# 5.5 Wheatfield Fork Subbasin

## 5.5.1 INTRODUCTION

The Wheatfield Fork Subbasin (Wheatfield Fork Hydrologic Subarea, Calwater 113.84 hydrologic subarea) has 246 miles of "blue line" stream in 111.6 square miles in the middle and eastern portion of the Gualala River Watershed. It consists of three Calwater 2.2a SPWSs: Walters Ridge (113.8401, 38.3 square miles), Hedgepeth Lake (113.8402, 28. 5 square miles), and Lower Wheatfield Fork (113.8403, 44.8 square miles). Most of the subbasin is privately owned (166 acres of federal land), with land uses in timber production, grazing, vineyard, and some rural subdivisions.

A stream flow gage was installed in 2001 near the confluence with the South Fork Gualala (Station GWF, Wheatfield Fork near Annapolis). It is maintained by California Department of Water Resources (DWR) and has been in operation since installation. Stream flow and water temperature data are available by accessing the California Data Exchange website at http://www.cdec.water.ca.gov.

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 5.5-2.

## 5.5.2 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 5.5-3). Figure 5.5-4 shows the relative landslide potential map for the Wheatfield Fork 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. Table 5.5-3 lists the lengths of sediment storage mapped and relative change between 1984 to 1999/2000 for the Wheatfield Fork Subbasin.

In the lower reaches of the subbasin, streams are mainly bedrock controlled within moderately steep valleys. The narrow floodplain is limited to the lower 2 miles.

## 5.5.3 VEGETATION

The 1942 photos show dense mature Douglas fir and redwood timber bordering both sides of the lower reaches of the Wheatfield Fork mainstem. However, in 1942, the river frequently shifted back and forth to the opposite stream bank throughout an aggraded channel valley. Despite the large standing timber flanking the streambank, the channel is wide enough to still create longer sections of bank-to-bank canopy exposure from the South Fork upstream to the confluence with Tombs Creek allowing for long term warming (Figure 5.5-5). The main tributary watercourses were largely covered. There was dense coniferous canopy cover over Fuller, Tobacco, and Haupt creeks. There was partial to entire canopy cover over the more inland locations including North Fork Wheatfield, Tombs and House creeks. These were consistent, with partial to entire oak-woodland cover along riparian channels in the dense mélange soil type.

