre-1973 practice to build roads and landings in or near streams was widespread and led to massive degradation of the stream system. They were choked with sediment and large woody debris (LWD). Stream side vegetation was eliminated and shade canopy was greatly reduced.” (S. Smith, California Department of Forestry and Fire Protection [CDF] Field Inspector)

**Table 5.4-1**  
Buckeye Subbasin Stand Replacement Operations 1942 – 1973 - Total Area = 25,768 acres

Time Period	Acres Under Operation	Type of Operation	Cumulative Percent of Subbasin Under Operation Since 1942	Mean Annual Increment (acres/percent by year)
1932 – 1942	0	Stand Replacement	0	0
1942 – 1952	100	Stand Replacement	1.3	10 (0.1)
1952 – 1960	10,550	Stand Replacement	41.0	1,382 (5.0)
1960 – 1964	5,300	Stand Replacement	61.5	1,325 (5.0)
1964 – 1973	2,050	Stand Replacement	69.5	205 (0.8)





**Figure 5.4-9**  
 Bank-to-Bank Canopy Exposure (White) in the Buckeye Subbasin in 1968 (Left) and 1999 (Right)  
 (Dark blue lines show partial to entire canopy cover )

Bank-to-bank overstory shade canopy cover for 1999 (Figure 5.4-9) shows improvement compared to 1968, reflecting riparian in-growth since the late 1960s. In 1942, approximately 2 percent of the blue line streams were exposed bank to bank (Figure 5.4-5), limited to alluvial openings in the lower subbasin reaches throughout generally wooded conditions. In 1968, approximately 60 percent of the blue line streams were exposed bank-to-bank by the end of the tractor harvesting era. By 1999, this improved to approximately 25 percent of blue line streams exposed bank-to-bank (Figure 5.4-9). Coastal Forestlands reported reinstatement of overstory shade canopy in numerous upper reach tributary watercourses (Coastal Forest Lands’ 1997 Sustained Yield Plan). Coastal Forest Lands, Ltd. (CFL) no harvest Watercourse and Lake Protection Zones (WLPZs) are routinely stipulated for all THPs along Buckeye Creek and Class II tributaries to mitigate temperature impairment throughout the subbasin. Canopy cover is lacking in most areas along the mainstem Buckeye Creek, in the middle to upper reaches.

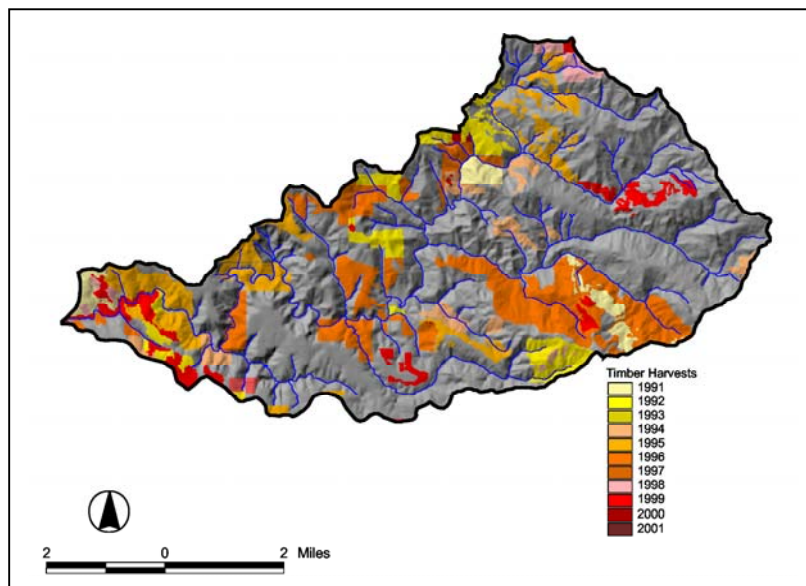
**Table 5.4-2**  
 Buckeye Subbasin timber harvest operations – 1974 – 2001 - Total Area = 25,768 acres

Time Period	Acres Under Operation	Type of Operation	Cumulative Percent of Subbasin under operation since 1974, some overlap with mid-20th-century areas	Mean annual increment (acres/percent by year)
1974 - 1990	550	Stand Replacement	.2	34 (0.1)
1991 - 2001	8,200	THPs	32.2 (42% cable, 58% tractor)	820 (3.2)

The 1970s were a period of relative inactivity compared to previous eras (Table 5.4-2). Partial entries and stand thinnings were common in the alluvial flats at this time. During the late 1980s through mid 1990s, active timber harvesting resumed. In the middle subbasin reaches, numerous seed tree overstory removal/ dispersed harvest THPs were conducted. These covered large areas but removed scattered single trees and remnant stands left from 1960s era entries. The 1999 air photos show these areas well vegetated. Agency review of these THPs clarified road upgrade work requirements to repair the erosion conditions of pre-1973 operations. Even-aged management has been the predominant silvicultural

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method in the lower alluvial subbasin since the mid 1990s (Figure 5.4-10). Some 580 acres (2.2 percent) of grazing lands occupy the upper subbasin reaches.



**Figure 5.4-10**  
1991 to 2001 Timber Harvests

#### 5.4.5 ROADS

##### Historic Roads (1952 – 1968)

Built between the mid 1950s and early 1960s, streamside/instream road and landing networks spanned most of the natural fluvial drainage system of the Buckeye Subbasin (Figure 5.4-6). These roads dominated stream channel structure throughout Franchini, Grasshopper, and the North Fork Buckeye including Osser creeks, simplifying stream channel structure and complexity. A total of approximately 27 miles of road were built at or near equal elevation to the streambank transition line with sidecast covering the streambank leading to the creek. More roads were located slightly upslope but still near the creek. However, these were not mapped with this study. After 1968, these roads were generally unused and left abandoned. There was no to minimal erosion control facilities left with these roads.

Stream channel morphology in the Buckeye Subbasin over the last 50 years experiences the following evolution thru time: (1) a high density of debris mounds in the active channel triggered by mid-20th-century storm events, (2) progressive abatement of the frequency of these point sources over successive decades, and (3) apparent improvements in instream channel conditions between 1984 and 2000 as evidenced by a reduction in the percentage of channel length that is affected by excess sediment storage or sediment sources. The 1961, 1965 and 1981 photos show that most of the point source sediment discharges consist of road debris slides accessing watercourses activated by large storm events. For example, 1965 photos show multiple road debris slides accessing Grasshopper Creek over relatively short sections of the stream. Fresh debris slides fanned out over the channel, forcing the stream to meander around the slide mass. These meandering stream channel patterns (Figure 5.4-7) returned to a more lineal pattern as observed with the 1984 photos, and again with 1999 photos. Sediment accumulations continue to be noted in low gradient steps. In the Grasshopper Creek tributary, stream

channels in many areas contain large amounts of stored sediment behind jams of LWD. The channel continues to downcut to pre-logging levels.

The California Geologic Survey (CGS) watershed-wide geofluvial mapping compared stored sediment channel characteristics between 1984 and 1999/2000. This comparison basically shows stream channel sediment residency movement thru time. The 1984 mapping spans 16 years after the end of the tractor logging era (by 1968). Most of the stream segments in the Buckeye Subbasin show a reduction in the percentage of channel length that is affected by excess sediment storage or sediment sources. The dense network of instream/streamside roads and landings that lined blue line streams in the Little Creek, Grasshopper Creek and Flat Ridge Creek PWSs showed a high correlation with stream braiding and aggradation (over 75 percent) in 1984.

### **Modern Roads**

Successive air photo overlays show a shift in new road construction to ridgelines and mid-slope benches. The total length of the road network consists of 229 miles of active roads, at a density of 5.7 miles/square mile. The U.C. Davis Information Center for the Environment (“ICE”) developed a contemporary road map for the total maximum daily load (TMDL), which shows most of the current roads located distant from watercourses. Approximately 1.5 miles of current roads are within 50 feet of blue line streams within the subbasin. Of these roads, less than a half mile total length are in areas that may be affected by historically active landsliding and stream bank erosion. Although the current road network shows less overall coincidence of debris slides and stream crossing failures compared to historic times, most of the contemporary road failures are in close proximity to streams and steep slopes. Approximately one mile total of modern road segments cross steep slopes (excess of 60 percent). Most of the historically active point slides found within 60 meters of a road occur predominantly along blue line streams in steep areas.

Substandard road networks continued to be vulnerable to large storm events in the 1980s and 1990s. Road washouts during the 1986 and 1996 storms generally characterize contemporary land use induced sediment pulses. There are 1.8 road crossings per stream mile. With 37.5 of the subbasin subject to Timber Harvest Plans since 1991, some road repair and upgrade work has been accomplished. More recent THPs require even higher construction/ replacement standards. Remaining areas of the subbasin are recommended as the highest priority for restoration work with this study. Gualala Redwoods, Inc. (GRI) has also completed road upgrade work in the lower reaches of the subbasin, with an estimated savings of 3,400 cubic yards. The NCWAP restoration map targets individual stream segments throughout the entire subbasin on a more or less even distribution (Plate 3, Figures 5.4-19a and 5.4-19b).

