A STUDY OF THE JACOBY CREEK WATERSHED, HUMBOLDT COUNTY, CALIFORNIA

BY

ALISON MURRAY AND ROBERT WUNNER

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JACOBY CREEK CANYON COMMUNITY, INC.

BAYSIDE, CALIFORNIA

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FOREWORD

This study was funded from June 1977 through July 1978 by CETA Title VI monies. Initially sponsored by the Center for Community Development of Humboldt State University, administration of the grant was later assumed by Jacoby Creek Canyon Community, Inc., a non-profit corporation. This organization was formed in 1977 by local residents to gather information about the watershed and its resources.

* * * *

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Many residents of the watershed contributed to the project in various ways, including granting permission for access to their land and assisting with editing and typing portions of this report. Special assistance was provided by Roger Barnhart, Bob Dod, Tom Hassler, Joe Jardine, Bill Lester, Tony Lucchesi, Bonnie McCabe, Jerry Martien, Kip Roberti, Mark Siemens and David Weiss.

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The photographs were taken by Dale McKinnon.

The authors assume full responsibility for the presentation of the material in this report.

INTRODUCTION

The Jacoby Creek watershed study was initiated by residents who wanted to know the answers to some basic questions about the watershed system:

* Is Jacoby Creek polluted?
* What can be done to help restore the salmon and steelhead fishery?
* How can landslides, developing gullies and road washouts be stopped?

Water is a unifying element in these questions. The passage of water through the watershed creates a diversity of habitats. Present land use is reducing habitat diversity. Changes in certain habitats and species populations affect other species. The impact on species which have a direct economic value, such as salmon, is noticed first. Impacts on our environment are noticed when our life support systems are jeopardized; as by water pollution and road washouts. The information necessary to accurately begin to predict the extent or outcomes of alterations of the watershed ecosystem has not been compiled in full; more information is needed to ensure that land use is compatible with long-term watershed integrity.

The objective of this report is to broaden the reader's understanding of the complexity and interdependence of organisms and processes of the Jacoby Creek watershed.

CHAPTER 1

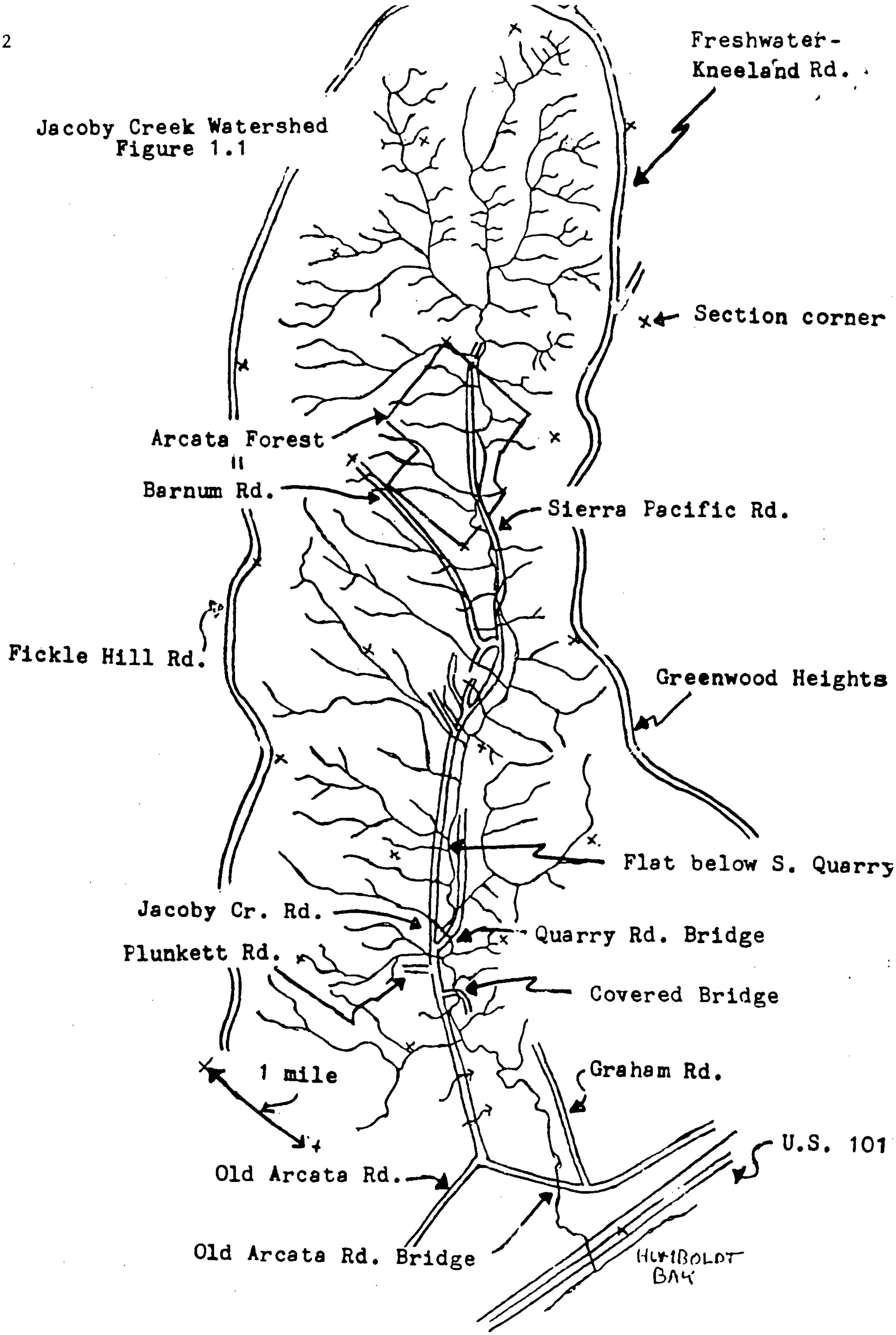
THE STUDY AREA

Location

The Jacoby Creek watershed is located in the coast ranges of northwestern California between the cities of Eureka and Arcata, and drains an area of 17.34 square miles (Pillsbury, 1972). The 11.1 mile long main channel flows northwesterly into Humboldt Bay.

The following is a description of the boundary of the watershed. The divide separating Jacoby Creek from Washington Gulch runs along Graham Road for 0.4 mile until the road forks. The ridge continues above the fork behind the Brookwood area and ascends to the headwaters of the left branch (the determination of left and right is made facing downstream) of Cascade Creek which drains Morrison Gulch. The drainage ridge first comes into contact with Greenwood Heights Road at a point 3.3 miles from Freshwater School near the spring in Section 23 (Range 1 East, Township 5 North, Humboldt Base Meridian). The other side of the ridge drains into Freshwater Creek.

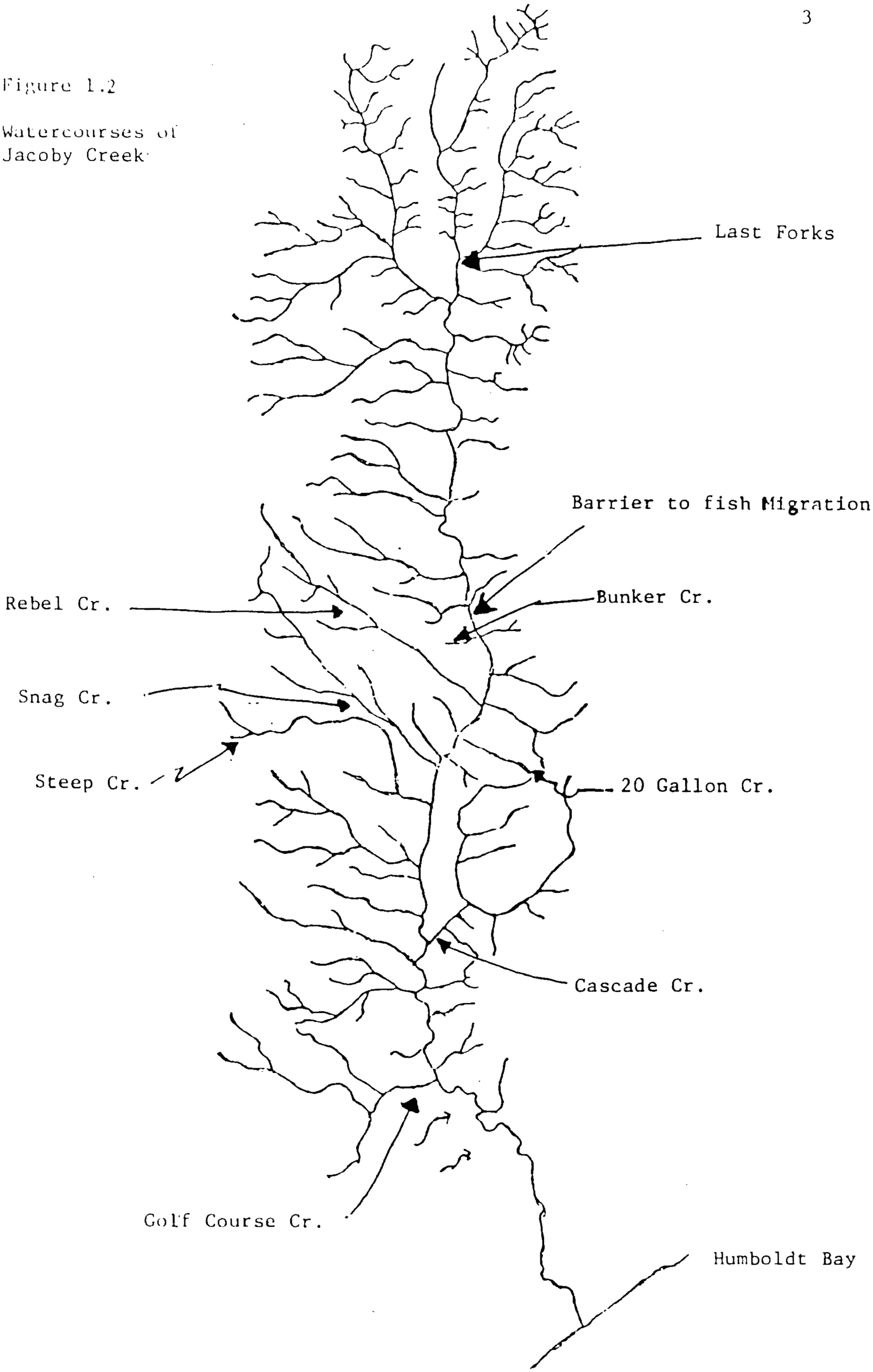
Greenwood Heights Road is located approximately along the drainage divide to its juncture with Freshwater-Kneeland Road. The latter road then curves around the upper basin of the watershed and meets the Maple Creek Road junction near the southeasternmost part of the drainage. At this point, the road becomes Fickle Hill Road and continues around the northeastern portion of the basin, skirting the headwaters of a Mad River tributary, Black Creek, and ascending to Boynton Prairie, the highest elevation (2388') in the watershed. Devil Creek and Dry Creek drain the other side of this divide toward the Mad River.



Jacoby Creek Watershed
Figure 1.1

Figure 1.2

Watercourses of
Jacoby Creek



At a point 13.3 miles from the Maple Creek Road junction, the watershed divide leaves the Fickle Hill ridge and passes through the Baywood Golf Course separating runoff of the Sunnybrae area from that of the Golf Course tributary of Jacoby Creek. The divide then follows a low forested hill running along the north side of Jacoby Creek Road, meeting Old Arcata Road near the former Jacoby Creek schoolhouse.

Old Arcata Road forms a dike across the floodplain perpendicular to Jacoby Creek. From the Old Arcata Road Bridge downstream to the mouth the stream channel is entrenched by levees on both banks. The creek enters the estuary near a red house on stilts by the railroad tracks and U.S. Highway 101.

Geology

Recent studies of the Pacific Ocean floor indicate that it moves approximately 2" per year from the mid-Pacific ridge toward and under the continental marginal trench. The sea floor moves in a series of gigantic rigid segements that slide past each other along great faults. The Coast Ranges are the products of these faults which were formed by the elevation and folding of off-shore marine sediments deposited directly on an oceanic crust about 160 million years ago (Cooper, 1975).

The stream drainage patterns of the Coast Ranges began on islands which gradually emerged from the Cenozoic sea. Increments of drainage were added downstream as the land arose. Subsequent earth movement sometimes altered the direction of these watercourses (Christensen, 1966). As streams cut into the Franciscan Formation landforms, typically bearing from northwest to southeast, thick layers of Cretaceous sediments were formed (see Fig. 1.3).

Figure 1.3

GEOLOGIC TIME AND FORMATIONS

ERAS	PERIODS AND SYSTEMS	EPOCHS	PRINCIPAL MOUNTAIN MAKING EPISODES	YEARS AGO LEAD-URANIUM RATIOS	EARLIEST RECORD
CENOZOIC	QUATERNARY	RECENT			
		PLEISTOCENE			MANKIND
	TERTIARY	PLIOCENE	CASCADIAN		
		MIOCENE			
		OLIGOCENE			
		EOCENE			
		PALEOCENE	LARAMIDE	70,000,000	PLACENTAL MAMMALS
MESOZOIC	UPPER CRETACEOUS				
	LOWER CRETACEOUS				GRASS (GRAMINAE) AND CEREALS
	JURASSIC	UPPER	NEVADAN		BIRDS
		MIDDLE			FLOWERING PLANTS
		LOWER		160,000,000	MAMMALS
	TRIASSIC	UPPER			
		MIDDLE			
		LOWER			
PALEOZOIC	PERMIAN		APPALACHIAN	230,000,000	GINKGO
	PENNSYLVANIAN				CYADS AND CONIFERS
	MISSISSIPPIAN		ACADIAN		HORSETAILS AND FERNS
	DEVONIAN			390,000,000	INSECTS AND REPTILES
	SILURIAN				SEED FERNS
	ORDOVICIAN				FISHES
	CAMBRIAN			500,000,000	
				620,000,000	AMPHIBIANS
					MOSSES
PROTEROZOIC					INVERTEBRATES
ARCHEOZOIC				1,420,000,000	MARINE ALGAE

Franciscan Formation This formation is an assemblage of various characteristic rocks that have undergone unsystematic disturbance (Page, 1966). The rocks include deep water sediments, marine volcanic material and serpentine. The rocks date from at least uppermost Jurassic to Lower Cretaceous times.

No base for the assemblage has been found, even at a depth of 25,000 feet (North Coast Area Investigation, 1966). The Franciscan Formation in the Great Valley of California has been postulated to be a minimum of 50,000 feet thick (Bailey et al., 1964).

Common components of the assemblage are: graywacke sandstone (a coarse dark gray sandstone of firmly cemented materials), shale (mostly gray to black, silty and brittle), serpentinite (green rocks often mottled by patches of black and invariably seamed in a criss-cross pattern of closely spaced fractures that have polished surfaces and feel soapy), and chert (closely jointed rocks composed of chalcedonic quartz with a distinctive red or green color).

The following soils are derived from the Franciscan assemblage. Soil characteristics and sample locations are given below.

Hugo - One mile along Fickle Hill Road from Maple Creek Road junction toward Boynton Prairie. Gray to pale brown color. Substrate: hard sediments.

Melbourne - Along Jacoby Creek Road between the end of the paved portion and Worksite #1 (see Soil Erosion Control chapter). Brown color. Substrate: hard sediments.

Atwell - Found at Worksite #1. Also along the north side of Jacoby Creek Road between the Golf Course Creek and Brookwood Drive. Grayish-brown color. Substrate: soft sediments.

The characteristics of Atwell soil have been researched in greater detail because of its common occurrence in erosion problem areas. Atwell usually occurs in swales or draws. Minor ridges and higher elevations between these areas are usually occupied by Hugo or Melbourne soils.

Atwell is composed of an expansive clay which swells in the presence of water and shrinks and cracks on drying. Clay, by definition, has a particle size of less than 0.02 mm in diameter. This small size makes it readily suspended in runoff.