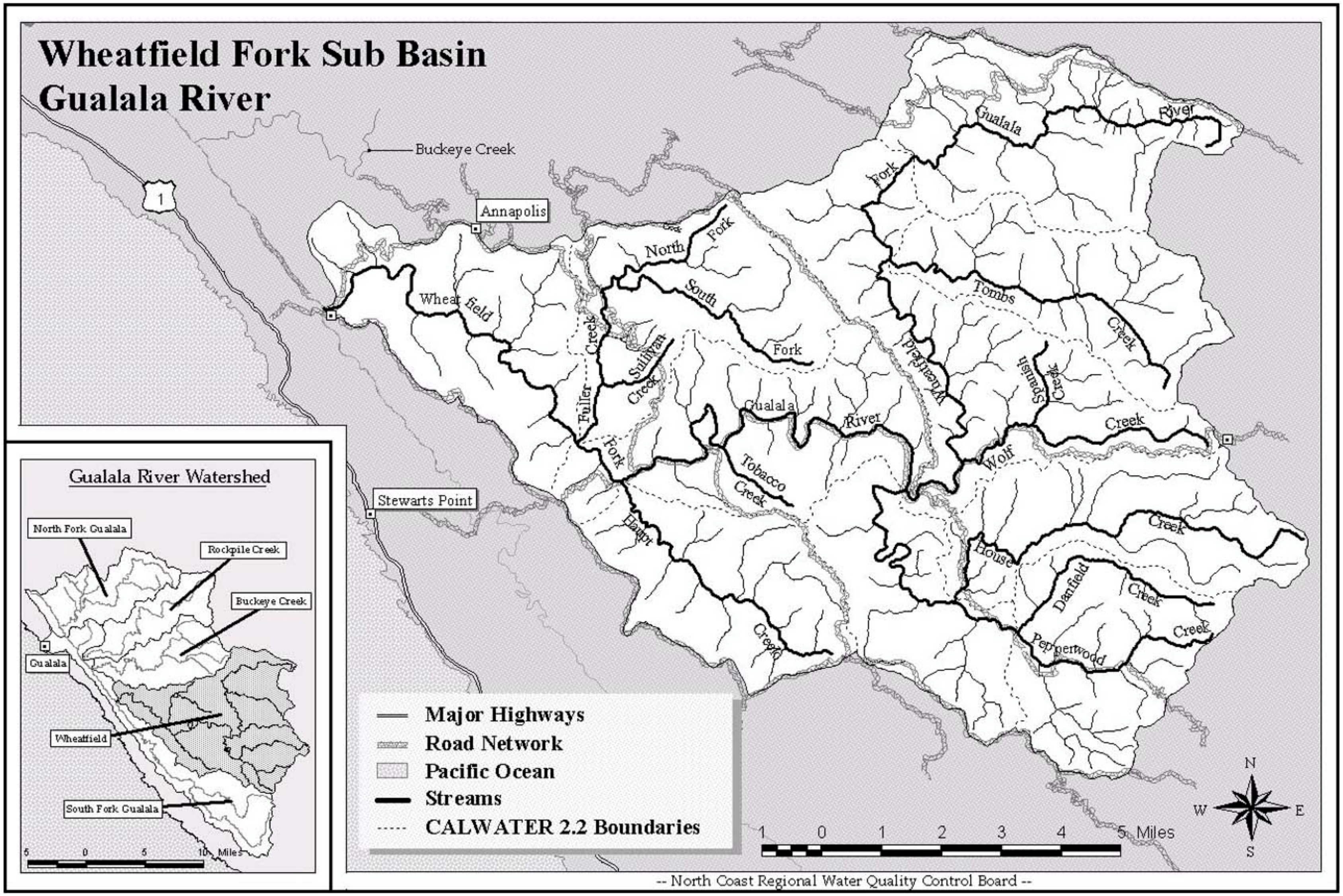



**Figure 5.5-1**
Wheatfield Fork Subbasin

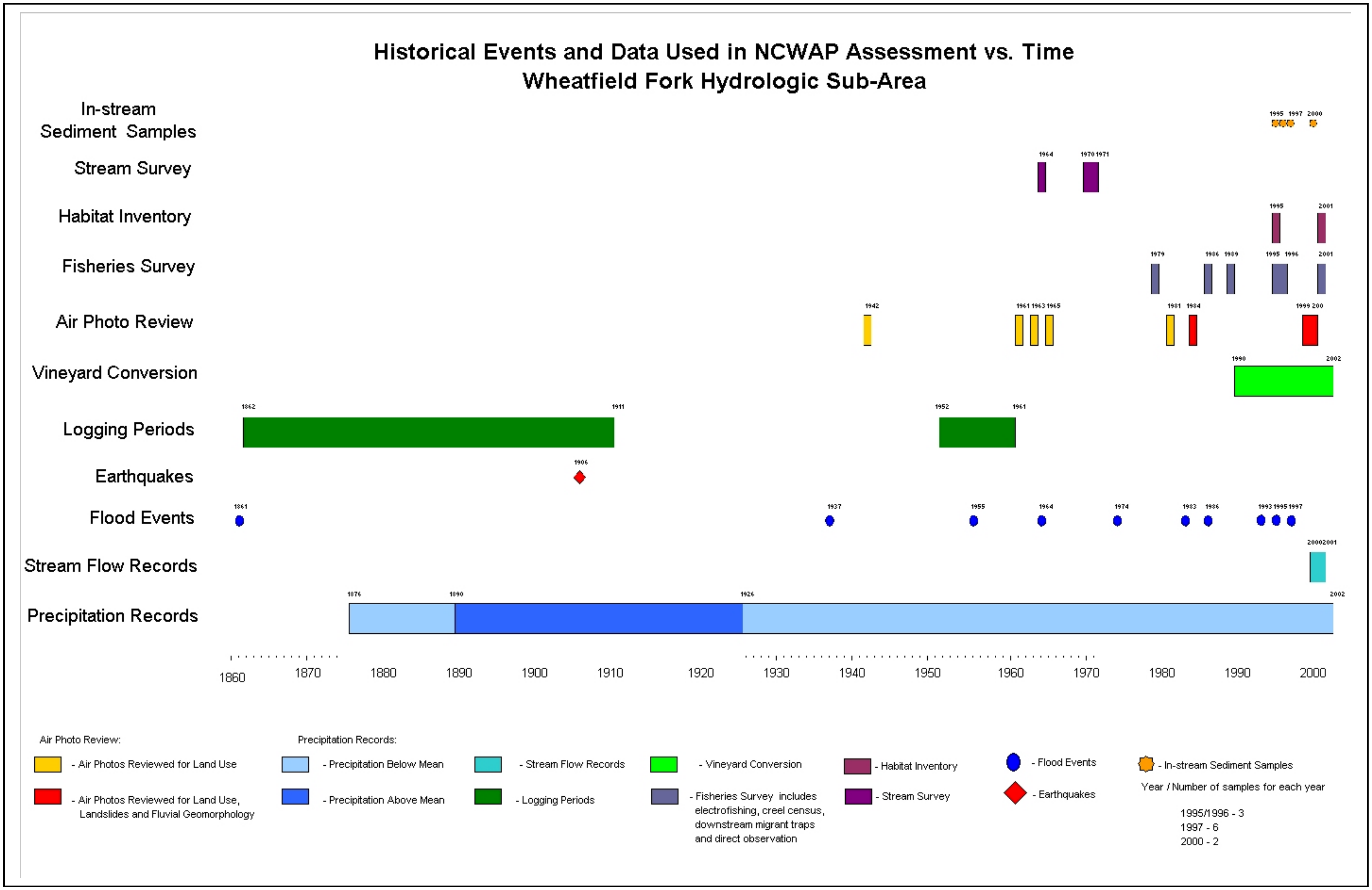



**Figure 5.5-2**
Historic Events and Data Used in the NCWAP Assessment for the Wheatfield Fork Subbasin

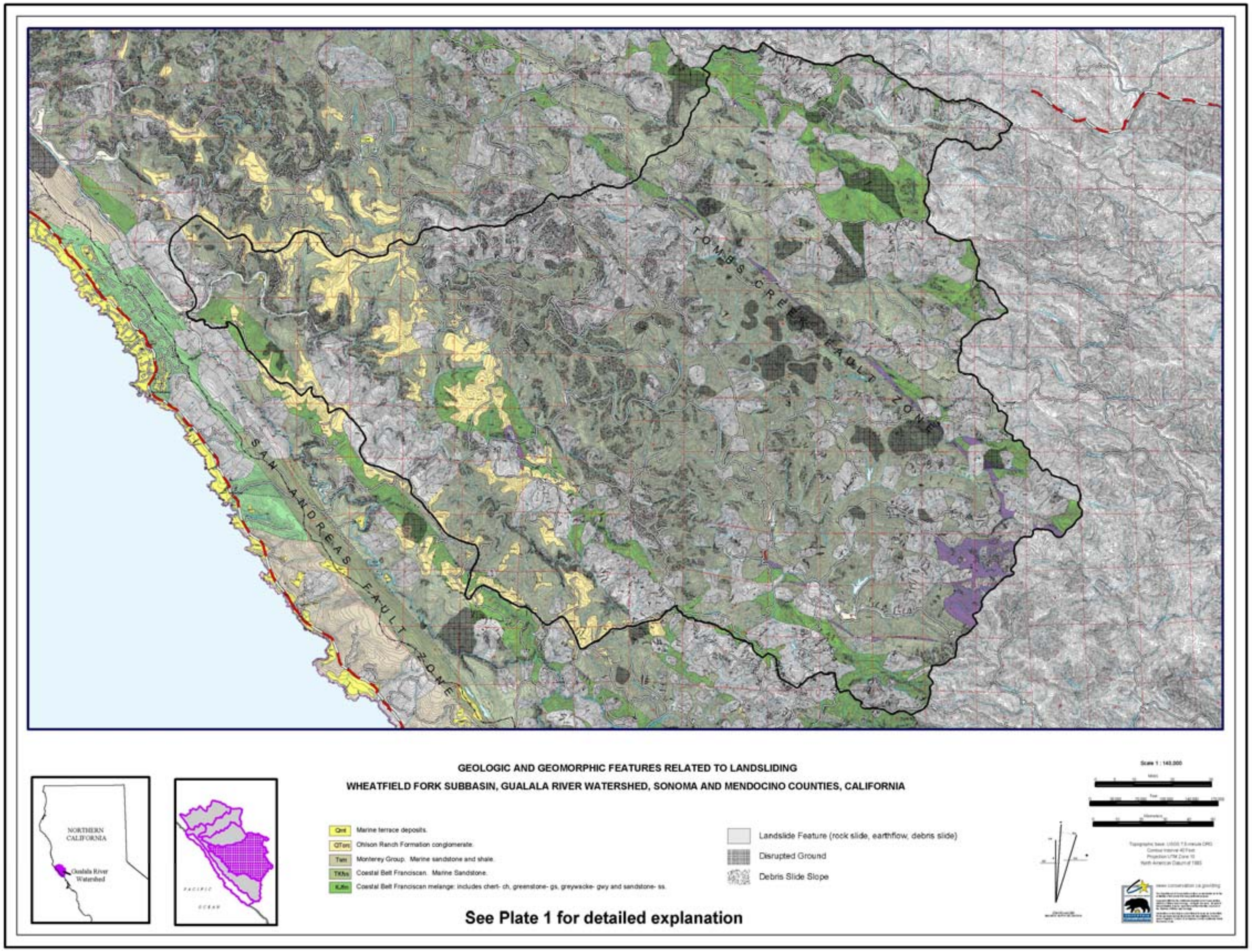



**Figure 5.5-3**
Geologic and Geomorphic Features Related to Landsliding - Wheatfield Fork Subbasin

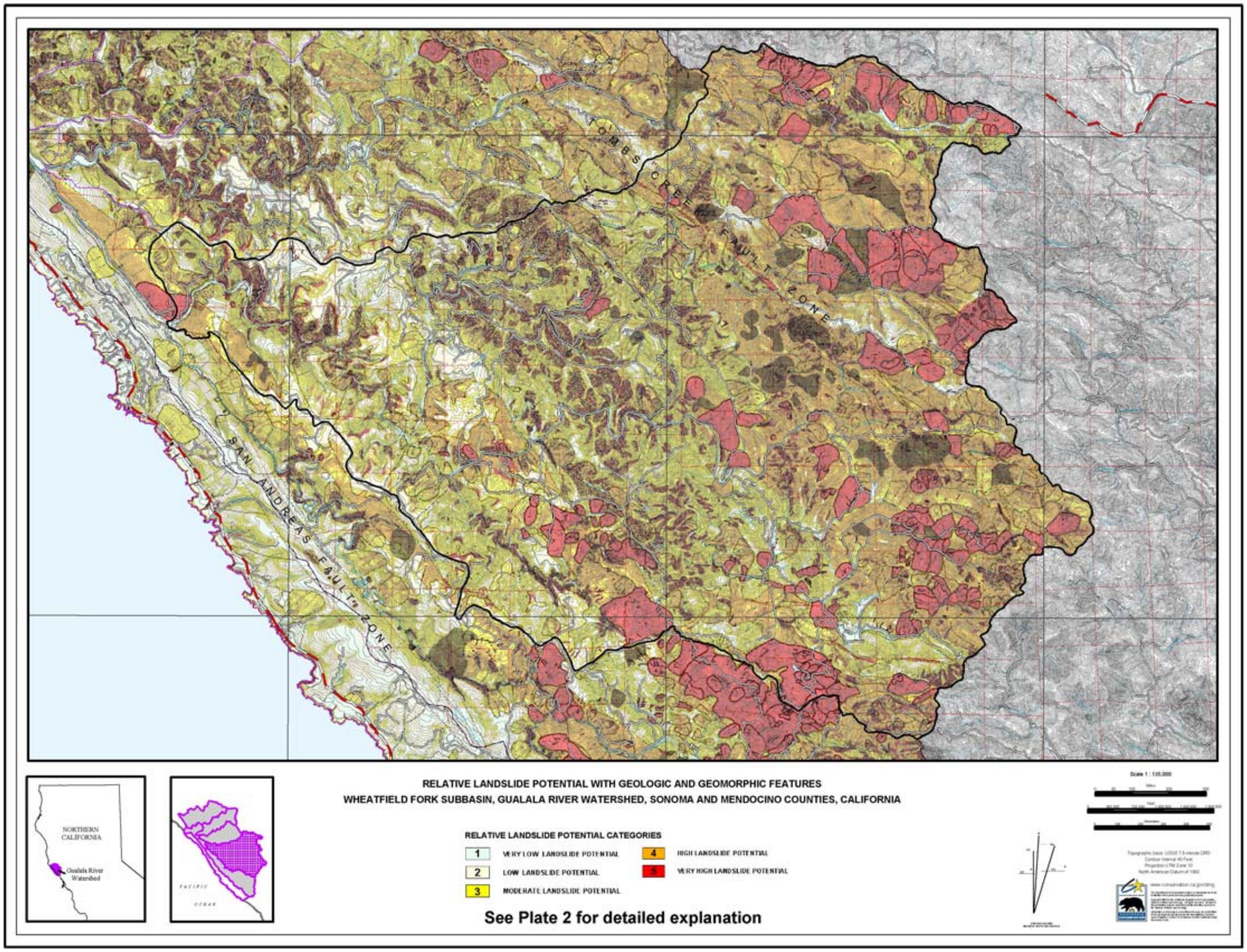



**Figure 5.5-4**
Relative Landslide Potential with Geologic and Geomorphic Features - Wheatfield Fork Subbasin

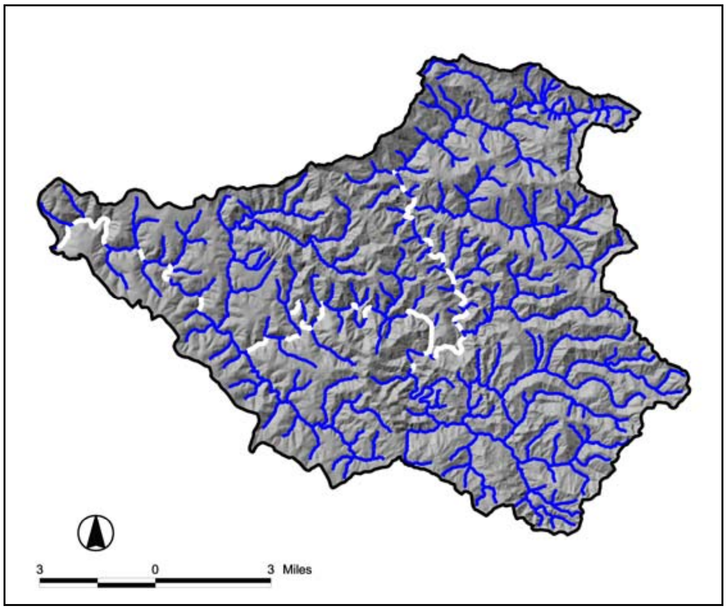



**Figure 5.5-5**
1942 Bank-to-Bank Exposure (White), Dark Blue Shows Partial to Entire Canopy Cover

### 5.5.4 LAND USE

Timberland use and ranching have been the dominant land use practices in the Wheatfield Fork Subbasin. Mid-20th-century to pre-1973 tractor method harvesting was the dominant land use era. Original turn-of-the-century steam donkey operations were limited to the lowest reaches of the subbasin at the confluence with the South Fork. Between 1952 and 1960, 15,850 acres were harvested (21 percent of the subbasin). After 1960, harvesting tapered off, with 4,650 acres harvested by 1964, and 2,250 acres by 1973 (Table 5.5-1).

The highest timber site ground occupies the lower reaches within the coastal fog influence. After World War II, these areas were logged first in the early 1950s, south of Knob Hill and flanked by Burnt Knoll Ridge to the east. During the middle to later 1950s, proximity to coastal transportation routes confined logging operations to the lower reaches of Fuller, Tombs, and House creeks. Tractor logging operations then spread east and north when road networks were built inland. The late 1950s, and early 1960s were the most active harvests in the North Fork of the Wheatfield, Tombs, and House creeks (Figure 5.5-7). Timber clearance and road building, followed by prolonged rangeland use, were the dominant practices in this portion of the subbasin, most evident in the Pepperwood Creek tributary to House Creek (Figure 5.5-6).

Figure 5.5-8 shows Tobacco Creek (right) incised through the instream landing (upper left) creating a canyon on the discharge side (red arrow). There were large storm events in 1962 and 1964 prior to this 1965 photo.

Inner riparian areas were the central locations for road building, tractor yarding, and timber removal. In the steep, deeply incised Sullivan and Fuller Creek canyons, the entire road network was built along the creek at the base of steep ravines. Streamside roads and landings are particularly concentrated along Tobacco Creek, lower House Creek, central North Fork Wheatfield, and central to higher Tombs creeks. As a result, 1965 aerial photo analysis found that high runoff from the 1964 storms incised instream landings and undercut streamside roads, collapsing sections into creeks. The roads concentrated runoff triggering debris slides into watercourses. Storm damage from similar peak flow events in 1962 and 1966 was not evaluated due to a lack of air photo coverage. Mid-20th-century logging operations removed riparian canopy cover leaving bank-to-bank watercourse exposure throughout the larger tributary watercourses by 1968 (Figure 5.5-9). Stream canopy elimination was most pronounced in Fuller, Haupt, Tobacco, Elk, House, and Pepperwood creeks.

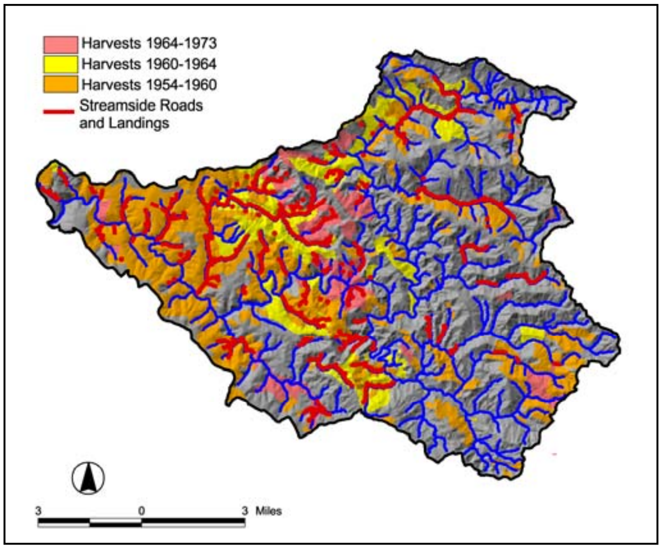



**Figure 5.5-6**
Mid-20th-Century Timber Harvest Operations and Streamside Roads and Landings (Red)

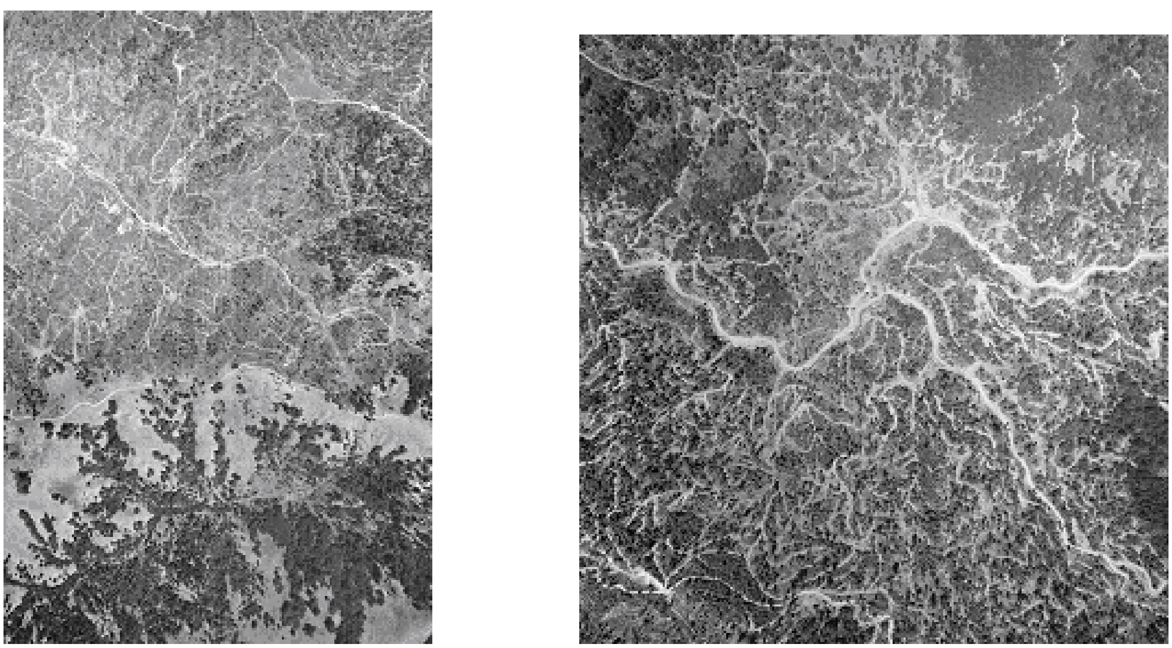
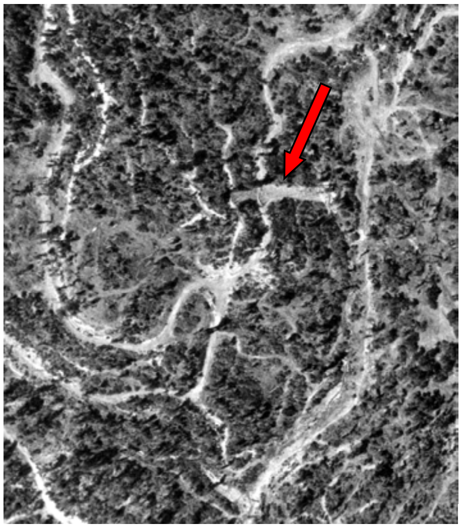


**Figure 5.5-7**
Conifer Block Removal Exposing Tobacco Creek (Left) and Streamside Roads Along the North Fork Fuller Creek (Right) 1965 Caltrans 1: 1200 Scale



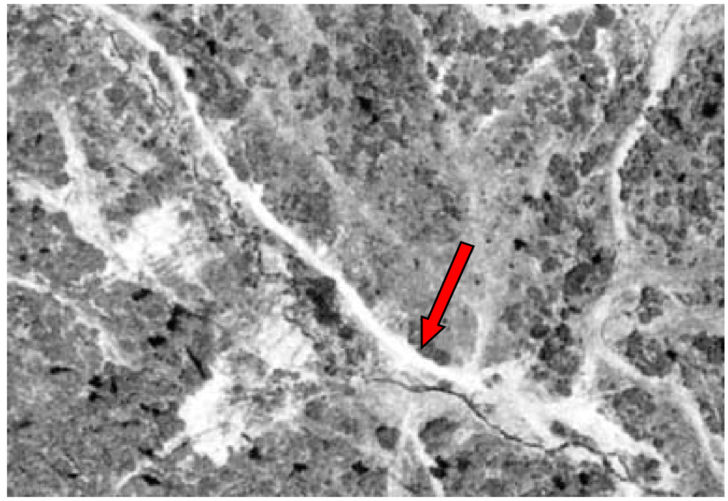


**Figure 5.5-8**
Debris Slides (Left) Slice Through Several Road Contours, Discharging onto a Tributary Watercourse to Wheatfield Fork, at Annapolis Fire Station, 1965 (Lower Left)
*Tobacco Creek (right) incised the instream landings (red arrow) creating a canyon on the discharge side.*

Sullivan Creek follows a fault that separates the Coastal and highly erodible Central Belts of the Franciscan Formation and crosses the poorly consolidated Ohlson Ranch Formation. As a deeply incised canyon, the haul road was built along the creek. By 1984, this debris had washed downstream. Sullivan Creek returned to a linear drainage. Much of this debris is probably still deposited and stored in the active channel deposits of gravel bars and/or historic terrace deposits along the aggraded substrate of lower Wheatfield Fork, one quarter mile downstream.

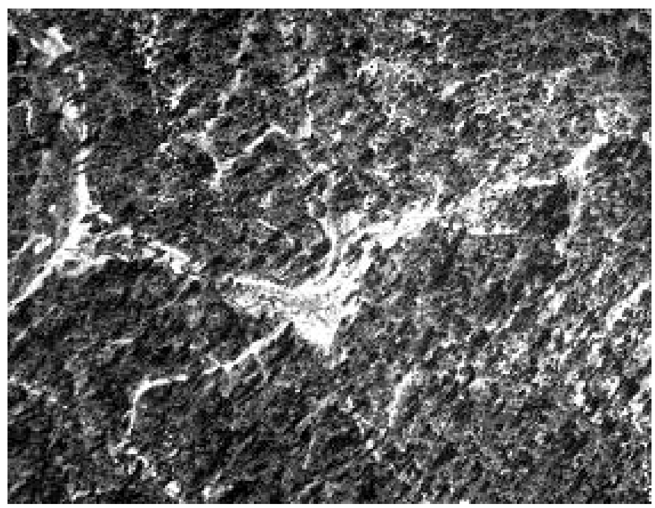
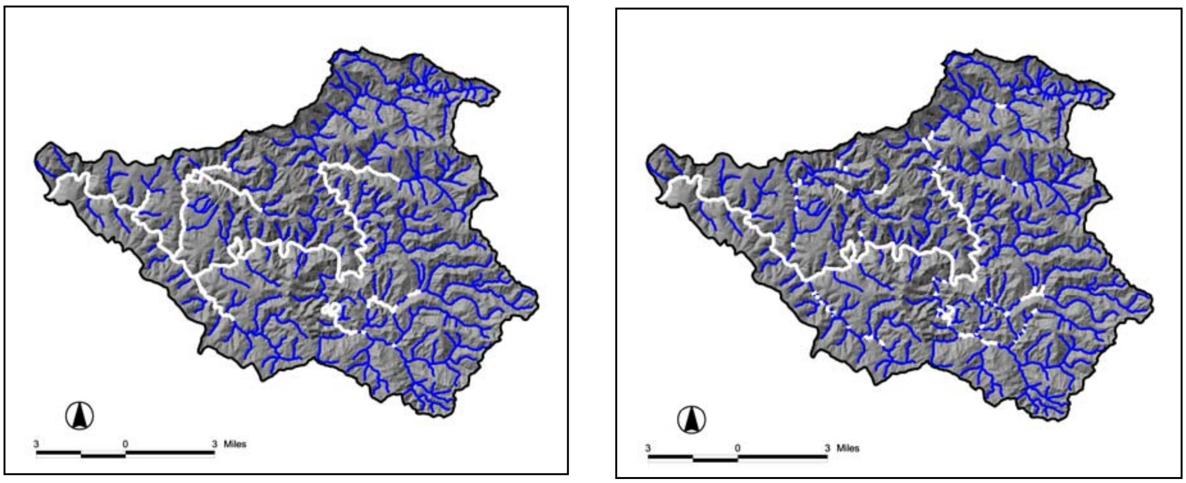