### **Documentation Of Land Use Impacts By Major Tributary**

#### ***Little Creek***

- The Little Creek watershed was logged during the late 1950s. The main haul road followed the stream channel throughout the entire Class I portion of Little Creek with numerous instream landings concentrated in this tributary watershed.
- In the lower to middle reaches of Buckeye, Coastal Forest Lands’ (CFL’s) main seasonal road followed the streambed or adjacent to Buckeye Creek. This road undercut steep ground between Stanly and Brushy Ridges causing debris slides into Buckeye Creek. This road section is currently abandoned due to a rockslide and numerous washouts. A Little Creek tributary also was

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similarly tractor logged. Tractor logging occurred on slopes in excess of 65 percent (THP 97-036, CFL).

**Franchini Creek**

- The entire tributary watershed was logged between 1959-1960. The main seasonal road was located in and adjacent to the stream channel. Numerous debris slide failures were noted along the main instream road in 1961 and 1965 photos as Franchini Creek undermined the road. The Franchini Creek watershed was burned during the 1950s. Subsequent salvage logging used roads adjacent to streams and instream landings (THP 97-034, CFL).
- Stream surveys in Franchini Creek by the North Coast Regional Water Quality Control Board (NCRWQCB) staff during development of the TMDL found fine sediment almost completely burying cobble (NCRWQCB 2001b).

**Grasshopper Creek**

- The main haul road, now abandoned, followed the stream channel of Grasshopper Creek, leading west to the Buckeye Creek Road. No culverts were used and the road was abandoned with no stabilization measures applied. Logs were skidded downhill, often directly in watercourses. No waterbars were built or stream crossings ditched out. Stream channels in 1993 contained large amounts of stored sediment behind jams of LWD. The channel continued to downcut to pre-logging levels in 1993 (THP 93-328).
- Fine sedimentation in pools relative to the residual pool volume ( $V^*$ ) showed 59 percent pool volume filled with fine sediment, rating comparatively high disturbance (Knopp 1993).
- Grasshopper Creek enters a steep, narrow canyon before its confluence with Buckeye Creek. The canyon walls are mapped as debris slide slopes, although no landslides were found in the photos examined. In fact, landsliding is relatively rare in the Grasshopper Creek watershed.

**Middle Reaches Buckeye Creek**

- This area was subject to harvest removals and conversion to pastureland, including burning, during the 1950s and 1960s. High sedimentation and accumulation of debris were found in the channels, and downcutting and subsequent downstream aggradations were noted. Uncontrolled installation of fills, failure to remove fills, and lack of erosion control facilities has caused several landslides and locally severe erosion. A Pre-harvest Inspection report described LWD as common in smaller streams. There were major road repairs to correct on-site sediment sources (THPs 97-070 and 442).
- Water temperatures collected during a timber harvest inspection ranged from 61 to 66 F in east and west tributaries to Buckeye Creek, exceeding the optimum for coho salmon south of Bear Ridge, Kelly Road (Flat Ridge Creek PWS). Much of the streams were forested with sapling sized conifers/hardwoods. Extensive grassland areas with more open riparian zones exist from older attempts at rangeland conversion and are now abandoned. Watercourse areas were heavily cut during the late 1950s tractor operations. Stream diversion repairs were noted, as well as new road construction to relocate road segments onto the ridgeline (THP 97-227).
- Stream diversion realignments of Class II watercourses were specified to repair deep gully erosion down roads and skid trails. This was required on an 800-acre plan upslope of Buckeye Creek. A no-harvest provision within the Class I follows a four year standard of added protection for Buckeye Creek. Past cattle grazing in this area after 1960s era harvest entries prevented timely overstory reestablishment of canopy cover over fish bearing watercourses (THP 97-442).

### **North Fork Buckeye**

- Steelhead trout and coho salmon were reported in the North Fork Buckeye in 1964. A 1982 survey found pools at 25-40 percent of the stream. Steelhead trout comprised 40 percent of fish observed, among high water temperatures, algae blooms, and lack of cover. A 1995 survey showed 20 percent pools.
- Specific no-harvest Watercourse and Lake Protection Zone measures were implemented to mitigate streamshade deficiencies from pre-1973 era logging. The area historically was forested with Douglas fir. The area was tractor logged during the 1950s, with some areas entered lightly due to terrain and poor quality of the timber stands. Uncontrolled installation of fills, failure to remove fills, and lack of erosion control facilities has caused several landslides and locally severe erosion. Correction of on-site sediment sources has occurred with THPs (watercourse diversion repairs were noted under THP 1-97-084). Historic attempts at permanent conversion to grazing lands occurred within the Howlett Ranch. A diverted Class II watercourse triggered a large translational/rotational slide and “massive erosion” (California Department of Mines and Geology [DMG] Report, M. Manson THP 97-084). The THP required redirection of the watercourse to the natural channel by excavator work. Class II watercourse tractor crossings left in place from the 1950s have washed through leaving vertical cuts over 6 feet high.

### **Roy Creek (upper Buckeye Subbasin)**

- Most areas were tractor logged during the late 1950s to 1960s. Logging was accompanied by attempted conversion to rangeland. Site reconnaissance during several Pre-harvest Inspections documented tractor skidding down all slopes, regardless of steepness, to roads and landings located in or adjacent to watercourses. The lack of erosion control caused deep gullying down skid trails discharging into watercourses. Large quantities of soil and debris were placed into or washed into watercourses. Debris slides above and below roads are common and frequent. Maintenance of a passable road surface involves clearing of slide debris from the roads and installing infrequent ditch relief culverts. Recent timber harvest activity since 1973 repaired and improved drainage conditions in those areas where operations occurred (M. Jameson, CDF Audit Forester, 1995).
- The lower two miles of Roy Creek above the confluence with Osser Creek was described as in poor condition in 1995. Sediment lined the channel, partially filling pools. LWD was not abundant. An upper tributary of the North Fork Buckeye Creek was reported as wide and shallow with low amounts of LWD. Most of the large hardwood and conifers that once lined the streambanks had been cut and the area was converted to grassland, perhaps creating high stream temperatures (M. Jameson, THP 95-114). One pool was 75 F at 2:00 p.m. on August 19, 1994, a second was 72 F. With the recent elimination of grazing activity, conifers have begun to reestablish in rangeland areas
- The lower half mile of Roy Creek crosses the Tombs Creek Fault Zone and is impacted by a large active earthflow complex that makes up the northwest hillside above the creek. The earthflow formed in the Central Belt Formation which is on the northeast side of the Tombs Creek Fault Zone. The earthflow is a grassy area, and probably never offered LWD.

### **Osser Creek (upper Buckeye Subbasin)**

- Logged by the late 1950s, many areas in the Osser Creek watershed were first harvested by a diameter limit cut. Tractor operations used some creek channels as skid trails, building landings in or near watercourses. Sediment pushed into creeks from historical operations was present in 1999, and was slowly flushing during peak flow events (THP 99-145).

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- Field reconnaissance during several Pre-harvest Inspections in 1995 and 1997 described Osser Creek as subject to heavy deposits of soil and debris (THP 97-070 and THP 95-114). The size of pools had been reduced substantially by filling with fine sediments. An active earthflow impinges on the creek in areas, probably contributing fines, but on-site evaluation is needed to verify. Most channel overstory cover was removed by historic logging and conversion to pastureland. Shade on Osser Creek in 2001 was estimated at 80 percent in the upper reaches, and lower in downstream reaches. Conditions were described as in a stage of recovery in 2001, and may require many decades for excess sediment to flush downstream during high flow events. Background levels of sedimentation were generally high but not specifically known and should be considered in evaluating recovery from land use disturbance. Streamside shading will similarly require several decades to recover with conifer ingrowth, after cessation of grazing and conversion to pastureland (M. Jameson, THP 1-95-114).

## 5.4.6 FLUVIAL GEOMORPHOLOGY

About 53 percent of the subbasin is classified as high to very high potential for landsliding and represents the major source area for stream sediment (Figure 5.4-3). Instream sediment levels, indicative of disturbance, occur along 18 of 90 miles of the blue line streams in the subbasin. This is a 57 percent reduction compared to levels in 1984. Most of the reduction occurred in the tributaries, while the lower reaches showed less change. Table 5.4-3 lists the lengths of sediment storage mapped and relative change between 1984 to 1999/2000 for the Buckeye Subbasin.