Clay particles are in the form of small flat plate-shaped crystals called platelets, with many small pore spaces between them. The rate at which the pore spaces can absorb water is slow, but large amounts of water can be held between the platelets. When the soil becomes saturated, the capillary attraction between the platelets is destroyed. The clay soil becomes plastic as the platelets slide over one another. Disturbance or compaction of wet clay causes packing of the platelets, creating a nearly impervious or puddled soil. The clay properties of Atwell soil contribute to its low shear strength, low infiltration rate, tendency to instability and susceptibility to severe gully erosion.

Cenozoic Soils The more recent Cenozoic marine sediments cover the older ones. Early Pleistocene (Holocene) deposits of the Hookton formation are found near the Covered Bridge area. Older Tertiary Pliocene and Miocene sediments of the Wildcat group (Pullen, Eel River, and Rio Dell--fine grained deep-marine sediments) compose the spur ridge in Section 14.

The location and color of soils derived from soft Cenozoic marine sediments identified are given below.

Larabee - Along the north side of Jacoby Creek Road near the Quarry Road junction. Grayish-brown to strong brown color.

Mendocino - Above the quarry at the end of Quarry Road. Brown to reddish-brown color.

Empire - At the upper edge of the meadow on the north side of Jacoby Creek Road near the Golf Course tributary. Also on the east side of Old Arcata Road, 0.5 mile south of Bayside Cutoff. Brown to reddish-yellow color.

Hely - Trees delineate this soil type near the Covered Bridge on Brookwood Drive. Dark grayish-brown to brown color.

Soils of Recent Alluvium The most recent soils on the watershed are derived from recent alluvium. There are three distinct genetically related soils associated with recent alluvium in the Jacoby Creek floodplain area.

Bayside - Bayside occupies the lowest or basin position. This soil is characteristic of the reclaimed tidal marsh flats at the edge of Arcata Bay. It occurs at elevations from 10' to 50'. This soil is imperfectly to poorly drained and is fine textured.

Loleta - Loleta occurs in a fan or low terrace position at elevations below 100'. It has a dark surface and is moderately to imperfectly drained and medium textured.

Russ - Russ is an undifferentiated young alluvial soil occurring on streambanks at elevations between 50' and 150'. It is better drained and coarser textured than the other two alluvial soils. It is also more strongly acid and lighter in color.

Climate

Our climate is created by the zonal circulation of the earth's atmosphere and influenced by topography. In summer the subtropical high pressure zone lies off the Oregon coast in the Pacific Ocean. Outbreaks of cold marine air from polar regions (the Aleutian low) sweep eastward with the westerly winds north of California. Air coming from the subtropical high is descending and therefore does not precipitate its moisture; hence California has a summer drought (Major, 1977).

During the winter the low is further south and California is subject to the stormy westerlies. Pulses of low pressure storms from the central Pacific or frigid air from the interior of Alaska temporarily dominate the skies. Windstorms up to 100 miles per hour occurred in October 1964 and December 1977.

Most rain falls between November and April (Pillsbury, 1972). A ten year average of 60.65 inches has been reported from Sunnybrae (John Borgerson, personal communication). A rain guage located three miles upstream from the mouth of Jacoby Creek (160' elevation) caught 44.39, 26.68, and 54.09 inches for the 1975-'76, '76-77, '77-'78 years (Bill Lester, personal communication). The upper basin is thought to receive greater amounts of precipitation, because rising moisture-laden air is cooled, allowing it to hold less water.

In the dry season the climate is moderated by summer fogs which reduce solar radiation and add moisture by fog-drip. The watershed area upstream from the spur ridge in Section 14 seems to have fewer fog days than the area downstream from this point.

Hydrology

Precipitation arises from fog-drip (fog condensing on vegetation) rain or snow. Rain or snow is intercepted by the vegetation or falls directly on the forest floor. Some of the intercepted water evaporates, the rest flows down tree trunks or falls to the forest floor. If vegetation is absent, rain drop impact on bare soil is a significant form of erosion. Undergrowth and litter are important in protecting the soil.

As the water reaches the forest floor, depending on its rate of arrival and the soil's capacity to allow water to enter, infiltration occurs. In undisturbed forest soils infiltration capacities far exceed maximum rates of rainfall, so that all water enters the soil and overland flow does not occur.

Soil water moves relatively slowly through the open pores as a liquid or a vapor and is subject to removal by plants. Soil moisture diminishes during the growing season on all but riparian sites and hillside seeps. On drier areas water becomes increasingly well held by the capillary attractions within the soil until water is unavailable to plants. At this time, usually in the late summer, plants become dormant, die back, or die. It is this water stress period that accounts for diminished growth and the dense summer wood in the annual rings of trees.

Components of Streamflow On an annual basis the difference between precipitation and evaporation is streamflow. The wetter the soil, the greate and faster the contribution of water to streamflow. Summer low flows are maintained by groundwater overflow. The source area of the stream expands and contracts, depending on rainfall and soil water storage. When the channe expands, transportation of bank materials occurs. Maximum runoff results from rain falling on snow.

Stream Order A numerical system helps to quantify streams in the watershed. The smallest streams, order one, have no surface tributaries and flow intermittently. Two first order streams join to form a channel segment of order two, and so forth until the highest order channel segment is formed. Jacoby Creek has over 160 first order segments, 40 second order, 11 third order, 2 fourth order and the 11.5 mile main stem fifth order. In terms of miles of stream, Jacoby Creek has 26.5 miles flowing the year long and 49.8 miles of intermittent tributaries (Johnson, 1972).

Stream Hydraulics Two basic factors are involved in stream hydraulics: channel characteristics and the amount of water discharged. The gravitational force which causes water movement depends on the gradient or slope. In resistance to gravity the bed and walls of the channel absorb the kinetic energy of the flowing water, depending on the nature, size and shape of bed materials (roughness) and the presence of stabilizing vegetation. Trees and woody debris buttress streambanks and lessen erosion.

The rate of stream flow, or discharge, commonly measured in cubic feet per second (c.f.s.), is dependent on channel depth, width and flow velocity. The discharge at a fixed point may be expressed as: Q=WDV where Q=width, D=depth, and V=the average velocity of water flowing past a given point. A change in a characteristic on the right side of the equation results in a change in at least one on the left side. If W doubles, for example, depth D, velocity V, or both must be decreased such that Q remains constant.

The kinetic (work) energy of water is directly proportional to the square of flow velocity. Energy is dissipated by the resistance caused by bends, junctures of tributaries--which set up eddies and secondary circulations, and by spill resistance--water flowing rapidly over logs, ridges of rock, or coarse bed materials into flow of much lower velocity--riffles and pools. The average channel gradient is inversely related to stream order number. Small streams have the steepest gradients.

The average discharge from the upper six square miles (6.09) of the watershed based on a gauging station operated by the USGS from 1954 to 1965 was 15.6 cfs or 11,290 acre feet a year. Records of this station show the lowest recorded flow as 0.6 cfs on September 24, 1957. High flows recorded were: December 30, 1954 - 1,670 cfs; December 21, 1955 - 1,490 cfs; and December 22, 1964 - 1,530 cfs.

The discharge of the stream recorded at lowest flow during the 1977 drought was 1.25 cfs on October 4, 1977 at the flat near the end of South Quarry Road (Humboldt County Dept. of Public Works).

Estuary

Information on Humboldt Bay is derived from an undated report by R.W. Thompson. Humboldt Bay is the largest estuary between San Francisco and Coos Bay, Oregon. It is composed of three coastal estuaries linked together by a sand spit to form one continuous bay. Arcata Bay, the northernmost of these estuaries, occupies the low seaward end of several valleys which have been filled by floodplain and tidal flat deposits.

Jacoby Creek flows into the Arcata Channel System, the main tidal artery of Arcata Bay. There are three morphological subdivisions to the bay: tidal channels (located almost entirely below mean lower low water MLLW), tidal flats (1' to 2' below MLLW to 4' to 5' above MLLW), and salt marsh (5.5' to 7' above MLLW or approximately at mean high water level). In most places salt marshes are separated from adjacent high tidal flats by a wave-cut cliff 2' to 3' high.

Tidal flats are classed as being either high or low. On the tidal flats soil particle size generally decreases with elevation, except near the mouth of Jacoby Creek. In this area at a distance of 2,000' from the marsh edge out into the bay, core samples show sand layers between layers of fine clay marsh bottom. The embedded layers of different sized soil particles are called laminations. At 1500' from the marsh edge, core samples show that interbedded and interlaminated silty sands and clayey silts predominate. At 500' silty sand with some gravel and thin interbeds of clayey silt occur.

When clays are eroded and carried off by water, they remain in suspension until reaching water rich in calcium or sodium, such as salt water, at which time they flocculate or aggregate. Coarse materials are carried downstream by winter runoff and spread on an outwash fan or small delta. Jacoby Creek is one of the very few areas in the bay where lamination of sediments occurs. This is evidence of a relatively rapid rate of sediment accumulation.

Comparison of recent aerial photographs and maps of Arcata Bay made in 1911 by the Army Corps of Engineers showed that 125' to 300' of salt marsh extension occurred in a 600' wide section adjacent to the mouth of Jacoby Creek. The tidal flats in this area have also undergone significant upbuilding during this same period of time.

Channelization of the stream by the construction of dikes and levees inhibits sediment deposition in the former floodplain. Channelization results in increased sedimentation on the tidal flats and marshlands surrounding the present mouth of Jacoby Creek.

Vegetation

The History of the Vegetation The following was developed based on information in Axelrod (1970, 1977). Evidence from fossil floras indicates that in the early Eocene, fifty million years ago, a warmer ocean allowed a subtropical climate to prevail along the Pacific Coast into southern Alaska. The climate was one of heavy rainfall, at least 80" during the warm season, and dry frost-free winters. Today this climate is typical of southeastern Mexico, Panama and southeastern China.

Fossil floras from the California region indicate that tree ferns, palms, cycads and numerous large-leaved evergreen dicots of tropical and subtropical families were dominant. Species similar to modern day fig, avocado, cinnamon, palmetto, oak, acacia and pecan have been reported. At the same time Sequoia was found in more northern latitudes: Canada, Yellowstone National Park and Greenland.

As the eastern Pacific Ocean cooled and the continent was gradually uplifted, a colder climate developed inland, leeward of the Sierra-Cascade axis. This climate change allowed a northern forest composed of ancestors of present day species (for example, redwood, Douglas fir, Port Orford cedar, hemlock, maple, tan oak, barberry and red huckleberry) to begin to invade what is now the northern Sierra Nevada and central Nevada by early Miocene times, thirty million years ago.

Replacement of the already present subtropical species occurred on the cooler leeward slopes. The subtropical species were constantly forced coastward and southward by the cooling of the climate and gradually eliminated from our area. As summer rains reduced, species similar to those still typical of the eastern deciduous forest of North America (hickory, beech, witch hazel, sweet gum, tupelo and swamp cypress) were eliminated from the Pacific coast flora. Also eliminated were species no longer found as natives in North America but still found in Asia: tree of heaven, Ginkgo and dawn redwood.

From the beginning of the Miocene invasion of the northern California area, the fossil evidence shows two distinct vegetation elements: the Arcto-Tertiary Conifer Hardwood Forest and the Madro-Tertiary Live-Oak Woodland Savanna. Arcto-Tertiary species similar to fir, maple, red cedar, salal, spruce, redwood, hemlock, Douglas fir and huckleberry evolved their distinctiveness in cold, humid arctic regions during the Tertiary. Madro-Tertiary species similar to California bay, madrone, cream bush, manzanita, silk tassel shrub and poison oak evolved in the cold, dry Sierra Madre Mountains of northern Mexico. It should be remembered that the Arcto- and Madro-Tertiary elements came from a common ancestorage.

The oldest Sequoia fossils, about 150 million years old, are from the Upper Jurassic of France (Arnold, 1947). Petrified wood from the Lower Cretaceous, 125 million years ago, has been found on the Isle of Wight. More recently, during the Pleistocene, Sequoia extended 200 miles southward from its present limits to Carpenteria and Santa Cruz Island.

<u>Present Plant Communities</u> A plant community is a group of plants which associate in a common environment. Salinity, soil water and saturation and parent material, exposure, and disturbance are important factors determining where plant communities occur. The following plant communities have been identified in the Jacoby Creek watershed: Salt Marsh, North Coastal Coniferous Forest, Redwood Forest, Douglas Fir Hardwood Mixed

Evergreen Forest, Coastal Prairie (Munz, 1970) and Riparian or Streamside. Each of these plant communities is discussed below except for the Coastal Prairie which occupies ridge tops. In general, the ridge-top prairies of the Jacoby Creek watershed are overgrazed: the native perennial plant community has been replaced largely by an annual grassland invader community of Eurasian grasses. A detailed investigation of this community is needed.

The vegetation of the tidelands occurs in zones corresponding to the tidal levels. In lowlands behind dikes, where the land is no longer subject to normal tidal influence, vegetation zones correspond to the extent of soil drainage (see Soils section).

On the low tideland flats (see Estuary section), the first flowering plant species is eelgrass (Zostera maritima). High flats are usually barren of vegetation except for seasonal mats of algae (Chaetophora aerea).

The Coastal Salt Marsh is characterized by the following species: pickleweed (Salicornia virginica), cordgrass (Spartina foliosa), salt grass (Distichlis spicata), bird's-beak (Cordylanthus maritimus), arrow-grass (Triglochin maritima), Jaumea carnosa, mousetail (Myosaurus minimus), and marsh rosemary (Limonium californicum).

In the late spring, slender orange threads of the parasitic dodder (Cuscuta salina) can be seen on pickleweed. Owl's clover (Orthocarpus castillejoides var. humboldtiensis), a small plant with conspicuous purple-tipped bracts, is endemic to the salt marshes surrounding Humboldt Bay. Salt Marsh species must be able to tolerate periodic flooding by salt water and obtain water for metabolic purposes despite high osmotic gradients.

Within the Distichlis-dominated former marshlands, the following species occur: sedge (Carex obnupta), yellow gum plant (Grindelia stricta), saltbush

(Atriplex patula), wiregrass rush (Juncus lesueurii) and cinquefoil (Potentilla egedei). Bog clubmoss (Lycopodium inundatum) has been reported to occur in the Humboldt Bay area, at the southern extent of its range (Munz, 1970).

California bay (Umbellularia californica) occurs just above the former Salt Marsh zone in the mild bay-moderated climate, about 300 yards southwest of the Bayside Post Office.

The Riparian or Streamside plant community begins at an elevation of nine feet near the Highway 101 bridge. Here species typical of brackish water appear: sedge, cattail (Typha latifolia), rush (Juncus bufonius), brass buttons (Cotula coronopifolia), and spike-rush (Eleocharis macrostachya). Willow (Salix spp.) is common in the overstory of the lower reaches of the stream. To date, S. parksiana, S. lasiandra, and S. sitchensis have been identified. Two species of horsetail are common in the understory; Equisetum hymale on perennially wet sites, and E. telmateia on sites which become dry during the summer.

Between the Highway 101 and Old Arcata Road bridges, scattered groves of black cottonwood (Populus trichocarpa) occur. An isolated redwood tree approximately fifty to sixty years old is found one fourth mile upstream from the mouth.

In the understory common shrubs are: ninebark (Physocarpus capitatus), salmonberry (Rubus spectabilis), thimbleberry (Rubus parvifolius), stink currant (Ribes bracteosum) and vines of bearberry blackberry (Rubus ursinus). Common species of grasses and herbs are orchard grass (Holcus lanatus), chickweed (Stellaria media) and Siberian miner's lettuce (Montia sibirica). Upstream from the Quarry Road bridge, New Zealand fireweed (Erechtites prenanthoides), western coltsfoot (Petasites palmatus) and sweet clover

(Meliolotus alba) are common.