**Figure 5.5-9**
Sullivan Creek Meanders Around Multiple Debris Slides Over Buried Stream Pools, June 1965

**Table 5.5-1**
Wheatfield Fork Subbasin Timber Harvest Operations 1932 – 1973 - Total Area = 74,444 acres.

| Time Period | Acres Under Operation | Type of Operation | Cumulative Percent of Subbasin Under Tractor Operations Since 1942 | Mean Annual Increment (acres/ percent by year) |
|---|---|---|---|---|
| 1932 – 1942 | 750 | Stand Replacement | 1.0 | 75 (.1) |
| 1943 – 1952 | 1,350 | Stand Replacement | 2.9 | 135 (.2) |
| 1953 – 1960 | 15,850 | Stand Replacement | 23.0 | 1,981 (2.5) |
| 1961 – 1964 | 4,650 | Stand Replacement | 29.4 | 1,162 (1.4) |
| 1965 – 1973 | 2,250 | Stand Replacement | 32.4 | 225 (.3) |

Approximately 10 percent of the blue line streams in 1942were exposed bank-to-bank (Figure 5.3-5), that was limited to the alluvial openings in the lower subbasin reaches throughout predominantly old growth wooded conditions. By the end of the tractor-harvesting era (1968), approximately 45 percent of the blue line streams were exposed bank-to-bank. Bank-to-bank overstory exposure for 2000 shows improvement compared to 1968, reflecting riparian in-growth since the late 1960s. By 2000, canopy cover improved with approximately 30 percent of blue line streams exposed bank-to-bank (Figure 5.5-10). Streamside canopy in these areas now consists of pole- to mid-sized conifers and mixed conifer/hardwood stands. Regeneration has been delayed by grazing in some of the eastern subbasin reaches.




**1968** **1999**

**Figure 5.5-10**
1968 Bank-to-Bank Stream Exposure. 1999 Bank-to-Bank Shade Canopy Exposure

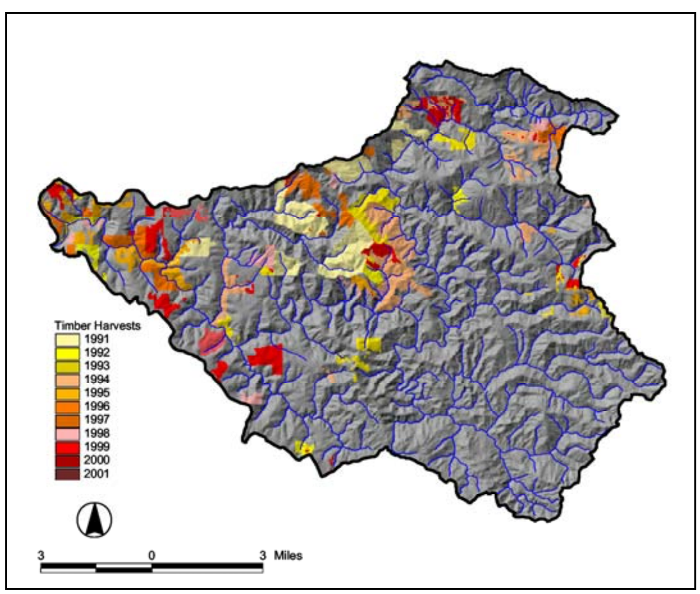
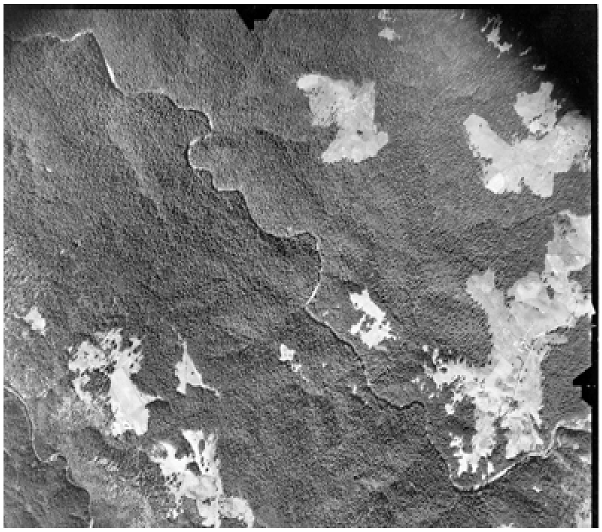
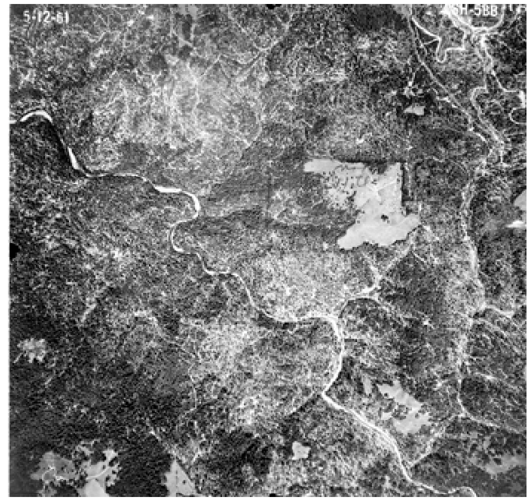



**Figure 5.5-11**
1991 to 2001 Timber Harvest Plans



**1942** lower Wheatfield Fork, Fuller Creek (right). The 1936 and 1942 photos were used to show baseline conditions of riparian cover. Large tracts of old growth redwood and Douglas-fir dominated the middle reaches of Rockpile, Buckeye, and Wheatfield basins by 1942.




**1961** Starting during the mid 1950s, early versions of the D-8 and D-10 tractors block-cleared the entire lower Wheatfield Subbasin. Tractors roamed up and down smaller creeks, and built roads and landings in or along larger streams. The lack of any erosion control measures in these areas made large parts of watershed vulnerable to large storm events. Tractors eliminated riparian canopy cover and in stream Large Woody Debris. There were still consistent coho salmon and larger steelhead counts during this time period.

**1984** Young conifer in-growth reestablished vegetative cover, although storm run-off continued to concentrate along streamside legacy roads and skid trails. Pool infill, shallow pool structure, stream simplification, and increasing embeddednes impaired anadromous fisheries habitat. CGS mapped stream channel disturbances in addition to landslide densities using the 1984 aerial photos. Stream surveys indicate fewer anadromous fisheries resources.

**1999** The area is now more fully vegetated. Streamside legacy roads and landings have increasingly stabilized. Deep road and skid trail gullies may have incised down to rock or hard clay. CGS generally found fewer stream channel disturbances compared to 1984. Road related debris slides generally diminished. The Gualala River Watershed Council has removed many of the old log chunk/ dirt fill road stream crossings in Fuller Creek (right).

The 1970s and 1980s were a period of low timber harvest activity due to depletion of the timber base in previous decades (Table 5.5-2). Ranching became a more dominant land use. Vegetational analysis in 1996 typed 6,004 acres of grazing lands (8.4 percent of the subbasin). Timber harvest operations increased in the 1990s in response to improving markets (Figure 5.5-11). Vineyard development also accelerated. Numerous vineyards are located in the east, upland portions of the subbasin. However, 1996 vegetational analysis found that vineyards consist of small patch clearances diffusely scattered throughout the central and each portions of the watershed. Vineyards typically range from 10 to 40 acres, and rarely exceed 100 acres. Total agricultural development consists of 195 acres (0.3 percent of the subbasin). In addition, California Department of Forestry and Fire Protection (CDF) timberland conversion files show a total of approximately 500 acres of timberland converted to vineyards throughout the entire Gualala River Watershed.

**Table 5.5-2**
Wheatfield Fork Subbasin Timber Harvest Operations 1974 – 2001 -Total Area = 74,444 acres

| Time Period | Acres Under Operation | Type of operation | Cumulative Percent of Subbasin Under Operation Since 1974 | Mean Annual Increment (acres/ percent by year) |
|---|---|---|---|---|
| 1974 – 1990 | 3,350 | Stand Replacement | 4.5 | 209 (.3) |
| 1991 – 2001 | 7,150 | THPs | 14.170% tractor, 30% c | 715 (.9) |

## 5.5.5 ROADS

### Historic Roads

Mid-20th-century instream/streamside road and landing networks spanned most tributary streams in the Lower Wheatfield Super Planning Watershed (SPW). This included Fuller, Tobacco, Haupt, and smaller unnamed tributaries leading to the mainstem. Streamside roads lined major portions of Tombs, Elk, and smaller tributaries in the Hedgepeth Lake SPW, and lower House, Pepperwood and Danfield creeks in the Walters Ridge SPW. A total of approximately 19 miles of road were build at near or equal elevation to the streambank transition line with sidecast covering the streambank leading to the creek. The dense network of instream/streamside roads that lined Fuller, Tobacco, Haupt, and Elk creeks showed a high correlation with stream braiding and aggradation (over 75 percent) in 1984. Roads located slightly upslope but near the creek, span longer distances (not measured with this study). After 1968, most of the streamside roads were unused and left abandoned. Some sections have been incorporated with the modern road network.

Stream channel morphology in the Wheatfield Fork Subbasin shows similar evolution through time, but most evident in the Lower Wheatfield SPW: (1) a high density of fresh sediment inputs shortly after mid-20th-century storm events characterized by debris mounds in the active channel, (2) progressive abatement of the frequency of these point sources over successive decades, and (3) apparent recovery of 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 1965 photos show extreme stream channel aggradation along major tributary streams of the Lower Wheatfield Super Planning Watershed (Figure 5.5-7). Throughout Fuller, Sullivan, Tobacco, and Haupt creeks, 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. Multiple road debris slide failures triggered by large storm events represented the largest mid-20th-century sediment sources (Figure 5.5-8). Meandering channel patterns returned to a more lineal pattern through 1984 and more so by 1999. This indicates decreasing bedload and a move toward recovery of the streambed. CGS fluvial geomorphic mapping of stream conditions documents that the channel conditions have improved from 1984 to 2000 throughout the watershed. Most of the stream segments throughout the Wheatfield Fork Subbasin show a reduction in the percentage of channel length that is affected by excess sediment storage or sediment sources.

## Modern Roads

Successive air photo overlays show a shift in new road construction to ridgelines and mid-slope benches. The "ICE" contemporary road map shows most of the current roads located distant from watercourses. The entire road network in the Wheatfield Fork Subbasin comprises 444 miles at a density of 4.1 miles/square mile. About 3 miles of modern roads are located within 50 feet of blue line streams. Of these roads, about 1.5 miles total length are in areas that may be affected by historically active landsliding and stream bank erosion. The largest amount of roads in historically active landslide areas unrelated to streams occurs in the Wheatfield Fork Subbasin with approximately 37 miles, in proportion to about 80 miles total in the watershed.

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 two miles of the modern roads cross steep slopes (excess of 60 percent). Substandard road networks were undoubtedly vulnerable to large storm events, particularly during the 1986 and 1996 water years. There are 1.4 road crossings per stream mile. The actual extent of road damage is less documented on non-timber production zone lands. With only 14 percent of the subbasin subject to Timber Plans since 1991, additional road repair and upgrade work is indicated. Haupt, Tobacco, Tombs, and Pepperwood creeks are recommended as the highest priority in restoration work in this assessment. The GRWC has storm proofed most of the Fuller Creek watershed by upgrading or abandoning a total of 39 miles or road, saving an estimated 40,000 cubic yards of annual discharge. Streamside roads and landings have been stabilized/ abandoned throughout major portions of Elk Creek.

## Land Use Impacts Documentation

### *Fuller Creek*

- The Fuller Creek Subbasin consists of steep, deeply incised terrain, with upper reaches characterized by inner gorge ravines. In the lower reaches, there has been deep downcutting by Fuller Creek between plateau areas of moderate to near level terrain upslope. The upper subbasin, including North and South forks, were mostly logged by between 1960 and 1964. The lower reaches south of Fuller Mountain were logged during the mid to late 1950s (Figures 5.5-6 and 5.5-11). Main haul roads were all built along the creek channel at the base of steep terrain. Large instream landing complexes were built by filling the channel with wood debris chunks topped with dirt. Skid trails were constructed in streams and draws, and surface flows were concentrated and diverted. High runoff during storm events caused massive erosion by downcutting, slides, and washing of soil and debris into watercourses. More recently, there has been concentrated restoration work to stabilize sediment sources.
- Four large debris flows are apparent in the 1965 photos. These slides originate from areas that were severely disturbed by logging. By 1984 these slides were obscured by revegetation.

Active landsliding is most abundant along the South Fork of Fuller. An unmaintained logging road parallels the creek on the north side. The road is generally 20-30 feet above the creek, with steep slopes. The road has been obliterated by debris slides. The 1961 photos show minimal active slide movement prior to harvesting. The 1942 photos show dense mature wooded cover with few visibly apparent active slides. Similarly, the South Fork contained dense mature conifer cover, which was logged by 1964. To this day, sideslopes along the South Fork continue to discharge sediment into the creek. The roadbed is actually intercepting large volumes of sediment. Field inspection of two of the delivering debris slides revealed that the one consisted mainly of coarse gravel and the other consisted mainly of crumbly shale that would readily decompose into fines. The streambed below these slides consisted of coarse gravel and cobbles and did not seem excessively sediment impacted.

- By 1968, a massive debris slide breached two road spans contouring steep terrain in the South Fork. Starting from the Fuller Mountain Ridge, the slide mass flowed down into the South Fork, creating a lake. This later breached, leaving a waterfall appearance in the channel.

### *Tobacco Creek*

- The main road was built along Tobacco Creek with series of landings in or adjacent to the main creek. High runoff from storm events incised each of these landings cutting deep vertical gorges and creating canyons on the discharge side (Figure 5.5-8).
- By 1964, harvest operations advanced east of the Tobacco Creek area to the higher reaches of an adjacent larger order stream flowing down a ravine to the Wheatfield Fork. High runoff from storm events triggered a long torrent slide all the way down the creek through a mature timbered tract discharging into Wheatfield Fork. By the late 1960s, a haul road was built over the torrent slide and following the creek
- Three large dormant landslides line the creek.

### *Haupt Creek*

- The first logging occurred in the late 1800s to early 1900s with steam donkeys. Ben May Lumber Company was the first major landowner. The lower portion of Haupt Creek was logged during the late 1950s. Most remaining areas upstream were logged by 1970.
- The creek runs through the Coastal Belt Franciscan and forms a steep inner gorge with debris slide slopes. The aggradation point causing subsurface stream flow in lower Haupt had washed downstream by 1970.
- Currently, the Louisiana Pacific Sustained Yield Plan (LP SYP) describes the main channel of Haupt Creek having relatively low structural diversity with long shallow stretches and only occasional pools. Heavy aggregation is not indicated. Historically active landsliding has been limited to small (< 100 foot greatest dimension) events. Haupt Creek is highly responsive to rainfall probably because of its steep narrow inner gorge (98-281 MRC). A major tributary Class II in the lower south bank of Haupt was used as a skid trail prior to 1970, downslope of Tin Barn Road.

