

Appendix C

M & M Consultants
Consultants Report

MAD RIVER: 1850-1925
THE EFFECTS OF FLOOD EVENTS
&
LAND USE ON SEDIMENT TRANSPORT PROCESSES

Presented to:
Humboldt County Department of Planning
3015 H Street
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Introduction

The transport and disposition of sediment in any given segment of river channel depends on many factors. Geology, climate, vegetation and land use activities being some of the more important variables. Each variable is not mutually exclusive, and each interacts with the others. A river channel responds to changes in these variables by adjusting its morphology through time. The most rapid adjustment periods often takes place during "channel forming" events. At any given location on a stream, conditions may favor the erosion of a bank at that point, and deposition of sediment at some location downstream.

Little is known about sediment transport processes of the pre- and early sediment period on Mad River. An understanding of the geomorphic agents controlling sediment transport processes in the river, and how historic land use activities have acted as geomorphic agents is relevant when making well-informed management decisions, and will be the focus of this report.

In terms of sediment transport processes, river morphology and riparian vegetation, Mad River in the 1850's was a very different river than it is today. Many of the features that regulated the disposition of sediment through the river, such as riparian vegetation, were removed, thereby producing more rapid transport of sediments through the project reaches.

The location, spatial distribution, and nature of river meanders and locations of flood-induced bank erosion and sediment deposition provide a marker for exploring the changes in river morphology since first settlement took place. A review of the more significant events during the first 75 years of settlement will be presented as outlined below:

- 1). A description river morphology and vegetative conditions of the floodplains at a time shortly after the first settlers arrived in the early 1850's.
- 2). The geomorphic response of the river to flood events, and the reconstruction of the geomorphic history of the river between 1861 and 1925.

From this, the following evaluations can be made:

- 1). The interaction between flood events and early land use activities as explained in newspaper accounts of the time.
- 2). The role of land use activities on river morphology and sediment transport mechanisms .

The following three periods will be discussed separately:

- a). 1850 - 1889, *Early Settlement*.
- b). 1890 - 1917, *Big Floods, Aggradation and the Railroads*.
- c). 1917 - 1925, *Drought and the Onset of Bed Lowering*

The Study Site

The study site includes roughly the lower 25 miles of Mad River up to, but not including, its estuary. The study site will be broken into four distinct reaches based on general geomorphic features. Figure 1 shows the project reaches which are:

Reach 1: Sweazey Dam Site to Fish Hatchery

Reach 2: Blue Lake Valley- Fish Hatchery to Lindsay Creek

Reach 3: Lindsay Creek to North Bank Road Meander

Reach 4: North Bank Road Meander to Highway 101 Bridge

A few things to keep in mind

There are a few things the reader should keep in mind when reading this report:

- 1). Conditions in the upper catchment and surrounding hillslopes influence the delivery of sediment to the into the project reaches. Although not the main topic of this report, this should not be ignored when considering the origin of sediments.
- 2). Where the river can spread laterally across its floodplain, the amount and thickness of vegetation growing on the floodplain and terraces influences the rate of sediment transport and the sizes of sediment travelling through the reach. Hydraulic roughness is a term used to equate the degree to which physical features in a river bed and on the floodplain can slow water down as it flows.
- 3). River and floodplain management should take into consideration pre-existing conditions of a river when making decisions affecting the balance of sediments in the river.
- 4). A reasonable understanding of the role of geology and land use activities as geomorphic agents and as regulators of sediment transport processes will provide for better informed management decisions.

Abbreviations used:

SBF = Susie Baker Fountain papers, Humboldt State University

AU = Arcata Union, Arcata CA.

HT = Daily Humboldt Times, Eureka, CA.

FE = Ferndale Enterprise, Ferndale, CA.

WCS = West Coast Signal, Eureka, CA.

HDS = Humboldt Daily Standard, Eureka, CA.



Figure 1. The project reaches.

See figure 2

Methods

Mapping Early Settlement Features

The U.S. Coast and Geodetic Surveys of 1854 and 1874, and photographs of the time provide a glimpse of the landscape that existed when the area was first settled in the mid-1800's. To recreate the course of Mad River and the vegetation that existed prior to significant landscape modifications, the U.S. Coast and Geodetic Survey notes (Foreman, 1874) and plat maps were obtained. Pertinent spatial information, such as the location of the river course and slough channels, vegetation breaks and marker trees, was first traced from the map onto matte acetate. These features were then manually digitized using Intergraph software to develop computer-generated maps. Section corners and quarter sections were used as control points.

Flood Events, Land Use, and Geomorphic Changes of Mad River

The geomorphic changes associated with specific flood events and the people's responses to these events were reconstructed using original newspaper accounts contained on microfiche; the Susie Baker Fountain Papers, a collection of historic papers found in the Humboldt State Library; and Haynes (1986). Land ownership was obtained using the 1898 and 1921 Belcher's maps and descriptive information contained in newspaper articles. Site specific information mapped in the fashion explained above.

Summary

Large flood events combined with land use activities that precipitated bank migration dramatically altered the ways in which course sediments were delivered to and transported through the project reaches. Early land uses involved the clearing of vegetation on the floodplains and terraces along most of the project reach. The logging boom in the 1870's drove men and mills up the river and into Blue Lake valley where old-growth redwood and other timber on the valley terraces and lower hillslopes, were cut for lumber and homesteading. Early attempts to float the logs downstream to the canal resulted in severe bank erosion (Haynes, 1986). During the flood events of 1878, '79, and 1880, moderate to severe erosion took place along much of the project reach. This dramatically increased the volume of sediment entering the project reaches that had been previously stored in raised fluvial terraces. The channel's responses were bank migration and bed aggradation. At the same time, efforts were being undertaken to stabilize the banks and prevent channel migration at certain locations. These sites, a few floods later, tended to be targets of erosion and would often fail.

The most catastrophic flood year was 1890 when one storm after another resulted in erosion in a number of places. A late February rain-on-snow event did severe damage in Blue Lake, West End, around Valley West, and near the old canal. It was this flood that placed the confluence of the North Fork with Mad River in a mid-valley position. The net effect has been an increase in gradient of the channel and a more rapid transport of sediment through the Blue Lake valley, a situation that has persisted ever since.

By the 1890's, technologic advances and a greater demand for the export of lumber, encouraged the expansion of logging and railroading further upstream and in the tributaries, and the expansion of the city of Blue Lake. During the 1902, '03, and '07 floods, more bank erosion and landslides occurred, resulting in damage to many structures, now built closer to the river. This resulted in pulses of sediment deposition into the river throughout the early 20th century.

After 1917, few devastating floods occurred. By the early 1920's, little of the sediment once stored in the Blue Lake valley terraces remained, although logging operations higher in the catchment probably still contributed large amounts of sediments as a result of bank erosion and slides. River bars along Arcata Bottom provided copious amounts of gravel for many local projects. By the late 1920's, signs that the river bed was starting to downcut became evident, a trend which has continued to the present. Removal of sediments from the project reaches, both by nature and by human extraction at rates that exceed the rate of recruitment into them, has resulted in a "net negative" balance of sediments and the bed lowering observed today.

Geologic and Geomorphic Setting

Figure 2 shows some general geologic and geomorphic features which affect the project reaches. The delivery of sediment into the project area and its subsequent transport through it are strongly influenced by thrust faulting in the vicinity and is described below. For a technical discussion of regional tectonics, see Clarke and Carver (1991) and references.

Reach Description

Reach 1: Sweazey Dam Site to Fish Hatchery

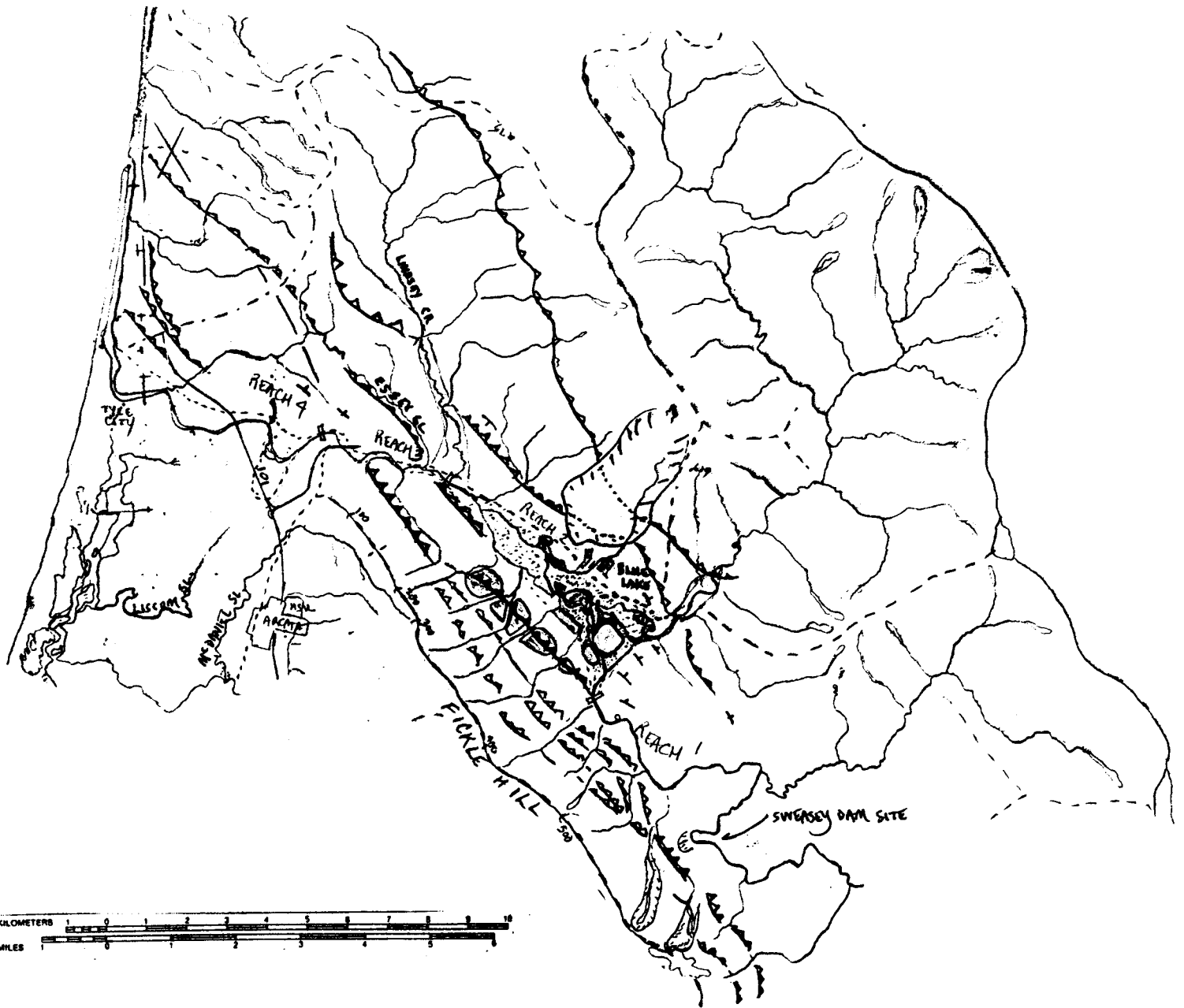
Reach 1 is a narrow canyon about 9 km long with a sinuosity of 1.6. The first 1.9 km is follows a northeast-trending ridge until it reaches the Canyon Creek meander. This meander is about 600 meters long by 400 meters wide and possesses at least 3 terraces. The river then flows west about 2.7 km contacting the Mad River fault zone where it deflects north-northwest. The river then parallels this fault boundary for the lowermost 3 km of this reach. From here, it empties out to the broad unconfined Reach 2, known as the Blue Lake valley.