From the Old Arcata Road bridge to the Covered Bridge at Brookwood Drive, the Riparian Zone overstory when present is composed predominantly of willow and red alder (Alnus oregona). Stink currant is common in the understory.

Along the entire main stem of the stream, the same pattern of canopy dominance by willow and alder can be seen. Big-leaf maple (Acer macrophyllum), often covered with licorice fern (Polypodium scouleri), is dominant in parts of the Riparian overstory from the Covered Bridge upstream. Common herbs are figwort (Scrophularia californica) and wood rush (Luzula subsessilis).

About one mile upstream from the mouth, just below the Old Arcata Road bridge, a rise in topography and the presence of Sitka spruce (Picea sitchensis) and grand fir (Abies grandis) mark the beginning of the North Coastal Coniferous Forest. Common species include: canoe cedar (Thuja plicata), western hemlock (Tsuga heterophylla), Douglas fir (Pseudotsuga menziesii), Port Orford cedar (Chamaecyparis lawsoniana), big-leaf maple and cascara (Rhamnus purshiana).

Humboldt and Del Norte Counties contain the finest development of the coastal Redwood Forest. The trees are the world's tallest (112 meters) and grow at rates near the world's maximum. Accumulation of wood mass in the Redwood Forest is unequaled in any other place (Zinke, 1977).

The redwood (Sequoia sempervirens) dominated forest ranges from the Chetco River near Brookings, Oregon to San Luis Obispo County, California, a range of about four-hundred fifty miles. The area occupied corresponds directly to a summer fog belt along the northern and central coast ranges. At its northern limit the forest gives way to a Spruce, Cedar, Hemlock Forest.

Remnants of the Redwood Forest plant community were encountered 8,000 feet upstream from the Old Arcata Road bridge near the 40-foot contour interval. Here on the left bank about 10 feet above the highest detectable channel, several massive stumps can be seen as the geologic parent material changes from recent alluvial deposits (Loleta) to soft Cenozoic marine sediments (Hely). A mile further upstream, just above the Brookwood Bridge, a few large old-growth and second-growth redwood trees are found with large maples along both banks. This location is also a point where the soil type changes from Loleta to Hely.

Depending on soil moisture, three common understories occur in the Redwood Forest: in dry areas, the Redwood-Swordfern association; in moderately drained areas, the Redwood-Oxalis association; and along watercourses and around springs and alluvial flats, the Redwood-Salmonberry association.

The following species compose the Redwood-Swordfern association: swordfern (Polystichum munitum), redwood violet (Viola sempervirens), salal (Gaultheria shallon), rhododendron (Rhododendron macrophyllum), black and red huckleberry (Vaccinium ovatum and V. parvilolium) and wax myrtle (Myrica californica). This association is common on well-drained soft Cenozoic marine sediments and Melbourne and Hugo soil types of the Franciscan Formation.

The Redwood-Oxalis association is noted for the absence of a shrub layer. The following species commonly occur: redwood sorrel (Oxalis oregona), redwood violet, trillium (Trillium ovatum), fetid Adder's tongue (Scoliopus bigelovii), anemone (Anemone quinquefolia), vanilla grass (Hierochloe occidentalis), fairy lantern (Disporum smithii), woodland star (Trientalis latifolia) and queen's cup (Clintonia andrewsiana). Species of the association occur on soils of soft Cenozoic marine sediments and the Franciscan soils: Hugo and Atwell.

Shrubs dominate the Redwood-Salmonberry association. In addition to the species listed for the Riparian Zone the following occur: red-flowering currant (Ribes sanguinum), red elderberry (Sambucus callicarpa) and lady fern (Athyrium filix-femina). Spike moss (Selaginella oregona) occurs on fallen trunks and deep-shaded banks.

When the Redwood Forest is clearcut, there is a reinvigoration of the understory shrubs in the Redwood-Swordfern and Redwood-Salmonberry associations and an invasion of both native and introduced pioneer species. Most native invaders come from the Hemlock Phase (Sawyer, et al., 1977) of the Douglas Fir Mixed Evergreen Forest and the Riparian plant community.

Exotic species from other parts of the world adapted to disturbance are also present. These disturbance-dependent species have been transported to our area by livestock and man. Seeds were carried in clothing, ship ballast, feed, fur, or for ornamental or garden planting. Introduced species are replaced by the native vegetation when disturbance ceases and canopy closure begins.

Besides ornamental and other cultivated plants and those listed for the Riparian Zone, common invader grasses are: Argentine pampas grass (Cortaderia selloana), Italian wild rye grass (Lolium multiflorum), orchard grass (Dactylis glomerata), wild oats (Avena sativa), and sweet vernal grass (Anthoxanythum odoratum).

Common invader herbs are: hawkbit (Leontodon leysseri), milkweeds (Lactuca biennis, L. canadensis, L. ludoviciana), cat's ear (Hypochaeris radicata), dandelion (Taraxicum officinale), sow thistle (Sonchus asper), thistle (Cirsium sp.), pearly everlasting (Anaphalis margaritacea), common groundsel (Sencio vulgaris), pineapple weed (Matricaria matricarioides), yarrow (Achillea millefolium), tarweed (Madia sativa), common mullein (Verbascum thapsus), lupine (Lupinus sp.), lotus (Lotus corniculatus) and clover (Trifolium spp.). Common invader shrubs are coyote brush (Baccharis vulgaris) and ceanothus (Ceanothus thyrsiflorus).

A Douglas Fir Hardwood Mixed Evergreen Forest is characteristic of the Franciscan Formation parent materials of the North Coast Ranges (Sawyer, et al., 1977). Douglas Fir is the major species. Stands of hemlock in the lower Mad River drainage have been cited as comprising a Hemlock Phase on the eastern edge of the Mixed Evergreen Forest (Sawyer, et al., 1977). It appears the occurrence of hemlock in this watershed would extend this range.

In locations that have been free from fire for a considerable length of time, hemlock occurs as a codominant with Douglas fir and tan oak (Lithocarpus densiflora). On recently cutover lands the following species become important: California bay, madrone (Arbutus menziesii), and wax myrtle. The shrub layer on northern slopes is salal, salmonberry, rhododendron, black huckleberry. On southern slopes salal, poison oak (Rhus diversiloba), bearberry blackberry, Oregon grape (Berberis aquifolium), ocean spray (Holodiscus discolor), and ceanothus characterize the shrub layer. Sword-fern is common throughout the community.

The herb layer on moist slopes includes: redwood sorrel, redwood violet, inside out flower (Vancouveria hexandra) and fairy bells (Disporium smithii). On drier slopes Yerba de Selva (Whipplea modesta) and red-flowered honeysuckle predominate.

Species which are rarely or infrequently encountered in the watershed include: calypso orchid (Calypso bulbosa), rattlesnake plantain (Goodyera oblongifolia), and burning bush (Euonymus occidentalis). Old growth forms of common trees, such as redwood, red cedar, grand fir, and hemlock are becoming rare. A yew (Taxus brevifolius) was found near the confluence of Snag Creek and Jacoby Creek, about 30 yards upslope from the house on the east bank.

Alders / Arcata Forest

McKinnon 79

Influence of the Riparian Zone on the Stream Headwater streams are the collectors, processors and conveyors of products from upland ecosystems. These small streams, Order 1 and 2, contain life forms highly senstive to imputs of light, sediment and runoff.

As small tributary streams unite, the channel widens and the forest canopy separates. The increased light penetration results in the establishment of a distinctive riparian vegetation. In response to increased light, benthic algal communites become an important energy base for the ecosystem and large particle detritus plays a lesser role in sustaining stream productivity.

Most materials enter small streams as litterfall from the overhead canopy. In coastal Oregon small streams were found to receive 170 to 200 lbs. of organic material per 100 feet per year, mostly from litterfall (Triska and Sedell, 1976). Storm flows form these materials into "debris dams". At these places debris is sieved from the stream during high flows and fine organics are filtered during low water times. Debris dams serve as the principal places where microbal colonization of litter occurs. Litter colonized by bacteria is used for food by invertebrates.

When leaves enter the stream they are leached in a manner similar to a teabag in hot water. Bacteria then invade the leaves and oxygen consumption increases. Thus slash discarded in a waterway promotes high levels of bacteria which use oxygen needed to sustain other living things.

Alder leaves, because of their high fiber content, are leached and invaded by bacteria more rapidly than those of Douglas Fir. Fir needles, slowly consumed initially in the fall become more rapidly used in the spring. Higher water temperatures speed up the bacterial colonization process.

Fish Besides salmon and steelhead, Jacoby Creek provides habitat for three anadromous fish species: Three-spined Stickleback, Pacific Lamprey and Sculpin.

Some details of the life histories of these species are given below. The major source for this information is from Kimsey and Fisk, 1964.

Three-spined Stickleback - Sticklebacks (Gasterosteus aculeatus) have small, spindle-shaped bodies covered with a few bony plates instead of scales. Three sharp erectile spines precede the soft dorsal fin. They are greenish or olive above and silvery on the lower sides and belly. Sticklebacks eat primarily insects, crustaceans, and algae.

During spawning the males have a red throat and belly with blue eyes and greenish fins, and the females have a pinkish throat and belly. Breeding occurs in the late spring or early summer. The male builds a nest of grass and sticks bound together by a glue like secretion, on the stream bottom in holes, cans, bottles or other debris. More than one female may deposit eggs in the same nest. The male guards the nest until the eggs hatch and the young are on their own.

Pacific Lamprey - The Pacific Lamprey (Entosphenus tridentatus) are among the most primitive of living vertebrates. They are jawless and the skeleton is composed of cartilage rather than bone. Lamprey are found in nearly all California coastal streams.

When Lamprey become sexually mature in the spring and early summer, they move from the ocean to freshwater streams, sometimes riding on a passing fish or boat by attaching themselves with their buccal funnels (mouths). This funnel is also used to move stones to build a shallow nest in a riffle. During spawning the female attaches with her buccal funnel to a stone while the male attaches his funnel to the female. Several pairs usually spawn close together. Lamprey die after spawning.

In a month or so, the minute larvae emerge from the gravel. When 12 to 15 mm long, they leave the nest area for quiet water where they construct and inhabit a U-shaped tunnel, emerging periodically to feed by filtering stream bottom organisms. The larvae, blind and toothless, remain in this stage for 3 to 4 years.

At the end of the larvae stage, strong teeth develop and lamprey move into the ocean. Here they attach themselves to fish using suction of the funnel and rasp a hole with their teeth. An anticoagulant is injected, and the host's blood flows to the lamprey.

Sculpin - The Jacoby Creek sculpins (*Cottus* sp.) inhabit the lower part of the stream near the mouth. They are small and have flattened heads with eyes located high up. Their bodies are thin and tapered with large pectoral fins.

Sculpin are commonly found in riffles. During spawning their eggs are deposited in clusters under large stones in flowing waters. When available they feed on young trout and salmon which have not yet learned to swim well; Sculpin are opportunistic bottom feeders.

Wildlife

The following section lists the species and status, where known, of the amphibians, reptiles, birds and mammals of the Jacoby Creek area.

KEY

C	Common or resident	?	Unknown
U	Uncommon	V	Visitant
R	Rare	SV	Summer Visitant
X	Species present, status undertermined	WV	Winter Visitant
		E	Extinct

Amphibians

Northwestern Salamander	X	Clouded Salamander	?
Pacific Giant Salamander	C	Arboreal Salamander	?
Olympic Salamander	X	California Slender Salamander	X
Western Red-bellied Newt	C	Western Toad	C
Rough Skinned Newt	X	Pacific Tree Frog	C
Ensatina	X	Red-legged Frog	C
Bull Frog	?	Tailed Frog	?

Reptiles

Pacific Pond Turtle	U	Common Gartersnake	X
Northwestern Fence Lizard	C	Western Rattlesnake	R
Western Skink	C	Rubber Boa	X
Southern Alligator Lizard	?	Pacific Gopher Snake	X
Northern Alligator Lizard	?	Western Gartersnake	X
Sagebrush Lizard	X	Sharp-tailed Snake	?
		Ring-necked Snake	?

Birds The key to the bird checklist denotes probability and season of occurrence, nesting and if found near the bay. Humboldt Bay on the western boundary of the watershed serves many species which only occasionally enter it. These species are indicated by **. David Weiss was helpful in compiling this list.

KEY

A	Abundant	r	Resident
C	Common	s	Summer visitant
U	Uncommon	w	Winter visitant
R	Rare	v	Irregular visitant
cas	Casual	m	Spring and fall migrant
Ac	Accidental	sp	Spring migrant
*	Known to breed	f	Fall migrant