### *North Fork Wheatfield (upstream from Tombs Creek)*

- Downslope areas along the Mainstem North Fork Wheatfield, flanked by Bear and Gibson ridges, were tractor logged during the late 1950s. This reach cuts a steep valley across Central Belt terrain and is flanked on both sides by earthflows. Upslope areas were logged by 1964. Tractor skid trails were excavated throughout deeply incised terrain along the North Fork. No active slide areas are apparent in 1942 photos. The 1964 photos show numerous steep inner channel debris slides along the North Fork among recently logged areas. During the 1964 flood, one watercourse diverted onto the haul road, discharging at the headwall of one the larger slides. Another major watercourse diversion onto roads is noted in this area. An earthflow and rockslides are notable along the stream. Shallow debris sliding is common in the steep canyon, mapped as debris slide slopes.

- The northeast corner of the watershed was logged from 1991 through 1997, and is the most heavily roaded area. The remaining portion of this part of the watershed was helicopter logged due to steep terrain. Ridge tops were converted to orchards or vineyards.

### *Elk Creek*

- Elk Creek, tributary to the higher reaches of North Fork Wheatfield, was used historically for livestock grazing (the Tabor Ranch. Mixed conifer/hardwood stands developed in response to clearing and burning operations with intent to convert to rangeland. Elk Creek was heavily impacted by tractor operations in the 1950s and 1960s. Upper segments of Elk Creek were used as skid trails with instream landings at road crossings, and logging debris and soil was placed in streambeds. Flushing of this material continues with peak flow events. An existing road adjacent to a Class II watercourse was abandoned with the new road relocated to the ridgeline (93-436 CFL). Five stream diversions onto roads were repaired (92-382). The streambank rehabilitation work was directed by J. Monschke.

### *Tombs Creek*

- The subbasin is underlain by the Central Belt of the Franciscan Formation, containing a high concentration of landslides, many of which are active.

- Upper Wheatfield and Tombs Creek were timber harvested to convert to grazing land in larger areas of the subwatershed. Sedimentation and accumulation of organic debris was observed in stream channels during original tractor logging during the late 1950s and 1960s (CFL 97-158). Conversions to pastureland have been the dominant form of historical use. Tractor skidding down watercourses removed overstory canopy cover with intent to maintain permanent conversion for grazing use.

### *House Creek*

- A large portion of the alluvium is out of the active channel. This terrace occurs approximately at the toe of a large active landslide. Some of the coarse material may have derived from the slide. The bedrock terrace may represent a localized uplift or tilting, perhaps due to deep-seated forcing of the landslide against the bank. For example some slides move by rotation about a horizontal axis. Therefore, in rotational slides, the toe area may become somewhat elevated. This has not been confirmed for this site.

- In the lowest reaches of House Creek near Wheatfield Fork, roads were built up several Class I tributary watercourses during the late 1950s throughout a larger timbered tract flanked by Skyline Ridge. Peak flows during storm events removed several sections of the road.

- In the highest reaches of the House Creek watershed, upstream of the confluence with both Brink and Cedar creeks, Douglas-fir tracts on north facing slopes were entirely removed during the mid 1950s. Long sections of riparian areas were entirely cleared of all overstory canopy cover with intent for conversion to rangeland. Lack of erosion control facilities created gully erosion noted in 1965 photos.

***Pepperwood Creek (Tributary to House Creek)***

- In the headwaters of Pepperwood (Oak Mountain) landsliding is especially abundant, active, and complex. Downstream in map Sections 15 and 16 the stream cuts into a broad alluvial terrace that is almost 900 feet wide at the confluence with Jim Creek. Much of terrace material is outside of the active channel. This terrace and those along House Creek seem to be isolated remnants of former drainage patterns and may even be related to isolated fluvial deposits along the crest of Kings Ridge about a mile to the south and elsewhere in the uplift. It is uncertain whether the coarse and locally abundant alluvial deposits and bedload result solely from sediment transport within the current stream network from the abundant landslides in the headwaters or from a former system that has been deranged by faulting and uplift and no longer operates.
- Other abandoned areas have regenerated with young conifer/hardwood overstory. Numerous active earthflows occur along large portions of channels. Even more abundant are dormant earthflows that potentially could be reactivated. In each of these landslide-impacted reaches, the channels widen.
- Vegetation has been shaped by repeated fires. There was entirely burned over in 1955, with other subsequent fires up to the present. Conversions to pastureland have been the dominant form of historical use. Tractor skidding down watercourses removed overstory canopy cover with intent to maintain permanent conversion for grazing use. In many areas, soil compaction by heavy cattle access has prevented timely reestablishment of overstory canopy cover on watercourses with recent abandonment of rangeland use.

### 5.5.6 FLUVIAL GEOMORPHOLOGY

About 60 percent of the subbasin has a high to very high potential for landsliding and represents the major source area for stream sediment (Figure 5.5-4). Instream sediment levels, indicative of disturbance, occur along 56 of 300 miles of the blue line streams in the subbasin. This is a 52 percent reduction compared to levels in 1984. Most of the reduction occurred in the tributaries. The lower Wheatfield Fork in the vicinity of Valley Crossing showed channel lowering over the past several decades.

**Table 5.5-3**
Wheatfield Fork 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 |
| ***Hedgepeth Lake*** | | | | | | |
| Britain Creek | 4.3 | 17.8 | 6.1 | 25.4 | -29.8 | 24.0 |
| Pepperwood Creek | 5.0 | 20.2 | 7.3 | 29.5 | -31.4 | 24.7 |
| House Creek | 3.2 | 18.3 | 5.6 | 32.3 | -43.5 | 17.5 |
| **Total** | **21.8** | **33.0** | **32.3** | **48.9** | **-32.5** | **66.1** |
| ***Little Wheatfield Fork*** | | | | | | |
| Haupt Creek | 2.5 | 13.0 | 7.2 | 37.7 | -65.6 | 19.2 |
| Tobacco Creek | 5.7 | 19.8 | 16.2 | 56.0 | -64.6 | 29.0 |
| Flat Ridge Creek | 7.4 | 34.2 | 14.1 | 65.6 | -47.8 | 21.5 |
| Annapolis | 5.3 | 25.2 | 10.0 | 47.2 | -46.7 | 21.1 |
| **Total** | **20.9** | **23.0** | **47.6** | **52.3** | **-56.0** | **90.8** |
| ***Walters Ridge*** | | | | | | |
| Buck Mountain | 1.8 | 5.9 | 7.0 | 22.5 | -74.0 | 30.9 |
| Tombs Creek | 0.5 | 2.0 | 4.5 | 20.0 | -89.8 | 22.4 |
| Wolf Creek | 4.6 | 12.9 | 12.4 | 34.9 | -62.9 | 35.6 |
| Total | 14.0 | 15.7 | 39.1 | 43.9 | -64.2 | 89.0 |
| **Watershed Total** | **56.7** | **18.9** | **118.9** | **39.6** | **-52.3** | **300.6** |

## 5.5.7 WATER QUALITY

### Water Chemistry

Basic water chemistry data were available from USEPA's StoRet system and NCRWQCB sampling for two sites in the Wheatfield Fork Subbasin: the mainstem Wheatfield Fork at the Berkeley YMCA camp (January 6 and June 3, 1988) and House Creek near the confluence with the Wheatfield Fork (February, May, and June, 2001). All parameters were within the water quality objectives in the NCWQCB's *Basin Plan*, and consistent with measurements in other north coastal streams. It appears that hardness, alkalinity, and conductance in House Creek may be higher than in the mainstem stations. However, the small amount of data available are not sufficient to make a conclusive statement. Appendix 4 contains the raw data and graphs for these stations.

### Water Temperature

Water temperature data from continuous recorders were available for 17 sites in the Wheatfield Fork Subbasin (Figure 5.5-12). The period of record from 1995 to 2001 yielded 35 observations for maximum weekly average temperature (MWAT) and seasonal maximum temperature (Table 5.5-4).

MWATs in the mainstem were fully unsuitable. MWATs in Fuller Creek ranged from undetermined to fully unsuitable. MWATs for the other three tributaries ranged from moderately to fully suitable for the period of record (Table 5.5-4, Figures 5.5-13 and 5.5-14).

Seasonal maximum temperatures were above the lethal limit of 75 F at all of the six mainstem sites at one time or another during the period of record (12 of 14 observations). Tributary sites were below 75 F except for two measurements in the upper Fuller Creek in 1997 and 1998.

**Table 5.5-4**
EMDS Ratings for Maximum Weekly Average Temperatures (MWATs) in the Wheatfield Fork Subbasin

| Stream | No. of Sites | No. of Observations | Period of Record | EMDS Suitability Ratings | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | +++ | ++ | + | 0 | - | -- | --- |
| Wheatfield Mainstem | 6 | 14 | 1995-2001 | | | | | | | |
| Fuller Creek | 8 | 14 | 1997-2001 | | | | | | | |
| Annapolis Falls Creek | 1 | 2 | 1996, 1999 | | | | | | | |
| Crocker Creek | 1 | 1 | 1997 | | | | | | | |
| Lower Tributary | 1 | 4 | 1995-1998 | | | | | | | |

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 (>67°F)