**Table 5.4-3**  
Buckeye Subbasin Stream Characteristics Representing Sediment Sources or Storage

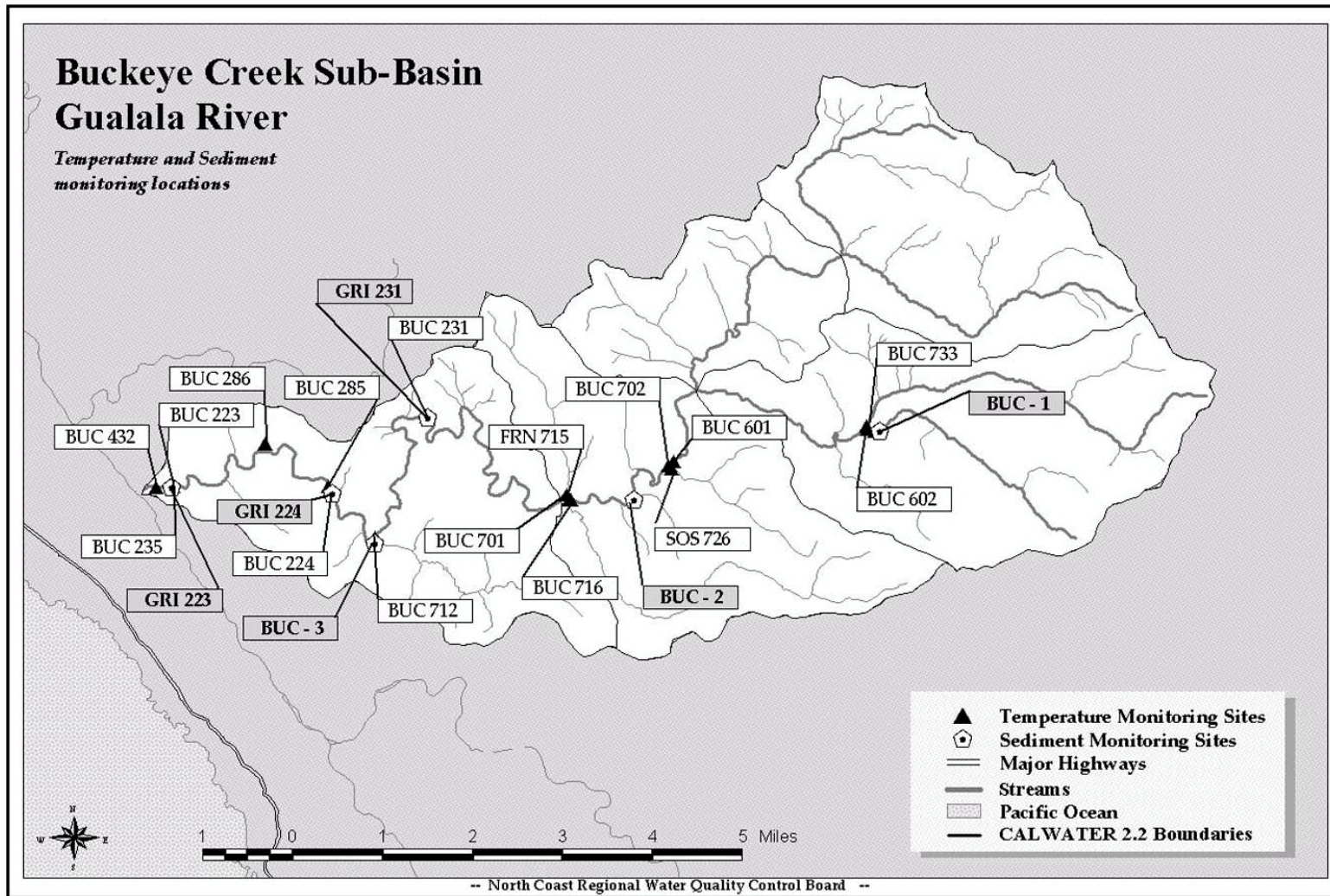
Planning Watershed	Year 2000		Year 1984		1984 to 2000	1:24K Streams
	Length Miles	Percent Total Stream for Subbasin	Length Miles	Percent Total Stream for Subbasin	Length Miles	Total Length Miles
North Fork Osser Creek	2.2	11.5	4.7	24.5	-53.2	19.0
Flat Ridge Creek	4.1	20.7	8.7	43.8	-52.7	19.8
Grasshopper Creek	4.8	25.1	11.4	59.1	-57.5	19.2
Little Creek	5.6	26.7	12.9	62.0	-57.0	20.8
<b>Total</b>	<b>17.9</b>	<b>19.8</b>	<b>41.6</b>	<b>46.0</b>	<b>-56.9</b>	<b>90.4</b>

## 5.4.7 WATER QUALITY

## Water Temperature

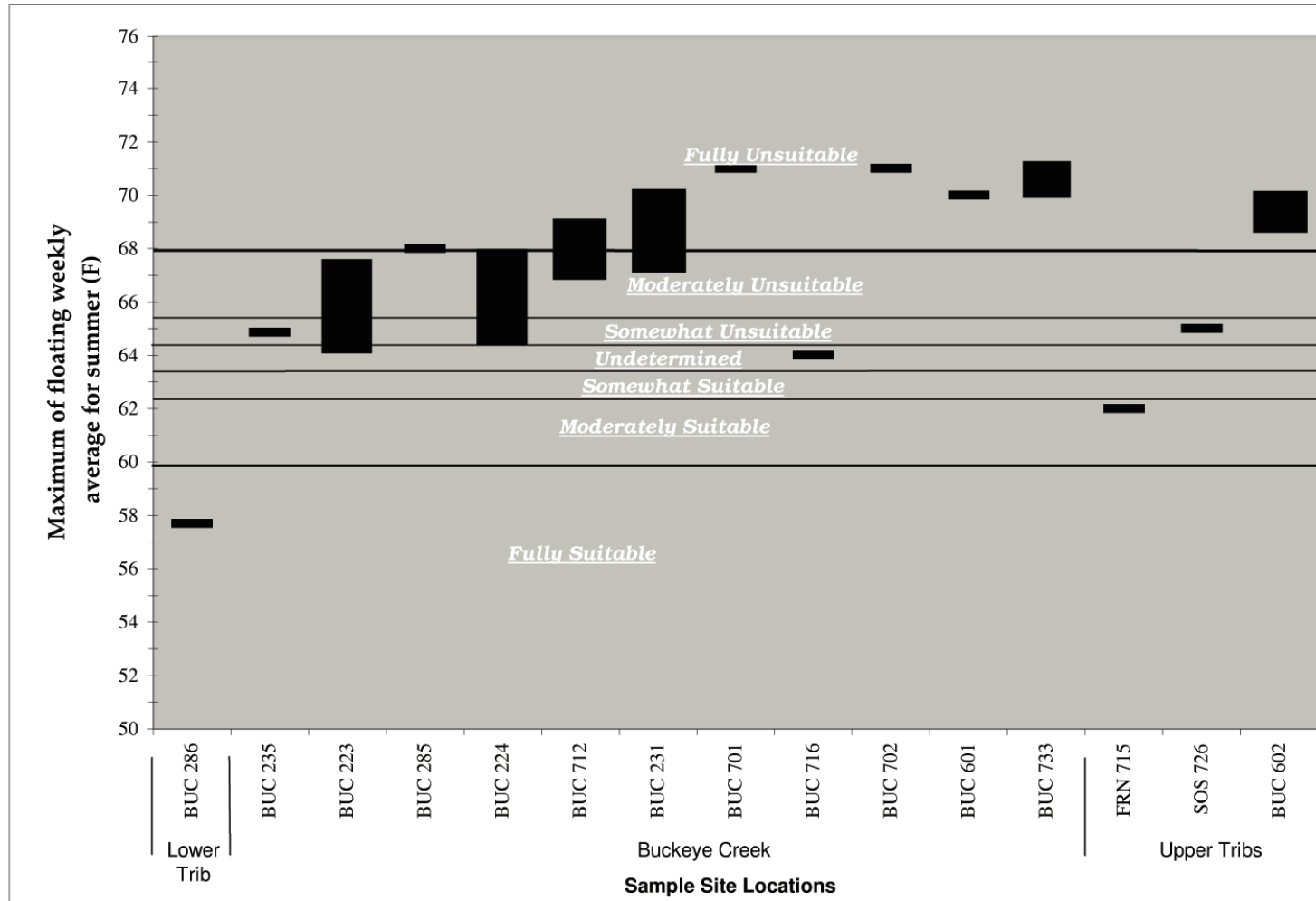
Water temperature data from continuous recorders were available for 15 sites in the Buckeye Subbasin (Figure 5.4-11). The period of record from 1995 to 2001 yielded 39 observations for maximum weekly average temperature (MWAT) and seasonal maximum temperature.

MWATs in the mainstem ranged from undetermined to fully unsuitable (Table 5.4-4). MWATs in Flatridge, Soda Springs, and Grasshopper creeks ranged from moderately to fully unsuitable. MWATs for the lower tributary were fully suitable for the period of record (Table 5.4-4, Figures 5.4-12 and 5.4-13).