Reach 2: Blue Lake Valley

Blue Lake valley is an elongated, triangular basin that has inflows; one at its southern end and one on its eastern end. The apex of the triangle is the outlet flowing northwestward. It is about 2 km wide along its southern base, narrowing to less than 1 km wide at its apex near Glendale. The delivery of sediments into the valley comes from several sources. The most relevant input of coarse sediments (gravels and cobbles) into the valley comes from the main stem Mad River. Its drainage area (da) is about 780 km² and flows into the valley from the south. The North Fork Mad River has a drainage area about 7.5 times smaller (da =105 km²) and entered from the east. Relative to the main Mad River, the North Fork probably contributes an additional 10-15% the amount of sediment to reach 2.

The valley is sandwiched between thrust faults of the McKinleyville and Mad River fault zones. This faulting increases the quantity of sediments entering the valley. Three steep, fault-bound gulches (Quarry, Palmer and Kelly Creeks) descend from Fickle Hill contributing sediments along the western margins of the valley. Episodes of earthquake-induced slumps, earthflows, and debris torrents have occurred down these gulches that have incised uplifted fluvial terraces at their bases. Descending down the southwestern flank of Liscom Hill some

time in the recent geologic past was a large earthflow (figure 2) that probably dumped a wide mix of sediments across the northern margin of Blue Lake valley.







-
-  Earthflow
 -  Thrust fault
 -  Uplifted fluvial terrace
 -  Strike and dip of bedding

Figure 2. Some general geologic and geomorphic features affecting sediment delivery into the project reaches.

On the periphery of the valley are uplifted fluvial terraces. Trenches across the McKinleyville fault near the town of Blue Lake showed late Pleistocene and Holocene river terraces that are offset due to thrust faulting (Carver, et al., 1991). Thrusted overbank floodplain sediments and scarp-derived colluvium were found representing 4 distinct events, occurring at roughly 3,000-5,000 year intervals, with the last one occurring more than 660 years ago (Carver, et al., 1991). Each event had 3 to 3.5 meters of slip on a northeast-dipping fault (Carver, et al., 1991).

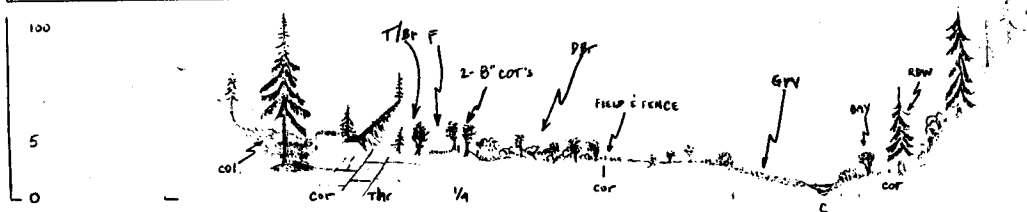
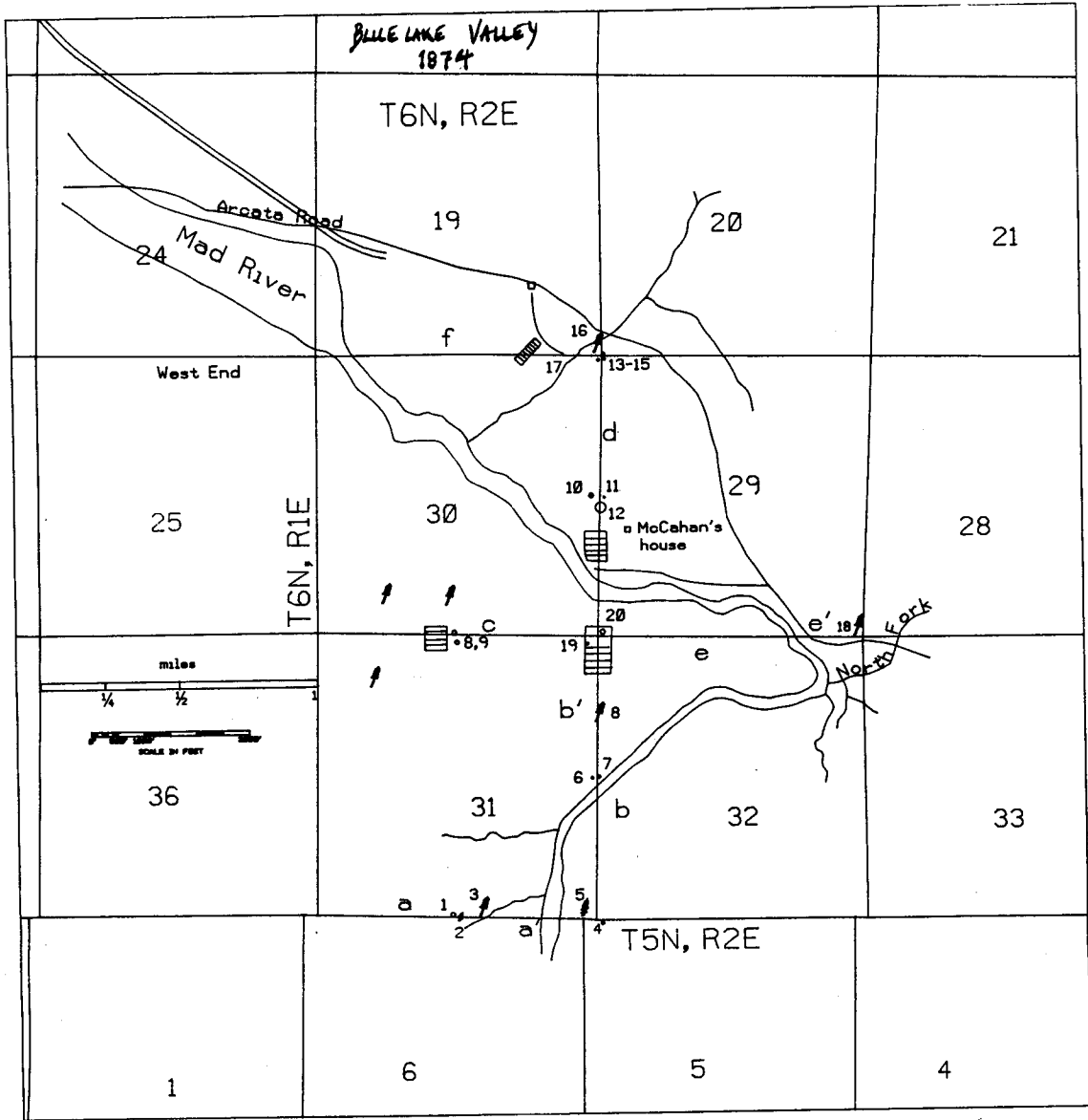
Geomorphology & Vegetation of Reach 2, 1870's

Figure 3 is reproduction of the U.S.Coast and Geodetic Survey map of Blue Lake valley, surveyed by S.W. Foreman in 1874. It shows the approximate location of the river course and the vegetation that existed at the time. Total length of the river between the east-west line between section 31, T6N-R2E and section 6 in T5N-R2E to the river's crossing of the north-south line of sections 19 and 24 was about 4 miles (6.4 km). The linear distance between these two points is 2.38 miles (3.84 km), giving a sinuosity of 1.67.* The following is the description of the valley given by Foreman in 1874:

"Along the East boundary and in sections 29 and 34, there are small prairies good for grazing. Timber is of excellent quality being mostly redwood, pine, and oak. The latter will afford a great quantity of tanbark. Mad River runs diagonally through the township from southeast to northwest. It is a rapid stream, well adapted to floating timber to the sea."

Only the section boundaries (1 mile intervals) were surveyed and the descriptions given below will be referenced to these boundaries. In figure 3, note the course of the river as it entered the valley. The lower 1,680 feet (510 meters) flowed directly north much as it does today. Following the dip of the bedding, the river deflected northeastward toward its confluence with the North Fork around an uplifted terrace. An area of "brush and timber" grew on this uplifted terrace, which forced the river in this direction. Prior to being wiped out by flood events of the late 1800's, this terrace probably received much of the finer sediments coming down from Mad River basin. The vegetation here consisted of "redwood, cottonwood, pepperwood (bay laurel), hazel, and salmon brush". This thickly-vegetated terrace slowed the velocity of overbank flows and received deposits of fine sediments coming down from the upper parts of the basin. The soil on the line between sections 30 and 31 was considered "first rate" and the land was "generally level".

*NOTE: Sinuosity is the ratio of a length of river from one point to another to the linear distance between those two points. As will be seen later, the length of river between these two points today is about 2.46 miles (4 km) giving a sinuosity is now nearly 1.0. This is important when considering the transport of sediments through the valley.



Diagrammatic cross sectional view, west to east along the southern border of sections 25, 30, 29 and 28.

T/Br = timber & brush	Grv = gravel
Thr = Thrust fault	Rdw = redwood
D.Br = dense brush	Col = colluvium

Transect descriptions, Foreman, 1874.

- a. Land steep, hill broken by tributaries of Mad River. Pine, cedar, bay, oak, fir.
- a'. On river bottom. Undergrowth dense oak brush.
- b. Timber redwood, cottonwood, pepperwood, pine, hazel & salmon brush.
- b'. Brush and timber
- c. Land level, soil 1st rate. Redwood, cottonwood, pepperwood, hazel, salmon brush.
- d. Land level, soil 1st rate. Redwood, maple, pine.
- e. Waste land of river bed. No timber.
- e'. Timber- redwood, pepperwood.
- f. Timber & brush (T/Br).