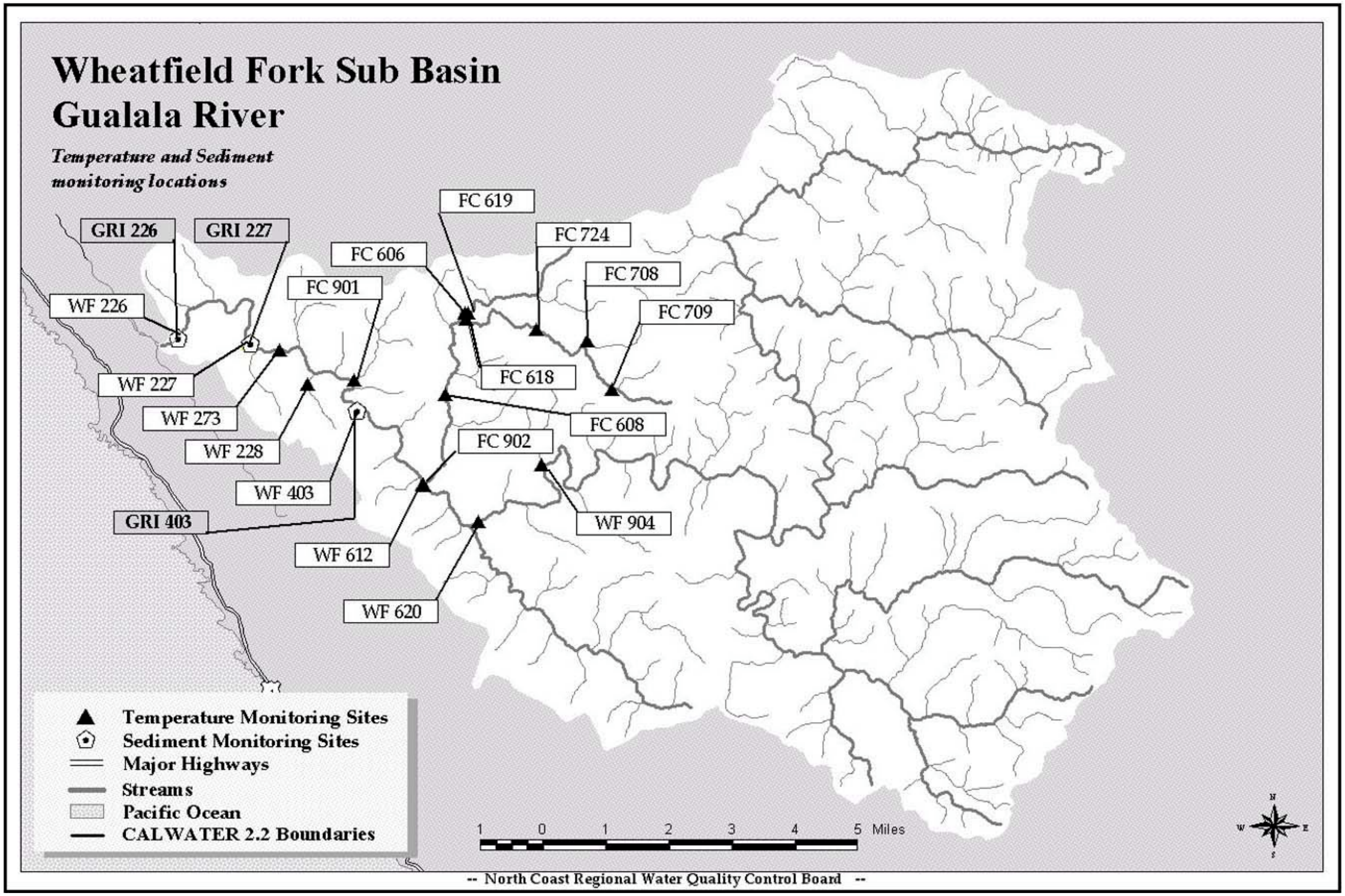



**Figure 5.5-12**
Instream Sediment and Temperature Sampling Sites, Wheatfield Fork Subbasin

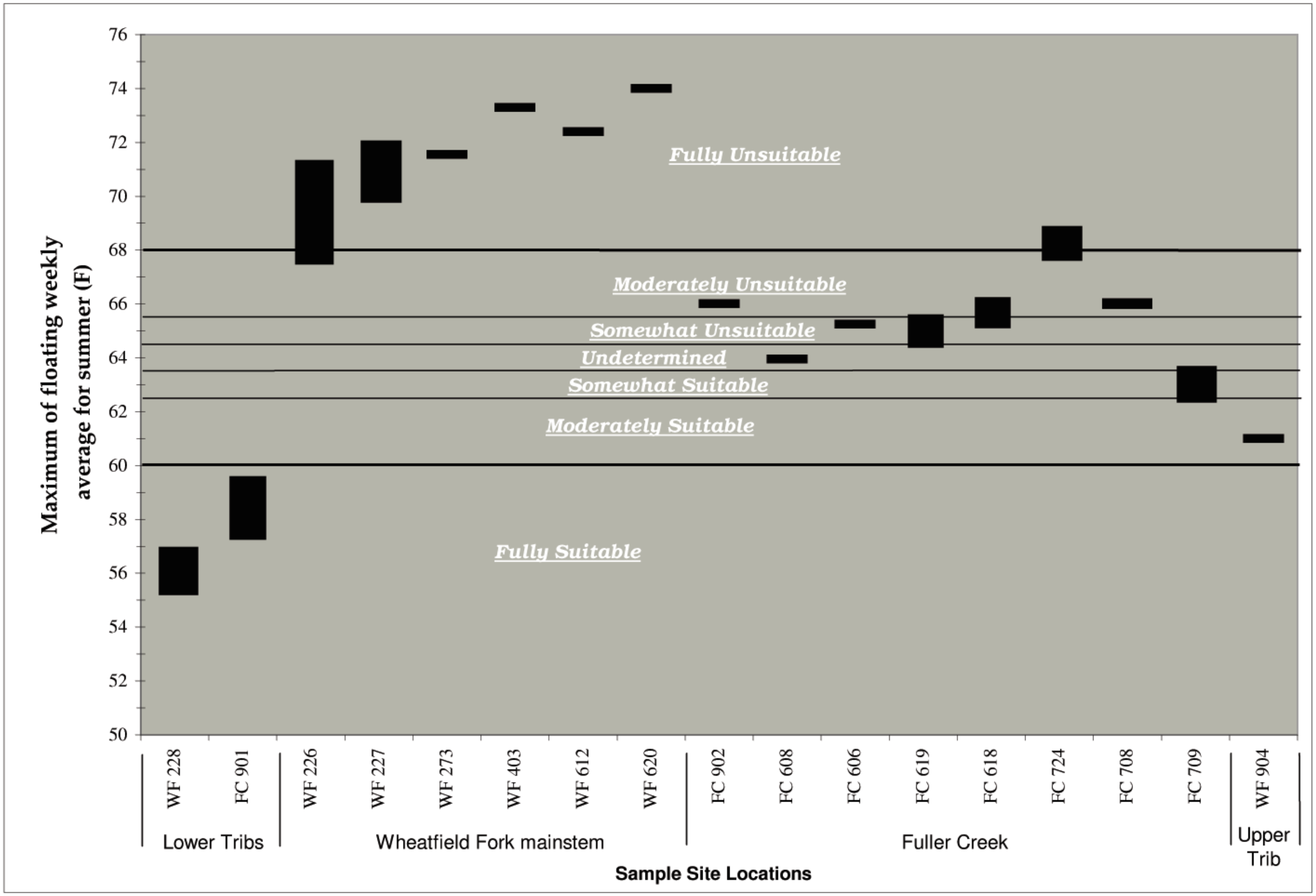



**Figure 5.5-13**
MWAT Sample Site Locations in the Wheatfield Fork Subbasin

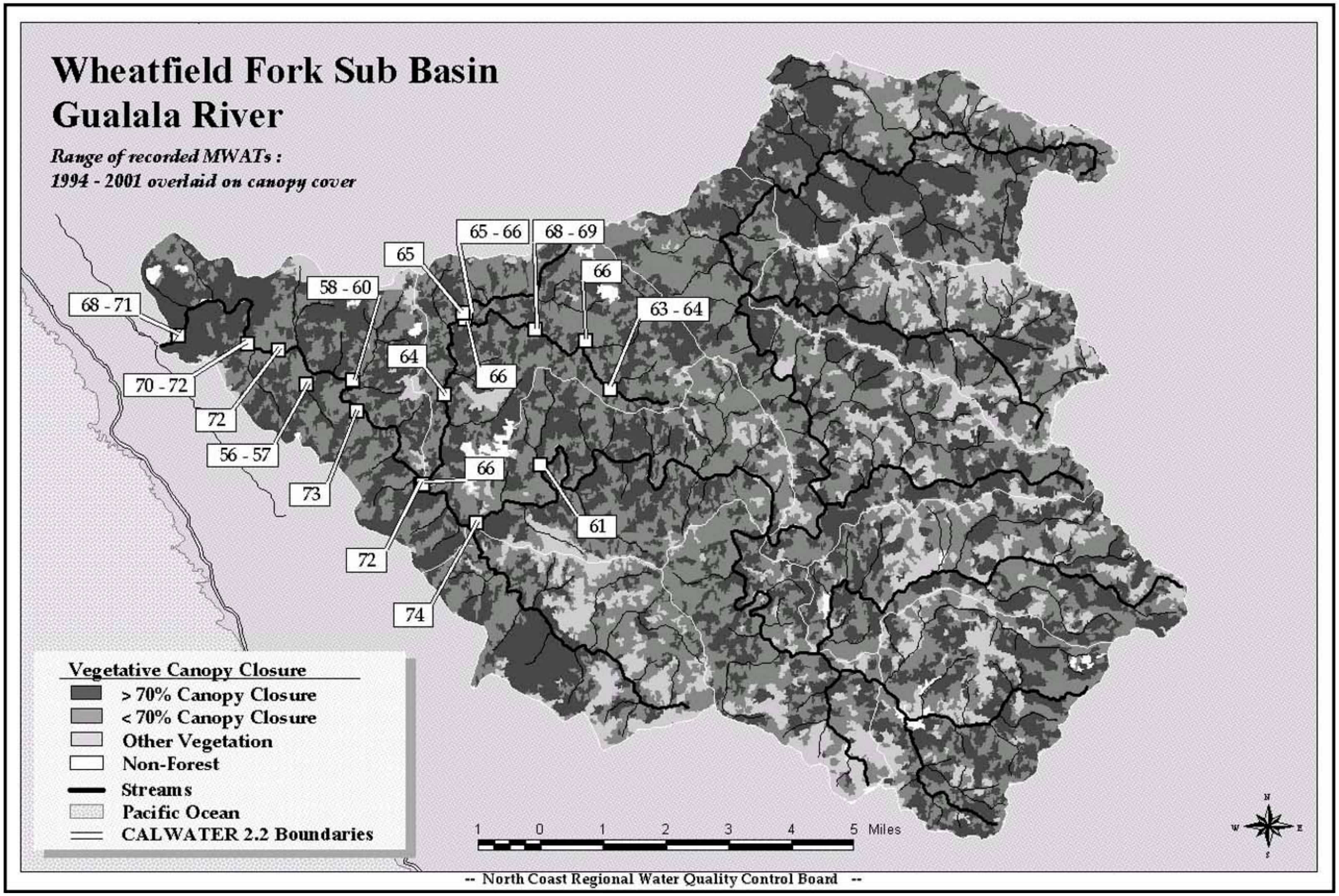



**Figure 5.5-14**
MWAT Temperature Ranges in the Wheatfield Fork Subbasin for the Period of Record, 1995-2001
*(Overlaid on the LanSat vegetation layer for 2000)*

## 5.5.8 FISH HABITAT RELATIONSHIP

### Historic Habitat Conditions

In 1964, 1965, and 1970, CDFG stream surveys were conducted on five streams in the Wheatfield Fork Subbasin: Wheatfield Fork, Fuller Creek, Haupt Creek, House Creek, and Patchett Creek. These surveys were made by direct observation and were not accompanied by quantitative data (Table 5.5-5).

**Table 5.5-5**
Summary of Historic (1964-1970) Stream Surveys Conducted in the Wheatfield Fork Subbasin
Gualala River Watershed, California

| Wheatfield Fork Subbasin Tributary | Date Surveyed | Habitat Comments | Barrier Comments | Management Recommendations |
|---|---|---|---|---|
| Wheatfield Fork | 9/28/1964 | Good spawning beds; Pool: Riffle ratio 75:25; Shelter provided by boulders, logs, overhanging water grasses, and undercut banks | Waterfall ¼ mile below the upper limit of anadromy; No complete fish passage barriers | Clearing of the log jam and clearing of the falls |
| Fuller Creek | 8/18-19/1964 | Spawning area fair, with less than 50% of the streambed containing suitable spawning area and gravel; Pool: Riffle ratio 70:30; Logs, rocks, and undercut banks provided good shelter | 9 partial barriers consisting of log jams | Removal of log jams to improve passage; Possible planting of coho salmon to re-establish a self-supporting run |
| Haupt Creek | 8/25/1964<br><br>6/24/70 | With a general clean-up and proper management, could become a first class steelhead trout, coho-salmon producing stream. A large amount of good spawning area available, consisting of loose gravel deposits, some places 60 feet wide; Pool: Riffle ratio 80:20; Good shelter provided by algae, boulders, undercut banks, and logs.<br><br>Spawning area from mouth to upper fish limit; About 60% pools; About 25% of shelter in the first 100 feet of stream. | 17 partial barriers, consisting of log jams; 1 fish passage barrier 20 log jams; no fish passage barriers | Removal of barriers; Removal of slash from streambed to improve nursery area; Careful management of a coho salmon program to re-establish a run in a stream which has a tremendous amount of suitable coho salmon spawning area. Remove log jams from mouth to upper fish limit 6 miles upstream. |
| House Creek | 9/17/65-9/18/65 | Pools: 60-80% in summer; Shelter is inadequate; Conditions favor rough fish over salmonid. | Concrete dam Numerous small log jams in headwaters and tributaries | Manage as steelhead trout spawning and nursery. |
| Patchett Creek | 8/20/1964 | 40% of the streambed below the upper anadromy limit good; Shelter provided by logs, undercut banks, overhanging grass – scarce in some areas | 15 log jams between mouth and upper limit of anadromy; 3 waterfalls | Removal of 15 log jams from mouth to bedrock falls 150 feet below the first fork |

## Current (1995-2001)

### *Target Values from the Habitat Inventory Surveys (Flosi et al 1998)*

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 5.5-6). When habitat conditions fall below the target values, restoration projects may be recommended to meet critical habitat needs for salmonids.

**Table 5.5-6**
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 |

Habitat inventory surveys were conducted in 1995 and 2001on nine streams in the Wheatfield Fork Subbasin (Table 5.5-7). Sullivan Creek was the only stream in the subbasin that met the target value for canopy cover. Five streams met the target value for embeddedness: House Creek, Pepperwood Creek, Sullivan Creek, Tombs Creek, and Wheatfield Fork. Danfield Creek, Fuller Creek, North Fork Fuller Creek, and South Fork Fuller Creek did not meet the target value for embeddedness. The target values for primary pool depth/frequency and shelter/cover were not met on any of the streams in the subbasin.

**Table 5.5-7**
Summary of Current (1995 and 2001) Conditions Based Upon Habitat Inventory Surveys from the Wheatfield Fork Subbasin, Gualala River Watershed, California
*Condensed Tributary Reports are located in Appendix 5*

| Habitat Element Stream Name | Surveyed Length (feet) | Canopy Density | Embeddedness | Primary Pool Depth/ Frequency | Shelter Cover Ratings |
|---|---|---|---|---|---|
| Target Values (Flosi et al 1998) | | >80% | >50% of the stream <50% embedded | >40% of the length is primary pools | >80 |
| Wheatfield Fork Subbasin | 199,627 | | | | |
| Danfield Creek | 2,103 | 49% | 28% | 5% | 26 |
| Fuller Creek (1995) | 17,952 | 66% | 3% | 5% | 25 |
| North Fork Fuller Creek (1995) | 14,275 | 68% | 20% | 13% | 58 |
| South Fork Fuller Creek (1995) | 23,198 | 59% | 28% | 13% | 37 |
| House Creek | 54,916 | 21% | 70% | 8% | 15 |
| Pepperwood Creek | 17,931 | 19% | 70% | 16% | 12 |
| Sullivan Creek (1995) | 5,015 | 89% | 63% | 7% | 36 |
| Tombs Creek | 37,359 | 65% | 55% | 9% | 51 |
| Wheatfield Fork | 116,878 | 45% | 50% | 25% | 17 |

Canopy coverage was below the target range on all streams surveyed in the Wheatfield Fork Subbasin except Sullivan Creek, which fully met the target value at 89 percent. The ranges were 49 percent on Danfield Creek, 65 percent on Fuller Creek, 21 percent on House Creek, 68 percent on North Fork Fuller Creek, 9 percent on Pepperwood Creek, 59 percent on South Fork Fuller Creek, 65 percent on Tombs Creek, and 45 percent on Wheatfield Fork (Figure 5.5-15).

Categories 1 and 2 embeddedness (<50 percent embedded) are considered the most productive for spawning. Category 5 is unsuitable substrate which includes clay, bedrock, and log. Data collected during 1995 and 2001 habitat inventory surveys showed that House Creek, Pepperwood Creek, Sullivan Creek, Tombs Creek and the Wheatfield Fork had more than 50 percent of all pool tails surveyed that were category 1 and 2. Less than 5 percent of surveyed pool tails were category 1 and 2 on Fuller Creek and less than 30 percent on the North and South Forks of Fuller Creek and Danfield Creek (Figure 5.5-16).

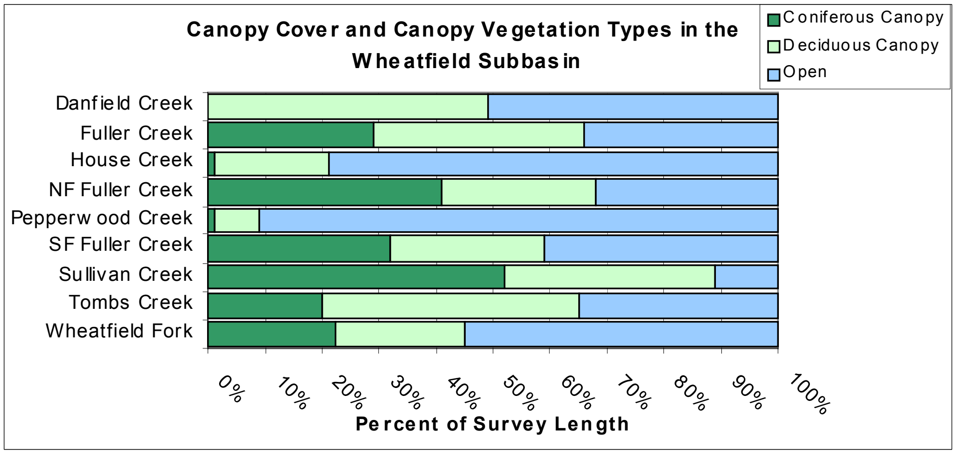



**Figure 5.5-15**
Canopy Cover and Canopy Vegetation Types by Percent Survey Length in Nine Tributaries, Wheatfield Fork Subbasin 1995 and 2001, Gualala River Watershed, California

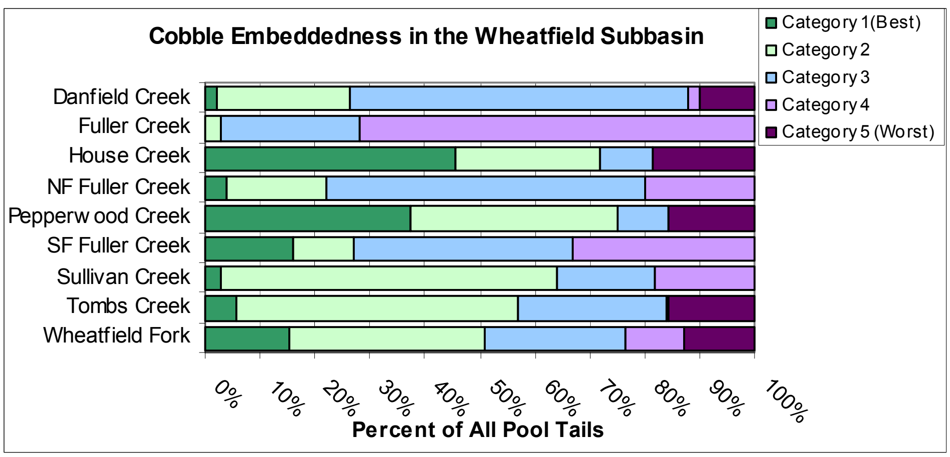



**Figure 5.5-16**
Percent of Cobble Embeddedness in all Pool Tails in the Wheatfield Fork Subbasin 1995 and 2001, Gualala River Watershed, California

All streams surveyed in the Wheatfield Fork Subbasin had habitat deficiencies in pool depth (Figure 5.5-17). None of the streams surveyed met pool frequency target values, except the Wheatfield Fork. Wheatfield Fork had a pool frequency of over 40 percent pools, meeting the frequency target value but not the depth target value based on stream order. Wheatfield Fork is a third order stream with a target of 40 percent of pools 3 feet or over. The rest of the streams in the subbasin did not meet the criteria for depth or frequency (Figure 5.5-17).