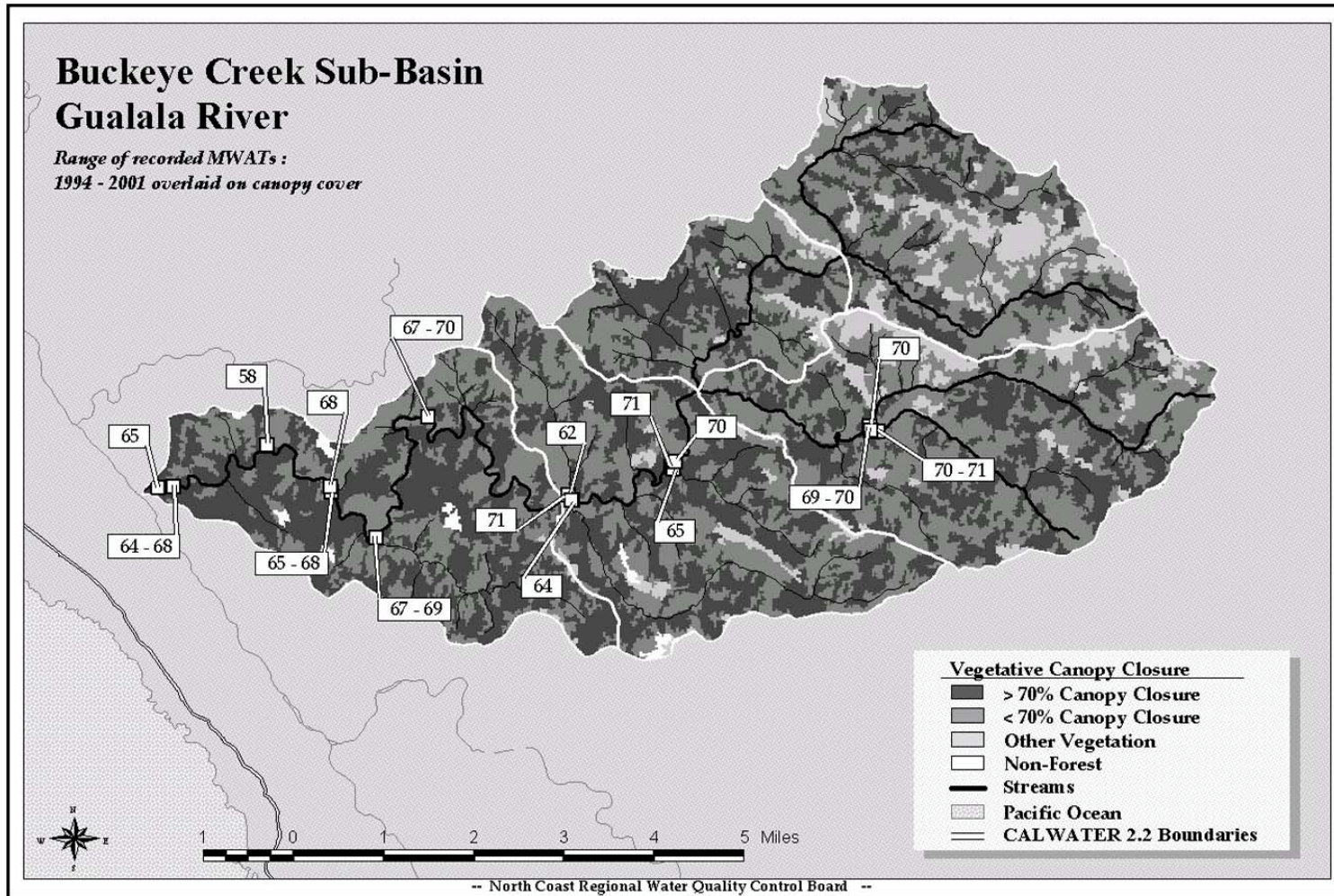
**Figure 5.4-11**  
 InStream Sediment and Temperature Sampling Sites, Buckeye Subbasin

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**Figure 5.4-12**  
 Maximum Weekly Average Temperature (MWAT) Ranges for the Buckeye Subbasin from 1995-2001  
 (Data From GRI And GRWC Continuous Monitoring Devices)





**Figure 5.4-13**  
 MWAT Temperature Ranges in the Buckeye Subbasin for the Period of Record, 1995-2001  
 (Overlaid on the LandSat Canopy Cover for 1999)

Seasonal maximum temperatures were above the lethal limit of 75 F at seven of the ten mainstem sites at one time or another during the period of record (15 of 28 observations). Flatridge, Soda Springs, and Grasshopper creeks seasonal maxima for 2000 and 2001 were 78 F to 77 F. The seasonal maximum in the lower tributary for the one measurement in 1998 was 59 F.

**Table 5.4-4**  
EMDS Ratings for Maximum Weekly Average Temperatures (MWATs) in the Buckeye Subbasin

Stream	No. of Sites	No. of Observations	Period of Record	+++	++	+	0	-	--	---
Buckeye Mainstem	10	28	1994 - 2001							
Flat Ridge Creek	1	4	1997 - 1998 2000 - 2001							
Franchini Creek	1	2	1997 - 1998							
Grasshopper Creek	1	2	1997 - 1998							
Soda Springs Creek	1	2	1997 - 1998							
Lower Tributary	1	1	1998							

EMDS ratings:

- +++ = fully suitable (50-60 F)
- ++ = moderately suitable (61-62 F)
- + = somewhat suitable (63 F)
- 0 = undetermined (between somewhat suitable and somewhat unsuitable) (64 F)
- = somewhat unsuitable (65-66 F)
- = moderately unsuitable (67 F)
- = unsuitable (> 68 F)

## 5.4.8 FISH HABITAT RELATIONSHIPS

### Historic Habitat Conditions

CDFG stream surveys were conducted on Buckeye Creek and North Fork Buckeye Creek in 1964. These surveys were made by direct observation and were not accompanied by quantitative data (Table 5.4-5).

**Table 5.4-5**  
Summary of Historic (1964-1982) Conditions Based Upon Stream Surveys Conducted in the Buckeye Subbasin Gualala River Watershed, California

Buckeye Subbasin Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
Buckeye Creek	8/27/64	Good spawning and rearing area; 50% pools; Steelhead present.	Some partial barriers	Replant riparian vegetation; remove log jams
	8/19/70	Silt and sand dominated substrate indicating poor spawning; 25% pools.		
North Fork Buckeye Creek	8/5/64	Pools 25%; Sluggish water with algal bloom.	Slash; Log jams	Plant riparian; Improve poor logging practice
	8/5/82	Pools 40%.		

### Current (2001) Conditions

#### Target Values and Current Conditions from the Habitat Inventory Surveys

Beginning in 1991, habitat inventory surveys were used as a standard method to determine the quality of the stream environment in relation to conditions necessary for salmonid health and production. Target values for each of the individual habitat elements measured are provided in the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al. 1998) (Table 5.4-6). When habitat conditions fall below the target values, restoration projects may be recommended to meet critical habitat needs for salmonids.

**Table 5.4-6**  
 Habitat Inventory Target Values Taken from the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al 1998)

Habitat Element	Canopy Cover	Embeddedness	Primary Pool Depth/Frequency	Shelter/Cover
Range of Values	0-100%	0-100%	0-40%	Ratings range from 0-300
Target Values	>80%	>50% or more of the stream length is <50% embedded	Depth-1st and 2nd order streams >2 feet 3rd and 4th order streams >3 feet Frequency->40% of stream	>80

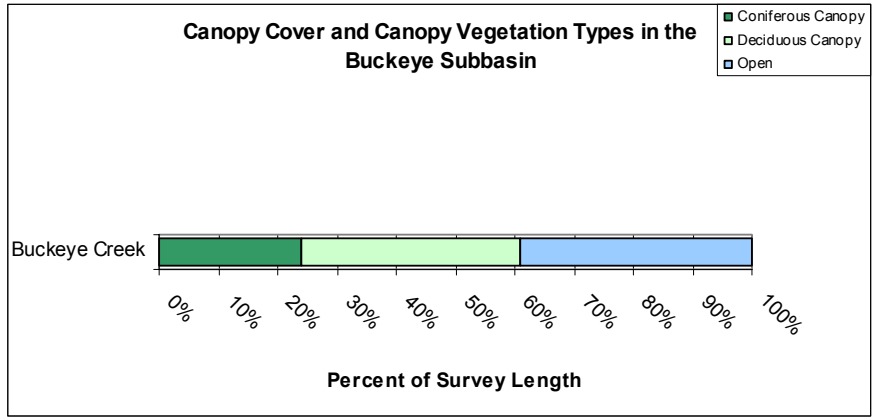
One habitat inventory survey was conducted in 2001 on the entire 51,085 feet of the main stem of Buckeye Creek. The embeddedness target value was reached, indicating good spawning substrate conditions. The target values for canopy density, pool frequency/depth, and the shelter/cover ratings were not met (Table 5.4-7).