Marker trees

1 10 in. bay	10 3 in. maple
2 3 ft. pine	11 6 in. maple
3 12 ft. redwood	12 24 in. maple
4 30 in. oak	13 4 in. fir
5 36 in. cedar	14 4 in. fir
6 10 in. cottonwood	15 6 in. fir
7 10 in. cottonwood	16 16 ft. redwood
8 10 ft. redwood	17 3 ft. fir
9 2- 8 in. cottonwoods	18 8 ft. redwood

Figure 3. Blue Lake Valley, 1870's. From Foreman, 1874. The letters represent general vegetation descriptions along each surveyed transect and the numbers represent trees that the survey used as markers.

The river flowed northwestward for about 5,900 feet (1,800 m) and was joined by the North Fork at the eastern corner of the valley. On the east end of the line between sections 29 & 32, (transect *e'*) timber consisted of old-growth redwood and bay laurel. With the additional water and sediment contributed by the North Fork, the river was then deflected westward across the southern boundary of section 29. The land was "level", soil "first rate except on water land in bed of (Mad) river." (transect *e*). This area was described as "waste land of the river bed" and "contained no timber." This was apparently a site where coarse sediments such as gravels, would deposit and spread laterally in the valley. A road traversed the valley on the north side of the river, probably an historic Indian trail that was used by the miners accessing their claims in the Trinity mines.

The river then flowed northwestward paralleling the Mad River fault zone. Where it crossed the line between sections 29 and 30, its active channel was 100 feet (30 meters) wide. About 650 feet (200 meters) south of the river (at the corner of sections 29, 30, 31, and 32), a 4 foot diameter bay laurel and a 30 inch diameter cottonwood stood as marker trees (veg.#'s 19 & 20) with "no other tree in marking distance." North of the river along this line, they crossed a field and McCahan's place. Two small maples (veg.#'s 10 & 12) were the 1/4 section marker trees that grew 1,530 feet (465 m) north of the river, probably well away from . Another 420 feet (128 m) north, the survey entered brush and timber consisting of "redwood cottonwood, pepperwood, pine, and hazel and salmon brush." (transect *d*) The soil along this line was considered "first rate."

Reach 3: Lindsay Creek to North Bank Road Meander

Reach 3 cuts through a narrow, bedrock gorge, crossing at least three fractures of the Mad River fault zone. Lindsay Creek and Essex Gulch enter from the north and Warren Creek from the south, bringing mostly fine sand and silt to the river.

The survey notes are of little use here. On a north line between sections 14 & 15, T6N, R1E, the survey crossed Mad River near today's Highway 299 bridge. The channel was 225 feet (69 meters) wide. Downstream from the 299 bridge, the river deflects off the valley wall below North Bank Road and flows southwestward toward Valley West.

The course of the river through this canyon may be a geologically recent one. Although not well understood, geomorphic evidence indicates that Mad River may have flowed through Fieldbrook valley long ago. Tectonic uplift in the Fieldbrook valley and newly-formed fractures in the presently occupied canyon forced the river to find a new course through this gorge.

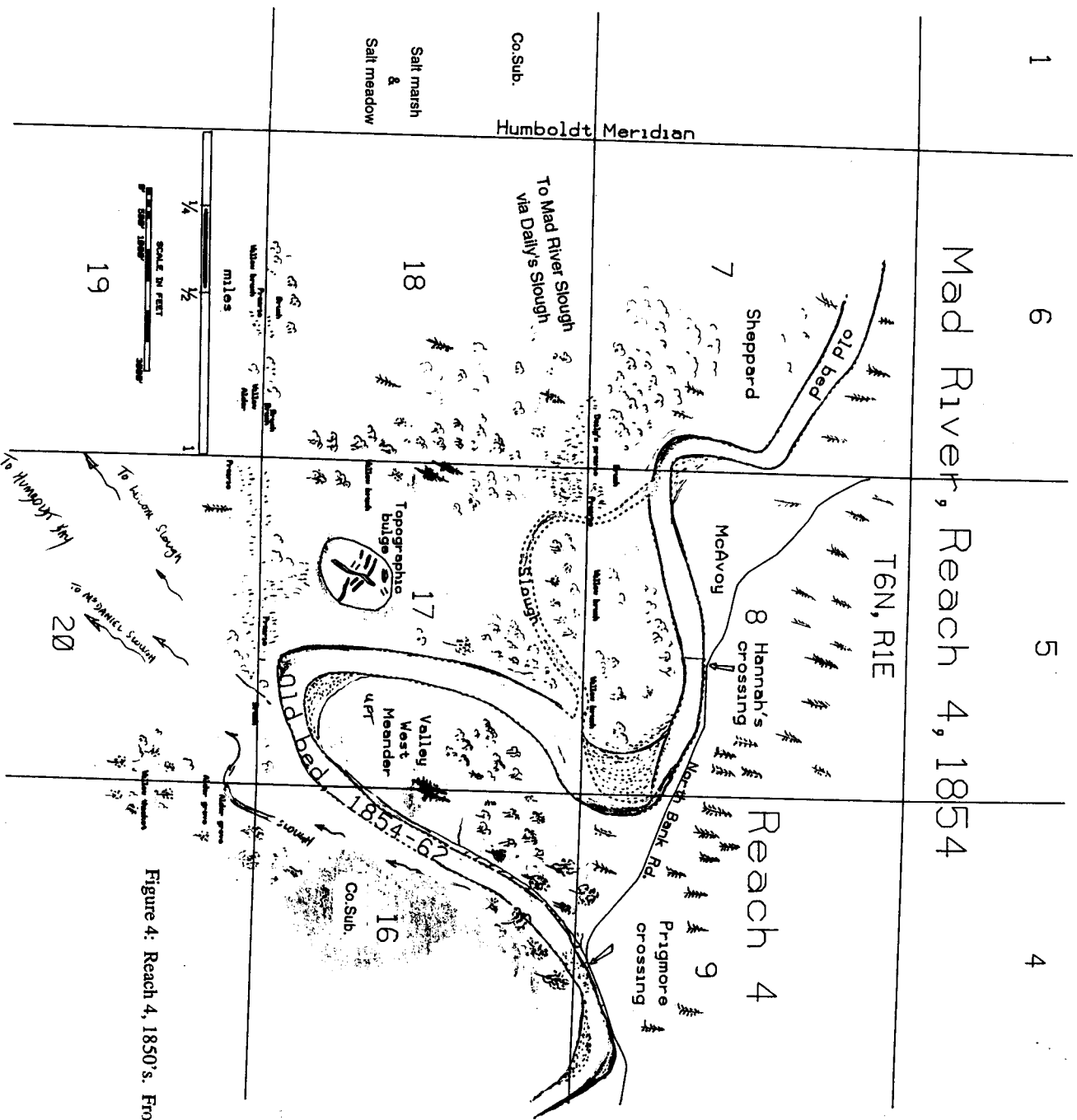
Reach 4: North Bank Road Meander to Highway 101 Bridge, Geomorphology & Vegetation, 1854

Once the river deflects southwestward off the bedrock bank below North Bank Road, it once again has a chance to spread laterally across a wide floodplain. It flows southwestward toward the Valley West Meander. When first surveyed in 1853-4, the length of channel from the North Bank Road meander to the meander was 6,530 feet (1,990 meters) (Figure 4). At the apex of this meander, distributaries would carry ordinary winter flood waters southwestward into upper Humboldt Bay, via Janes Creek and Liscom Slough. These and other distributaries are shown in Figure 4.

As a result of this lateral spreading of flood waters across the Arcata Bottom, the soil here consisted of deltaic deposits of Mad River. When the Arcata Bottom was first surveyed in 1853-54, the area between Arcata (then Uniontown) and Mad River was referred to as "the Spruce Belt." Old-growth Sitka spruce trees dominated the scene. Willow brush thickets occurred along the riparian margins of the river and a few patches of prairie could be found.

The low-lying area east and south of the Valley West meander, known as Aldergrove, was an area of earthquake-induced subsidence, while on the west side of this meander, a site of uplift occurred. This topography, shaped by large magnitude Cascadia Subduction Zone earthquakes, is the primary factor responsible for the position of this meander. The last of

which is thought to have occurred some 300 years before present (Clarke & Carver, 1992). Two 4-foot diameter Sitka spruce trees were found in the middle of the Valley West meander, a site of geologic uplift. This indicates that the river bed had not passed through this location for at least 100 years and may have even predated the 300 ybp earthquake (Scalici, 1993).



Co. Sub. = Cosismic subsidence
 Arrows indicate direction of flood waters

Figure 4: Reach 4, 1850's. From U.S. Coast & Geodetic Survey, 1854.

1850 - 1889, *Early Settlement.*

The discovery of gold in the Trinity and Klamath mountains brought a rush of settlers to Northern Coastal California in the late 1840's and early 1850's. The focus of land activities along Mad River during the early settlement period was to cut the trees, clear the land for farming and establish roads and railroad lines. As early as the mid-1850's, logging was occurring in the Arcata Bottom and Blue Lake valley but was still localized. The first major enterprise was the digging of a canal in 1854. Schimps (1986) provides a good description of the Mad River Canal and the events that revolved around its operation. The intent was to float logs down the river, capture them by a boom and transport them through the canal. From there, they were to be floated to the mills on Humboldt Bay. As will be seen in the flood accounts below, this enterprise never operated as it was intended, and the floating of logs down the river caused tremendous amounts of bank erosion (Haynes, 1986).

A few ferries were operating from the river mouth to the Valley West meander. Much of the historical descriptions of the area around Blue Lake could be found in the *Blue Lake Advocate* and writings of Susie Baker Fountain.

The November 30-December 4, 1861 Flood Event

This flood event was the first major storm witnessed by the new settlers of the region. The storm that generated it was probably the most severe that Northern California has experienced since. The impact land use activities had on Mad River at the time were still quite localized and minor. Blue Lake valley was still largely undeveloped and few accounts have been found. It was this flood that allegedly formed the lake from which the town of Blue Lake was to be named (Fountain, 1955).