Shelter/Cover ratings were below the target values for all of the streams surveyed in the Wheatfield Fork Subbasin (Figure 5.5-18). The top three types of shelter/cover provided were boulders, large woody debris and terrestrial vegetation (Figure 5.5-19). The primary cover types were root masses, boulders, and bedrock ledge on Danfield Creek. The primary cover types were undercut banks, large woody debris, and terrestrial vegetation on Fuller Creek. The primary cover types were boulders, root masses, and bedrock ledge on House Creek. North Fork Fuller and South Fork Fuller Creeks showed the primary cover types were undercut banks, large woody debris, and boulders. The primary cover types were boulders, bedrock ledge, and aquatic vegetation on Pepperwood Creek. Undercut banks, small woody debris, and large woody debris provided the most shelter on Sullivan Creek. The primary cover types were small woody debris, white water, and boulders on Tombs Creek. Wheatfield Fork primary cover types consisted of small woody debris, terrestrial vegetation and boulders.

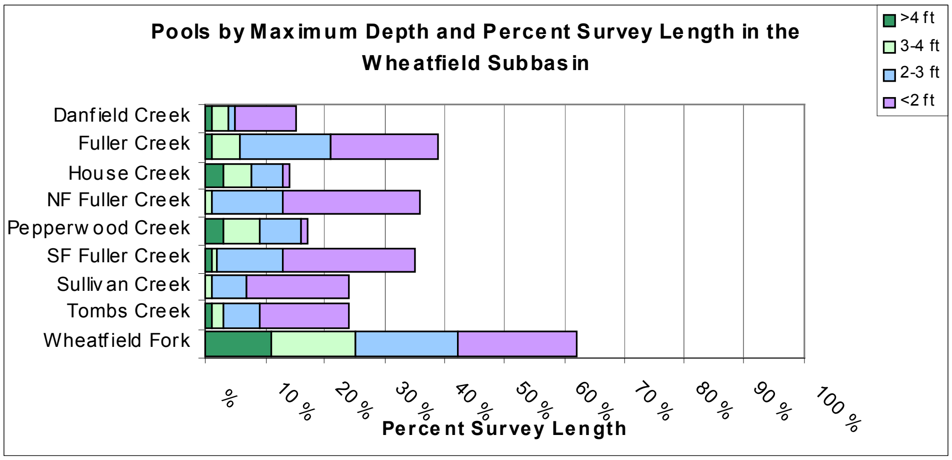



**Figure 5.5-17**
Pools by Maximum Depth and Percent Survey Length in the Wheatfield Fork Subbasin 1995 and 2001, Gualala River Watershed, California

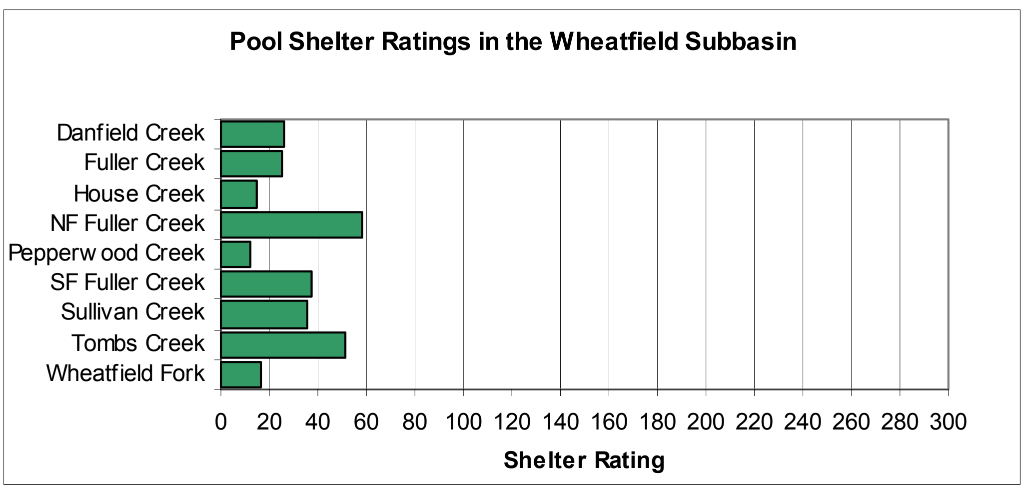



**Figure 5.5-18**
Average Pool Shelter Ratings in the Wheatfield Fork Subbasin 1995 and 2001, Gualala River Watershed, California

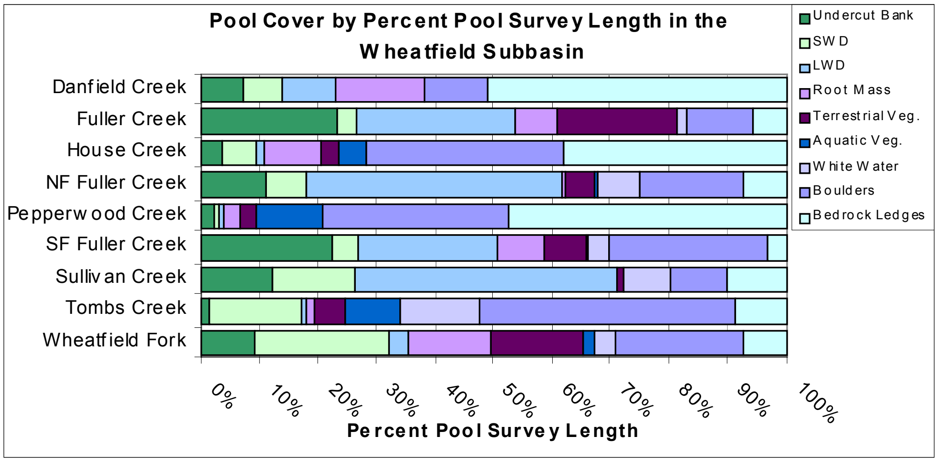



**Figure 5.5-19**
Type of Pool Cover by Percent of Pool Survey Length in the Wheatfield Fork Subbasin 1995 and 2001, Gualala River Watershed, California

## Large Woody Debris Data

Most large wood was cleaned (cleared) from the streams during the 1950s, 1960s and 1970s. A target value of 130 pieces of large woody debris >8 inches per 1,000 feet of stream is recommended in the literature (Beechie and Sibley 1997, Martin 1999).

The Cooperative Monitoring Program surveyed one site for large wood in the lower Wheatfield Fork. This site lacked volume and pieces of large woody debris (Table 5.5-8).

**Table 5.5-8**
Summary of the Watershed Cooperative Monitoring Program Large Woody Debris Survey, Wheatfield Fork Subbasin (1998 - 2001)

| Tributary | Site Number | Watershed* Size (acres | Volume Cubic Feet/1,000' | Quantity Pieces/1,000' |
|---|---|---|---|---|
| Wheatfield Fork | 226 | 71,409 | 1,531 | 15 |

*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 and subsequently habitat inventories from 2001 (Table 5.5-9). Data from the 1964 stream surveys provide only a qualitative snapshot of the conditions at the time of the survey and the 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 density of the 1960s was reduced substantially from the conditions observed in the 1940s. The canopy appeared to be below or absent throughout the subbasin.

**Table 5.5-9**
Comparison Between Historic Habitat Conditions Observed in 1964, 1965, and 1970 with Current Habitat Inventory Surveys Based Upon Quantitative Measurements in 1995 and 2001 from the Wheatfield Fork 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 |
|---|---|---|---|---|---|---|---|---|---|
| ***Wheatfield Fork Subbasin*** | | | | | | | | | |
| Fuller Creek (1995) | Low or Absent | 66% | Fair | 3% | 70% | 5% | Good | 25 | Some canopy recovery: Decreased spawning conditions, pool habitat and shelter/cover. |
| House Creek | Low or Absent | 21% | Good | 70% | 70% | 8% | Inadequate | 15 | Little or no recovery of canopy: Improved spawning conditions: Decreased pool habitat: No change in shelter/cover. |
| Wheatfield Fork | Low or Absent | 45% | Good | 50% | 75% | 25% | Good | 17 | Some canopy recovery: No change or return of in spawning conditions: Decreased pool habitat and shelter/cover. |

In the Wheatfield Fork Subbasin, House Creek, and the Wheatfield Fork were surveyed in 1964 and 2001. Fuller Creek was surveyed in 1964 and 1995. The canopy cover on House Creek and the Wheatfield Fork appears to have decreased or remained the same and still does not meet target values, indicating no improvement over those observed in the 1960s aerial photographs. Fuller Creek's canopy cover appears to have increased somewhat, but still does not meet target values, indicating some improvement. The spawning substrate on House Creek appears to have improved somewhat, while the Wheatfield Fork has remained or returned to the same acceptable conditions observed in 1964. Spawning substrate conditions appear to have decreased on Fuller Creek indicating a worsening of upstream and/or upslope habitat conditions. The 2001 pool frequency/depth and shelter cover appear to have decreased since 1964 on Fuller Creek and the Wheatfield Fork. On House Creek, the pool frequency/depth appears to have decreased while the shelter/cover values have remained inadequate.

## Ecological Management Decision Support

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, Chapter 4.

EMDS scores were not calculated for the Wheatfield Fork Subbasin because only 62 percent of the blue line streams were habitat inventoried and water temperature data were recorded in 2001 on only one stream. MWAT was available for the Wheatfield Fork only and was moderately unsuitable at two sites and fully unsuitable at the third (Table 5.5-10).

**Table 5.5-10**
Ecological Management Decision Support (EMDS) Reach Model Scores on Salmonid Health and Productivity Suitability for the Wheatfield Fork Subbasin, Based Upon Habitat Inventory Surveys Conducted in 1995 and 2001

| Subbasin Stream Name | Canopy Cover Score | Embeddedness Score | Pool Depth Score | Pool Shelter Score | Pool Quality Score | 2001 MWAT Water Temperature Score |
|---|---|---|---|---|---|---|
| Wheatfield Fork Subbasin Score | n/a | n/a | n/a | n/a | n/a | n/a |
| Danfield Creek | - - - | - - | - - - | - - - | - - - | |
| House Creek | - - - | ++ | - - - | U | - - | |
| Pepperwood Creek | - - - | + | - - - | - - - | - - - | |
| Tombs Creek | - | - | - - - | - | - - | |
| Wheatfield Fork | - - | - | + | - - - | - | - - - |

The 2001 water temperature data were provided by GRI and the GRWC.
+++ = Fully Suitable
++ = Moderately Suitable
+ = Somewhat Suitable
U = Undetermined
- = Somewhat Unsuitable
- - = Moderately Unsuitable
- - - = Fully Unsuitable

## Limiting Factors Analysis

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 5.5-11). The LFAs for the subbasin could not be identified because only 45 percent of all the blue line streams were habitat inventoried. Canopy Cover was the highest limiting factor on Danfield, House, and Pepperwood creeks. Embeddedness was the predominant limiting factor in the Fuller Creek watershed. Pool depth/summer condition was the highest limiting factor on Tombs and Sullivan Creeks. Pool shelter/cover was the highest limiting factor on the Wheatfield Fork (Table 5.5-12).

**Table 5.5-11**
Limiting Factors for the Wheatfield Fork 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 highest 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 |
|---|---|---|---|---|
| Wheatfield Fork Subbasin Score | n/a | n/a | n/a | n/a |
| Danfield Creek | 1 | 4 | 3 | 2 |
| House Creek | 1 | | 3 | 2 |
| Pepperwood Creek | 1 | | 3 | 2 |
| Tombs Creek | 2 | 4 | 1 | 3 |
| Wheatfield Fork | 2 | 3 | | 1 |

**Table 5.5-12**
Limiting Factors Affecting Salmonid Health and Production in the Fuller Creek Watershed Located in the Wheatfield Fork Subbasin of the Gualala River Watershed, California Based Upon Habitat Inventory Surveys Conducted in 1995
*Rank of 1 is the highest limiting factor.*

| Watershed Stream Name | Canopy Related to Water Temperature | Embeddedness Related to Spawning Suitability | Pool Depth Related to Summer Conditions | Pool Shelter Related to Escape and Cover |
|---|---|---|---|---|
| Fuller Creek | 4 | 1 | 2 | 3 |
| North Fork Fuller Creek | 4 | 1 | 2 | 3 |
| South Fork Fuller Creek | 4 | 1 | 2 | 3 |
| Sullivan Creek | | 3 | 1 | 2 |

## 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 Wheatfield Fork Subbasin are listed by priority, "1" being the greatest priority. The highest priority for restoration is riparian canopy development. The next four recommendations, in order of decreasing priority, are instream structure enhancements (second), bank stabilization, livestock/feral pig exclusion, and roads repair or removal. Barrier removal is not a restoration priority in the subbasin (Table 5.5-13).

**Table 5.5-13**
Priorities for Restoration in the Wheatfield Fork Subbasin Based Upon 1995 and 2001 Data
*Rank of "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 |
|---|---|---|---|---|---|---|
| Wheatfield Fork Subbasin | 3 | 5 | 1 | 2 | 4 | |
| Danfield Creek | 2 | | 3 | 4 | 1 | |
| Fuller Creek (1995) | 2 | 3 | 1 | 4 | | |
| North Fork Fuller Creek (1995) | | | 1 | 2 | | |
| South Fork Fuller Creek (1995) | | | 1 | 2 | | |
| House Creek | 3 | 2 | 4 | 5 | 1 | |
| Pepperwood Creek | 4 | | 2 | 3 | 1 | |
| Sullivan Creek (1995) | | | | 1 | | |
| Tombs Creek | 2 | | 3 | 4 | 1 | |
| Wheatfield Fork | 2 | 3 | 4 | 1 | | |

Figure 5.5-20a illustrates the limiting factors as determined by CDFG and various sediment sites identified by CGS as potential restoration targets. Figure 5.5-20b 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]).

### Potential Refugia

No potential refugia were identified based upon 2001 data.

## 5.5.9 Fish History and Status

Salmonid population data were limited in the Wheatfield Fork Subbasin. No data were available for the period, 1950s- 1970

- **1980s-** A population estimate with confidence interval was calculated for one station located on the mainstem of Fuller Creek just upstream of the ford on the entrance road from the Hollowtree store in 1989. The steelhead trout juvenile population, of Fuller Creek (approximately 6-mile-long, 3rd order stream), was estimated at 62 with a standard error of 8.6. Four stations were two or three pass electrofished on the South Fork and Mainstem of Fuller Creek with the intent to collect baseline data to assess the impacts from the upstream logging. Station 4 was upstream of the falls on the South Fork, where rainbow trout were observed. Young-of-the-year and one-year and older steelhead trout, western roach, and three-spined stickleback were found.
- **1990s**-A one-pass electrofishing survey was conducted in 1995 on Fuller Creek and South Fork Fuller Creek. The results were not comparable to the 1989 survey. During snorkel surveys, GRI observed one-year and older steelhead trout on the Wheatfield Fork in 1998.

- **2000s**-As part of NCWAP and the CDFG Coho Status Review, electrofishing surveys were conducted on Wheatfield Fork, Haupt Creek, Tombs Creek, House Creek, and Pepperwood Creek, creeks in 2001. Young-of-the-year and one-year classes of steelhead trout were present on all of the streams surveyed. Two- and three-year old steelhead trout were found on the Wheatfield Fork and Tombs Creek.