**Table 5.4-7**  
 Summary of Current (2001) Conditions Based Upon Habitat Inventory Surveys from the Buckeye Subbasin, Gualala River Watershed, California  
*Condensed Tributary Reports are located in CDFG Appendix 5.*

Habitat Element Stream Name	Surveyed Length (feet)	Canopy Cover	Embeddedness	Primary Pool Depth/ Frequency	Shelter Cover Ratings
Buckeye Subbasin	51,085				
Buckeye Creek	51,085	61%	68%	11%	44

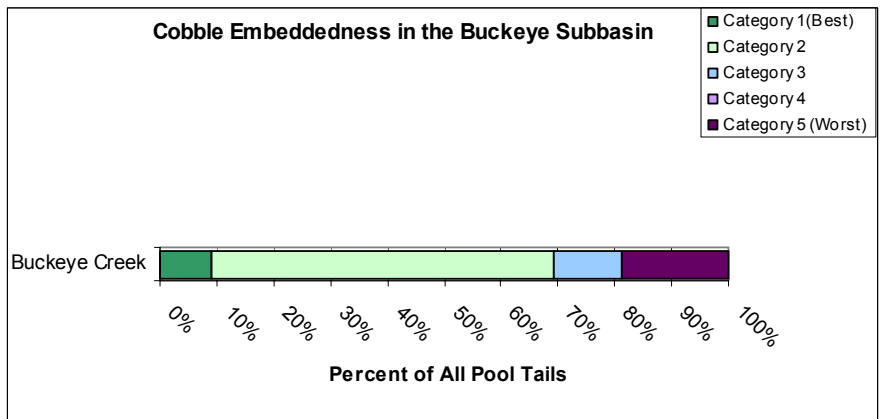
Buckeye Creek is a third order stream. Habitat deficiencies were documented by the habitat inventory surveys related to canopy cover, pool frequency/depth and shelter cover. Canopy cover averaged 61 percent with conifers contributing 37 percent and deciduous 24 percent (Figure 5.4-14). Sixty-nine percent of pool tails surveyed in Buckeye Creek were category 1 or 2 embeddedness (Figure 5.4-15). Buckeye Creek showed 11 percent of the survey length consisted of primary pools (Figure 5.4-16). Shelter/cover received a rating of 44 (Figure 5.4-17), and the cover was provided by large and small woody debris, boulders and root masses (Figure 5.4-18).

5.4 Buckeye Subbasin



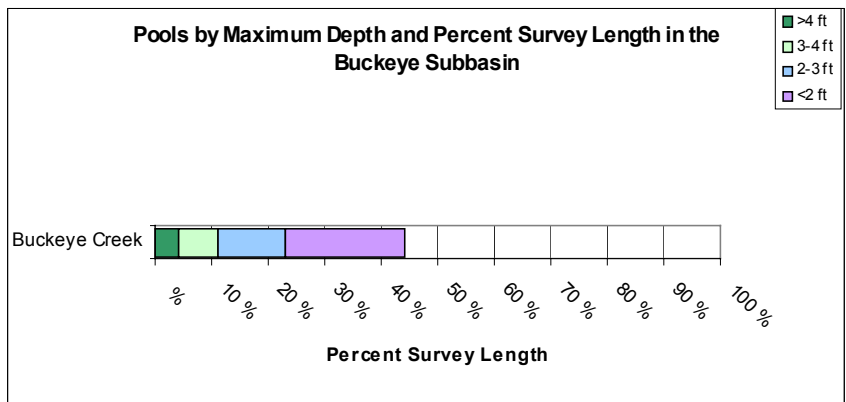
**Figure 5.4-14**

Canopy Cover and Canopy Vegetation Types by Percent Survey Length in the Buckeye Creek, Buckeye Subbasin 2001, Gualala River Watershed, California



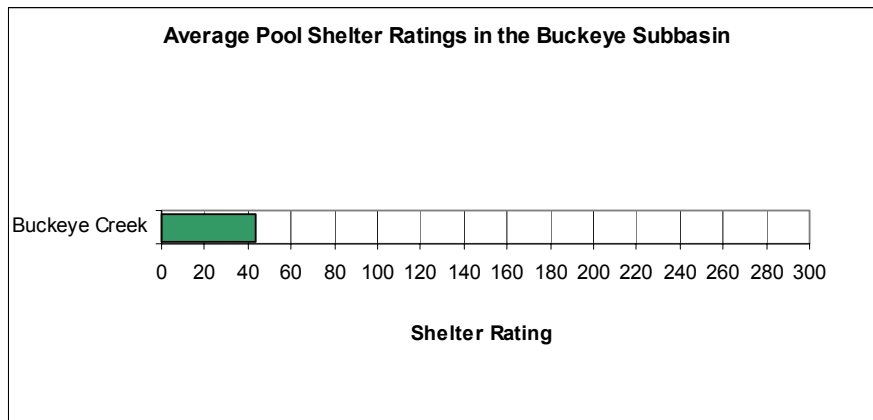
**Figure 5.4-15**

Percent of Cobble Embeddedness in all Pool Tails in the Buckeye Subbasin 2001, Gualala River Watershed, California

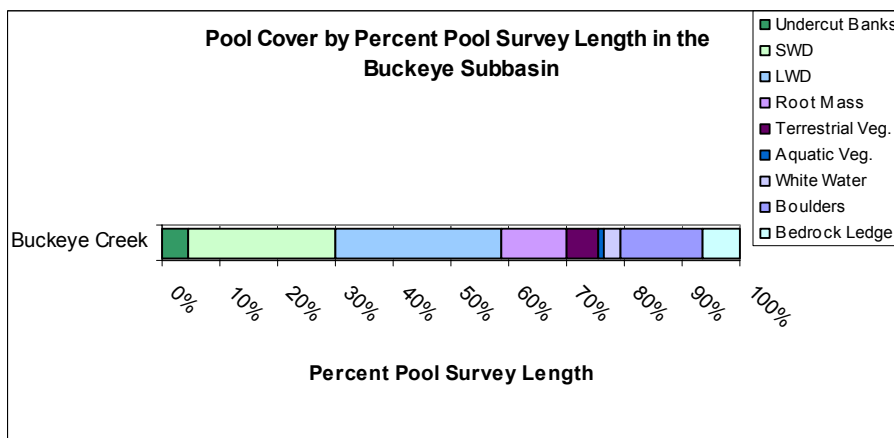


**Figure 5.4-16**

Pools by Maximum Depth and Percent Survey Length in the Buckeye Subbasin 2001, Gualala River Watershed, California



**Figure 5.4-17**  
 Average Pool Shelter Ratings in the Buckeye Subbasin 2001, Gualala River, California



**Figure 5.4-18**  
 Pool Cover Types by Percent of Pool Survey Length in the Buckeye Subbasin 2001, Gualala River Watershed, California

### Large Woody Debris Data

Large woody debris data were provided by the Gualala River Watershed Council’s Cooperative Monitoring Program. Most large wood was cleared from the streams during the 1950s, 1960s and 1970s. A target value of 130 pieces of large wood >8 inches per 1,000 feet of stream is recommended in the literature (Beechie and Sibley 1997, Martin 1999). The monitoring surveys demonstrated that large wood was deficient in the areas of Buckeye Creek surveyed. This finding was supported by the habitat inventory survey data collected in 2001 and the EMDS reach model.

The Cooperative Monitoring Program surveys found both of the Buckeye Creek sites lacking volume and pieces of large woody debris (Table 5.4-8).

## 5.4 Buckeye Subbasin

**Table 5.4-8**

Summary of Watershed Cooperative Monitoring Program Large Woody Debris Data, Buckeye Subbasin, (1998 - 2000)

Tributary	Site Number	Watershed* Size (acres)	Volume Cubic Feet/1,000'	Quantity Pieces/1,000'
Buckeye Creek	223	25,588	2,946	49
Buckeye Creek	231	21,198	228	7

\*Watershed size is calculated as the area above the monitoring site.

### Changes in Habitat Conditions From 1964 to 2001

Changes between historic and current instream conditions were compared between the streams surveyed in 1964, 1970, and 1982 and subsequently habitat inventoried in 2001. Data from the 1964, 1970 and 1982 stream surveys provide only a qualitative snapshot of the conditions at the time of the survey and terms such as excellent, good, fair and poor were based on the judgment of the biologist or scientific aid conducting the survey. The results of the historic stream surveys cannot be used in comparative analyses with the quantitative data provided by the habitat inventory surveys with any degree of accuracy. However, the two data sets may be used to show general trends.

According to aerial photographs, the canopy cover of the 1960s was reduced substantially from the conditions observed in the 1940s. The canopy appeared to be low or absent throughout the subbasin.

In the Buckeye Subbasin, Buckeye Creek was surveyed in 1964 and 2001 (Table 5.4-9). The canopy cover appears to have increased somewhat, but still does not meet target values, indicating some improvement over those observed in the 1960s aerial photographs. The 2001 spawning substrate conditions continue to provide the same acceptable conditions observed in 1964. It is unknown whether the substrate has remained acceptable or has returned to the conditions observed in 1964. The 2001 pool frequency/depth and shelter cover appear to have decreased since 1964. The apparent reduction in pool frequency, pool depth and shelter/cover were likely exacerbated by “over” clearing of large woody debris from the stream.

**Table 5.4-9**

Comparison Between Historic Habitat Conditions Observed in 1964 with Current Habitat Inventory Surveys Based Upon Quantitative Measurements in 2001 from the Buckeye Subbasin Gualala River Watershed, California

Habitat Element Stream Name	1960s Canopy Cover Photos	2001 Canopy Cover	1964 Spawning Conditions	2001 Spawning Conditions	1964 Pool Depth/Frequency	2001 Pool Depth/Frequency	1964 Shelter Cover	2001 Shelter Cover	Change in conditions from 1964 to 2001
<b>Buckeye Subbasin</b>									
Buckeye Creek	Low or Absent Replant	61%	Good	68%	50%	11%	N/A	44	Some canopy recovery: Improved spawning conditions: Decreased pool habitat and shelter/cover.