In December, 1861 there were 3 distinct freshets or storms in 10 days "during which time the whole country was inundated and a vast amount of damage done." (*Arcata Union*, Feb.1, 1888). The following account was published in the *Humboldt Times*:

"The rain commenced November 30, 1861, and poured in torrents for 60 hours; by Wednesday noon the waters in Mad River were 18 inches higher than ever known before. The bottom lands north and west of Arcata were submerged; fences, bridges, across the little stream that runs through Arcata were washed away. The four bridges across the little stream that runs through Arcata (Janes Creek) were washed away and all communication cut off from the bottom, except by boat...The rain ceased on Tuesday night and by Thursday the river was again "confined to its bed," but on Thursday day the windows of heaven were again opened and the river, now truly Mad, rushed over its banks and submerged prairie. The water continued to rise

until dark Sunday at which time it was much higher than the "oldest inhabitant had ever before known." Up the river (near Blue Lake) it was 5 feet above the previous high water mark.

"At Cook's ranch, the water compelled him to leave, a huge log struck and demolished his house and nearly his whole place ruined. At Prigmore's, the water was several inches from the houses and other families down the river were obliged to leave for higher land. Mad River swept over the bottom to the bay with great force, carrying with it bridges, fences and other moveable objects with which it came in contact; the soil in many fields was washed off for several inches in depth. Near the house of Mr. Arment (Valley West) an eddy washed out a hole where the road formerly ran..." (SBF vol. 82, pg. 224).

More storms followed during that winter and the sites vulnerable to flooding became obvious to the settlers. The most susceptible site was just south of the Valley West meander. The following summer, this meander was cut off the local farmers (Haynes, 1986). This would be the first of many attempts to prevent Mad River from flowing southward through the Valley West area and into Humboldt Bay via McDaniel and Liscom Sloughs. Figure 4 shows the location of this diversion (Brk 1). Written 26 years later, the following is a description of this enterprise, which would be the first of many diversions on Mad River:

"During the following summer (1862), farmers on Arcata bottom began to consider the danger that threatened them each succeeding year, and to provide a remedy. It was found by a little simple engineering that the channel of Mad River could be turned, at a trifling expense, so as to run further north, and no time was lost in undertaking the enterprise. To old settlers here the result of that scheme is well known. By private enterprise a canal, or ditch, was cut, commencing near the crossing at the Shaw place (then the Prigmore Crossing), that diverted the water of the river from the old channel and made a new one, connecting with the old bed some miles below." (*Arcata Union*, Feb.4, 1888).

1863-1880

By 1866, farmers were busy working the rich terrace soils around Mad River. A ranch above the mouth of Warren Creek, called Skeedaddle Murphy Ranch was run by Mr. Anderson who raised potatoes. This ranch would be washed away in subsequent floods. The bed of the river at that time had a good supply of gravels and was quite shallow from there to Valley West, as evidenced by the following account:

"The Mad River being so low in early December (1866) he was able to drive a team (of horses) down the river bar, fording the small riffles and coming out on Arcata Bottom there being no wagon road up Mad River at that time. (SBF vol. 82, pg 228).

The 1860's and 70's was a time of 'booming.' John Vance had timber land along the river along reach 3 and established a mill at Essex. The trees that were being cut along the floodplain and surrounding hills were dumped into the river where they were supposed to float down during high flows and boomed above the canal. Here they could be gathered and transported through the canal. In many of the large flood events of the 1870's and 1880's, the force of the current was so strong that the boom often failed and logs washed out along the beach (Schimps, 1986). These log brought down by the floods, resulted in tremendous bank erosion during and had major effects on reducing bank stability (Haynes, 1986).

November, 1872.Flood Event

A 5-10 year flood event occurred in November, 1872. On November 16, 1872, the *Humboldt Times* reported:

"Heavy rains of last Monday caused a raise of waters in Mad River to such an extent as to call into requisition all the ferries on the stream. We also hear that Mad River Jas. Brown who has been logging on the other side of the Mad River, near John Hannah's place, lost 100,000 feet of logs which were swept out to sea by his boom across the river near canal breaking (SBF vol. 82, pg. 230).

The logs mentioned in the above account were probably mostly logged from Essex Gulch, lower Fieldbrook Valley and lower Blue Lake valley.

John Vance realized the futility of the canal and boom and built his mill along the north bank of Mad River at Essex and laid out a railroad for hauling the cut lumber to the Arcata wharf. In 1875, a suspension bridge was built by the Pacific Bridge Company for John Vance on Mad River at a cost of about \$6,000. It connected the railroad on both sides of the river,

and by this means logs and lumber could be transported from the mill to tide water on Humboldt Bay. (Humboldt *Times*, Mar. 7, 1879)

The January-February, 1878 Flood Events

On February 2, 1878, a 10-15-year recurrence interval flood event occurred along with unusually high tides (Scalici, 1993). The headlines of the *West Coast Signal* read, "Lively times at the Mad River Boom." A log jam occurred at Vance's bridge, but they passed through eventually. "Piers at head of slough and south bank swept away, some 14 or 15 pine pilings broken off." (SBF vol. 82, pg.231). Two miles of Vance's railroad was washed out, and Hannah's ranch was again a repository for logs. (*Weekly Democratic Standard*, Feb. 2, 1878, in Haynes, 1986). The January 30th edition of the *West Coast Signal* filed this report:

"The flood Sunday (January 27) made things unusually lively along Mad River and at the Boom. All the logs in the river and its tributaries and an immense amount of uprooted trees and drift accumulation came down in a solid body. For at time it was feared that Vance's railroad bridge would be carried away, but the jam loosened and went plunging and thundering on to the Boom just in time to save the bridge, which stood a terrible test. The scene at the Boom was exciting and grand, but the structure was equal to the emergency. It is most satisfactorily proven that the Boom can successfully withstand any pressure which a Mad river flood can bring, and the lumbermen on that stream rejoice equally with the Boom Co. Some of the piles at the head of the Slough on the south side of the river were broken, but logs were all secured. Some 5,000,000 feet of logs are now held in the Boom, sloughs and canal. (WCS, Jan.30, 1878).

Later reports disproved the boom's survival. In addition, a new channel was formed on the north side of the river downstream of today's 101 bridge. (Figure 5).

"We learn from a gentleman who passed the Mad River Boom yesterday that the great body of water in the river has been turned into a new channel on the Dow's Prairie side (north side), and that it is cutting through Baker's field. Of course, at the present stage of the river there is some water on the canal side (south side) but how long there will be is a question. The canal is full of logs, the banks of the river are lined with them, and there are supposed to be from 150 to 200 on the beach at the mouth of the river." (WCS, Feb.6, 1878).

A letter dated February 5, at 9 p.m. stated that "at that hour the Mad River Boom was considered to be in a critical condition." The canal was full of logs, and there was "an immense lodgement of logs and driftwood pressing against the boom. The writer expressed fears of the destruction of the boom, and wrote:

"Should tonight's rain continue long enough to bring down the rest of the North Fork logs which are ready to come, nothing short of a miracle can save the boom." (WCS, Feb.6, 1878).

Another flood, this one not as great as the one mentioned above, occurred about 3 weeks later which further crippled the Boom. One of the upper piers of the boom was carried away by the flood and "some logs went to sea." (WCS, Feb.20, 1878).

The March 6 & 20, 1879 Flood Events

The March 6 flood was more severe than both the 1872 and '78 flood events. The river was "considerably higher" than at any time during the winter of 1877-8 (HT, Mar. 7, 1879), and was probably a 20-25 year event. The March 7th edition of the *Humboldt Times* reported that "without any exception, this was the most serious freshet that had ever been experienced in Humboldt County." The writer also stated that since the county had first been settled, there had been higher water, but it was at a time when it was sparsely populated and little improvements made. (HT, Mar. 7, 1879). It was apparent that the increase of people and land clearing around the river was already starting to affect the river's response to flooding.

Mell Grimmer, who operated a ferry at Vance's place, said Mad River was 8 inches higher than the 1878 flood and that "the Vance railroad bridge over Mad River was carried away." (HT, Mar. 7, 1879).

Other accounts estimated the volume of logs that were brought down by the flood. A March 8th account reads as follows,

"For the past two months the general cry has been for rain, only enough rain to cause a freshet and bring the logs down. Tuesday the logs in the main streams came down to tide water, and the rains of Tuesday night and yesterday morning caused the forks and tributaries to give up what they contained. The rivers yesterday were running bank full and loggers had all they could attend to. The number of feet of logs brought down by the freshet is estimated at forty-millions." (SBF, vol.82, pg.232).

"The rain of yesterday and the day before has caused the various rivers and streams to rise considerably. Mad River is booming, and logs were coming down lively. (SBF, vol.82, pg.232).

The March 20th flood was stated to be "the greatest rise known in that stream since the winter of 1861-62." (WCS, Mar. 21, 1879). The river's base flow was probably very high at the onset of this storm and the magnitude of this event was on the order of a 25-30-year flood (Scalici, 1993). The "rushing torrent" of this flood destroyed the remainder of Vance's railroad bridge (WCS, Mar. 21, 1879). It was estimated that 2,500 logs passed the boom and entered

Humboldt Bay. A party of loggers stated that they were a short distance up North Fork the day before and the logs had all come down as far as they went. The only reliable news obtained from upper Mad river on the 20th was contained in a dispatch from Mr. Ed Janssen to Mr. Wunderlich, sent at 4:30 p.m. It was to the effect that "some 60 logs had come out of the North Fork, and that the main river was rising rapidly." (WCS, Mar. 21, 1879).

The January, 1881 Floods

In January, 1881, two years after the severe winter of 1879, another flood occurred. This event was probably only an 8-15 year event (Scalici, 1993) and was the first to attest to erosion in Blue Lake valley. An account describing storm-induced erosion near the confluence of the North Fork and the main Mad River appeared in the newspapers.

"Foley's farm, near the mouth of North Fork, was washed away, except a small patch of land where his house stands. The families of James McDermott and Mr. Stebbins were rescued from their dangerous quarters by L. Puter, who conveyed there in a boat to places of safety." (SBF vol. 82, pg. 234).

Once again, Hannah's place was a deposition site for a large number of logs that floated down with the flood waters.* Again, this flood was compared to the 1861 flood. However, the fact that the water was higher does not mean that the flood was a greater magnitude as the previous floods. Since the river had been severely aggraded by the input of sediments eroded from reaches 2 and 3 in this and past floods, the bed level was higher thereby giving the illusion of a great flood.

"John Hannah's place has more the appearance of a logging camp than a productive farm. A great many logs that came down with the flood have found a resting place in his fields." (SBF vol. 82, pg. 234).

"More water fell during a shorter period that a larger amount of damage has been done no one can doubt. At Mad River, the water was higher than at any time since '61 and some go so far as to place it higher...Much damage was done to the farm lands adjacent to the river. About 60 feet of trestle on the north side of Vance's railroad bridge was washed away, but the bridge itself, the main structure is all safe and secure. The water stood 15 inches deep in James Sinclair's yard...In many places on the farms, the water cut out small channels and in other places piled up sediment and a great deal of fencing was destroyed." (SBF vol. 82, pg.237).