  Volunteer spawning surveys were conducted in the Subbasin February through April, 2001. Because of the period in which the surveys took place all of the redds found were considered to be steelhead trout. On the lower 14.1 miles of the Wheatfield Fork, 112 redds were found. During these surveys 26 live fish were observed. Haupt Creek (2.2 miles) was surveyed on 2/16/01, no redds were found.

  Coho salmon were not historically observed in House and Pepperwood Creeks and were not observed during electrofishing surveys in October of 2001.

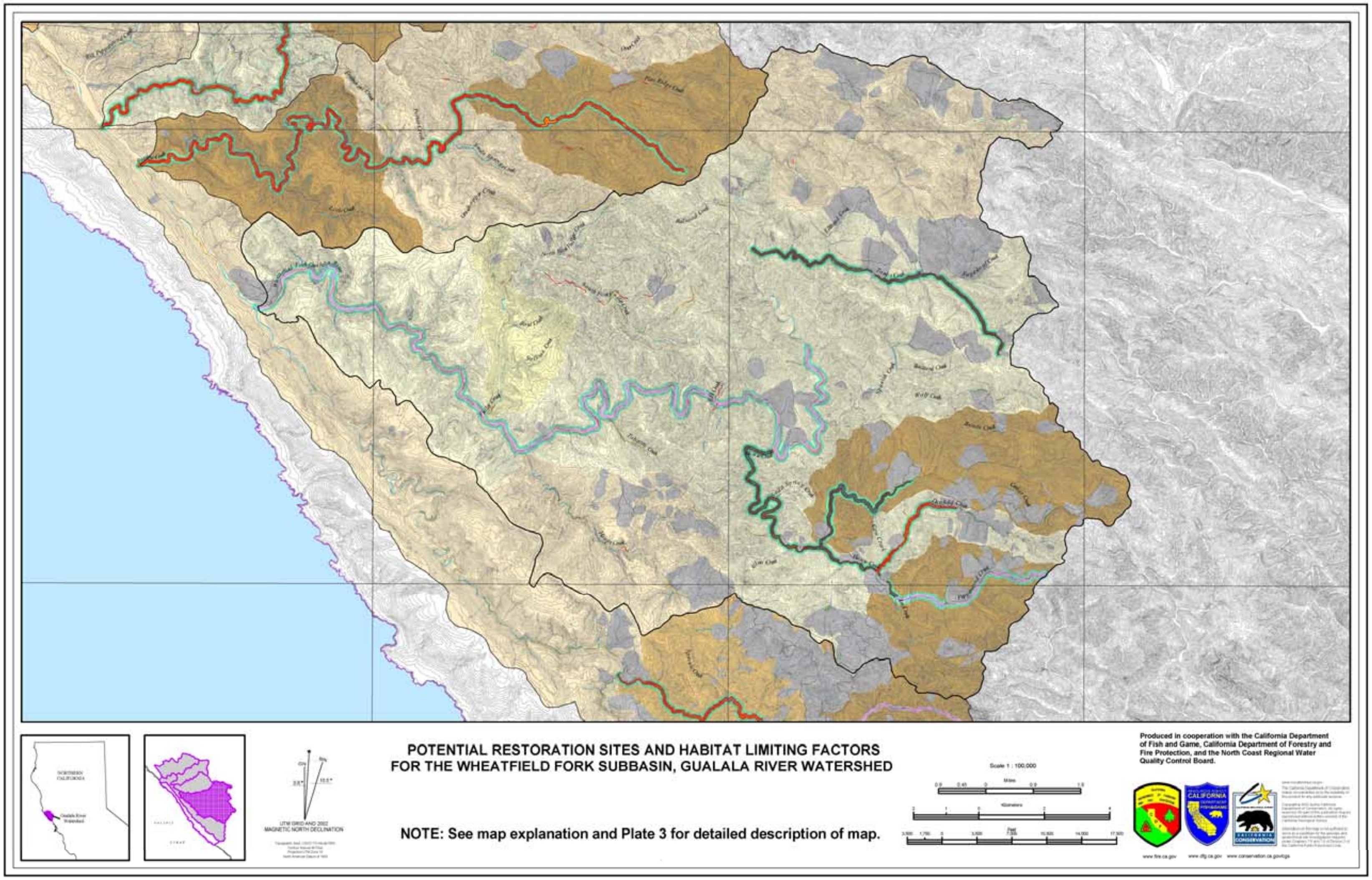



**Figure 5.5-20a**
Potential Restoration Sites and Habitat Limiting Factors for the Wheatfield Fork Subbasin, Gualala River Watershed

## Explanation

- Roads
- Streams
- Watershed boundary
- Sub-basin boundary
- Historically Active Landslides (mapped as a point if too small to delineate at the scale of this map)

**I SPATIALLY ASSOCIATED FACTORS DERIVED FROM AERIAL PHOTO INTERPRETATION OF LANDSLIDING AND SEDIMENT CONDITIONS**

A *HISTORIC IN-STREAM ROADS POSSIBLY RELATED TO FLUVIAL SEDIMENT*

- Stream reaches with persistent aggrading or braiding in both 1984 and 2000 photos that may be associated with historic in-stream roads or landings. See recommendation #5.

B *ROADS POSSIBLY RELATED TO LANDSLIDES AND/OR ERODING BANKS*

- Road segments that may be affected by historically active landsliding and bank erosion. See recommendation #6.
- Road segments that may be affected by historically active landsliding. See recommendation #7.

C *FLUVIAL SEDIMENT CONDITIONS POSSIBLY RELATED TO LANDSLIDES*

- Stream reaches with potentially adverse sediment accumulations that may be affected by historically active landslides and lack any apparent association with the modern road network or the historic in-stream roads or landings. See recommendation #8.
- Stream reaches with potentially adverse sediment accumulations that may be affected by erosion from adjacent dormant landslide terrain that lack any apparent association with historically active landsliding, the modern road network, and historic in-stream roads or landings. See recommendation #9.

D *POTENTIALLY UNRELATED FLUVIAL SEDIMENT CONDITIONS*

- Stream reaches with potentially adverse sediment accumulations that lack any of the above associations. See recommendation #9.

**II LIMITING FACTORS DERIVED FROM GROUND BASED HABITAT SURVEYS (SEE DFG APPENDIX)**

A *CANOPY AND POOLS AS LIMITING FACTORS* (All stream reaches surveyed by DFG in 2001 are highlighted as follows. Reaches that were not surveyed in 2001 are not highlighted on the map.)

- Stream reaches with inadaquate canopy cover as the limiting factor. See recommendation #2.
- Stream reaches with inadequate pool depths as the limiting factor. See recommendation #4.
- Stream reaches with inadequate pool shelter as the limiting factor. See recommendation #3.
- Stream reaches with both inadaquate pool depths and shelter as limiting factors. See recommendations #3 and #4.

B *EMBEDDEDNESS AS A LIMITING FACTOR*

- Areas draining into where embededdness conditions are unknown.
- Areas draining into reaches where embeddedness is not limiting.
- Areas draining into reaches where embeddedness is marginal but not limiting.
- Areas draining into reaches where embeddedness is somewhat limiting. See recommendation #1.
- Areas draining into reaches where embeddedness is significantly limiting. See recommendation #1.

**RECOMMENDATIONS BASED ON LIMITING FACTORS**

(1) Reduce production of fine sediment throughout the contributing area. Evaluate contribution from roads and upgrade roads as appropriate. Evaluate contribution from soil disturbance and control erosion as appropriate (see recommendations 5-10). Evaluate contribution from soil disturbance and control erosion as appropriate. Consider the additive effect of the short-term increases in erosion due to mitigation activities. Distribute individual activities both spatially and temporally as appropriate to avoid additive sediment impacts. Institute best management practices in erodible areas; such as, areas shown on the CGS Relative Landslide Potential Map (Plate Two), and National Resources Conservation Service soil maps.

(2) Enhance current riparian vegetation by planting additional trees, and stabilize stream banks as needed. Also, consider both downstream and upstream effects.

(3) Enhance pool shelter by adding submerged or partially submerged structures. Consider both upstream and downstream effects due to operation and possible failure.

(4) Install in-stream structures to produce hydraulic variability and to scour pools. Consider both downstream and upstream effects due to operations and possible failure.

**RECOMMENDATIONS BASED ON SPATIAL ASSOCIATIONS**

(5) Evaluate relationship on-site. Consider channel restoration and drainage improvements for the road and landing. Consider engineered abandonment.

(6) Evaluate relationship on-site. Consider road drainage improvements to prevent saturation of slide area. Consider abandonment or realignment where feasible. Consider stream bank stabilization where feasible.

(7) Evaluate relationship on-site. Consider road drainage improvements to prevent saturation of slide area. Consider abandonment or realignment where feasible.

(8) Evaluate on-site whether these represent natural background conditions. If mitigation is desired, road construction may be needed for equipment access.

(9) No recommendation because potentially associated active sediment sources have not been identified.

**EXPLANATION FOR POTENTIAL RESTORATION SITES AND HABITAT LIMITING FACTORS FOR THE GUALALA RIVER WATERSHED MAP**

**NOTE: See Plate 3 for complete description of map.**

Produced in cooperation with the California Department of Fish and Game, California Department of Forestry and Fire Protection, and the North Coast Regional Water Quality Control Board.

www.fire.ca.gov www.dfg.ca.gov www.conservation.ca.gov/cgs

**Figure 5.5-20b**
Explanation for Potential Restoration Sites and Habitat Limiting Factors for the Gualala River Watershed Map

### 5.5.10 WHEATFIELD FORK 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 Wheatfield Fork Subbasin and its fisheries, but do not necessarily reflect the findings of the assessment. Some have been disproved by the assessment findings.

- Coho have not been observed in the Wheatfield Fork Subbasin since 1970 indicating prolonged habitat impairment.
- Water temperatures may be high for sustainable salmonid health and production.
- Streamside canopy is deficient.
- Excessive sediment influx in parts of the subbasin has impaired salmonid habitat.
- Instream structures are deficient.
- Subdivision development, grazing and new vineyard development are emerging issues.

#### Working Hypotheses

The primary purpose of these hypotheses is to elucidate in a succinct format the judgment of the Team regarding watershed conditions relative to anadromous salmonids. They are responsive to the assessment questions presented on 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 findings are presented for each of three Super Planning Watersheds (SPWS), because of differences in geology, climate, and land use. The hypotheses are:

1. The Wheatfield Fork Subbasin provides unsuitable habitat for salmonids.
2. Depleted overstory shade canopy cover along Wheatfield Fork and tributaries from legacy harvests and other factors continues to contribute to elevated water temperatures (Lower Wheatfield SPWS only).
3. A lack of instream large woody debris contributes to simplified riparian habitat structure (e.g., lack of large, deep pools).
4. Land management activities in the Wheatfield Fork Subbasin, especially road building adjacent to stream channels or across debris slide slopes and/or steep terrain, have contributed sediment to streams.
5. Instream and near stream conditions have improved.

***Working Hypothesis 1***

*Stream conditions in all three of the Super Planning Watersheds in the Wheatfield Fork Subbasin provide unsuitable habitat for salmonids.*

<u>Supporting Findings</u>

*Lower Wheatfield Super Planning Watershed*

- Coho salmon were not observed in the Wheatfield Fork during electrofishing surveys in October of 2001.
- Water temperatures expressed as MWAT ranged from undetermined to fully unsuitable at 13 of 17 sites in the Wheatfield Fork (Table 5.5-4).
- Canopy cover, primary pool depth/frequency, and shelter/cover on the mainstem of Wheatfield Fork did not meet CDFG habitat inventory target values (Table 5.5-7).
- Canopy cover, embeddedness, primary pool depth/frequency and shelter/cover on Fuller Creek and the North and South Forks of Fuller Creek did not meet target values (Table 5.5-7).
- Canopy cover, pool depth and pool Quality EMDS scores were moderately unsuitable for the mainstem of Wheatfield Fork. Embeddedness was somewhat unsuitable. Pool Shelter was fully unsuitable (Table 5.5-10).
- Embeddedness may be naturally high due to the geology coupled with Tombs Fault (page 5.5–1).

*Walter's Ridge Super Planning Watershed*

- Coho salmon were not observed in Tombs Creek during electrofishing surveys in October of 2001.
- Canopy cover, pool depth and shelter cover did not meet CDFG habitat inventory target values in Tombs Creek (Table 5.5-7).
- The EMDS scores for canopy cover, embeddedness, pool depth and pool shelter were moderately unsuitable for the mainstem of Tombs Creek. Pool depth was fully unsuitable (Table 5.5-10).

*Hedgepeth Lake Super Planning Watershed*

- Coho salmon were not observed in House and Pepperwood Creeks during electrofishing surveys in October of 2001.
- Canopy cover, primary pool depth/frequency, and shelter/cover did not meet target values on House, Pepperwood and Danfield Creeks.
- The EMDS scores on House, Pepperwood and Danfield Creeks for canopy cover, pool depth were fully unsuitable. Embeddedness was moderately unsuitable on Danfield Creek. Pool Shelter was fully unsuitable on Danfield and Pepperwood Creeks and undetermined on House Creek.

<u>Contrary Findings</u>

*Lower Wheatfield Super Planning Watershed*

- Steelhead trout (young-of-the-year, one year, two-year and three year olds) were observed in the Wheatfield Fork during electrofishing surveys in October of 2001.

- Steelhead trout (young-of-the-year, one-year, two-year and three-year olds) were observed in Tombs Creek during electrofishing surveys in October of 2001.
- Water temperatures expressed as MWAT ranged from somewhat to fully suitable at 4 of 17 sites in the SPWS (Table 5.5-4).
- The EMDS score for embeddedness was somewhat suitable on the Wheatfield Fork.
- Macroinvertebrate sampling at one site in the lower Wheatfield Fork indicated a good biotic condition.

*Walter's Ridge Super Planning Watershed*

- Embeddedness may be naturally high due to the geology, coupled with the Tombs Fault.

*Hedgepeth Lake Super Planning Watershed*

- Steelhead trout (young-of-the-year, one year, two-year and three year olds) were observed in House, and Pepperwood Creeks during electrofishing surveys in October of 2001.
- Embeddedness met the target values on House and Pepperwood Creeks.
- The EMDS scores for House and Pepperwood Creeks for embeddedness were moderately suitable and somewhat suitable, respectively. (Table 5.5-10).

*Limitations*

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.
- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.
- The modified ten pool protocol (electrofishing methodology) used was designed to indicate coho salmon presence/not detected status only, and can not be used to indicate species composition, species density or estimate populations.

*Conclusions*

- The hypothesis is supported.

***Working Hypothesis 2***

***Depleted overstory shade canopy cover along Wheatfield Fork and tributaries from legacy harvests and other factors continues to contribute to elevated water temperatures.***

*Supporting Findings*

*Lower Wheatfield Super Planning Watershed*

- Canopy cover did not meet CDFG habitat inventory target values on the mainstem of Wheatfield Fork Fuller Creek and the North and South Forks of Fuller Creek.
- The EMDS score for canopy cover was moderately unsuitable on the Wheatfield Fork.
- Canopy density is known to be naturally low in grasslands and oak woodlands, which appeared to occur naturally in some areas on the 22 of 36 miles of the Wheatfield Fork that were habitat inventoried.

- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of the Wheatfield Fork and tributaries. There was near entire canopy elimination along the lower main stem and main tributaries, especially pronounced during the mid to late 1950s (Figures 5.5-5 and 5.5-10).
- Water temperatures expressed as MWAT ranged from undetermined to fully unsuitable at 13 of 17 sites in the SPWS (Table 5.5-4). Some evidence of mainstem cooling by Fuller Creek was observed (from site WF620 to WF612) (Figures 5.5-13 and 5.5-14).

*Walter's Ridge Super Planning Watershed*

- Canopy cover did not meet CDFG habitat inventory target values on Tombs Creek. The EMDS score for canopy cover was somewhat unsuitable on Tombs Creek.
- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of the main stem Wheatfield Fork, Tombs and Wolf Creeks, and tributaries (Figures 5.5-5 and 5.5-10).
- Bank-to-bank exposure increased substantially from 1942 to 1999 (Figures 5.5-5 and 5.5-10).
- Prolonged ranchland operations with intent of conversion to pastureland prevented timely reestablishment of vegetative cover over streams.
- Some of the recent vineyard development has encroached into riparian areas that were once covered in 1942 (Section 5.5.4).

*Hedgepeth Lake Super Planning Watershed*

- Canopy cover did not meet CDFG habitat inventory target values on House, Pepperwood and Danfield Creeks (Table 5.5-7).
- The EMDS scores for canopy cover were fully unsuitable on House, Pepperwood and Danfield Creeks (Table 5.5-10).
- Timber harvest operations, including road building in riparian zones, shortly after WW II eliminated overstory shade canopy cover throughout long sections of House and Pepperwood Creek watersheds (Figure 5.5-6).
- Prolonged ranchland operations with intent of conversion to pastureland prevented timely reestablishment of vegetative cover over streams. This caused longer term warming, and development of algal blooms currently noted in many of these stream reaches.
- Some of the recent vineyard development has encroached into riparian areas that were once covered in 1942.

<u>Contrary Findings</u>

*Lower Wheatfield Super Planning Watershed*

- Water temperatures expressed as MWAT ranged from somewhat to fully suitable at 4 of 17 sites in the SPWS (Table 5.5-4).
- Photos from 1942 show some bank-to-bank exposure along the lower main stem Wheatfield Fork, where old growth timber occurs along the edge of an alluvial channel (Figures 5.5-5 and 5.5-10).
- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches (Figures 5.5-5 and 5.5-10).

- Bank-to-bank exposure decreased from over 50 percent of the blue line streams in 1968 in the Lower Wheatfield SPW to approximately 20 percent in 1999 (Figure 5.5-10).

*Walter's Ridge Super Planning Watershed*

- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches.
- Bank-to-bank exposure improved in some areas by 1999 (Figure 5.5-10).

*Hedgepeth Lake Super Planning Watershed*

- Advanced conifer hardwood regeneration since 1968 has reinstated canopy cover throughout many of the highest tributary reaches.

<u>Limitations</u>

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.
- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.

<u>Conclusions</u>

- The hypothesis is supported.

#### *Working Hypothesis 3*

- A lack of instream large woody debris contributes to simplified riparian habitat structure (e.g., lack of large, deep pools).

<u>Supporting Findings</u>

*Lower Wheatfield Super Planning Watershed*

- Shelter/cover did not meet CDFG habitat inventory target values on the mainstem of Wheatfield Fork, Fuller Creek, and the North and South Forks of Fuller Creek (Table 5.5-7).
- The EMDS score for pool shelter was fully unsuitable on the Wheatfield Fork (Table 5.5-10).
- Heavy tractors building roads, landings, and skid trails in or adjacent to streams between 1952 and 1968 buried, removed, or dispersed LWD in the SPWS. Aerial photos from 1961 and 1965 show riparian areas entirely cleared of vegetation and remnant downed logs in the Fuller Creek, Tobacco, and Annapolis Planning watersheds (Section 5.5.4).
- The LP SYP describes LWD as not abundant in any of the survey reaches (Appendix 3).
- While the literature suggests about 130 pieces over 8 inches in diameter per 1,000 feet of stream may be desirable (Beechie and Sibley 1997, Martin 1999) the Watershed Cooperative Monitoring Program (1998-2001) identified 15 pieces per 1000 feet of stream channel (Table 5.5-8).

*Walter's Ridge Super Planning Watershed*

- Shelter/cover did not meet CDFG habitat inventory target values on Tombs Creek.
- The EMDS score for pool shelter on Tombs Creek was somewhat unsuitable.

*Hedgepeth Lake Super Planning Watershed*

- Shelter/cover did not meet CDFG habitat inventory target values on House, Pepperwood and Danfield Creeks.
- The EMDS scores for pool shelter on Pepperwood and Danfield Creeks were fully unsuitable. House Creek was moderately unsuitable

Contrary Findings

- None noted.

Limitations

- Only 62 percent of the Lower Wheatfield Super Planning Watershed was habitat inventory surveyed.
- Only 32 percent of the Walter's Ridge Super Planning Watershed was habitat inventory surveyed.
- Only 42 percent of the Hedgepeth Lake Super Planning Watershed was habitat inventory surveyed.

Conclusion

- The hypothesis is supported.

***Working Hypothesis 4***

*Land management activities in the Wheatfield Fork Subbasin, especially past road building adjacent to stream channels or across debris slide slopes and/or steep terrain, have contributed sediment to streams.*

Supporting Findings

- Approximately 13 miles of historic logging roads built in or along the streambed in the Lower Wheatfield SPW eliminated pool structure and complexity throughout Fuller, Sullivan, Haupt, and Tobacco Creeks (Section 5.55).
- Most of the lower reaches of the Wheatfield Fork Subbasin were clear-cut and roaded between 1952 and 1961 in or along the major tributaries (Figure 5.5-6). This left large areas of disturbed ground prone to erosion.
- Both historic and modern aerial photos showed that numerous debris flows and debris slides involved roads and that numerous failures occur along instream and near-stream roads and landings. These resulted in increased sedimentation in the streams (Section 5.5.5).
- Modern road segments within 60 meters of historically active landslides are numerous in the upper stream reaches of Haupt Creek and may be contributing excess sediment.
- Analysis of 1942 photos of Fuller Creek in an undisturbed old growth condition found fewer overall landslides compared to 1965 and 1984 photos.
- Embeddedness was somewhat to fully unsuitable on the 22 of the 36 miles of the Wheatfield Fork and on the North and South Forks of Fuller Creeks.
- Four large debris slides are apparent in the 1965 photos. These originate from areas of dense skid trail networks. Active landsliding is most abundant along the South Fork Fuller. By 1968, a massive debris slide starting from Fuller Mountain Ridge breached two road contours and continued down into the South Fork Fuller Creek.

- Photos from 1965 showed an approximate one-quarter mile section of streamside road collapsed into the North Fork Fuller Creek by 1965.
- Photos from 1965 showed sinuous meandering channel patterns in the North and South Forks upper mainstem Fuller Creek from multiple road debris slides entering streams.
- Figure 87 shows two slides that cut through two road contours in the Annapolis PWS.
- Many undersized culverts and substandard road drainage facilities failed during the 1986 and 1996 storms, representing a portion of contemporary sediment pulses in the subbasin. These failures were generally more numerous where the road network crosses high or very high potential landslide areas.

Contrary Findings

- Most of the historic streamside roads are now abandoned and vegetated throughout Fuller, Haupt, Sullivan, and Tobacco Creeks.
- Successional analysis of air photos since 1942 indicates downcutting of the stream channel in the lower Wheatfield suggesting sediment transport was exceeding supply. Bed elevations have lowered since 1942 and perhaps since 1921 (Appendix 2).
- The active program to decommission streamside roads and landings in the Fuller Creek PWS appears to have reduced sediment sources. The graveled stream substrate observed today compares favorably with the aggraded channel infill of silt and sand deposits observed in the 1965 photos in the same stream reaches.
- There is a declining association of the historic instream roads with channel aggradation indicators between 1984 and 1999. This further indicates net outflow of material and gradual recovery of the streambed. The geofluvial analysis indicates that there are fewer areas in the major tributaries of the SPW that may still now be contributing excess sediment from the mid-20th-century instream roads.
- There is no difference in overall landslide mapping over the entire SPWS between 1984 imagery (76 slides accessing watercourses) and 1999/2000 photos (75 slides).

Limitations

- Only 62 percent of the SPWS was habitat inventory surveyed.
- Analysis of sediment sources and changes in fluvial characteristics was from aerial photo interpretation with little ground-truthing.

Conclusions

- The hypothesis is supported.
- Past logging practices, specifically tractor operations on steep slopes and adjacent to streams, accelerated erosion and added excess sediment to stream channels. Modern logging operations are far less intense than those practiced from 1950-1968.
- Indications from the aerial photo analysis of fluvial characteristics, lower river downcutting, and data from the Fuller Creek roads improvement program all point towards reduction of sediment sources and improvement in the stream channel with regard to sediment. Positive responses by the salmonid habitat should be realized in the future.

### *Working Hypothesis 5*

*Instream and near stream conditions have improved.*

Supporting Findings

- Aerial photo interpretation of the Fuller Creek PWS found overall levels of channel disturbance improved in the 1999/2000 photos compared to 1984. Within the planning watershed, approximately 80 percent of the main channel appeared disturbed with enlarged and numerous bars and lack of riparian vegetation in 1984. By 1999/2000 the main channel appeared to have improved with disturbance at less than 30 percent (Table 5.5-3).
- At least 80 per cent of the South Fork Fuller Creek channel was disturbed in 1984 images, compared to 50 per cent in 1999/2000 images (Table 5.5-3).
- The Wheatfield Fork in the Tobacco Creek PWS showed improvement in channel conditions from at least 75 per cent disturbed in 1984 to less than 50 percent in the 1999/2000 photos. Tobacco Creek had approximately 30 percent channel disturbance in the 1984 imagery compared to less than 20 percent disturbed by 1999/ 2000 (Table 5.5-3).
- Bank-to-bank exposure decreased from over 50 percent of the blue line streams in 1968 in the Lower Wheatfield SPW compared to approximately 20 percent in 1999 (Figure 5.5-10).

Contrary Findings

- There is no substantial difference in overall landslide mapping between 1984 imagery (76 slides accessing watercourses) and 1999/2000 photos (75 slides) at the scale of 1:24000. There is considerable variation between PWSs.

Limitations

- Analysis was limited by a lack of comparable historic stream surveys in this SPW with which to indicate comparative trends.
- Analysis of sediment sources and changes in fluvial characteristics was from aerial photo interpretation with little ground-truthing.
- The extent to which recent and current land use practices may individually or cumulatively affect the rate of improvement in the observed fluvial characteristics, other channel characteristics, and fish habitat is beyond the scope of this assessment and has not been determined.

Conclusions

- The hypothesis is supported.
- Overall levels of channel disturbance have improved since 1984. The streambed in the lower Wheatfield Fork has downcut since 1942 or before.
- 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.

### *Wheatfield Fork Subbasin Recommendations*

Restoration and land use activities should be targeted on the three highest priorities for restoration in the Wheatfield Fork Subbasin: (1) riparian canopy development, (2) fish habitat improvement structures including large wood placement, (3) bank stabilization, (4) feral pig and livestock impacts, and (5) road repair or removal.

1. Address riparian canopy development:
    a. Ensure that adequate streamside protection zones are used to reduce solar radiation and moderate air temperatures in order to reduce heat inputs to Wheatfield Fork and its tributaries
    b. Maintain and enhance existing riparian cover. Improvement of riparian canopy is a priority 1 restoration recommendation. Ensure that adequate streamside protection zones are used on the Wheatfield Fork and tributaries to reduce solar radiation and moderate air temperatures, particularly on the mainstem and upper tributaries. Retain, plant, and protect trees to achieve denser riparian canopy where current canopy is inadequate, particularly in the Lower Wheatfield SPWS: Fuller, Tobacco, and Haupt Creeks.
2. Install fish habitat improvement structures including large woody debris placement:
    a. The suitability of F4 channel types for fish habitat improvement structures include: good for bank placed boulders; fair for plunge weirs, single and opposing wing-deflectors, channel constrictors and log cover; poor for boulder clusters.
    b. Land managers in the 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. The natural large woody debris recruitment process should be enhanced by developing large riparian conifers with tree protection, planting, thinning from below, and other vegetation management techniques. Instream structure enhancement is a restoration priority 2.
3. Address stream bank stability issues
    a. At stream bank erosion sites, encourage cooperative efforts to reduce sediment yield to streams. Grazing is an issue in the subbasin. Bank stabilization is the third of the top three recommendations.
    b. Reduce livestock and feral pig access to the riparian zone to encourage stabilization of stream banks and revegetation of the riparian zone. Improvement of riparian canopy is a priority 1 restoration recommendation, and bank stabilization is a priority 3.
4. Address road-related sediment sources
    a. Decommission and revegetate streamside roads, focusing on those where channel braiding and/ or aggradation are persistent today (from restoration map)
        i) Lower Wheatfield SPW: The lower reaches of Haupt and Tobacco Creeks
        ii) Walters Ridge SPWS: Lower to middle reaches of Tombs, Wolf, and Elk Creeks, and unnamed tributaries to the main stem Wheatfield Fork upstream from Tombs Creek, to Elk Creek, and flanked by Bear and Gibson ridges.
        iii) Hedgepeth Lake SPW: (a) Larger tributary watercourses to the lower reaches of House Creek, (b) Middle to higher reaches of House, and Pepperwood Creeks, Danfield and Cedar Creeks.
    b. Upgrade and maintain existing road systems to eliminate sediment sources to pools and spawning gravels. Carefully engineer new roads or repairs to reduce adverse sediment impacts. Use the Restoration Map to locate where ranch roads cross

historically active landslides to target further field evaluation. These areas have been mapped in dense concentrations in the east subbasin reaches.

c. Target road upgrade/repair starting with instream sediment indicators where fish habitat is less than suitable, such as (House, Danfield, and Tobacco Creeks.)

d. In the timber dominant Lower Wheatfield SPW: incorporate mitigation elements into Timber Harvest Plans and pursue cost sharing grants for decommissioning legacy streamside roads and upgrading road drainage facilities.

e. In the ranchland dominated Walters Ridge and Hedgepeth Lake SPWs: pursue cost sharing grants organized by the Sotoyome RCD to upgrade ranchland roads.

f. Landowners should develop erosion control plans for decommissioning old roads, maintaining existing roads, and constructing new roads. Target road upgrade and repair in the areas identified above.

g. Consider careful planning of land uses that could exacerbate mass wasting, since the relative potential of landsliding is high to very high in 60 percent of the subbasin.

5. Conduct both instream and hillslope monitoring to determine whether current timber harvesting, ranchland, and vineyard development practices are allowing for recovery and protection of the salmonid habitat in the subbasin.

6. Expand monitoring and analysis efforts:

a. Conduct both instream and hillslope monitoring to determine whether current land use practices are allowing for recovery and protection of the salmonid habitat in the subbasin. Use GRWC protocols for instream and channel measurements. Improve baseline information on habitat conditions by conducting inventory surveys in more Wheatfield Fork 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 45 percent of the subbasin has been completed.

d. Investigate the availability and quality of other temperature and canopy data for the eastern area, and reevaluate the relationship of canopy to actual stream temperatures. Spot temperature and canopy measurements from habitat inventory data may be useful in providing information from areas in the subbasin for which we have no other data.

e. Survey for salmonids using consistent methods to estimate population numbers for comparison.