### Ecological Management Decision Support (EMDS) Reach Model

Although the EMDS Reach Model scores are based upon the habitat inventory survey data, the analysis differed. The habitat inventory data were divided into reaches based upon Rosgen Channel type and then converted to a weighted average. Each weighted average reach was compared to a set of habitat reference conditions which were determined from empirical studies of naturally functioning channels, expert opinion, and peer reviewed literature. EMDS rated each habitat component with a suitability score between -1 and +1, where suitability is a function of salmonid health and productivity. The reference curve breakpoints for these habitat parameters are presented in Table 4-1.

An EMDS score for the overall subbasin could not be calculated due to limited data. Only one stream equal to 37 percent of all the blue line streams was habitat inventoried. Data from five habitat categories and four temperature sites in 2001 were evaluated in EMDS (Table 5.4-10).

**Table 5.4-10**

Ecological Management Decision Support (EMDS) Reach Model Scores on Salmonid Health and Productivity Suitability for the Buckeye Subbasin Gualala, California, Based Upon Habitat Inventory Surveys Conducted in 2001

Subbasin Stream Name	Canopy Cover Score	Embeddedness Score	Pool Depth Score	Pool Shelter Score	Pool Quality Score	2001 MWAT Water Temperature Score
Buckeye Subbasin Score	n/a	n/a	n/a	n/a	n/a	n/a
Buckeye Creek	-	U	--	-	-	--

The 2001 water temperature data was provided by GRI and the GRWC.

- +++ = Fully Suitable
- ++ = Moderately Suitable
- + = Somewhat Suitable
- U = Undetermined
- = Somewhat Unsuitable
- = Moderately Unsuitable
- = Fully Unsuitable

### Limiting Factors Analysis (LFA)

The Gualala River Watershed LFA was developed for assessing coarse scale stream habitat components. Habitat inventory data, EMDS reach model scores, and the biologist's professional judgment were incorporated into both the identification of LFAs and their ranking (Table 5.4-11). The LFAs for the subbasin could not be calculated due to limited data. Only one stream equal to 37 percent of all the blue line streams was habitat inventoried.

**Table 5.4-11**

Limiting Factors for the Buckeye Subbasin Affecting Salmonid Health and Production Based Upon Habitat Inventory Surveys Conducted in 2001 and EMDS Scores in the Gualala River Watershed, California

*Rank 1 is the most limiting factor.*

Subbasin Stream Name	Canopy Cover Related to Water Temperature	Embeddedness Related to Spawning Suitability	Pool Depth Related to Summer Conditions	Pool Shelter Related to Escape and Cover
Buckeye Subbasin Score	n/a	n/a	n/a	n/a
Buckeye Creek	3	4	1	2

**5.4 Buckeye Subbasin**

Figure 5.4-19a illustrates the limiting factors as determined by CDFG and various sediment sites identified by CGS as potential restoration targets. Figure 5.4-19b is the map explanation. General recommendations are made for each limiting factor and type of sediment site. The map is a reduced image of Plate 3, *Potential Restoration Sites and Habitat Limiting Factors for the Gualala River Watershed*. (See Plate 3 to view details at a higher scale [1:48,000].

**Restoration Recommendations**

The proposed restoration recommendations were based upon the habitat inventory surveys, limiting factors analysis, landowner and local expertise, and the biologist's professional judgment.

Restoration recommendations for the overall subbasin could not be calculated due to limited data. Only one stream equal to 37 percent of all the blue line streams was habitat inventoried. To enhance pool development, increase pool depth, and provide improved pool shelter cover, the addition of instream structures is the highest restoration priority. To reduce sediment and improve spawning substrate on the lower reaches, road repair or removal is the second restoration priority. The third priority is to increase the riparian canopy to provide more shade over the stream, reduce water temperatures, and provided potential large woody debris. Bank stabilization, livestock/feral pig exclusion and barrier removal were not identified as restoration needs (Table 5.4-12).

**Table 5.4-12**  
Priorities for Restoration in the Buckeye Subbasin Based Upon 2001 Surveys  
*Rank 1 indicates highest priority.*

Stream Name	Bank Stabilization	Roads Repair or Removal	Riparian Canopy Development	Instream Structure Enhancement	Livestock or Feral Pig Exclusion	Barrier Removal
Buckeye Subbasin	n/a	n/a	n/a	n/a	n/a	n/a
Buckeye Creek		2	3	1		

**Potential Refugia**

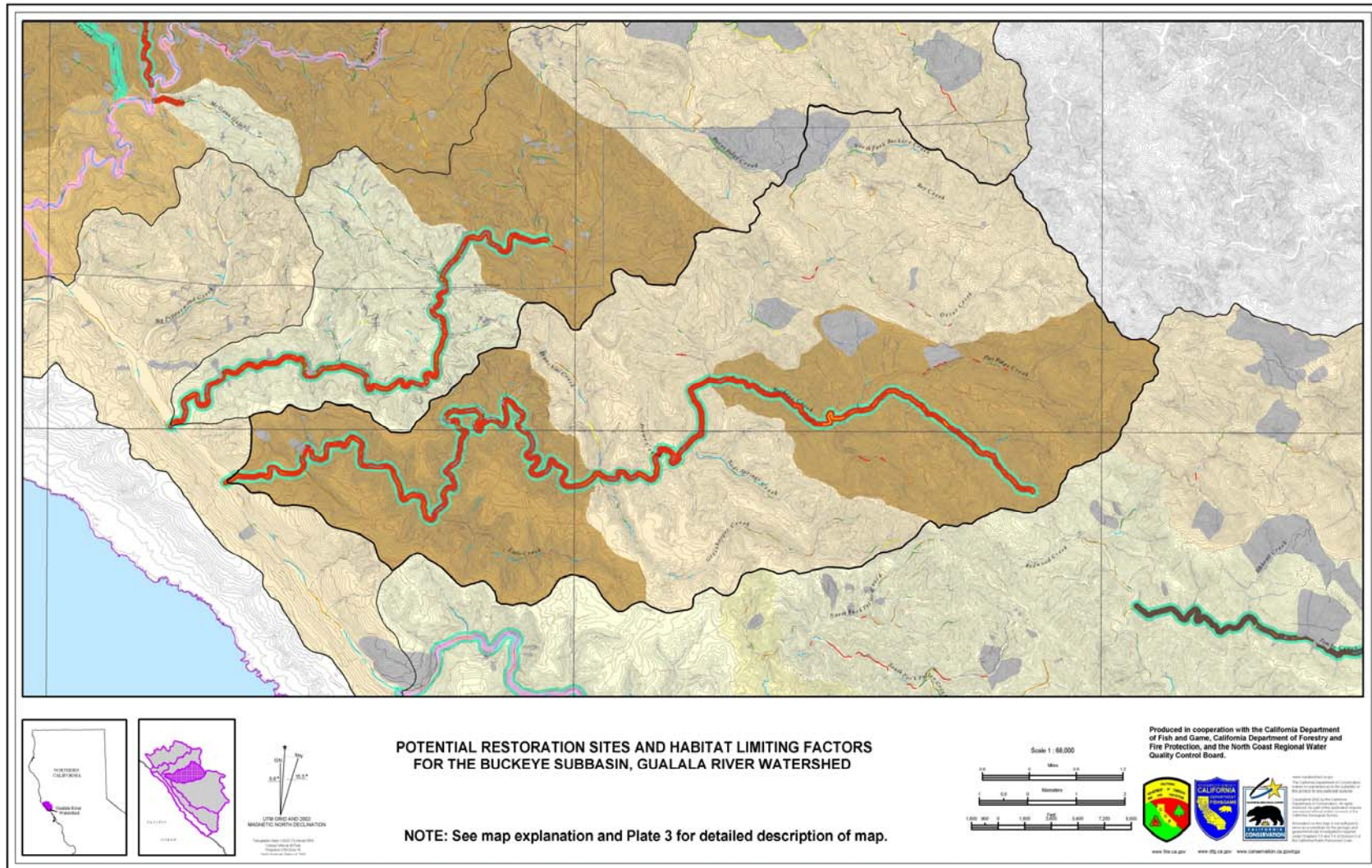
No potential refugia were identified.

**5.4.9 FISH HISTORY AND STATUS**

Salmonid population data are limited in the Buckeye Subbasin and were not collected or available prior to the 1960s.

- **1960s**-Steelhead trout were observed on the mainstem and North Fork of Buckeye creeks. Coho salmon were observed in Franchini Creek.
- **1970s and 1980s**-Data were not available.
- **1990s**-During snorkel surveys, Gualala Redwoods, Inc. observed one year and older steelhead trout on the mainstem of Buckeye Creek in 1997 and 1998.
- **2000s**-Modified Ten Pool Protocol on Franchini Creek showed young-of-the-year and one-year-old steelhead trout, but coho salmon were not observed on Franchini Creek during electrofishing surveys in 2001. During snorkel surveys, Gualala Redwoods, Inc. (GRI) observed one year and older steelhead trout on the mainstem of Buckeye Creek in 2000 and 2001.