*NOTE: In recent years, this site has been downcutting, and is no longer a site where significant deposition occurs. This is important to realize in light of today's extraction activities occurring in this area.

The following winter, in 1882, deep holes were reported being cut in the river bed at Hannah's crossing. The breakwater, (Brk 2 in figure 5) constructed just upstream of the crossing to prevent the river from flowing southwest to the bay, was being undermined. These scour holes formed around the breakwater pilings as later accounts suggest.

"The crossing had always been considered very good, but lately deep holes were cut in, making the ford deep and difficult. (SBF, vol.42, pg. 180, dated December 20, 1882).

December 24-26, 1883 Rain-on-Snow Event

This flood was not very severe, probably a 2-5 year event. It was reported that "Mad River, Tuesday afternoon December 25, reached its highest mark, and in several places left its banks, covering fields, but "the current was not sufficient to create any wash or do much damage." From Vance's mill, it was reported that all bridges spanning Mad river were safe, and that the river was falling by the 26th. At the North Fork, the river had caused some little damage to the mill yard, "but nothing to speak of." Along the line of the road where "new earth had been piled in some injury had been occasioned by the water, and the track had settled in places." The current had made an eddy about the western abutment of the bridge, but prompt action had prevented trouble, and no more danger was anticipated. Every precaution (was) taken and every move made to keep the river in its channel and guide the drift on a straight course to the sea." (HT, Dec.27, 1883).

Blue Lake in 1883-87

These were heady times in vicinity of Blue Lake. The lumbering was in full swing, the mills adding the latest machinery. Minor's mill on Hall Creek was considered "one of the most substantial and best arranged in the Mad river belt" and employed 120 men in both the mill and in the woods. The town of Blue Lake was growing rapidly. A man named Scott built a new hotel and in the vicinity Blue Lake, improvements were "too numerous to mention." Mr. Chartin, the enterprising proprietor of a large hotel, store and public hall had picnic ground adjoining his place in Blue Lake. He also surveyed and platted 15 blocks of land, lying between the railroad and Scott's place, which he was to "offer for sale for residences or business purposes." (AU, Sat. Aug.7, 1886). By December, Chartin was selling lots on Mad river where it was said "the soil cannot be excelled." (AU, Dec.18, 1886).

In March, 1887, a new mill on the North Fork was completed, and turning out lumber rapidly (AU, Mar.19, 1887). The timber boom was in full swing. Quite a town was springing

up at Blue Lake and Scottsville. In April, 1887, Mr. Chartin laid off the plateau just above the hotel into town lots. (AU, April 30, 1887).

January 1888 Rain-on-Snow Flood Event

In January, 1888, Aleutian cold fronts dropped snow level down to sea level. The January 12, 1888, the *Weekly Humboldt Times* reported 2 inches of snow in Eureka with temperatures down to 26-27° for two days (SBF vol. 82, pg. 243).

During this year, moderately strong El Nino conditions prevailed (Quinn, et al. 1978). This phenomenon drives warm, subtropical moisture to northern California. On February 2, such a storm occurred generating a rain-on-snow flood. Although the resulting flood had a recurrence interval of 5 to 10-years (Scalici, 1993), it did considerable damage. By this time railroads were built along the banks of Mad River and human activities were increasingly confining the river and spreading out into the floodplains. The following account was reported on this date:

"From Mad River, we hear that it is 20 feet above low water mark, but not rising very rapidly. About the only immediate danger that threatens is the washing away of the Webster Place, this side of Warren Creek in which event the trestle of the A & M.R. that runs through it will be damaged."

A later report showed that the Webster place, a short distance above the county bridge was washing out badly and had taken out about 400 feet of A & M.R. track (SBF vol. 82, pg. 245). Dr. Banos passed by Vance's Mad river bridge on Thursday, February.2, and informed the *Union* that the falling river was causing a cut in the breakwater above the bridge, on the north side, and that a crew was at work filling in rock from the quarry to stop the cut (AU, Feb.4, 1888). He also stated that Mad river "toyed with Vance's picnic ground to the extent of taking off a portion of that classic spot including the spruce tree against which the music stand stood, and under the generous shade of which brave men and ladies have tipped the light fantastic in days gone by." (AU, Feb.4, 1888).

1890 - 1912, *Big Floods, Aggradation and the Railroads.*

January-February, 1890 Rain-on-Snow Event

In early January, 1890, a series of storms brought record amounts of snow to the North Coast. By the second week however, the weather started turning warmer. An account from the *Weekly Humboldt Times* dated January 16 reads:

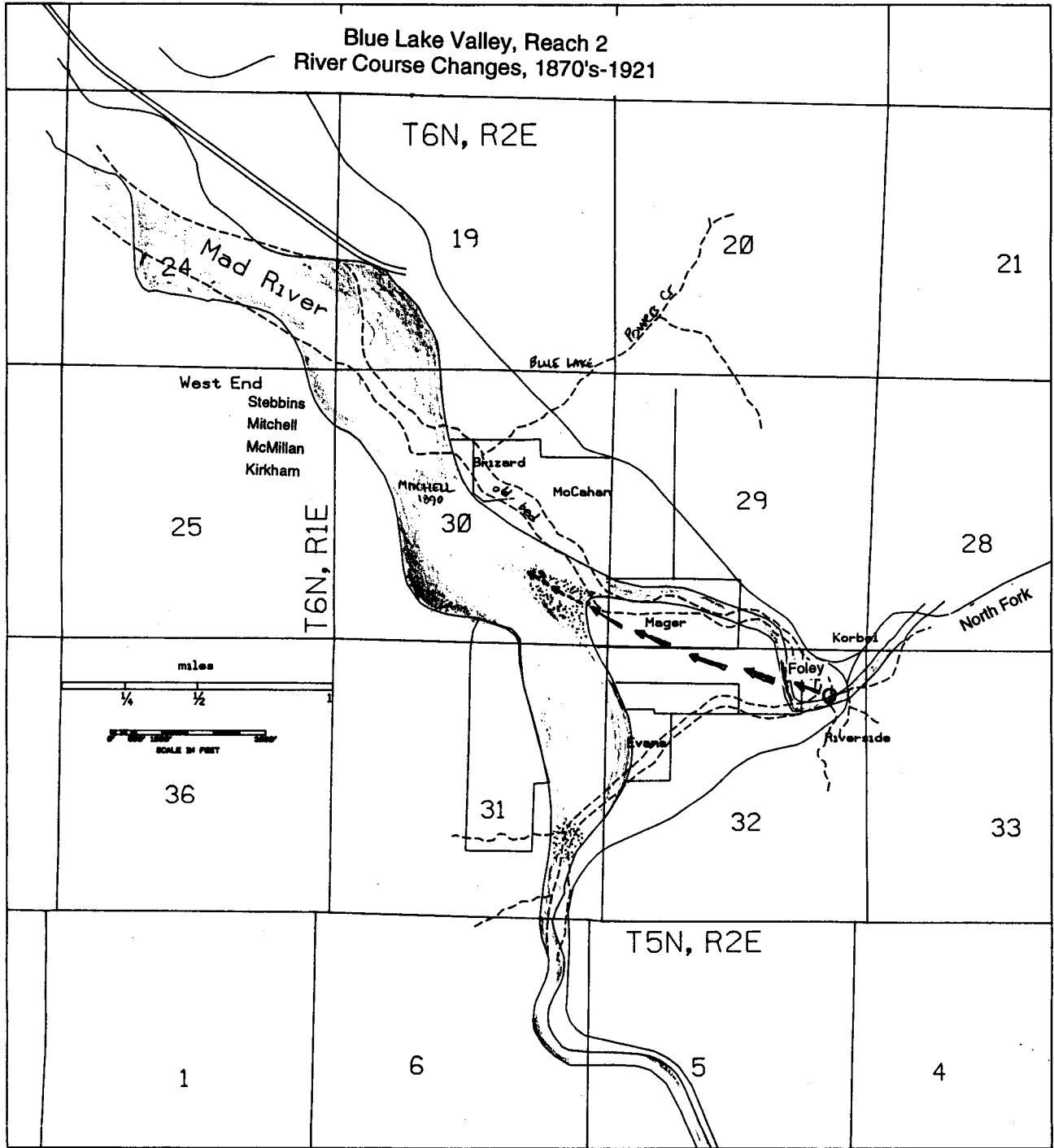
"The deepest snow mass ever known. Warm weather and light rain yesterday, may bring a sudden melting of the snow and consequent floods and great damage. (SBF vol. 82, pg. 207).

Indeed, the people's worst fears came true. Heavy rains fell the first 3 days of February, melting the record snow and creating the greatest flood since 1861, on the order of a 40-60 year recurrence interval (Scalici, 1993). The Blue Lake valley was devastated as the river took a new course, shortened its length through the valley (Figure 5). One dated February 5 from J.H. Blake of Blue Lake to the *Times* stated that the North Fork railroad bridge had "gone out clear from bank to bank. (SBF vol. 82, pg. 181). In Blue Lake, nearly all low part of town was under water." (SBF vol. 82, pg. 208) as the high stage of the river backed up Powers Creek.

Larkin's place was covered with water from 2-4 feet deep all afternoon on February 4th, but damage there was "slight." Water began to recede about 4 a.m. and by the morning of the 5th was down 4 feet. Some 40 yards of track washed away near the Mad river railroad bridge. Some piers were injured on the same bridge and a bad slide occurred at the Webster place. (HDS, Feb.5, 1890). It was reported that the county road at the Webster place, on Mad river, between the county bridge and Warren creek was buried in the slide, "or at least so much of it as to entirely prevent teams from passing over it." (AU, Sat., Jan.18, 1890).

A February 8, account read:

"Monday morning, after a hard and steady all-night rain, it looked serious. The creek was booming, and heavy drift logs were coming down. By hard work the bridge on Railroad Ave. was saved, and this prevented damage to the candy store, opera house, Brizards and buildings below. Mad River has been at its highest, but excepting fences down, has done no great damage this side. (Blue Lake) But West End will have a different story to tell when it gets across. The river moved that direction, cutting badly into Evan's and Kirkham's and now running right through McMillans." (SBF, vol. 82 pg.).



Arrows indicate the position of the confluence of North Fork with Mad River. A migration of 5,055 feet (1.54 km) between 1870's and 1921 took place. The 1890 flood event allegedly resulted in the most dramatic change in confluence position.

Figure 5: Reach 2, Blue Lake Valley after the 1890 flood showing the names of land owners affected by floods.