** Arctic Loon

** Red throated Loon

** Common Loon: C-w: R-s

** Eared Grebe: C-w

** Western Grebe: C-w: U-s

** Pied-billed Grebe: U-r: *

** Brown Pelican: C-s, f

** Double-crested Cormorant: C-r:*

Great Blue Heron: C-R:*

Green Heron: U-r: *

Common Egret: C-r: *

** Snowy Egret: U-r: *

Black-crowned Night Heron: C-r: *

White-faced Ibis: Ac-f

** Black Brant: U-f: R-w: A-sp

Ross's Goose: Cas-f

Mallard: C-r: *

** Gadwall: U-w: R-s: *

** Pintail: C-w: R-s: *

** Common Teal: Cas-w

** Green-winged Teal: C-w: R-s: *

** Blue-winged Teal: R-s: *

** Cinnamon Teal: C-s: R-w: *

** European Widgeon: R-w

** American Widgeon: C-w

** Shoveler: C-w: R-s:*

** Redhead: C-w

** Canvasback: C-w

** Greater Scaup: C-w:R-s

** Lesser Scaup: C-w: R-s

** White-winged Scoter: C-w: U-s

** Ruddy Duck: C-w: R-s: *

Common Merganser: C-r: *

Turkey Vulture: C-s: R-w: *

White-tailed Kite: U-r: *

Goshawk: R-r

Sharp-shinned Hawk: C-w: R-s: *

Cooper's Hawk: U-r

Red-tailed Hawk: C-r: *

Red-shouldered Hawk: U-w: R-s

Rough-legged Hawk: U-w

Golden Eagle (?): U-r: *

Marsh Hawk: C-w: R-s: *

Osprey: C-s: R-w: *

** Prairie Falcon: Cas-w

** Peregrine Falcon: R-w

** Merlin: U-w

Kestrel: C-r: *

California Quail: C-R: *

Ring-necked Pheasant: R-r: *

Coot: C-w: U-s: *

** Semipalamated Plover: U-w: R-s

Killdeer: A-w: C-s: *

** Black-bellied Plover: C-w: R-s

** Black Turnstone: C-w

Common Snipe: C-w

** Long-billed Curlew: U-w

** Whimbrel: U-m

** Willet: C-w: U-s

** Greater Yellowlegs: C-w

** Lesser Yellowlegs: U-f: Ac-sp

** Knot: U-w

** Pectoral Sandpiper: R-f

Least Sandpiper: C-w

Dunlin: A-w: R-s

** Short-billed Dowitcher: A-m: U-w

** Long-billed Dowitcher: C-m: U-w

** Stilt Sandpiper: Cas-f

Western Sandpiper: A-w: R-s

** Buff-breasted Sandpiper (?)

** Marbled Godwit: C-w: U-s

** American Avocet: C-w

** Northern Phalarope: A-m

** Pomarine Jaeger: U-f

** Glaucous-winged Gull: C-W: R-s

** Western Gull: C-r: *

** Herring Gull: R-w

** California Gull: C-w

Ring-billed Gull: C-w

** Mew Gull: C-w

** Franklin's Gull: R-f, s

** Boneparte's Gull: C-m: R-s, w

** Forster's Tern: U-m, s

** Common Tern: U-f

** Least Tern: Ac-f

** Elegant Tern: Cas-f

** Caspian Tern: C-s: *

** Black Tern: Cas-f

** Black-headed Gull (?)

Band-tailed Pigeon: C-m,s: R-w

Rock Pigeon: R-r

Mourning Dove: U-s: R-w

Barn Owl: C-r

Screech Owl: C-r

Great-horned Owl: U-r

Pygmy Owl: U-r

Spotted Owl: R-r

Saw-whet Owl: U-r

Snowy Owl: Ac-w

Black Swift: R-m

Vaux's Swift: C-m,s

Anna's Hummingbird: U-r

Rufous Hummingbird: C-m: U-s

Allen's Hummingbird: C-m, s

Belted Kingfisher: C-r

Red-shafted Flicker: C-r

Pileated Woodpecker: U-r *

Acorn Woodpecker: C-r

Red-breasted Sapsucker: U-r

Hairy Woodpecker: U-r

Downy Woodpecker: U-r

Ash-throated Flycatcher: U-s

Black Phoebe: C-r

Western Flycatcher: C-s

Western Wood Pewee: C-s

Olive-sided Flycatcher: C-s

Violet-green Swallow: C-s *

Tree Swallow: C-s

Bank Swallow: Cas-m

Rough-winged Swallow: C-s

Barn Swallow: C-s: A-f *

Cliff Swallow: C-s *

Gray Jay: R-r

Steller's Jay: C-r

Scrub Jay: C-r

Common Raven: C-r

Common Crow: C-r

Chestnut-backed Chickadee: C-r

Common Bushtit: U-r

Red-breasted Nuthatch: U-s: C-w

Brown Creeper: U-r

Wrentit: C-r

Dipper: U-r

House Wren: U-s

Winter Wren: C-r *

Bewick's Wren: C-r

Long-billed Marsh Wren: C-r

Robin: C-s: A-w *

Varied Thrush: C-r *

Hermit Thrush: C-r

Swainson's Thrush: C-s *

Western Bluebird: U-r

Blue-gray Gnatcatcher: Cas

Golden-crowned Kinglet: C-r

Ruby-crowned Kinglet: C-w: R-s

Water Pipit: C-w

Bohemian Waxwing: Cas-w

Cedar Waxwing: C-m,s: R-w

Starling: A-w: C-s

Hutton's Vireo: C-s: U-w

Warbling Vireo: C-s

Black and White Warbler: Cas-m,w

Orange-crowned Warbler: C-s: Cas-w

Nashville Warbler: C-s: Cas-w

Yellow Warbler: U-s

Myrtle Warbler: C-w

Audubon's Warbler: C-w: U-s

Black-throated Grey Warbler: C-s

Townsend's Warbler: U-m,w

Hermit Warbler: C-s

Blackpoll Warbler: Cas-f

Macgillivary's Warbler: U-s

Yellowthroat: R-s,m

Yellow-breasted Chat: U-s: Ac-w

Wilson's Warbler: C-s: R-w

American Redstart: Cas-s

House Sparrow: C-r

Western Meadowlark: C-r

Red-winged Blackbird: C-r

Bullock's Oriole: C-s

Brewer's Blackbird: C-r

Brown-headed Cowbird: C-s: U-w

Western Tanager: C-s

Black-headed Grosbeak: C-s: *

Lazuli Bunting: C-s: *

Evening Grosbeak: R-v: *

Purple Finch: C-r: *

House Finch: C-r: *

Pine Siskin: C-r: *

American Goldfinch: C-r: *

Lesser Goldfinch: C-s: U-w: *

Rufous-sided Towhee: C-r: *

Savannah Sparrow: C-r: *

Black-throated Sparrow: Ac-sp

Dark-eyed Junco: C-r *

Chipping Sparrow: C-s: *

White-crowned Sparrow: C-r: *

Golden-crowned Sparrow: C-w

White-throated Sparrow: R-w

Fox Sparrow: C-w: R-s: *

Song Sparrow: C-r: *

Mammals

Oppossum	?	Mexican Free Tail	?
Trowbridge Shrew	?	Silver-haired Bat	?
Vagrant Shrew	?	Black Bear	R
Pacific Shrew	?	Raccoon	U
Water Shrew	?	Ringtail Cat	U
Shrew-mole	?	Marten	?
Townsend's Mole	?	Fisher	?
California Myotis	?	Mink	?
Red Bat	?	Shorttail Weasel	X
Fringed Myotis	?	Longtail Weasel	X
Hoary Bat	?	River Otter	X
Long-legged Myotis	?	Striped Skunk	C

Coyote	R
Gray Fox	X
Mountain Lion	R
Bobcat	U
Mountain Beaver	U
Golden-mantled Ground Squirrel	X
California Ground Squirrel	X
Douglas Squirrel	?
Western Gray Squirrel	C
Chickaree	?
Gopher	X
Harvest Mouse	?
Deer Mouse	C
Dusky-footed Woodrat	C
Tree Phenacomys	X
Pacific Phenacomys	?
White-footed Vole	?
California Red-backed Vole	X
Red Tree Mouse	?
House Mouse	X
Pacific Jumping Mouse	X
Pinyon Mouse	?
Porcupine	U
Black-tailed Jack Rabbit	X
Brush Rabbit	X
Black-tailed Deer	R

CHAPTER 2

BACTERIOLOGICAL WATER QUALITY

History of Bacteriological Standards

In 1912, a federal regulation was adopted to prohibit the common drinking cup on interstate carriers (Wolf, 1972). It was then realized that a clean cup would not help if the water placed in it were foul. In 1914 the United States Public Health Service adopted a standard for drinking water based on the scientific method for sampling, culturing and recognizing coliform bacteria.

Increasing reports of recoveries of coliform bacteria from uncontaminated environments stimulated research for a means of distinguishing fecal from non-fecal coliforms. It was discovered that fecal coliform bacteria (those from the gut of a warm-blooded animal) could be distinguished from non-fecal coliforms by testing for the production of gas from glucose at a temperature of 116 degrees F.

Current Standards

The present drinking water standard applied to interstate carriers is one fecal coliform colony per 100 millitlers (ml) of water. This does not preclude the possibility of infection. Nonetheless the coliform test has been of great value in locating sources of communicable diseases. It indicates the possible presence in water of pathogens such as: Typhoid (*Salmonella*), Weil's disease (*Leptospira*), enteropathogenic *Escherichia coli*, Plague (*Pasteurella*), Asiatic cholera (*Vibrio*) Tuberculosis, Human Enteric Virus, cysts of Amebic dysentery, Chicken pox (*Varicella*) and hookworm larvae.

The mobility of these microbes is demonstrated in a study (Geldreich, 1972) on the Red River between Fargo, North Dakota and Moorehead, Minnesota where Salmonellae bacteria travelled 73 miles downstream in four days.

The correlation between total coliform count (non-fecal and fecal coliforms) and illness becomes significant in the range of 2,300 to 2,700 colonies per 100 ml in freshwater used for recreation and bathing. (Wolf, ibid).

The objectives of the Regional Water Quality Control Board, North Coast Region (RWQCB) state "in no case shall fecal coliform concentrations exceed 400 per 100 ml in 10 percent of the samples, or exceed a median of 50 per 100 ml in a minimum of 5 samples in a 30 day period. For recreational waters, the mean coliform density is not to exceed 1,000 per 100 ml in more than one sample out of five."

Jacoby Creek Water District (JCWD)

The JCWD was established in 1970. The present district boundaries do not correspond to the watershed: parts of Bayside and Washington Gulch are included in the district and the ridges of Fickle Hill, Kneeland and Greenwood Heights are not included (see Fig. 2.1). Two annexations to the original district were made in 1978. These two areas are located between subareas A and B (see Fig 2.2).

JCWD finances originate from the sale of Mad River Water purchased from the City of Arcata. The JCWD water line was constructed with the aid of a Davis Grunsky federal loan of $447,500. The 50 year repayment schedule begins in 1986. The importation of water has spurred housing development within the district.

In 1976 JCWD received a $35,875 grant from the Environmental Protection Agency and the State Water Resources Control Board to study the adequacy of sewage disposal systems (Phase 1) and evaluate alternative disposal techniques (Phase 2) if existing systems proved to be inadequate.

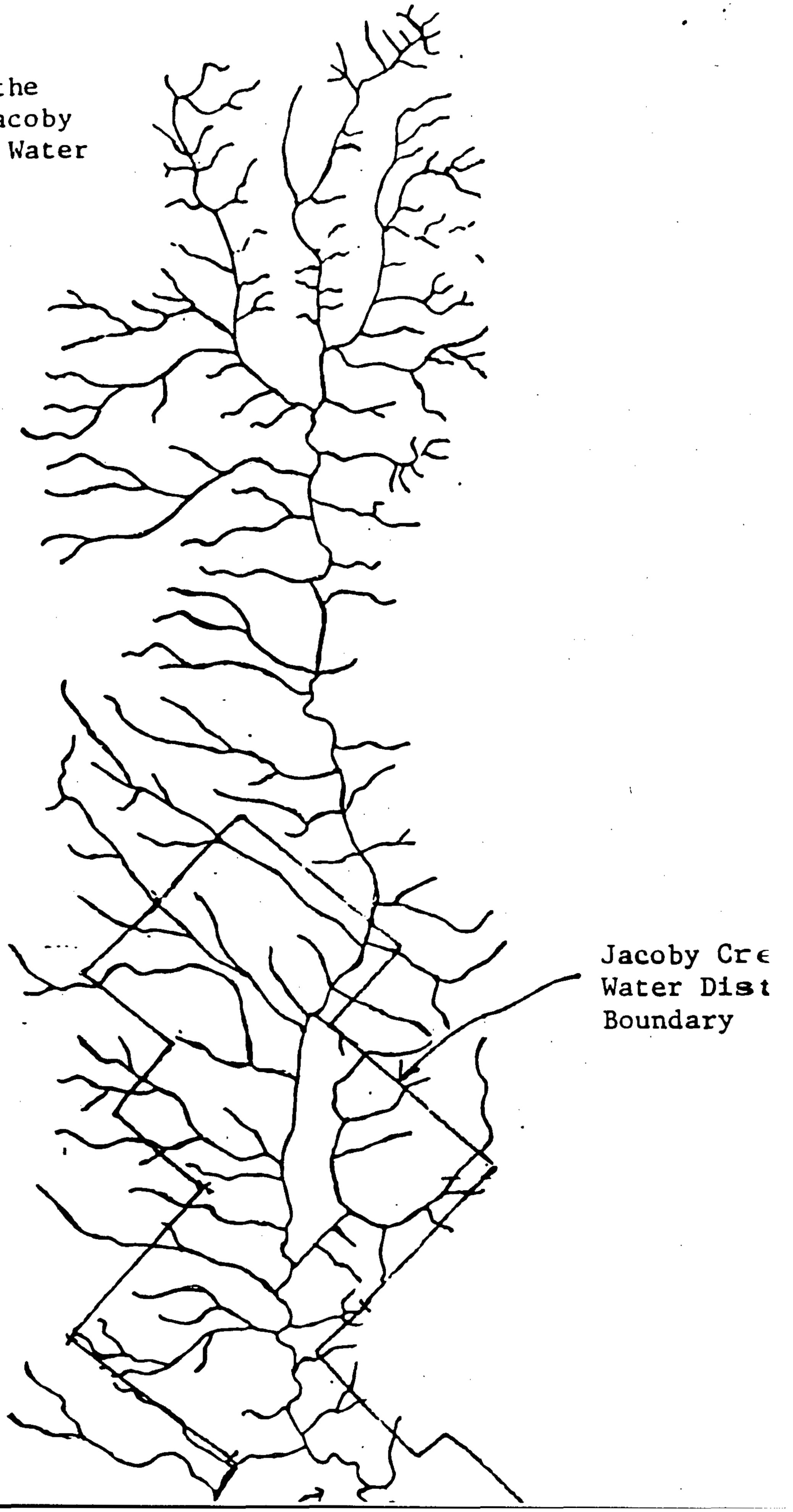
The consulting firm of Winzler and Kelly was hired to conduct the study. In the October 1978 report on Phase 1, the present sewage disposal system, septic tanks, was found to be inadequate on the basis of these criteria: surface water quality testing (total and fecal coliform and fecal streptococcus), a septic tank survey, high groundwater levels, saturated soils and poor soil permeability.

Adequacy of the Present Sewage Disposal System

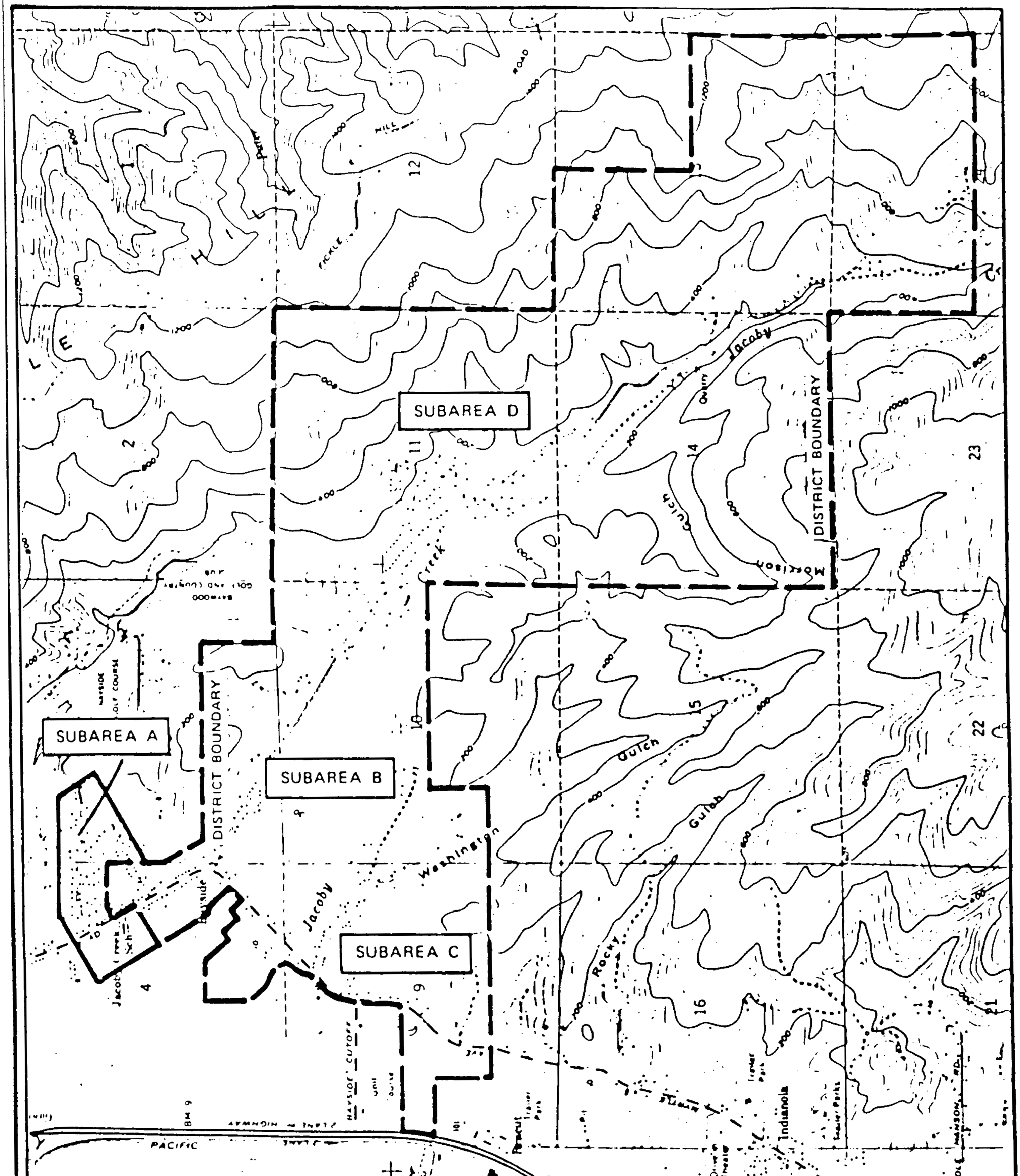
The results of the Winzler and Kelly tests and of samples taken during the course of this study, analyzed by the Humboldt County Health Department, are shown in Fig. 2.3. The results show high bacteria levels during the rainy season in waterways adjacent to residences. Fecal streptococcus

Figure 2.1

Comparison between the boundaries of the Jacoby Creek watershed and Water District



Jacoby Creek
Water District Boundary Map
Figure 2.2



From Cook, 1978

Numbers are fecal coliform bacteria - most probable number /100 ml.