**Figure 5.4-19a**  
 Potential Restoration Sites and Habitat Limiting Factors for the Buckeye Subbasin, Gualala River Watershed

5.4 Buckeye Subbasin

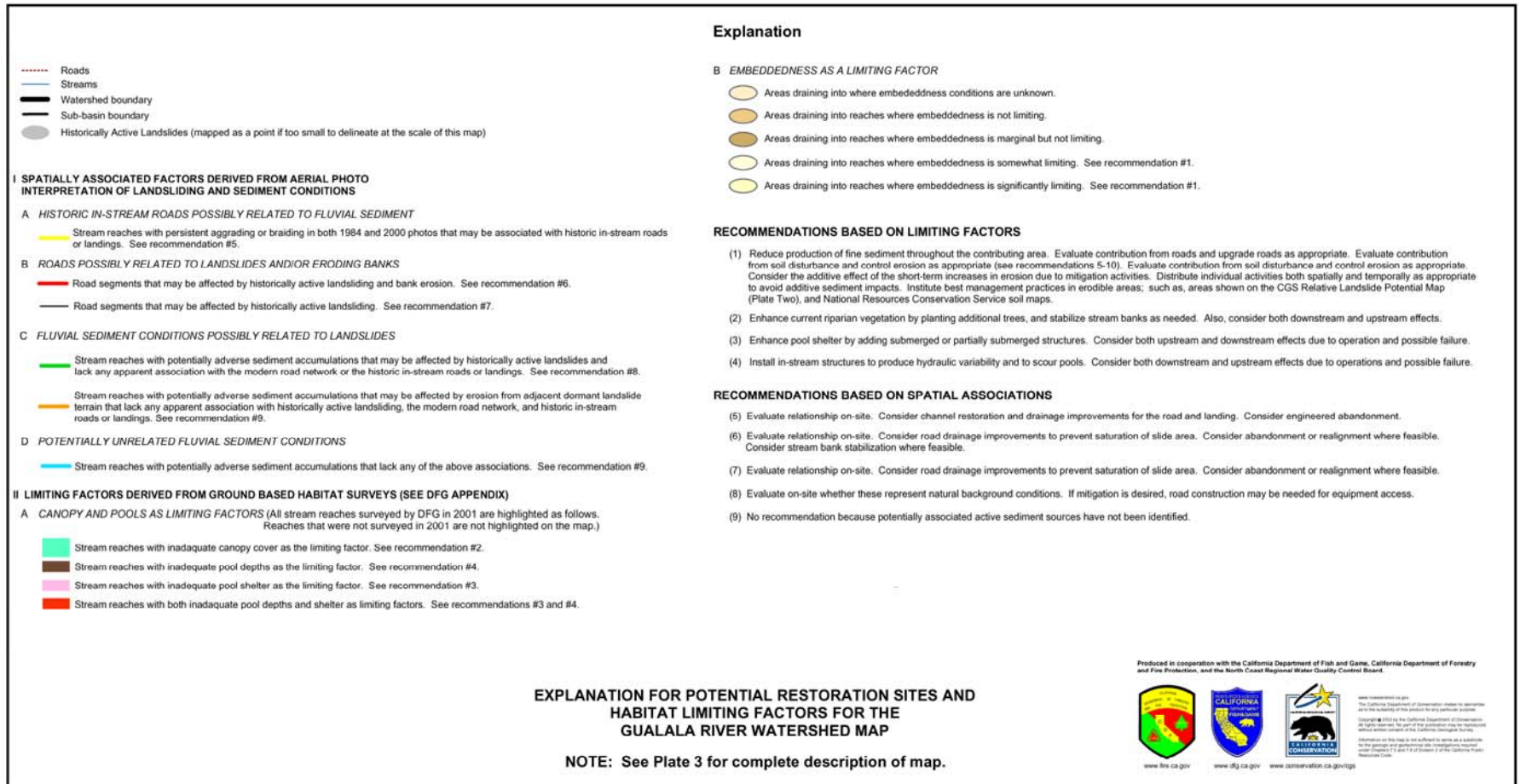


Figure 5.4-19b  
Explanation for Potential Restoration Sites and Habitat Limiting Factors for the Gualala River Watershed Map

### 5.4.10 BUCKEYE SUBBASIN PUBLIC ISSUES, SYNTHESIS, AND RECOMMENDATIONS

After conducting public scoping meetings and workshops, the NCWAP team compiled a preliminary list of general issues based upon public input and initial analyses of the available data. Some issues were suggested by watershed analysis experts, and some by Gualala River Watershed residents and constituents. The following general concerns were expressed as potential factors affecting the Buckeye Subbasin and its fisheries, but do not necessarily reflect the findings of the assessment. Some have been disproved by the assessment findings.

- No current salmonid or other fish population data exist. Very limited historical data exist.
- There is concern over abandoned roads, new road construction, and road maintenance issues related to landsliding and sediment input. Without appropriate maintenance or storm proofing, existing roads, both active and abandoned, may continue to supply sediment.
- Best management practices required by current forest practice rules are reducing forestry impacts to insignificance.
- Summertime water temperatures are a concern for salmonid suitability.
- The paucity of large woody debris in streams, especially in the mainstem, is a concern. Low canopy coverage is effecting water temperatures and large wood recruitment.
- Subdivision construction is not an issue at this time. However, Pioneer Ltd owns a larger portion of the upper subbasin and is in escrow.
- Grazing is a possible issue in the upper subbasin.
- Summertime water temperatures are a concern for salmonid suitability.

#### Working Hypotheses

The primary purpose of these hypotheses is to elucidate in a succinct format the judgments of the Team regarding watershed conditions relative to anadromous salmonids. As such, they are responsive to the assessment questions (pages 1-1 and 1-2). The findings supporting the hypothesis are presented, along with recommendations for watershed improvements as well as recommendations to further investigate the hypotheses. As such, they are not intended to be the final word, but are the best judgment based on the information at hand.

Recommendations for watershed improvements and further study are presented at the end of the section, as single recommendations apply in many cases to more than one hypothesis.

The working hypotheses are:

1. The mainstem of Buckeye Creek provides generally unsuitable habitat for salmonids.
2. Depleted overstory shade canopy cover along the mainstem of Buckeye Creek and tributaries from past harvests continues to contribute to elevated water temperatures that are unsuitable for salmonids.
3. A lack of in stream large woody debris contributes to a simplified habitat structure (e.g., lack of large, deep pools).

4. Instream and near stream conditions are improving.

### **Working Hypothesis 1**

*Stream conditions in the Buckeye Subbasin provide unsuitable habitat for salmonids.*

#### Supporting Findings

- Coho salmon were last observed from a bank observation taken during a stream survey on the mainstem of Buckeye in 1964 and in Franchini Creek in 1970.
- Temperatures on the Buckeye Creek mainstem and 3 of the 4 sampled tributaries ranged from fully unsuitable to undetermined (between suitable and unsuitable) (Table 5.4-3), with 7 of 10 seasonal maximum temperatures above the lethal temperature for salmonids.
- CDFG habitat inventory target values for canopy cover, pool frequency/depth and pool shelter/cover were not met on Buckeye Creek, the only stream surveyed in the Buckeye Subbasin (Table 5.4-7).
- Canopy cover, pool shelter and pool quality EMDS scores were somewhat unsuitable on Buckeye Creek. Embeddedness was somewhat unsuitable on the lower reach. Pool depth was fully unsuitable on this second order stream. The Maximum Weekly Average Temperatures at four sites sampled in 2001 on Buckeye Creek were in the somewhat unsuitable range (Table 5.4-10).
- The Gualala River Watershed Council’s Cooperative Monitoring Program identified a lack of large woody debris (LWD) at two sample sites on Buckeye Creek (Table 5.4-8).
- Twenty-seven miles of historic logging and ranchland roads built in or along the streambed eliminated pool structure and complexity throughout the major tributary streams of the Buckeye Subbasin (Figure 5.4-6). Early 1960s air photos showed a high density of road debris slides accessing streams in the Little Creek, Grasshopper, and Flat Ridge Creek PWSs (Appendix 2).
- Mid-20th-century roads and landings built in or near the main channel may still be contributing excess sediment (this may be true where channel braiding and/or aggradation are persistent) along the mainstem and Flat Ridge, an unnamed tributary below Flat Ridge, Franchini, North Fork Buckeye, and lower Little creeks. The residual effects of channel aggradation from streamside road failures built in the 1950s and 1960s are noted in timber harvest plan records particularly in the Little Creek, Grasshopper, and Flat Ridge Creek Planning Watersheds (Section 5.4.4).
- The length of channels features indicative of “excess” stream sediment in the mainstem Buckeye Creek in the Grasshopper Creek PWS increased from about 25 to 50 percent of channel length from 1984 to 2000. The length of channels features indicative of “excess” stream sediment in Roy Creek increased from 10 percent to almost 25 percent (Appendix 2).

#### Contrary Findings

- Steelhead trout one year and older were observed on the mainstem of Buckeye and on Franchini creeks (Section 5.4.9).
- Water temperature MWATs on the lower tributary were fully suitable (Table 5.4-3).