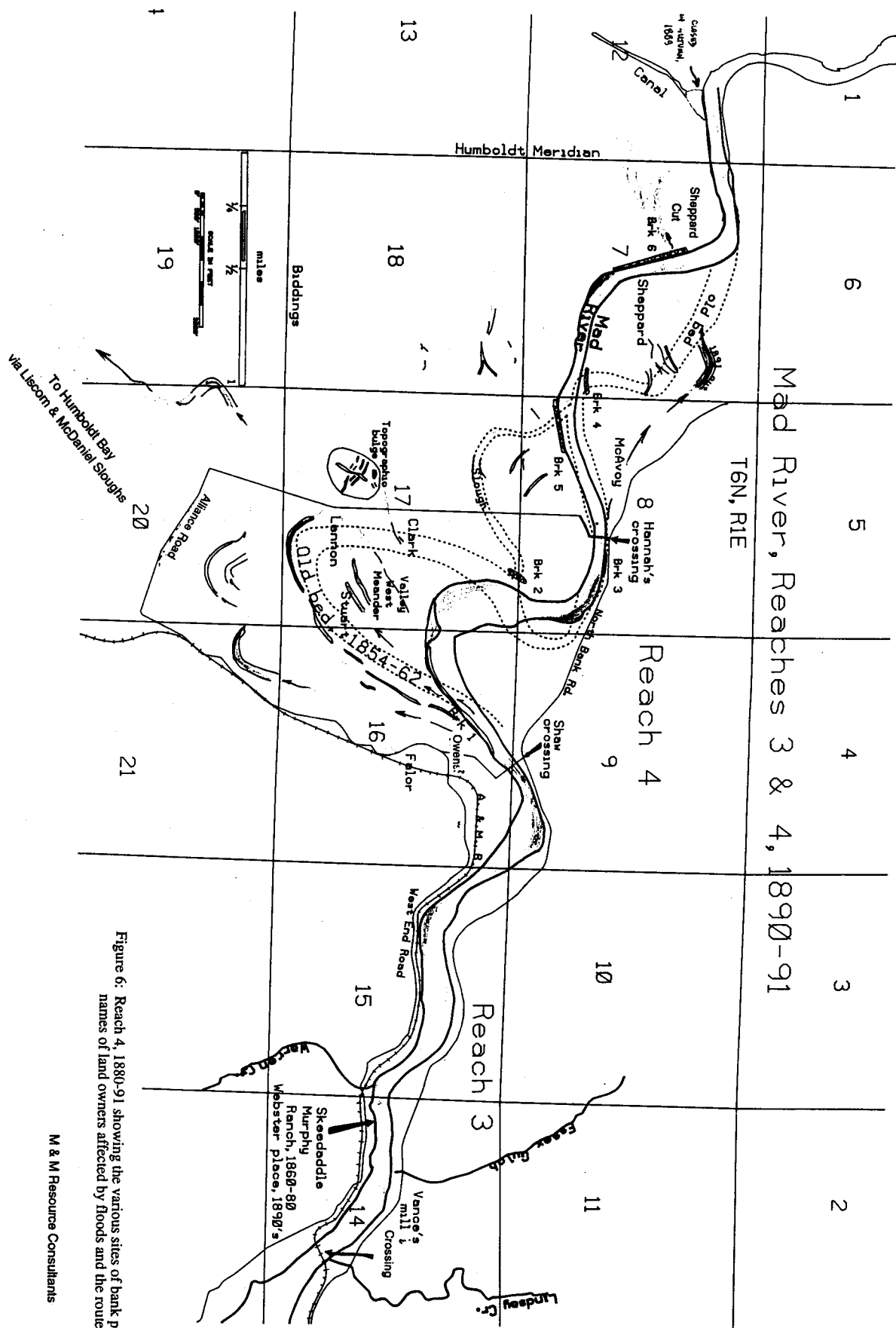


Figure 6: Reach 4, 1880-91 showing the various sites of bank protection (BRK 1-6), the names of land owners affected by floods and the routes taken by flood waters.

It wasn't until March 1 that the first wagon since the storm came across the Mad River. By March 8, the weather was trying to settle. More flooding occurred that week and an account from March 15 summarized the damage at two Blue Lake valley ranches:

"McCahan's ranch badly washed by change in current of Mad River ...Friend McMillan puts his loss at not less than \$5000. Well, 40 acres of land worth \$100 an acre, and buildings, will figure up all of that. He says that, when young, he resolved not to fret about what couldn't be helped, and so he takes it cheerfully, but it does look a little rough, you must admit." (SBF, vol. 82 pg.).

This flood proved disastrous to farmers living along the south bank of Mad River, from the Shaw crossing to the head of the bay. (AU, April 5, 1890). On February 8th "the flooded district on lower Mad river," it was stated, "is a dismal looking locality." From 6 to 12 inches of sediment lodged on the fields and in backyards, gardens and houses. Fences were gone, out houses up turned, fruit trees broken down. (AU, Feb.8, 1890). A tremendous amount of the silt and sand, eroded from the bank erosion in Blue Lake valley, funneled through reach 3 and spread across Arcata Bottom.

In April, 1890, the *Arcata Union* published a very informative article about the flood damage to the south bank of Mad River describing the effects of early land use activities on flooding.

In early years of the clearing of a portion of the bottom land adjacent to Arcata and extending back to the river, resulted in an overflow of the cleared portion, the water leaving the river at the Schuyler Clark place and passing into the bay through the Daniels's slough. Many of our older inhabitants vividly remember the occurrence, while at the present time deep gullies are to be seen through the farms traversed by the flood.

Immediately after the flood above mentioned, the persons interested took steps to prevent a re-occurrence, and a ditch was dug which cut off the bend that curved toward the bay and straightened the course of the stream. The first freshet cut the ditch to accommodate the water flowing, and the river has passed through that channel ever since until this season, although it has shown a tendency to move towards the bay, cutting the soft banks on the south side each winter, and has been materially assisted in later years by some sheers, or wing dams, which have been placed on the north bank for the protection of property there.

The farmers who have in later years cleared farms along the south bank of the river are now aware that there is a decided slope from the river bank towards the bay, and consequently the more the south bank cuts the greater the opportunity for the river to leave its banks. As most of the bottom land is cleared of the trees and brush, there is nothing to impede its course to the bay in such a case.

The recent high water, while an exceptionally severe freshet, has demonstrated the fact that some decided steps are necessary to protect our farmers, and most important of all considerations, our harbor, from the encroachment of the river.

A representative of the Union visited the river in early April, surveyed the flood damage and interviewed some residents who were effected. See figure 6 for the locations of the landowners mentioned in the following report.

"The Shaw crossing was first visited and a moments inspection looking down the river, showed plainly that since last fall a great piece had been cut, extending down the river as far as the eye could reach. Jerome Owens, who owns a small place near by, lost a few rods from one corner. Turning backward, and passing across the old bed of the river, very marked evidence was on every hand that the water has found its way through the old channel (through Brk 1, fig. 5). Some sand was deposited on the Falor place, but otherwise the land in the old bed is very much improved by a generous deposit of rich sediment where the soil before was nothing extra. While most of the farms and roads in this vicinity were under water for a time, no particular damage was noticed until the ranch of A. R. Stuart was reached. In conversation, Mr. Stuart stated that a portion of his land would be improved by the deposit of rich sediment, but that he would loose the clover crops for this year. His loss which will amount to about \$1,000 was caused principally by the destruction of his fences, most of which are entirely gone, and the covering of two acres with coarse gravel. Mr. Stuart has well grounded fears for the future, as the river demonstrated a tendency to cut a channel through his place in the direction of the bay and thinks that unless steps are taken, the river will eventually go that way. He thinks that the water should be effectually shut out of the old bed, and means used to turn the force of the current to the north bank.

"Mr. P. Lennon was next seen and while he does not lament the destruction of 10 acres of grass by the deposit of sediment, he fears the ultimate destruction of his farm if steps are not taken to prevent it. He says that he and others have spent much time and money each season in caring for the river, but that they are not able to do the work necessary to properly accomplish the desired result. he wishes us to say that after his experience with the last freshet, he does not wish to be placed in a position where he will have to depend on being rescued with a boat, intimating that the boat was very tardy in making its appearance.

"On going further down the river we found W. L. Dickerson and Charles Sheppard inspecting the land of the former, which had been treated to a deposit over its entire surface, consisting of rich sediment in most places, with here and there and objectionable patch of sand. Mr. Dickerson expresses grave fears for the future of all the farms in a line with his place and the bay, unless protective measures are adopted, and expresses it as his opinion that substantial work should be done in the vicinity of the Shaw crossing, just above where the old river bed leaves the main river. He and Mr. Sheppard both realize that the undertaking is one of no small magnitude, and one that will call for an outlay of considerable money, far beyond the means of the farmers directly interested. They estimate that another freshet

will destroy farms to the approximate value of \$70,000, besides turning the river into the bay.

"With Mr. Sheppard we visited the spot where the water has broken through the levee (Brk 6, fig. 6), constructed on the bank of the old bed a few hundred yards above where the river and old bed meet, and there we found a very deep channel which had cut for 300-400 yards at a right angle with the river and towards the bay (later to be known as the Sheppard cut).

"The gentlemen seen reside near where the river leaves its banks, and but very little drift wood was left on their land, but from them we learned that many of the farms further down were injured more or less by the loss of fences and an accumulation of logs and other drift wood. Every rise in the river hereafter will flow through the break in the levee until the damage is repaired.

"Supervisor Fernald and Road Overseer Sowash have visited the ground and made themselves familiar with the situation, and will probably move in the matter before next winter." (AU, April 5, 1890).

Expansion of Blue Lake, Summer, 1890

In June, 1890, Blue Lake was being surveyed to create the city for the logging boom families. An account from June 7 read:

"LeConte and Norton will soon survey and plat off into town lots the fine field on Greenwood Ave. in which the big tree stands and with a few houses on the side opposite the Greenwood house, that end of town will begin to put on citified acres. (SBF vol.68, pg.34).

February, 1891 Freshet, Erosion Above the County Bridge

The first rise in Mad River for the winter took place around the 18th of February. The river, though not high, made a considerable cut above the county bridge on the north side, and threatened to cut a channel around the northern end of the bridge. (AU, Feb. 21, 1891).