Date	UPSTREAM	Above Rebel Cr.	Jacoby Cr. at end of Jacoby Cr. Rd. (Below Snag Cr.)	Cascade Cr. (Tributary on S. Quarry Rd.)	Jacoby Cr. at Quarry Rd. Bridge	Jacoby Cr. Rd. near Plunkett Rd. (ditch)	Covered Bridge	Golf Course Tributary	Above Old Arcata Rd. to Golf Course Tributary	Old Arcata Rd. Bridge	Downstream from Old Arcata
3/2/76					49*	490*		80* 33* 23* 130*	5400*		130
8/-/76					49*	490*		23* 80*	5400*		130 17
10/5/76			2* (7)			70* (220)	63* (540)	180* (350)	2200* (920)	350* (140)	
1/3/78		9+	39+				43+			240+	150
3/3/78							11+			240+	
3/7/78						240* 130*	23* 70*	2400* 700*	220* 240*	110* 330*	
3/8/78						7900* 2200*	790* 490*	1300* 1800*	330* 240*	490*	
3/9/78				11*		350*		1400*	220*	170*	
3/10/78				3500*		170*	49*	4900*	240*	330*	
3/28/78					33* (<100)	8* (100)	13* (<100)		240* (<100)	350* (<100)	
7/11/78		9+	4+	150+			43+	240+	460+ 240+	460+	460+

* = Cook, 1978
\+ = Humboldt Co. Health Dept.
( ) = Fecal Streptococcus from Cook, 1978

bacteria are especially indicative of human feces since they survive only five days in water.

W. Rodriquez, an associate engineer with the RWQCB, noted that water samples collected in 1977 near the mouth of the creek in Arcata Bay by the Federal Food and Drug Administration contained bacteria levels which indicate that the bay shellfishery could be endangered.

A door-to-door survey conducted by Winzler and Kelly indicated that 30% of the residences contacted had problems with their septic systems. The consultant stated he believed this indicated that probably 60% of the septic systems in the JCWD are failing.

High groundwater levels, saturated soils and poor soil permeability were assessed by observation, digging test holes and researching the geology of the alluvial soils. Generally, the soils were found to be unconducive to septic systems, having a high clay content and impermeable layers or draining to soils with these characteristics (see Soils section).

Schumps Landing [illegible] [illegible] '79

CHAPTER 3

SALMON AND STEELHEAD

Description of Species

Coho Salmon (Oncorhynchus kisutch) and Steelhead Trout (Salmo gardnerii) and Coastal Cutthroat Trout (Salmo clarkii) are found in Jacoby Creek. These species can presently migrate to a rock waterfall about six miles upstream. Steelhead are found above the present barrier to fish migration. A Chinook Salmon (Oncorhynchus tshawytscha) smolt was caught at the fish trap located ¼ mile from the mouth of Jacoby Creek (Harper, 1980). Only coho and steelhead are considered in detail in this report.

Coho Salmon range from central California to Alaska, and along the coast of Asia to northern Hokkaido and the Honsu Islands of Japan (McNeil and Bailey, 1975).

In salt water, coho are blue or green with small black spots on the back, dorsal fins and upper part of the tail. The sides and belly are a silver color. The mouth lining is dark with a light gum line. In fresh water, the male becomes bright red and develops a hooked nose, and the female becomes a dull bronze color.

Steelhead range from southern California to the Bering Sea Coast of Alaska. In large rivers of our area, such as the Rogue, Klamath, Trinity, and Eel, seasonal stocks of migrating steelhead are present. But Jacoby Creek has only a "winter run".

Steelhead are a steel blue or silver color in the ocean, with well-defined black spots smaller than 1/8" in diameter on the back, sides, dorsal and caudal fins and head. The mouth lining is white. In freshwater, they develop a pink or red stripe along the sides of the body.

Ocean Life

In the ocean salmon are usually found in schools within 200' of the surface, moving southward in the winter and northward in the summer. The common belief is that steelhead are solitary or travel in much smaller schools than salmon do; they are illegal to catch in the ocean. While steelhead are seldom caught offshore salmon by contrast are heavily harvested. VTN Environmental Services (1979) has estimated that 70% of the harvestable Klamath River salmon are caught in the ocean.

The ocean area utilized by salmon and steelhead is twice as large as the continental U.S. (McNeil and Bailey, 1975). A steelhead released at the Alsea, Oregon hatchery and recovered there 22 months later had been tagged on the high seas southwest of Kodiak Island, Alaska (Ricker, 1966).

A narrow belt of cold coastal water along western North America provides nutrients for salmonids. North and northwest winds associated with the earth's rotation move offshore surface water, causing colder water richer in nitrates and phosphates to rise to the surface. This phenomenon, known as upwelling, promotes plankton growth. The fish feed on these microscopic algae and invertebrate blooms.

Upstream Migration

The annual migrations of Steelhead Trout and Coho Salmon begin as the fish usually "home" (return using the senses of sight and smell) to the stream where they spent their early life. There are records of both species "overshooting" the home tributary and returning to enter it, or going up the wrong tributary and coming back down (Ricker, 1966). Steelhead from the Rogue River have been reported in the Klamath and vice versa (Everest, 1973).

Many steelhead begin the spawning migration after one year in the ocean. Some coho males known as "jacks", migrate to spawn after only 6 months at sea. Jacoby Creek is unique for its high jack population. Adult steelhead typically migrate after 1 year of ocean life.

Upstream migration in Jacoby Creek was monitored during the 1977--1978 season using a weir and trap located ¼ mile upstream from Humboldt Bay. Fish were caught, tagged and released to continue their migration upstream (Harper, 1980). Upstream, fish were recaptured with electro-fishing equipment. Population numbers were estimated by determining the ratios of tagged to untagged fish (Modified Peterson Method). The populations were estimated to be 123 $\pm$ 41 coho and 217 $\pm$ 95 steelhead (Harper, 1980). Eighteen percent (22 fish) of the returning coho were fish which had been released as fry from the Arcata Oxidation Pond. Twelve thousand fry were released in the spring of 1976.

Fish were caught in the trap when flows were above 22 cfs. Over three spawning seasons, 95% of the coho were found in Jacoby Creek between November and January. Records for steelhead show use of the stream by the majority of spawners to be from December to June. The peak migration was from January to March.

Migration Barriers

Salmon and steelhead will use streams with a minimum water depth of 1 foot and can jump waterfalls 2-3 feet high. Lower water depth and higher obstacles may constitute barriers to upstream migration, especially if a "running" start is not available for the jump.

On the main stream a potential barrier exists about 4 ¼ miles from the mouth at the base of the spur ridge near Kirkpatrick Quarry in Section 14 at an elevation of 150 feet. Here rock debris and logs from an adjacent landslide form the nucleus of a large debris dam.

A barrier to migration was located 5 ½ miles from the mouth in Section 24, just above the mouth of an ephemeral tributary originating from Greenwood Heights called 20 Gallon Creek. This barrier, a log and rock debris dam, created an impassable waterfall. The barrier was situated at the juncture of Atwell with Melbourne soil; it was located at the lower end of a reach made unstable by road and railroad construction, logging and instream logging debris. The barrier washed out in April 1980. However, both banks being composed of "blue goo" Atwell soil continue to visibly erode even at moderate flows.

Several other large debris dams containing logs with sawn ends occur in the ½ mile upstream from 20 Gallon Creek to the bedrock waterfall in a narrow gorge just above the locked gate. Because of the extent of streambank disturbance by construction of the railroad and road bed, it is not known how long this area has functioned as a barrier to migration.

Most tributaries to Jacoby Creek are blocked to fish passage by roads and culvert placement. Examples of these "hanging" tributaries can be seen where Jacoby Creek Road crosses Rebel and Snag Creek and where Quarry Road crosses Cascade Creek.

Spawning

For spawning, coho prefer well-shaded riffles with gravel up to 4" in diameter (Moyle, 1976). Harper (1980) found most of the coho redds (nests) between the Golf Course Creek and the flat below S. Quarry (reaches 3, 4 and 5 of the fish habitat survey) and that females composed ¼ of the population. Using the side of her body, the female coho makes a redd, a 2-4 foot long depression in the stream gravel. As one or more males release milt, the female deposits 1,500 to 3,500 eggs in the redd.

The female coho stays in the vicinity of the redd for about 2 weeks before dying. From the time of spawning she drives other fish away from the eggs. Males die after spawning, but do not stay in the vicinity of the redd.

Harper (1980) found steelhead generally spawned higher in the stream system than coho: from the flat below S. Quarry to the barrier to fish migration (reaches 6-7). Steelhead redds are often more circular than those of coho, are composed of a smaller diameter spawning gravel, and are usually located at the lower end of a pool where stream velocity is increasing (Brock, 1978).

Steelhead may live after spawning. Harper (1980) found 17% of steelhead on Jacoby Creek were spawning for the second time. A steelhead caught off the Alaskan Coast was judged from its scales to be eight years old and to have spawned four times (McNeil and Bailey, 1975).

Hatching

The buried eggs depend on an intergravel water flow to provide oxygen and carry away carbon dioxide and ammonia. The eggs usually hatch in fifty to sixty days, depending on water temperature.

After three to four more weeks, the young wiggle up through the gravel.

Early Life

The emerged juveniles, called fry, live off their yolk sacs for 2 1/2 to 3 months after hatching and then begin feeding on plankton (Moyle, 1976). At first, fry school in the shallow stream edges. As they become parr (with the appearance of oblong dark elipses on their sides), the individual fish establish territories, focal points in the stream where the most time is spent. Generally coho parr occupy the shallow glides at the tail of pools, while steelhead parr prefer the head of pools and riffles. One year old steelhead and coho occupy pools. The juvenile salmonid's diet consists of insects fallen or blown into the water and aquatic insects, principally stone flies, caddis flies and mayflies.

Stocking History

Records of the California Department of Fish and Game show that Jacoby Creek has been stocked from 1930 to 1975 with coastal cutthroat and steelhead trout.

Figure 3.1

Stocking History of Jacoby Creek

Year	Species	Number	Origin
1930	Steelhead	50,000	Unknown
1936	"	7,000	Unknown
1938	"	5,000	Prairie Creek Hatchery
1939	"	10,000	" " "
1955	"	5,000	" " "
1962	Coastal Cutthroat	290	" " "
1963	" "	290	" " "
1964	" "	320	" " "
1965	" "	600	" " "
1966	" "	1,152	" " "
1975	Steelhead	200	Humboldt State University

Fish Habitat Survey Between May 22 and June 6, 1978, a fish habitat survey (Dunham and Collotzi, 1975) of Jacoby Creek was conducted from Highway 101 to the mouth of Rebel Creek, a distance of 5.8 miles. Transects were located 100' apart with 500' between each set of five. Each transect consisted of a line perpendicular to the direction of streamflow along which the following features were noted:

a) stream width and depth

b) width of the high water stream channel

c) width of pools and riffles

d) composition of streambottom material (boulders, rubble, gravel, sand or silt)

e) pool quality (depth and cover)

f) vegetation of streambanks

The stream was divided into seven reaches, and a total of 175 transects were made. Feature measurements along these transects have been summarized as five ratings. These ratings and the methods used to derive them are given below.

Pool Measure: This rating indicates the width of pools relative to the width of the stream. A score of 100% is given if the pool width is 50% of the total stream width or greater. If pool width (p) is less than 50%, then the pool measure rating = 100-(50-p)x2.

Pool Structure: This rating combines the pool depth and amount of cover available with the pool measure rating. Pool structure rating =

$$100 \times \%\ \text{pool measure rating} \times \frac{\text{feet pools with good cover and depth}}{\text{total feet sample pools}}.$$

Streambottom: This indicates the ratio of gravel and rubble to the total feet of streambottom in the sample.

$$\text{Streambottom rating} = \frac{\text{feet gravel and rubble}}{\text{total feet in sample}} \times 100.$$

Stream Environment: This indicates the vegetative cover along the streambanks and is expressed as a ratio of the actual to the total possible points (trees = 4, brush = 3, grass and exposed = 1). Stream environment rating = $\frac{\text{total points for sample}}{\text{maximum possible points (8)}} \times 100.$

Habitat Percent of Optimum: This is a combination of the previous four ratings. Habitat percent of optimum =

$$\frac{\text{pool measure + pool structure + streambottom + stream environment}}{400}$$

Figure 3.2 gives the rating averages for each of the seven reaches. The habitat surveyed ranges from 32% to 48% of the optimum. Low scores are attributed to the narrow and shallow nature of the pools and to the lack of protective fish cover. The stream environment scores indicate there is considerable disturbance of streamside vegetation.

Figure 3.2

Average Fish Habitat Ratings by Reach

Reach No.	Location	No. of Transects	Average Habitat Percent of Optimum
1	Highway 101 to Old Arcata Rd.	29	32%
2	100' above Old Arcata Rd. to Golf Course Creek	49	39%
3	100' above Golf Course Creek to Brookwood Dr. covered bridge	9	41%
4	100' above covered bridge to Quarry Rd.	20	48%
5	100' above Quarry Rd. to 0.8 mile from Jacoby Cr. Rd. on Quarry Rd.	33	46%
6	500' above the uppermost transect in Reach 5 to 100' below Snag Creek	20	42%
7	400' above Snag Creek to Rebel Creek	15	43%

Reach No.	Average Pool Measure	Average Pool Structure	Average Streambottom	Average Stream Environment
1	20%	7%	52%	52%
2	20%	4%	80%	51%
3	20%	3%	95%	47%
4	29%	19%	85%	57%
5	22%	5%	88%	72%
6	7%	0	86%	73%
7	18%	3%	74%	74%

CHAPTER 4

STREAM CHANNEL STABILITY INVENTORY

The stream channel stability inventory was developed to evaluate the resistive capacity of stream channels to the detachment of bed and bank materials (Pfankuch, 1975). The inventory was conducted on a portion of Jacoby Creek in May and June of 1978.

Methods Two to three surveys were made in every 500' segment of the creek from Highway 101 to Rebel Creek, a total distance of 5.8 miles. Each survey was made at a distance of at least 100' from the previous one. At each survey location, a series of questions were answered concerning observable physical characteristics of the stream channel components: the upper banks, lower banks and channel bottom.

Scores were obtained from points, assigned according to the inventory directions. Low numerical values indicate that the reach is relatively stable, while high scores indicate instability. The scores for the different stream sections, summarized in Figure 4.1, represent the average of the survey scores in a particular reach.

Figure 4.1

Summary of Stream Channel Stability Inventory

Section	Average Score
Highway 101 Bridge to Old Arcata Rd. Bridge	128
Old Arcata Rd. Bridge to Golf Course Tributary	117
Golf Course Tributary to Quarry Rd. Bridge	109
Quarry Rd. Bridge to Flat below S. Quarry	121
Flat below S. Quarry to Snag Creek	111
Snag Creek to Rebel Creek	114

Highway 101 Bridge to Old Arcata Road

This part of the creek was the most unstable of the area inventoried. A levee embanks the stream throughout. At most sample points sloughing of the upper and lower banks was evident, especially near the mouth, and fine sediments and gravel 1" to 3" in diameter predominated. Bottom materials were loosely packed and were in movement during storm flows.