- CDFG habitat inventory embeddedness target values were reached on Buckeye Creek, indicating good spawning substrate conditions.
- The embeddedness EMDS score was somewhat suitable on the upper reach.
- Little Creek PWS improved between 1984 and 1999/2000 from 80 percent of main channel disturbance to 50 to 75 percent disturbance. Little Creek itself improved from 80 percent disturbance and 14 delivering landslides to 25 percent channel disturbance and 6 delivering landslides.
- In the Grasshopper Creek PWS, channel disturbance in Franchini Creek decreased from 90 to approximately 50 percent from 1984 to 1999/2000, and in lower reach of Grasshopper Creek disturbance decreased from 50-75 percent to 25 percent. Channel disturbance in the mainstem Buckeye Creek below Flat Ridge Creek decreased from up to 75 percent in 1984 to 20 percent in 1999/2000.
- Bank-to-bank exposure has decreased from 58 percent of the blue line streams in 1968 to approximately 22 percent in 2000.

#### Limitations

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.
- Water temperatures were available for the period of record (1994-2001) only in the lower 13.5 miles of the mainstem and in Flat Ridge, Franchini, Grasshopper, and Soda Springs creeks, and a small tributary near the mouth.

#### Conclusion

- The hypothesis is supported.

#### **Working Hypothesis 2**

*Depleted overstory shade canopy cover along the mainstem of Buckeye Creek and tributaries from past harvests continues to contribute to elevated water temperatures that are unsuitable for salmonids.*

#### Supporting Findings

- Temperatures on the Buckeye Creek mainstem and 3 of the 4 sampled tributaries ranged from fully unsuitable to undetermined (between suitable and unsuitable), (Table 5.4-3) with 7 of 10 seasonal maximum temperatures above the lethal temperature for salmonids. Temperatures in open areas, such as those in the upper, eastern subbasin, were fully unsuitable (Figures 5.4-12 and 5.4-13).
- The Maximum Weekly Average Temperatures at four sites sampled in 2001 on Buckeye Creek were somewhat unsuitable.
- The CDFG habitat inventory canopy cover target value was not met on Buckeye Creek, the only tributary surveyed in the Buckeye Subbasin (Table 5.4-7).
- The EMDS scores for canopy cover were somewhat unsuitable on Buckeye Creek (Table 5.4-10).
- Post World War II construction of roads, landings, and skid trails in riparian zones by crawler tractors eliminated overstory shade canopy cover throughout long sections of Buckeye Creek

**5.4 Buckeye Subbasin**

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and tributaries. There was near entire canopy elimination in the Buckeye Subbasin, with operations especially pronounced during the late 1950s to 1964 (Figures 5.4-6 and 5.4-9).

- Twenty-five percent of the blue line streams still had bank-to-bank exposure (open canopy) in 1999 photos (Figure 5.4-9) compared with 2 percent in 1942 pre-harvest photos.
- Contrary Findings
- Bank-to-bank canopy cover has improved on upper Buckeye, Osser, Little and Flat Ridge creeks (Figure 5.4-9), and has decreased overall in the subbasin from 60 percent exposure in 1968 photos.

Limitations

- Water temperatures were available for the period of record (1994-2001) only in the lower 13.5 miles of the mainstem and in Flat Ridge, Franchini, Grasshopper, and Soda Springs creeks, and a small tributary near the mouth.
- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

Conclusion

- The hypothesis is supported.

**Working Hypothesis 3**

*A lack of in stream large woody debris contributes to a simplified habitat structure (e.g., lack of large, deep pools).*

Supporting Findings

- CDFG habitat inventory targets for pool frequency/depth and pool shelter/cover target value were not met on Buckeye Creek, the only stream surveyed in the Subbasin (Table 5.4-7).
- The EMDS scores for pool shelter and pool quality were somewhat unsuitable on Buckeye Creek. Pool depth was fully unsuitable on this second order stream.
- The Gualala River Watershed Council's Cooperative Monitoring Program identified a lack of large woody debris (LWD) at two sample sites on Buckeye Creek (Table 5.4-8).
- Historic and recent timber harvest has reduced the available recruitment supply of large woody debris (see findings in Hypothesis 2, above).
- Dense buffers of conifers large enough to function, upon recruitment, as LWD in channel formation processes have not been fully reestablished (Section 5.4.4).

Contrary Findings

- None noted.

Limitations

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

Conclusion

- The hypothesis is supported.

### **Working Hypothesis 4**

*Instream and near stream conditions are improving.*

#### Supporting Findings

- Little Creek improved between 1984 and 1999/2000 from 80 percent of main channel disturbance and 14 delivering landslides to 25 percent channel disturbance and 6 delivering landslides.
- In the Grasshopper Creek PWS, channel disturbance in Franchini Creek decreased from 90 to approximately 50 percent from 1984 to 1999/2000, and lower reach Grasshopper Creek disturbance decreased from 50-75 percent to 25 percent.
- Channel disturbance in the mainstem Buckeye Creek below Flat Ridge Creek decreased from up to 75 percent in 1984 to 20 percent in 1999/2000.
- Bank-to-bank canopy cover has improved on upper Buckeye, Osser, Little and Flat Ridge creeks (Figure 5.4-9), and has decreased overall in the subbasin from 60 percent exposure in 1968 to 25 percent exposure in 1999/2000 photos.

#### Contrary Findings

- Above the Flat Ridge Creek junction, similar channel disturbance levels were observed in 1999/2000 compared to 1984.
- Twenty-five percent of the blue line streams still had bank-to-bank exposure (open canopy) in 1999 photos (Figure 5.4-9) compared with 2 percent in 1942 pre-harvest photos.

#### Limitations

- Habitat inventory surveys were conducted on 39 percent of Buckeye Subbasin.

#### Conclusion

- The hypothesis is supported.
- Overall levels of channel disturbance have improved since 1984.
- Canopy coverage as measured by bank-to-bank exposure has improved since 1968, but not to 1942 levels. More information on the improvement with regard to riparian composition over the period of photo records is needed to discuss improvement in the riparian zone beyond canopy coverage.

### **Buckeye Subbasin Recommendations**

Target restoration and land use activities to the three highest priorities for restoration in the Buckeye Subbasin: large wood placement, road repair or removal, and riparian canopy development.

1. Enhance instream structure, including large woody debris:
  - a. Land managers in this subbasin should be encouraged to add more large organic debris and shelter structures in order to improve sediment metering, channel structure, channel function, habitat complexity, and habitat diversity for salmonids. Pool shelter is the most limiting factor in the Buckeye Creek, the stream surveyed in

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the subbasin. Instream structure enhancement is the first of the top three recommendations.

- b. Enhance large woody debris through short and long-term efforts through (1) ongoing large wood placement efforts, and (2) enhancement of the natural large woody debris recruitment process by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques.
  - c. Support ongoing large wood placement efforts.
2. Address road issues.
    - a. Landowners should develop erosion control plans for decommissioning old roads, maintaining existing roads, and constructing new roads. Decommission and revegetate streamside roads where feasible, focusing on those associated with unsuitable fish habitat conditions such as Little, Franchini, Grasshopper, and Osser creeks.
    - b. Size culverts in steep terrain to accommodate flashy, debris-laden flows and maintain trash racks to prevent culvert plugging. Critical dips should be required to minimize the potential for culvert failure.
    - c. Evaluate the possibility of spreading timber-harvesting operations over time and space to avoid concentrated road use by heavy equipment and resultant mobilization of road surface fines into watercourses.
    - d. Incorporate mitigation elements into Timber Harvest Plans and pursue cost share grants for decommissioning legacy streamside roads and upgrading road drainage facilities.
    - e. Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 53 percent of the subbasin.
  3. Address riparian canopy issues.
    - a. Ensure that adequate streamside protection zones are used on Buckeye Creek to reduce solar radiation and moderate air temperatures, particularly on mainstem.
    - b. Maintain and enhance riparian zones to achieve target canopy density and diversity, including large conifers for LWD recruitment. Ensure that adequate streamside protection zones are used on Buckeye Creek to reduce solar radiation and moderate air temperatures, particularly on mainstem and upper tributaries. Retain, plant, and protect trees to achieve denser riparian canopy where current canopy is inadequate, particularly on the mainstem and Franchini, Grasshopper, and Soda Springs creeks.
    - c. Collect data to evaluate and possibly model relationship between water temperature and canopy levels where canopy is still recovering to establish reasonable recovery targets.
  4. Monitor instream and hillslope conditions.
    - a. Conduct both instream and hillslope monitoring to determine whether current timber harvest practices are allowing for recovery and protection of the salmonid



habitat in the subbasin. Use GRWC protocols for instream monitoring activities. Improve baseline information on habitat conditions by conducting inventory surveys in Buckeye Creek major tributaries.

- b. Expand continuous temperature monitoring efforts into the upper subbasin and tributaries. Consider looking at canopy composition and monitoring air temperatures to examine canopy, temperature, and other microclimate effects on water temperatures.
- c. Encourage more habitat inventory surveys and biological surveys of tributaries as only 37 percent of the mainstem Buckeye has been completed.
- d. Survey for salmonids, using consistent methods to estimate population numbers, for comparison with recovery targets to be set by NMFS.