The February 28 edition of the Arcata Union read:

"BRIDGE DAMAGE. Considerable uneasiness is felt in this section for the safety of the county bridge over Mad river... The danger is that a channel will cut around the north end of the bridge and leave it spanning either a sand bar or shallow pool. To protect his railroad and land on the north side of the river, John Vance erected a pier a few rods above the bridge, where the river showed signs of cutting a new channel around (Brk 3, fig. 6). The rise in the river last week caused the water to work behind this pier and make considerable headway towards forming a new channel altogether. Supervisor Hill and road overseer Nellist have been at work this week, placing stone and brush in the breach, and doing all possible to confine the river to its proper channel, but what success remains to be seen, as much will surely depend upon the rise and fall of the river next month. Supervisors Mercer and Power have been on the ground this week, in consultation with Supervisor Hill, and the matter will probably come before the Board next week." (AU, Feb. 28, 1891).

April, 1891 Flood Event and Its Effects in the Blue Lake Valley

Another series of storms hit in mid-April, 1891 that did damage around Riverside Road in Blue Lake. Several giant redwoods were undermined by the rapidly migrating river resulting in considerable damage around Blue Lake. An April 18 account attests to the damage:

"The last storm was rather severe in this part of the Mad River section (Blue Lake), and was considerably felt by all in the way of blockaded roads and railroads, trees having fallen all along the railroad, especially one big one, which fell last night at the junction of the Riverside Road. The tree fell across a little above the switch, just where the Riverside depot stood. It demolished the depot and warehouse, leaving only one side of the house on the ground. The tree measured 6 1/2 feet in diameter and buried itself about 2 1/2 feet in the ground, demolishing the track on both roads."

Summer, 1891; The Work to Repair the County Bridge

On August 15, the Board of Supervisors advertised for bids for the construction of a bulkhead on the north bank of Mad river, to protect the county bridge (Brk 3 in Figure 5). The work was to be completed by the first of November. (AU, Aug. 15, 1891). The contract was awarded to Mr. Gastman. On September 29, in company with O.H. Spring, a *Union* reporter went out to take a look at the work being done to protect the Mad river bridge. This insightful reporter stated that the cause of all this trouble with the north bank of the river "was occasioned by clearing away the timber and brush that grew along the bank, which formed a natural protection, and where the river had probably run for centuries. It was the killing of the fabled goose that laid the golden egg." (AU, Oct. 3, 1891).

On October 5th the *Union* reporter went back to look at the work on the bridge pier. Pile driving was progressing fairly and had probably been finished. The work consisted of driving piles into the bed along the north bank of the river, backfilling with gravel, adding a layer of topsoil and planting brush. There were probably some large boulders added which may have been obtained from the nearby Hannah's quarry. The work was progressing slowly but Mr. Gastman said that new methods would be adopted which he expected would allow them to make better headway. (AU, Oct. 10, 1891). The methods of hauling gravel across the river, in scrapers, had been abandoned, and an iron rail track, with cars, substituted. In mid-October the new work was still not fully in operation, but it was hoped it would be the following week, when it was thought gravel would be put in rapidly. (AU, Oct. 17, 1891). A heavy downpour on Wednesday, November 4 caused a rise in Mad river that temporarily put a stop to work on the bulkhead operations. (AU, Nov. 7, 1891). The following week, C.S. Daniels told the

Union that the brush and gravel part of the work is completed, and that the finishing touch of putting on the rock had been commenced. (AU, Nov. 14, 1891).

More Problems at Mad River County Bridge. 1893

Two years later, more problems were occurring near the bridge breakwater. A *Union* reporter visited the site in early October, 1893, and made a careful inspection of its condition.

"About two years ago the river swerved in from the old Webster place and threatened to cut a new channel around the bridge, cutting off one end from the main land. The river made a crescent shaped cut into the land and the breakwater was built across from the two points of the crescent, making the water take its original course (Brk 4, fig. 6). The work was carefully done and seemed immovable, yet there are two weak places in it that threaten to cause trouble."

"The building of the breakwater has caused the water to flow right along side of it making a deep hole along the lower side. On the upper side a small riffle flows into the hole and directly against the rock and brush forming the dam.

"The rock and the brush come up within 3 feet of the spiles, but where this riffle strikes it, the breakwater has sunk down at least 6 feet for some distance. This is only a small matter, but it shows the action of the water eating under and washing out the gravel. This is about 50 feet from the up river end."

"The principle break, however, is near the lower end. Here a larger current strikes in and the same effect is to be observed as in the case of the smaller riffle, only on a larger scale. Here the water seems to have washed much farther under, for the rock and brush along the inner row of spiles has sunk down 10 feet from the top. The immense weight of rock and gravel on the outer row of spiles has pushed 8 of them out of place and they slant out toward the river. The ties that bound them together on top have been washed away and the braces are cracked and split."

"Directly opposite the bridge and running parallel with it about half way is a bank of gravel averaging about 10 feet high. It looks very much as if the water would flow along this bank and be deflected, striking the breakwater with re-doubled force. In the case of it striking directly in on the break it would undermine the second row of spiles and cause considerable damage. We have had two mild winters, but the coming winter may be a serious one and if a break should be made the present bridge would be cut off from the main land and be rendered useless." (AU, Oct. 7, 1893).

November Storm and Recently Exposed Buried Redwood Tree, 1893

The "biggest November storm since 1861" occurred in 1893. This storm resulted in what was probably a 5-10-year flood event and did little damage. In December, an account of a buried 10 foot diameter redwood log was exposed in a recently eroded streambank in West End. This log may have been at least a thousand years old when it fell, and may have been buried over a thousand years. Thus, the age of the floodplain soil there may have been two to three thousand years old before it was washed away by the rapidly migrating river.

"Messrs William McCleod and John Farneau are making bolts for Mr. Benjamin Vaissade in the West End section have cut down a tree on the banks of that noble stream commonly known as Mad River. We are ready to concede that there is nothing specially remarkable in the circumstance that they have felled a tree. Many other men have done likewise; but this is a monarch of the forest from which depends a tale. The redwood tree 16 feet in diameter stood very close to the river. Ten feet below the stump of the tree and directly under it, the body of a redwood log 10 feet through projects from the bank, it having been exposed to view by the encroachment of the river. The 10 feet of earth between the log and the stump is all what in popular phrase is known as "madeland." As the log was there before the deposit of soil above it, and both log and soil were there before the big tree above it had ever sprouted, an interesting question is-how long has the redwood log, still sound as a dollar, been lying there?" (SBF, vol.15, pg.237)

February, 1902 Storm Event

The winter of 1902 was a wet one. In the third week of February of that year, a storm that lasted a few days brought the Mad River up to bankfull, an event with a recurrence interval of 2-5 years (Scalici, 1993). An account dated February 22 reads:

"This section was visited by the severest rain storm of the season, which lasted for a few days. As a consequence, Mad River was bank full and up to Tuesday it threatened to do considerable damage in this valley and Arcata Bottom, but Tuesday the rain subsided some and the river began falling." (SBF vol. 82, pg. 269).

This event, although not nearly as severe as the 1893 or 1890 events, resulted in considerable damage, especially in Riverside and West End. Lumbering was in full swing and much of the land had already been cleared.

"As it was the trestle of the Riverside Lumber Co. bridge to their bolt camp was carried away. Some land was washed away on Boyce & Mahoney's places in West End and considerable on the McCahan ranch on this side. At one time the river overflowed in an old channel back of Mr. McCahan's barn and about 9 or 10 inches was running in a current toward that low place back of the lake. Quite a current was running near Thad Smith's slaughter house into the creek, but no damage was done. In West End, the rapid current did

very little washing on the Mahan and Kelly ranches. After leaving the Kelly place, the current makes straight for the Indian rancherie on the Norton property and considerable land was washed away there. Misfortune to see his cabin go down stream together with a good deal of fencing along the river bank. Jack is now without a home and naturally feels bad over his ill luck." (SBF vol. 82, pg. 269).

Further down stream, very little damage was done. The A.&M.R. railroad bridge and the old county bridge at Vance's crossing were intact. A crew of men had to clear the drift from the pilings of the E.&K.R. bridge, some of which had been carried away. At Hannah's crossing, the new bridge stood the flood well. Some parts of the Arcata Bottom were inundated, but no damage was reported. (SBF vol. 82, pg. 269).

January, 1903 Storm Event

In January, 1903, another storm resulted in what was considered the highest flow in the past 6 or 7 years (SBF vol. 82, pg. 273). A record 5.10 in. of rain recorded at Eureka (AU, Jan.20, 1951). By this time, the lumber railroads were being laid out up North Fork, up Mad River to Canyon Creek, and Hall Creek.

On January 24, the Mad River was said to be running at bankfull (SBF vol. 82, pg.272). A report written on January 29 from Blue Lake is summarized below:

"A heavy rain of the last few days caused the creek that runs through the town to rise higher than has been known for years. Great excitement was caused yesterday (January 21) about 4 p.m. when the flume began to wash out and the banks to give way, causing the houses along the line of the flume to give way... In all, 4 buildings were damaged... The railroad bridge at Riverside went out entirely, but the county bridge at Korbel is still intact. A slide occurred just this side of Korbel causing the regular train to lay out in the storm during last night. The railroad to Canyon Creek has slides in numerous places which will take some time to repair. (WHT, Jan.29, 1903).

On the 29th the mills were all shut down on account of the water under them, but were able to start up the following morning." (WHT, Jan.29, 1903).

Winter, 1905-06: The January Flood, Janes Lagoon, and New Mad River Bridge

On December 2, the Mad River bridge being out of commission and the river was too high to ford at Shaw's crossing. (AU, Sat. Dec.2, 1905, pg.1).

An 8-15-year storm event occurred in the second week of January, 1906. Heavy rains and the melting of the snow on the high ridges was responsible for the freshet. A report on Wednesday, January 17 stated:

"The storm Monday and Monday night (January 15) was a bad one and immense quantities of rain fell, raising the streams higher than they have been for several years past. Mad River left its banks and Arcata Bottom was an inland sea on Tuesday morning. The road was entirely covered from the Higgins ranch to the county bridge and a boat was the only communication. The old bed of Mad River by the Robert Foster ranch was full of water which ran across the Bottom and emptied into the bay. Several feet of water stood in the barn of Schulyar Clark. The water came within 7 feet of the road bridge over the river at Hannah's crossing and considerable drift was coming down..."

"Reports from Korbelt stated that although while the water was very high, no particular damage was reported. A bad slide occurred on the logging road on main Mad River but as no logs were being hauled at the present time, the road would not be cleared until the storm was over..."

"The O & E train only went as far as Essex on Tuesday morning, but expected to go through alright in the afternoon. No particular damage was reported there but there was too much water running over the tracks to permit a transfer. A tree had fallen across the track but was quickly removed." (AU, Jan.17, 1906).