The flood plain area extends upstream 8,500 stream feet to near the Golf Course tributary at the 40 foot contour interval. Willow predominates in the lower part, frequently falling or growing into the channel, trapping floatable objects and causing deflection of flow into the banks. Nevertheless, willows make the banks more stable than if they were unvegetated.

This reach represents the former estuary which was eliminated by levees and dikes for railroads, highways and agricultural use. Embankments affecting the estuary zone were first constructed around 1875 with "improvements" through the marsh for the Old Arcata Road and the laying of a railroad bed, now known as the Bayside Cutoff. Later construction of levees on both banks of the stream, the railroad, and Highway 101, helped to reduce the estuary area further. Filling of the marshland for human habitation and agricultural activities still occurs.

The influence of winter high tides was observed to extend approximately ¼ mile upstream from the mouth just beyond the location of the fish trap. When heavy storm runoff corresponds to high tides, the tidal influence extends to Old Arcata Road which acts as a dike. The stream drops only about one foot in elevation from a short distance below the Old Arcata Road Bridge to the mouth.

On some parcels, riparian vegetation has been completely removed from the banks. Horses and cattle going into the stream to water have trampled the earth bare. Seven barbed wire fences cross the stream. A 60 foot PG&E right of way perpendicular to the stream cleared of willow overstory is maintained through the riparian zone.

Old Arcata Road to the Golf Course Tributary

Along this reach the streambank was unstable because of almost continuous undercutting and sloughing. Research of aerial photographs is necessary to determine if the channel is actually widening.

Riparian vegetation, predominantly willow, stabilized the banks in only a few places. In most areas severe disturbance has occurred, especially in the upper part of the reach. Here signs of mowing were apparent and cattle were seen in the stream channel.

To protect property loss during flood waters some residents have "riprapped" the streambank with rock, pieces of concrete and car bodies. A large field of rock rubble near the middle of the reach at the large meander is noteworthy. Nine barbed wire fences and two bridges cross the stream.

Golf Course Tributary to Quarry Road Bridge

This section rated as the most stable because high scores above the Brookwood Bridge resulted from old growth vegetation stabilizing the streambanks. A few small wooded unleveed active floodplains occur along the reach.

The lower bank materials were commonly 3" to 6" in diameter with some rock fragments and bedrock. The size of bottom materials and the stable rock frequency are greater than that found in the lower reaches.

The riparian vegetation of willow and Red Alder and other brushy species has been substantially cleared along the banks of most parcels, especially below Brookwood Bridge. In some areas of the Brookwood Subdivision, the riparian zone had been mowed, making the stream an accessible part of the backyard.

Quarry Road Bridge to Flat below South Quarry

Flow obstructions and deflections which cause bank cutting are more frequent here than downstream. On the left bank--designation of left or right is made looking downstream--logging occurred during the summer of 1978 (Timber Harvest Plan 1-77-1040H). Harvesting activities measured 15 to 20 feet from the stream edge at low flow. Operations were within the peak flow channel. A tractor had pushed stream gravel into the high flow channel, blocking it off. Streamside vegetation, including large alders and maples, were knocked down and left in the channel. The operation occurred along 925 feet of the streambank. A tributary, Cascade Creek, flowing out of Morrison Gulch, enters along the lower edge of the logged area.

The upper end of this reach is a flat devoid of vegetation. An easy ford of the stream exists here. Continual disturbance by automobiles and other human activities prevents the establishment of vegetation. It appears that the area was a redwood-dominated floodplain before disturbance. Two culverted tributaries enter on the right bank.

Flat below South Quarry to Snag Creek

The upper banks were steep with little vegetative bank protection. Bedrock, boulders and cobbles were common in the sample reaches. Logs with sawn ends were present which deflected streamflow, causing bank cutting and deposition of new coarse gravel and sand in pools.

The bottom materials were slightly imbricated (overlapped) and had well-rounded corners and edges. Algae and moss were present on rocks in the upper end of the reach.

The remains of a bridge which crossed the stream from Quarry Road have aggraded the channel. The bridge was washed out during the 1964 flood.

Snag Creek to Rebel Creek The majority of surveys in this section showed that the banks were unstable. Numerous raw spots eroded by high water, are visible. The lower banks show almost continuous cutting.

Large numbers of logs and stumps were encountered from the middle to the upper end of the section. The former area was logged in 1967; the latter in 1972. Redwood stumps show that trees were taken from the riparian zone. Logs were also taken from the stream channel during harvest operations according to local residents.

There was little imbrication of the bottom materials. Surveys showed that about one half of the stream bottom was composed of stable materials.

A seasonal tributary, Snag Creek, enters at the beginning of the section. Snag Creek is aggraded with logs remaining from logging around the turn of the century. Parts of this tributary's drainage were logged again in 1964.

Formerly a bridge crossed Snag Creek in back of the house on the left bank. Now the main road crosses Snag Creek over two large culverts on the Jacoby Creek side of the house.

The activities of a rapidly developing quarry at the top of Eric Lane during the winter of 1977-78 added visible turbidity to Snag Creek. During storm flows of this period, Snag Creek was observed to be more turbid than Jacoby Creek.

Residents who had used Snag Creek water for drinking purposes prior to 1977, complained because of the increased amount of suspended sediment. Quarry operations were suspended by the RWQCB in early 1978, but the quarry reopened shortly thereafter. Despite attempted road bars, no mitigation of the contribution of suspended sediment from the interruption of drainages by the steep road to the quarry or the quarry itself has been accomplished.

Humboldt County has abandoned the Jacoby Creek Road at Snag Creek, 3.2 miles from the Bayside Grange. The road beyond this point is now private and is maintained by residents and mining and logging interests when access is needed. Each year after winter rains cause slumping and gullying, the road must be rebuilt. The culvert at Rebel Creek is broken in the middle. Other culverts, are inadequate to handle peak flows. The ones at Snag and Rebel Creeks, which do not have trash racks, could easily become plugged during storm flows. An example of an inadequate culvert is the one at the Jacoby Creek - Eric Road junction. Five other culverts in this area are positioned so that runoff is directed away from natural watercourses.

A log bridge crossing of Jacoby Creek 2,400' upstream from Snag Creek was constructed during logging in 1967 (Schimps and Capps parcels). Materials from this bridge washed downstream and formed debris dams which have clogged the main channel. The blockage resulted in the formation of two additional channels, one of which is causing considerable bank erosion, even at only moderate flows.

A large "blue slide" near the upper end of the reach has an unprotected slope toe of Atwell soil which continually erodes during storm flows. This area is discussed in Chapter 5: Soil Erosion Control.

Logging occurred on the upper part of Rebel Creek during the summer of 1978. The lower part of this tributary, logged for the second time in 1971, is still clogged with logs and slash, causing bank cutting during storm runoff.

CHAPTER 5

SOIL EROSION CONTROL

An indication of the amount of soil loss from the Jacoby Creek watershed is given by Pillsbury (1972) who estimated from suspended sediment samples that 1400 tons of sediment were being transported by a 1.6" storm of 54 hours duration. Ten storms of this magnitude were estimated to be typical of an average water year.

Four unstable areas were selected as sites for experiments to demonstrate methods of reducing soil loss. In general our efforts focused on providing for the overland flow of water, reestablishing natural drainages, and stabilizing undercut streambanks and surface soil movement so that natural vegetation could recover.

Erosion Control Methods and Structures The following methods were used at the worksites:

Culvert placement and design Culverts should be of sufficient capacity to handle peak flows, and they must be maintained during storms to keep them from becoming plugged. A trash rack installed at the culvert inflow combined with a headwall built of rocks protects the embankment.

The culvert outflow should be directed to a natural watercourse. Culverts channel water in a manner similar to that used in hydraulic or placer mining. During times of high flow, a considerable force is directed at the outfall area.

Culverts are often placed in the road fill at grade level, with the end elevated above the ground. Culverts installed in this manner give the water greater kinetic energy that it formerly had requiring additional protection of the outfall area. Logs, large rocks, or rock-filled wire baskets (gabions) can be used for this purpose.

Water bars A water bar is a drainage ditch which directs surface runoff from a dirt road or trail. Water bars supplement culvert placement; they serve to lessen storm damage to roads. Water bars prevent the concentration of runoff in a few drainages below the road which would likely result in erosion problems. Water bars should be placed to approximate the natural drainage pattern interrupted by road construction.

Water bars must be located and angled properly to divert water from the road onto a non-erodable vegetated or rocky area which will absorb the energy of the runoff and thus prevent erosion of the slope below the road. Water bars must be deep enough to carry the flow during peak storms, and the berm along the lower edge of the ditch must be high enough that it won't be overtopped. Water bars need to be maintained during storms.

Checkdams A check dam channels runoff and catches sediment. It functions by slowing down the velocity of water, causing the sediment to be deposited. The checkdam must be securely anchored into the bank and notched to allow water to pass during peak flows. Water should spill onto a splash-board, rocks, logs or a gabion. Checkdams are usually arranged in a series so that each dam is constructed above the expected sediment plain of the one below. For more detailed information concerning checkdams and other erosion devices, consult specifications available at Redwood National Park headquarters.

Wattling Wattle rows serve to slow surface runoff, trap sediment and, as live cuttings sprout foliage and develop roots, stabilize and protect the soil.

Using an abney level to determine the slope contour line, guide stakes are driven to a firm hold at least 15" deep perpendicular to the slope. A level trench 8" wide and about 4" deep is dug directly behind the guide stakes.

The trench is filled with 2½" diameter bundles of live willow cuttings and conifer boughs. The necessity of covering the willow bundles with soil depends on the season and the soil type, but generally they are covered to prevent drying.

Live willow stakes about 2½' long and 1" to 2" in diameter are planted between the guide stakes about 18" apart. If several contours are planted, the spacing is arranged so that workers can stand on the previously completed trench.

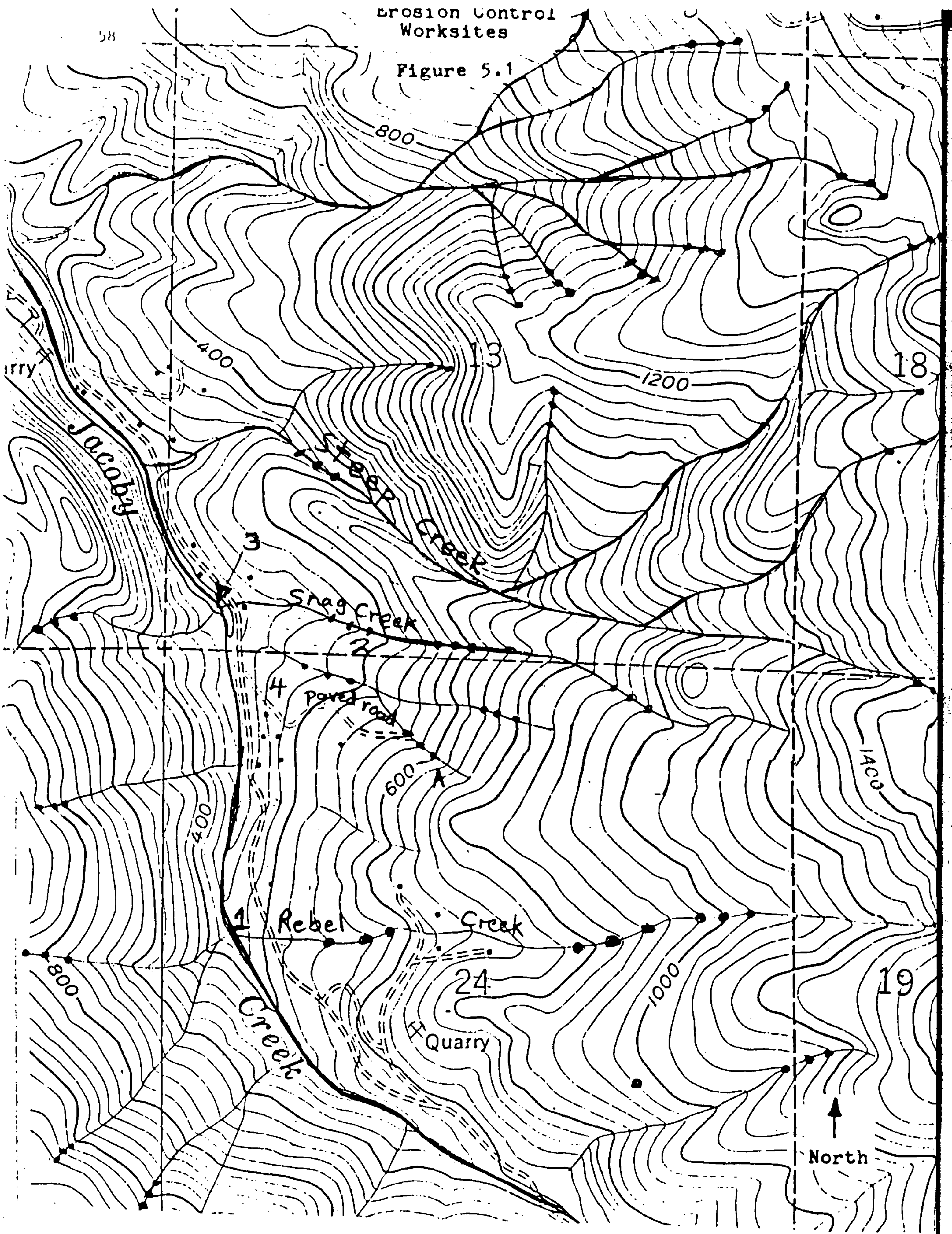
Staked limbs or rails In areas of mudflow or very loose soil where wattling would be quickly engulfed, small diameter limbs or split rails may be staked on the contour to catch mud and debris. Willow and/or other woody species are planted to hold the little retaining walls in place and to provide long term stability and cover for the growth of other weedy species which help hold the soil in place. Staked limbs or rails can be combined effectively with wattling, since staked limbs can be used on steeper areas where wattling might be impractical.

Cribbing Cribbing is used to stabilize road cuts, fill or sidecast areas and streambanks. Cribs are constructed of logs or formed concrete elements. The side arms must be securely anchored into the bank. The finished structure resembles a three-sided log cabin filled with rock.

The crib is placed as close as possible to the bank on a solid foundation and is constructed to withstand peak flows. The crib is packed with large rocks and planted with willow and redwood to provide for its replacement in time by natural vegetation.

Erosion Control Worksites

Figure 5.1



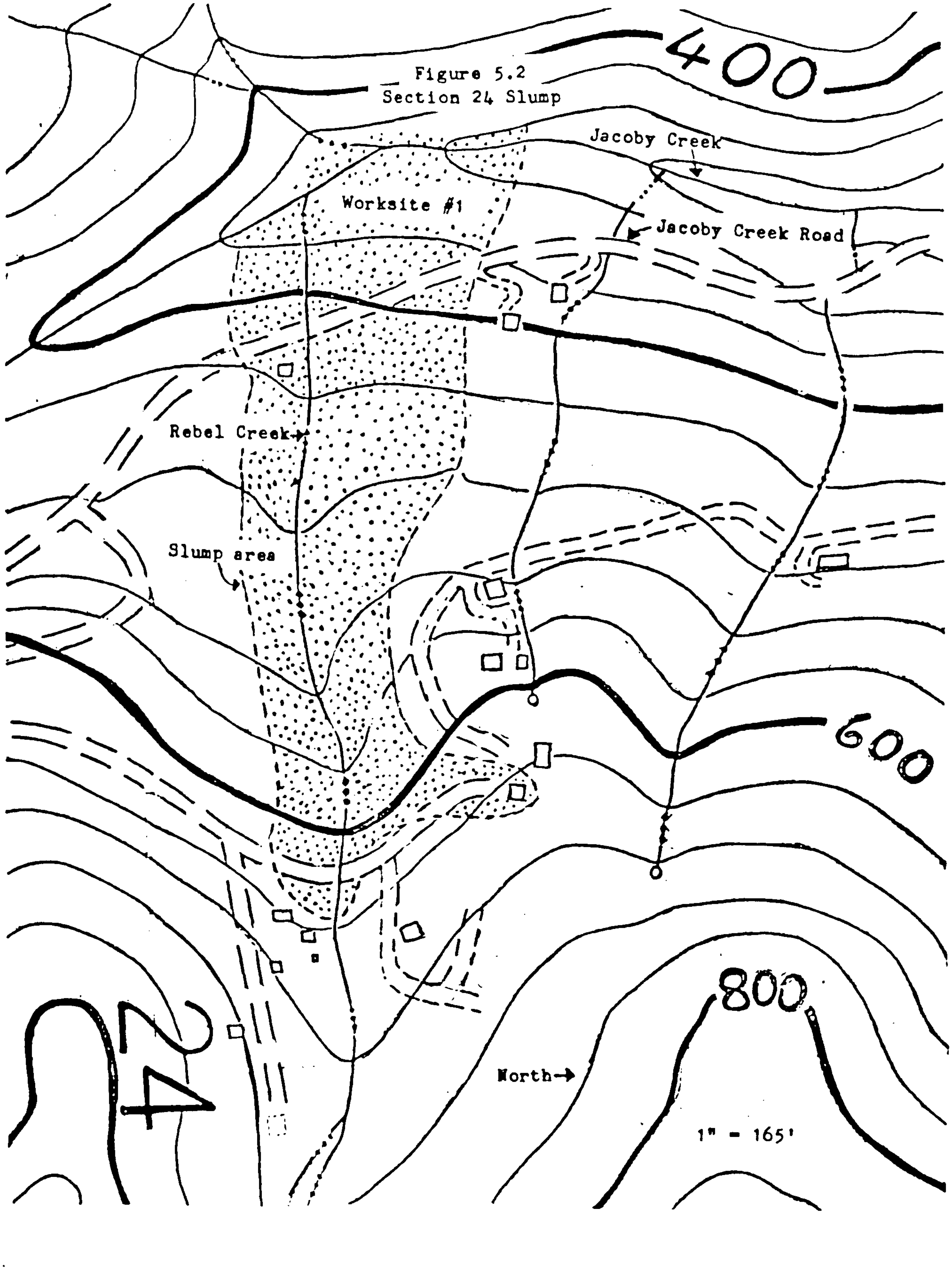


Figure 5.2
Section 24 Slump

<u>Erosion Control Worksites</u> The following is a description of the four work sites, their treatment and a discussion of the results (site locations are shown on Fig.5.1):

<u>Worksite #1</u> This site is the base of an Atwell soil ("blue goo") slump located in T. 5N, R. 1E, Section 24 (see Fig. 5.2). The site is approximately 100' long x 70' wide and has a southwestern exposure. Jacoby Creek has cut a narrow gorge just below the worksite. A second-order wet season tributary, Rebel Cr., joins Jacoby Cr. along the southern edge of the site. Jacoby Cr. Road crosses the slump about 70' above Jacoby Cr.

Looking up the slope above the road, the swoop of the trees indicates that the basin of Rebel Cr. (Atwell soil type) is slipping away from the ridgetops (Melbourne soil type). A dramatic example of land movement is a severely tilted chimney and house foundation caught up in the slide near the top. The extent of the slump as judged from leaning trees and open fissures is indicated by the dotted line on Map 5.2.

About ¼ mile above Jacoby Cr. Rd., another road crosses Rebel Cr. Between these roads, Rebel Cr. contains much sediment and debris and considerable bank cutting is apparent. Mass movement is indicated, accelerated by the harvest of stabilizing trees along Rebel and Jacoby Crks. and by tractor skid roads and yarding of logs during timber harvest operations in 1972.

The design of Jacoby Cr. Rd. also contributes to the landslide along the creek. In particular problems arise from culvert placement, the lack of sufficient water bars or culverts on Jacoby Cr. Rd., and a collapsing culvert at Rebel Cr. The channel of Rebel Creek below Jacoby Cr. Rd. is clogged with Douglas fir stumps, a huge rock, an old culvert, and debris from an old railroad trestle, causing bank cutting. In addition, an old growth redwood log,

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6' in diameter and about 20' long, located about 35 yards upstream from the mouth of Rebel Cr., diverts Jacoby Cr. into the slump.

Site #1 treatment 1977 During the summer of 1977, a crib was constructed at the confluence of Rebel and Jacoby creeks. Also in this area rocks were moved from the center of the channel of Rebel Cr. and stored behind a log retaining wall along the right bank. Debris not anchored into the bank was removed to the hillslope, and small flow diverters were installed along the right bank to direct water away from the unstable bank into the natural channel.

On the slope above the right bank of Rebel Cr., redwood limbs were staked in contour rows with live cuttings of species from the vicinity, including: willow (Salix lasiandra), alder, coyote brush, salmon berry, bearberry blackberry, thimbleberry and redwood. A wood chip mulch was spread over the slope to retain soil moisture.

In the fall, the area was sown with seeds collected in the vicinity of the slide: sweet clover, thistle, Italian wild rye, lion's tooth, lupine and cat's ears.

Site #1 results 1977 The crib was undercut from behind and disassembled after the winter storms. Most wattles and staked limbs were filled with flowing gray mud, activated by torrents which flowed down the road onto the slide. The log retaining wall along the right bank of Rebel Cr. held and gave the streambank and hillslope stability. The channel definition reduced streambank erosion and thus upper slope movement. The alder and coyote brush cuttings did not sprout. The cuttings of willow, salmonberry, redwood and thimbleberry sprouted, as well as the seeds of sweet clover, lupine, lion's tooth and cat's ears. Wattled areas caught mud flows and prevented lower planted areas from being covered by mud.

Site #1 treatment 1978 Treatment during 1978 consisted of wattling more of the slope between the confluence and the road and along the right bank of Rebel Cr. The mudflows of 1977 were replanted and more staked limbs were installed. The log retaining wall was lengthened along the right bank of Rebel Cr. More stumps and logs were removed from the tributary channel, and part of the large redwood log upstream in Jacoby Cr. was removed.

Site #1 prognosis The flood flows of Jacoby Cr. and the water running down the road aggravate the inherent instability of unvegetated Atwell soil. It will take a concentrated effort and dedicated maintenance to prevent further mass wasting and soil loss.

New mass movement is occurring (1980) immediately downstream in the narrow gorge, just above the Twenty Gallon Creek confluence. The right bank has been made unstable by alterations to provide for roads and homesites so that runoff no longer follows the natural drainages. Drainage alterations in the entire Rebel Cr. basin need to be comprehensively treated. Rehabilitation should include: use of crib or other stabilizing structures along Jacoby and Rebel creeks, stream clearance of Rebel Cr., removal of the large redwood log from Jacoby Cr., installation of checkdams, water bars, water ladders, wattling, staked logs, a bridge or arched culvert at Rebel Cr., and the planting of additional vegetation.

Worksite #2 This site is located at the end of an unpaved driveway approximately 0.3 mile up Eric Lane, a dirt road which takes off from Jacoby Cr. Rd. 3.2 miles from the Bayside Grange. The site is in T. 5N, R. 1E, Section 13. The driveway cuts across an unstable Atwell soil slope of Snag Cr., a tributary of Jacoby Cr. Snag Cr. is 15' to 30' below the driveway. A new bridge crosses the creek to a house on the right bank. On the left bank, another house is situated about 30 yards above the top of the slide.

Prior to the subdivision and development of the area in 1976, a logging road bridge consisting mostly of logs and fill, crossed Snag Cr. here. Since 1976, the channel of the creek has widened and deepened at the crossing as flood flows have removed fill materials. The vegetation in the slide area was alder with an understory of Western Coltsfoot.

Site #2 treatment Logs were staked in place in the tributary channel to divert streamflow away from fill slopes. Redwood logs were staked horizontally along the edge of the driveway at the base of the slide, and the slide cut bank was wattled using redwood and alder.

Site #2 results The structures in the stream channel were swept away by storm flows during the 1977-78 winter. The blue goo slump continued to creep onto the road so that residents had to remove some of the logs at the base of the slide in order to use the driveway. By the end of the winter, the slump made the road impassible, except on foot. The slump was observed to flow at least 6' around a power pole during the winter. The alder and redwood cuttings sprouted but did not survive.

Site #2 prognosis Mass movement continued in this area. Residents cleared the driveway of mud and cut away overhanging vegetation on the lower part of the slump. The top of the slide in 1978 formed a steep cliff just below the recently completed upper house. Residents were considering excavation of slide area.

Factors contributing to the instability of the area included: the road at the base of the slide, water from domestic leach fields and runoff from the upper portion of Eric Lane around the quarry.

Worksite #3 This site is located at the end of the pavement of Jacoby Cr. Rd., 3.2 miles from the Bayside Grange, in T. 5N, R. 2E, Section 13. The right bank of Jacoby Cr. is composed of road fill. The area was being constantly disturbed by traffic to the stream. The site is bordered to the east by Snag Cr. where it discharges from culverts into Jacoby Cr.

During heavy rains, runoff from Eric Lane flows down the road and onto the work site. A culvert at the foot of Eric Lane has insufficient capacity and is not properly located to carry the flow of the ephemeral tributary which Eric Lane intercepts. This culvert has a 90 degree elbow at the uphill end and becomes plugged at peak flows because of the volume of sediment contributed by grading and the design of Eric Lane. The culvert does not have a trash rack or an outflow area.

Before treatment, the site was sparsely vegetated with horsetail, velvet grass and Italian Wild Rye grass.

<u>Site #3 treatment</u> Treatment of the slope adjacent to Snag Cr. consisted of wattling and staked logs. A path to Jacoby Cr. was established. Redwood, willow and alder cuttings were planted.

A water bar was built to channel the overflow from the culvert at the foot of Eric Lane directly across Jacoby Cr. Rd., and a checkdam was constructed at the lower end of the water bar to protect the edge of the road from erosion.

<u>Site #3 results</u> The terracing effect of the erosion control devices and the definition of a single trail to the creek lessened the overall disturbance and soil movement on the slope. One new small eroding area on the slope appears to have been caused by a portion of the trail which was not constructed along the contour of the slope.

The checkdam at the foot of Eric Lane functioned until January, 1979, when the culvert became plugged at the inflow for an extended period of time. Consequently the entire flow spilled across the road and around both sides of the checkdam, making it ineffective.

Site #3 prognosis The 90 degree elbow culvert should be replaced by an arch culvert or small bridge and relocated about 15 yards up Jacoby Cr. Rd. from its present location. Reconstruction of the upstream drainage pattern and a series of checkdams are needed along Eric Lane to mitigate the excessive sediment contribution from this road.

Worksite #4 This site is located in T. 5N, R. 1E, Section 24, along the north side of the steep (15 degree) paved road between the first two left-turning driveways. The work site is a 330' long gully in Melbourne soil which varies in width from 3' to 22'. The gully is the result of the concentration of storm runoff on a new drainage area. A seasonal tributary, indicated on Map 5.1 as "A", has been diverted above the worksite into the roadside ditch.

Site #4 treatment Gully slopes were wattled with alder, Sitka willow and Red Flowering Currant, and six checkdams were constructed in the gully bottom.

Site #4 results The checkdams were filled with sediment by the end of 1978. Willow and currant sprouted; alder did not.

Site #4 prognosis Many more checkdams are needed. Wattling should use Sitka willow, Red Flowering Currant and rush (*Juncus* sp.). A culvert outfall should be installed at the top of the gully. The entire drainage should be investigated in conjunction with the adjacent drainage intercepted by Eric Lane.

CHAPTER 6

LAND USE

The Wiyot People

The Jacoby Creek watershed was within the territory of the Wiyot people for a very long time - at least 2,000 years and probably longer (Hedlund, 1978). The Wiyots were related to the Yuroks; both spoke languages of the Algonquin family. Other languages of this family include Arapho, Blackfoot and Cheyenne (Loud, 1918).

Wiyot was the southern extension of a distinctive northwest coast culture which ranged from Yakutat in southern Alaska along the Pacific Ocean frontage to Cape Mendocino. This non-planting (except for tobacco) and non-animal breeding culture was perhaps the most elaborate in the world (Kroeber, 1962).

The Wiyots were bordered on the north by the Yurok at Little River, and to the east and south by Athapascan tribes; Chilula, Whilkut, Nongatl, Sinkyone, and Mattole. While relations were friendly with the Yuroks, there were hostilities between the Wiyots and the Athapascans (Loud, 1918). For example, conflicts were reported over Kneeland prairie, as both Wiyot and Whilkut used this area for hunting and gathering.

The Wiyots, estimated to number 1,000 before contact with the whites (Kroeber, 1953), occupied the Mad and Eel River floodplains and the drainages of Humboldt Bay. Every settlement was close to water; the majority at tidewater (Kroeber, 1918). The trail between Wiyot camps skirting the marshy lowlands later became Old Arcata Road (Hedlund, 1978). The area between the Bayside Cutoff and Anvick Road was particularly densely populated. The Wiyot name for Jacoby Creek was CIRUKTOMI -- i as in b<u>i</u>t, c as in cell or say (Northwest Indian Cemetery Protective Association in Hedlund, 1978).

Archaeologists studying the potential impacts of the proposed widening of the Old Arcata Road have expressed concern about the potential damage to historical artifacts and burial grounds in this area. Another village site was near the South Quarry Road bridge.

The tribe lived on the edges of a forest so dense, it was comparable only to the rainforests of the tropics (Loud, 1918). They were fine trappers. With iris-rope snares they caught elk, bear and deer. The bow was used for targets under 50 yards (Loud, 1918). Birds were an important part of their diet, including ducks, geese, pelicans, gulls and cormorants. However, their mainstay, salmon and steelhead, surf fish, clams and seals was from the sea, the bay, and streams such as Jacoby Creek.

Huckleberry was the most important berry. Seeds of grasses and members of the sunflower family were ground into flour or parched and eaten dry. The blossoms and leaves of clover (Trifolium sp.) were eaten raw. Sweet anise (Perideridia kelloggii and P. gairdneri) stalks were eaten after the skin was removed; its tuberous roots were eaten also. A medicinal tea was made from roots of the nettle plant (Urtica lyalli); the stem fibers were used for twine.

Houses were made by splitting redwood with elk horn wedges into planks 10' to 16' long and 2' to 5' wide. The houses were often nearly square with sides 10' to 16' long. Several small plank houses were in the vicinity of the old Jacoby Creek School in 1857 (Loud, 1918). Redwood was also used in making dug-out canoes. Vessels commonly 18' long and 4' wide were made from a log hollowed out by fire.

The California Gold Rush marked the beginning of the end of the Wiyot Indians as it did many other tribes in the state. The Wiyots had little contact with western civilization before white men began arriving in large numbers in the 1850's (Loud, 1918).

The promise of easy money drew from the world at large the wildest, most savage and dangerous men ever collected in a likesized area anywhere in the world (Loud, 1918). Law was essentially absent. The Wiyots were at the mercy of the whites and their guns.

From the beginning, the Wiyots were evicted from their lands. The introduction of domestic animals and plants and the clearing of land interfered with the life the Wiyots had evolved. The Athapascans, who were more dependent on land-based resources were first affected. Market hunters and cattle herds depleted wild game and habitat. For self-preservation, Athapascans started preying on cattle. As a matter of course, "punitive expeditions" followed. These forays usually meted out punishment to the closest group, without due process or consideration of tribal affiliation.

In the fall of 1858, a few months after the killing of two whites (one of whom was Paul Boynton at Boynton Prairie) the state commissioned a 90 man militia. In a short time this militia had killed 100 persons and had taken 320 captives from tribes neighboring the Wiyots; Chilulas, Whilkuts and Nongatls.

In 1859, J.R. Browne, a Special Agent for the U.S. Treasury Dept., wrote that many Indians had been killed by private companies the previous winter and spring, and that the Wiyots were being starved, hunted and slaughtered without regard to age or sex (Hedlund, 1978).

The scene was then set for a series of raids, including a terrible massacre on Indian Island in 1860. Here 50 or 60 persons, mostly women and children and mostly from the Mad River area (Loud, 1918), were hacked to death with knives and axes by persons from the Eel and Van Duzen River areas (most likely Larabee and Seaman Wright's group). Murders from this attack and others coordinated with it on the south spit and Eel River resulted in about 150 Wiyots killed. The perpetrators of these killings were never brought to justice. At first newspaper accounts tried to minimize these events, but eye-witness accounts reaching the San Francisco newspapers presented more complete stories.

The Wiyots were then taken to the Klamath, Smith River, and Seiad Valley Reservations for their own safety. This same reservation policy was applied disastrously to other native American groups during this time period (Navahos). While in confinement a large number died of starvation or disease. Reports of the Superintendent of Indian Affairs in 1862 and 1863 are concerned with the conditions on local reservations and the inadequate provisions for feeding and shelter (Loud, 1918).

It took only 10 years for the Wiyots to be displaced from the land. The 1910 census listed only 152 Wiyots, 58 of whom were fullblooded (Loud, 1918).

Colonization Period

In 1853 Elizabeth and Augustus Jacoby built a house on their 240 acre claim near the present Bayside Post Office. He was from Prussia, and she was from Nova Scotia. Jacoby established a rock quarry from which the original fireproof bottom of the Jacoby Storehouse was constructed. After Elizabeth died in 1861, Augustus moved to San Francisco. In 1868 he sold the property to Austin Wiley (Hedlund, 1978). Wiley, as editor of a Eureka newspaper, wrote a justification of the Wiyot massacre on Indian Island in rebuttal to Bret Harte's account.

In the 1860's the Jacoby Creek bottom land was covered with dense underbrush of alder, willow, pepperwood and cottonwood. Elk, deer, and bear were still common, and the stream was filled with salmon and "speckled beauties" (Arcata Union, Nov. 5, 1887).

Many of the early residents of the Jacoby Creek area were from eastern Canada and the northeastern U.S. This was especially true of those who worked in the lumber camps. The 1860 census shows that out of 114 men listed as having an occupation in the timber industry, 46 were from New Brunswick and 31 were from Maine. Most immigrants continued in the lumber occupation with which they were familiar in their country of origin. The censuses of 1870 and 1880 show immigration following this same pattern (Hedlund, 1978).

During the first 30 years of the timber industry most of the logs had been cut near tidewater or along river banks and floated to the mill (Melendy in Carranco, 1971). When this accessible resource was used up, oxen and horses were used to skid logs to water access. Railroads came into the picture in the 1870's and 1880's and the mill's range was extended. Railheads then became depleted of timber, and the problem was how to get the logs to the railheads profitably. In 1881, the Dolbeer Steam Logging Donkey revolutionized the industry by replacing oxen.

Operations of the Dolbeer and Carson Lumber Co. began in 1875 in the Washington Gulch area. Logs were taken to the bay by means of a railroad line along what is now the Bayside Cutoff and then rafted to Eureka (Thornburg, 1969). Log cars came downhill on their own momentum and horses pulled the empty cars back uphill. Bolts for shingles were taken to a mill near the Old Arcata Road. In 1876, forty men were employed in this area. The company's operation closed in 1898 (Fountain, Vol. 23).

Another company important to the history of Jacoby Creek is Flanigan and Brosnan. This company was formed in 1876. It was a partnership of Flanigan, Brosnan, Harpst and Gannon. In 1882 the firm built a regular gauge logging railroad 1-1/2 miles up Jacoby Creek (Humboldt Times, Dec. 24, 1881). The firm's shingle mill, cookhouse, store, four stall train shed, warehouse and several cabins for workers were located across the street from the present Bayside Post Office. The company continued under the name of Bayside Mill and Lumber Co. until timber was exhausted in 1913 (Fountain, Vol. 23).

The road beside the railroad tracks going up Jacoby Creek on the north bank was first called Railroad Drive. Eventually the tracks extended to the headwaters region, about 10 miles. Johnson and Son and a Mr. Thompson had shingle mills up the creek. Rail loads consisted mostly of shingle bolts, logs, and rock and brush used for building the north and south jetties of Humboldt Bay. Material to be rafted to Eureka was taken to Gannon's Slough. The remains of this railroad bed through the marsh can be seen at the corner of Old Arcata and Jacoby Creek Roads. It is reported that a 50 ton Shay locomotive followed by a road engine once ran off a trestle into Jacoby Creek (Thornburg, 1969). The railroad was taken apart in 1926 (Johnson, 1972).

The standard logging practice in the redwood forest in the middle 1890's was to fell and cut the trees into logs, and then set a fire to burn away the debris, leaving the fire resistant logs (Melendy in Carranco, 1971).

The first mail carried to the Bayside Post Office, established in 1886, was by horse stage. Later a train carried mail between Arcata and Eureka across the marshlands. Mail was unloaded at the junction of Bayside Cutoff and the railroad tracks, then carried by wheelbarrow to the post office (then located near the Old Arcata Rd. Jacoby Creek bridge) over a three plank boardwalk (Thornburg, 1969).

By 1887, most of the houses in the watershed were owned by men who worked in the woods in the summer and fixed up their homesteads during the rainy season.

In 1896, the newly constructed Bayside Presbyterian Church was dedicated; the site was donated by the Flanigan and Brosnan Company; the lumber by Wm. Carson (Thornburg, 1969). In 1902 the second Jacoby Creek School was built at the Bayside Corners. The first School Board had purchased the site for $50 in 1875 (Thornburg, 1969).

Near the end of the first logging around 1910, the land ownership and use pattern was similar to that of today. A few owners, mostly companies, held most of the heavily vegetated timber lands, while on the flat lands of the lower part of the watershed and open prairies along the Kneeland and Fickle Hill ridges, family ownerships prevailed.

Swamp and overflow lands, the former marshlands, were "reclaimed" for pasturage. Parcels along traveled ways became more valuable and smaller. Access often determined the shape of the parcel. For example, short property widths along access and deep long sides allowed a maximization of property value.

The ownership history of the Arcata Forest parcel provides an illustration of land use and transactions, from its withdrawal from the public domain in 1880 to the present time.

History of Arcata's Jacoby Creek Forest

The City of Arcata owns 561.9 acres of land in the upper part of the watershed through which Jacoby Creek runs. The parcel is located in Section 30, Township 5M, Range 2E Humboldt Base Meridian. The following information on property ownership is from deeds in the Humboldt Co. Recorder's Office.

Frank McPhee filed on 160 acres of public domain Dec. 30, 1880 and sold his rights a week later on Jan 6, 1881 to O. H. Spring for $50 "gold coin in hand."

Twenty years later, the 160 acres was purchased by John Harpst. Upon his death, ownership of the land passed to Kate Harpst on May 11, 1907. The property was sold to Bayside Lumber Co. on Jan. 21, 1911. It was most likely logged by 1913. On May 26, 1916 the parcel was placed under the name of Ambia Benjamin and combined with 200 adjacent acres. The resulting 360 acre parcel was sold the same day to J. N. Lentell.

Lentell bought another 160 acres in Section 30 on July 29, 1916 from Edward and Eleanor Putnam, who had purchased the property from the estate of Truman Collins on June 19, 1916. In July 1923 Lentell applied to the State Dept. of Public Works for water rights on Mad River and Jacoby Creek on behalf of the Eureka water supply. In September 1934, Lentell acquired ten more acres, bringing his ownership to a total of 530 acres.

On July 2, 1943, a right of way to be used for hauling logs and timber products was acquired from Lentell by Charles R. Barnum. This right of way states that it is "exclusive to Grantee or assigns and is to connect with the exisiting County Road...." The deed also specifies that the right of way shall not be in excess of 40 feet in width and shall follow generally the east bank of Jacoby Creek. Prior to this time extensive commercial use of Douglas fir had not taken place.

At an informal meeting of the Arcata City Council on July 27, 1943 it was agreed that the City should acquire Lentell's Jacoby Creek property for $10,000 cash "as a future supply of water for municipal purposes." The Council decided the matter should be put on the April, 1944 ballot.

On March 7, 1944, the Council passed a resolution to let the voters decide whether or not to buy the Lentell property and water rights for $12,500 "for the purpose of future development as an additional water supply for the City of Arcata... ." On April 7, 1944, the Council received an estimate by the City

Engineer of $262,430 to carry water from the Lentell property to Jolly Giant Reservoir.

In the estimate, the amount of $50,000 was set aside for the "road from quarry to dam." The City Engineer noted "this piece of road is in very rough country and would be very expensive to build." On July 17, 1944, the City Council voted to purchase the property for $12,500. The transcation was completed on Aug. 4, 1944.

In August, 1944, Charles and Helen Barnum sold rights to build a road for $10. The road was to run from the north line of Section 31, northwesterly over Barnum rights of way in Sections 13, 14, 24, and 25 (T. 5N., R1E.) and Section 19 (T. 5N., R2E.). A 40' right of way was specified, except at such points where greater width is required to construct road without excessive grade.

Barnum reserved the right to use the road and assumed no responsibility for maintenance--"it will be done by the grantee, his heirs or assigns." Where the right of way passes over lands of other owners, the right of way is exclusive to grantee for timber and timber products from lands now owned.

City Council minutes of Sept. 1, 1944, show that N. Lucchesi had asked the City if they would be interested in sharing the expense of building a road to timber holdings he had recently acquired beyond the City's property.

On Sept. 25, 1944, the City Council passed a resolution accepting deeds to certain parcels of land and water rights from N. N. Lentell. The title reserved, however, oil and precious metal rights to other parties according to a 1916 deed and Charles Barnum's 1943 right of way. In 1977, adjacent landowners maintained that the City can grant access to its parcel only to City officials.

The Arcata electorate in 1948 rejected a proposal to dam Jacoby Creek in three places in the City's forest.

In 1977 the City hired Natural Resources Management Corporation (NRM) to determine the worth of timber on the property. The NRM Inventory, costing $28,000 was completed on Feb. 20, 1978. The results were presented to the Council study session on April 4, 1978 by John Miles. The report includes options for obtaining income from the property which range from immediate patch clearcutting and sale of the land, to retention of the property with a series of "sustained yield" timber harvests.

Careful consideration of the data presented in the informative NRM Inventory suggests a need for further investigation to ensure the protection of watershed resources for recreational, scientific and educational use. The contribution of this part of the watershed to the year-long flow of Jacoby Creek and its aquatic life and to the water budget of the Arcata Bay should be assessed.

Other information which should be gathered prior to a decision on the management of the property includes:

1. Assessment of the impact of the timber harvest which occurred from 1911 -- 1913, as well as the impacts of recent timber harvests on adjacent lands with the same soil types and corresponding degree of slope. The assessment should include any changes in the distribution of plant communities and species.

2. Survey the condition of the Jacoby Creek channel and its tributaries throughout the forest to identify aquatic resources and areas needing bank stabilization, logjam removal or erosion control.

3. Reestablishment of the former USGS gauging station owned by Humboldt State University to resume measurements of flow patterns in the uppermost 6 square miles of the watershed.

4. Investigate the City's right to access to the property.

5. Investigation of the potential for using the streams in the forest as anadromous fish rearing areas. This assessment should include a fish habitat survey from Rebel Creek to the headwaters.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

The amount of soil erosion, the quality of the water, and salmon and steelhead productivity are indicators of the condition of the watershed. Evidence from these indicators points to a need for improvement. Planning recommendations are outlined for each of these areas below:

Soil Resource

Soil is the basic resource of the watershed. The standard of living of any area is directly related to the kind and quality of plants and animals the soil will support. Soil is protected and enriched by vegetation. The forest canopy has been removed twice over much of the watershed, causing increased runoff. Drainage networks have been disrupted by roads and railroads, resulting in the loss of soil, minerals, and biological productivity.

1. A watershed rehabilitation plan should be developed which includes a winter maintenance program. The plan should address the following objectives:

   a. stabilization of landslides along Jacoby Cr. and its tributaries;

   b. restoration of natural drainages impacted by paved and unpaved roads;

   c. return of sidecast material from failing landings and abandoned roads to cut banks, followed by revegetation;

   d. construction of sediment catchment basins to reduce sediment contributions from the quarries.

2. A county ordinance should be enacted to protect drainages from sedimentation caused by road and housing construction activities.

3. Timber harvest procedures should be modified to prevent erosion and sedimentation:

a. Logging and construction of roads should not occur in areas of extreme erosion hazard potential.

b. The timber harvest plan (THP) should state that the landowner is responsible for sources of sediment on the property until stabilizing vegetation has become established.

c. The THP review team should include an erosion control specialist experienced in watershed rehabilitation work.

d. The THP should include site-specific rehabilitation plans for areas the erosion control specialist considers likely to erode.

e. Slash burning of entire units after logging should be prohibited. Large fires burn too hot and destroy valuable soil humus. When slash fires get out of control, fire lines contribute to sedimentation problems.

f. A post-harvest inspection should be conducted by the review team, and significant penalties should be imposed for non-conformance with the filed THP and for repeated violations of the California Forest Practice Rules.

Water Quality

During the rainy season, effluent from many septic systems pollutes drainage ditches and Jacoby Cr. and creates conditions in which pathogenic organisms may flourish.

1. The Jacoby Creek Water District should be enlarged to include the portions of the Greenwood Heights, Kneeland and Fickle Hill areas which drain into Jacoby Cr. The possibility that some pollution of the creek originates from these areas must be considered.

2. New housing construction and new hook-ups to the Arcata water line should be prohibited until solutions to present water pollution problems are developed.

3. The JCWD board of directors should establish a compost toilet maintenance program. Grant funding should be sought to hire installation and maintenance personnel.

4. A wastewater treatment solution should be found as soon as possible for those areas draining into the marsh behind Jacoby Creek School, as the present situation could result in a serious community health problem.

5. A pamphlet should be prepared under the direction of the JCWD board of directors and distributed to residents of the watershed, listing chemical compounds and products which are known to be toxic to aquatic organisms and should not be used or disposed of in septic systems.

Salmon and Steelhead Habitat

Salmon and steelhead populations have declined during the last 35 years in streams of the Pacific Northwest. Many factors have contributed to the decline, and one factor is the deterioration in quality of freshwater habitat.

Protection of the soil resource and water quality will benefit the fisheries of Jacoby Cr. and Humboldt Bay. The following additional actions are needed to improve and increase existing habitat:

1. provision for fish passage at the barrier 6 miles from the mouth of the stream to allow access to upstream spawning beds;

2. provision for fish passage to tributary spawning areas cut off by roads with "hanging" culverts;

3. installation of logs and gabions in some areas to provide additional pools and protective cover;

4. revegetation of streambanks where the canopy has been removed;

5. The clearing of vegetation in the path of power lines by Pacific Gas & Electric Co. through riparian zones contributes to debris dams and sedimentation. Increased exposure to sunlight promotes algal growth, reducing fish habitat quality. The effects of this practice should be brought to the attention of the Calif. Dept. of Fish and Game and P.G.&E.

Watershed Planning

The following items should be considered by agencies in whose planning jurisdiction the Jacoby Creek watershed lies:

1. Subdivisions along the ridgetops of the watershed affect Jacoby Cr.

2. There should be a parcel-by-parcel determination of buildable lots. Lot split and subdivision proposals should address the effects of the proposed development and appropriation of ground and surface water (during both summer and winter flows) on the biological requirements of the stream and estuary. These issues should also be addressed on building permit applications.

3. Conversions from Timber Preserve Zone (TPZ) to agricultural or other zones should not occur. Other zoning classifications allow the permanent removal of forest canopy, resulting in increased runoff, sedimentation, and downstream effects such as landslides and channel erosion.

4. It should be recognized that Jacoby Cr. and the riparian vegetation are part of the public trust. Disturbance of vegetation within the riparian zone should require the approval of the Calif. Dept. of Fish and Game.

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