The breakwater at the site of the 1890 Sheppard cut (Brk 6, fig. 6) also suffered damage. A report from lower Mad River on the afternoon of January 16 stated that

"the breakwater which was put in in the Glasson place was not holding out against the high water as well as was expected, and was washing out badly in places. Considerable fencing was washed out, and the drift had been floated up into the fields at several points." (AU, Jan.17, 1906).

On Arcata Bottom, the Carson Road (Humboldt Meridian line, later to become the Hammond Railroad) was washed out due to the flooding. According to Neils Lorenzen, the road formed a dyke and when the overflow from the river struck it, it backed up and could not escape into the bay. When the pressure became too great, the road bed washed out in several places. The railroad crew attempted to stem the current with brush "but were not able to do much against the rush of the waters." (AU, Jan.17, 1906).

By January 20, the waters subsided but not before extensive damage rendered the breakwater (Brk 6) useless.

"While Mad River was again out of its banks on Thursday evening (January 18), Friday morning found the water down again...It was reported Friday morning that considerable water was running down the road from the William Turner place west and travel in that vicinity was suspended for the time being. The breakwater at Glasson's also suffered damage and will have to be rebuilt. At the county bridge at Mager's, a big cut in the bank was being made by the water where the road had been cut to haul gravel up from the river bed. This place may give trouble later on, and if it cuts too deeply will threaten the south approach to the bridge."

During late summer, 1906, an irrigation project was undertaken on Janes Creek at Aldergrove. On August 25, the Arcata *Union* reported on the project.

"A drainage ditch about 3/4 mile in length, 3 feet wide at the bottom, and varying in depth from 2 feet. The old Janes lagoon is among the bodies of water to be drained by the ditch besides the other creeks and swamps in that vicinity. The property of John Roth and N. Falk the other side of the railroad is swampy and covered with pine timber and underbrush and which will make good farming land when drained and cleared up. (This area) is under water most of the year. (AU, Aug. 25, pg.1).

By September 22, the Janes Creek Canal was completed. It was said that the successful completion of this enterprise meant much to the people owing land between Alliance Road and Mad River and it gave them all "a chance to drain their land directly into the bay."

A new bridge spanning the Mad River near Prigmore Crossing was built between 1905-06 and was completed by September 1, 1906. (AU, Sept.1, 1906).

January, 1907 Flood

Early January, 1907 brought yet another storm that resulted in considerable damage in West End and on Arcata Bottom.

"The storm of Thursday afternoon and night (January 3) was one of the most severe we have experienced in a long time and the wind blew at a terrible rate for several hours. A number of fences in town and on the Bottom went down... and a small shed on the McMillan place south of the plaza collapsed. The records at Eureka show that 2.24 inches fell of rain during the storm. On Friday morning (Jan.4), it was reported from Mad River that the stream was at bankfull and raising rapidly with a chance that it would be out of its banks by night if any more rain fell. It was running full of logs and drift." (SBF vol. 82, pg. 273).

In an account dated February 9, 1907, 80 hours of rain was reported, and the river at Blue Lake once again changed course. (SBF vol. 82, pg. 273).

February, 1907: "A Big Storm and High Water Follows"

The recurrence interval of this flood was on the order of 15-25 years (Scalici, 1993). After raining for several days in the last week of January, a major flood occurred doing severe damage as the following account attests:

"The storm broke into a good old fashioned one on Friday, (February 1), and on Saturday morning reports reached town that Mad river was out of its banks, and all smaller streams following out over the country. The river fell some that day and Sunday (February 3) when the flood gates of the heavens

were seemingly thrown open wide and a down pour visited us that brought the water up to the high water mark of 1890, and Mad river poured over its banks from the old bed of Mad river at the Falor ranch, at the Shepperd place and again swept things before it at the Glasson place." (AU, Sat.Feb.9, 1907)

The water again rushed across the ranches from the Falor place to the Mad river slough but did no further damage than to take out considerable fencing. But this loss was "more than made up by the large deposits of silt spread over the pastures and fields." (AU, Sat.Feb.9, 1907)

"The water across the road at Henry Biddings place and the ranch leased by Bert Caston, was nearly 5 feet deep, and both of these gentlemen perhaps lost more fencing than anyone else with the exception of Matt Kjer, and it was on the north boundry of this ranch west to the Glasson place where most havoc was brought by the mad rush of waters of old Mad river." (AU, Sat.Feb.9, 1907)

The damage here was all on the floodplain and not to the banks, as the rip-rap work and levee built along and on the ranches (Brk 5 & 6) "stood the ordeal with no damage to speak of." At this point Mr. Kjer had several hundred feet of new fencing washed away, and the county road was badly washed out, cut up and covered with drift at a point opposite the Canal schoolhouse. Beyond here the road was impassable "on account of a big hole washed out right in the middle of the highway." (AU, Sat.Feb.9, 1907)

On the O. & E.R.R. trains were delayed for a few hours on account of high water in Lindsay Creek, and other than a few slides in the fill along the old Vance pond site, no damage was reported. On the A. & M. R.R., no damage on the main line was reported, but on the logging road to Canyon creek a good deal of trestle would have to be rebuilt, as a section man stated to a Union man that "3 to 5 bents would have to be replaced in about one dozen trestles." (AU, Sat.Feb.9, 1907)

The storm was prolonged and severe, though not cold, and it was thought that the county was the heaviest loser, as it would "take hundreds of dollars to place the roads in proper condition again." (AU, Sat.Feb.9, 1907).

March, 1907 Rain-on-Snow Event

This storm probably brought a good deal of snow to the mountains. A rain-on-snow event in March resulted in "a stage higher than at any other period since February, 1890" and was called a "raging torrent." (SBF vol. 82, pg. 279). March 16-17, Mad River left its banks but did little damage."

For the second time in three months, Humboldt had a freshet, and the early part of the week, conditions in the vicinity of Mad river, from the county bridge to the mouth looked "rather squally." The heavy rains of March 16 and 17, started logs booming, and the water reached its highest point about 10 o'clock Sunday morning, the 17th. At the Sheppard & Hammerdiener store on the river, the marks showed that the water did not reach as high a point as in January, but on the other side it seemed higher, on count of the water cutting a channel through above the Mager place and allowing a large volume of water to flow across the bottom. The water was flowing rapidly over the breakwater at the Sheppard ranch, and John Olsen of Warren Creek who was on his way to Dows Prairie in a cart, narrowly escape from drowning at that point. He attempted to drive along the road, when his horse was swept off of its feet, and then carried down against some willows. Olesen was thrown out, but managed to get hold of a fence post, where he was to remain until nearly an hour later. (AU, Mar.23, 1907).

No great damage had been done by the water except to wash some soil "as if a ploughed field" on the Mager place. A quantity of silt and driftwood was deposited here, and destroy a number of fences. At the Glasson ranch, the river ran through a low place and across the road as it did in January, but did not do as much damage to the place as the former freshet did. (AU, Mar.23, 1907).

An account dated April 12, 1907 reported that the river was changing its course on Arcata Bottom and described with detail the erosion that took place.

"Unless the appropriately named Mad River becalms itself and its treacherous waters became less cutting next year, what is now the river bar from above Hannah's crossing down to the William Turner's place on Arcata Bottom will be but a rocky waste of unproductive ground and the river will cut its way though a new channel, a half mile south of the present course, rendering valuable lands, wagon roads and a big county bridge worthless, says the Herald. In fact, it is almost assured that the river will change its course within the next year or two, and already property owners along that section of the valley are making preparations for the change. The change in the river bed will involve a loss of hundreds of thousands of dollars to the owners of the land in the most productive section of the Arcata Bottom. Even now, the river has cut through to such an extent that during every high water this winter, a

great quantity of the river's water has run through the new course, making roads unusable and even shutting the children away from the Canal Schoolhouse."

"At the point where the new river bed crosses the county road running from Arcata to Hannah's crossing, the water at this writing is up to the hubs of a wagon. Whenever the water becomes low, the river runs back through the old channel, but it is thought that next winter the entire course of the river will be changed unless some work is done this year by the county to protect the banks."

"The river has made its cut about 200 yards above the county bridge at Hannah's crossing, which is situated opposite the Joseph Mager residence. From this point the new course runs south a half mile, then west a mile and a half, and then north, running back into the old channel at a point just above the William Turner home. The new river bed will cross the county road at a point a half mile south of the Mager home. The new course, as outlined above, carried quite a body of water during the March storm and considerable water during Friday, Saturday, and Sunday last week (April 5-7). The water has left its mark by huge piles of sediment and debris along the route."

"At the point where the water cut away from the regular channel above Hannah's crossing, a cut is left large enough for several teams to drive through abreast. The new course will traverse land owned by Joseph Mager, the Shepard ranch, Robert Foster, and William Turner. Also the land owned by David Boyd, Thomas Brogan, Stewart Foster, George Glasson, Andy Kirkpatrick, and M. Bognuda will be directly affected to a great degree by the changing river course. While these farmers mentioned will suffer the greatest loss from the changing stream, and they have already suffered considerable loss, the county will also be a big loser. The county bridge which spans Mad River at Hannah's crossing will be over a barren waste of land, and another bridge will have to be constructed across the new river bed at big expense. New roads will also have to be built and new rip-rapping done. The Arcata Bottom farmers are preparing to take the matter of changing river course up with the county supervisors in an effort to have the rip-rapping work done this summer which may possibly forestall the cutting of the river any further." (FE, April 12, pg. 1 col.4).

Property Owners along Mad River Seek State Aid for Protection From Flooding, 1910-11

In late December, 1910, at the request of a number of lower Mad River ranch owners, Assemblyman William H. Kehoe of Eureka, under the chaperonage of William Turner and A.N. Hunt, visited and inspected about 5 miles of the river bank, viewing the protective work done in the past, and making a careful examination of the weak places threatened by flood waters. (AU, Jan.7, 1911, pg.4).

As a result of the visit, which drew Mr. Kehoe's attention strongly to the needs of the river, Kehoe agreed to introduce a bill asking for an appropriation, and in order to bring the matter before the California Legislature in regular form, a petition was prepared and circulated

by Turner, and was forwarded to Mr. Kehoe at Sacramento. The document bore the names of more than 300 free holders and voters of the 2nd Assembly District, and Mr. Turner "would have no trouble in securing many more, except that he was anxious to lose no time in sending the petition to Sacramento." The document stated that thousands of dollars had been spent, both by the county and by private owners in building protective work along Mad River, and that while the work was proving a protection for the time, the property owners had "spent about all they can spare," and unless state aid was obtained, much of the work already done would be "rendered useless and valueless, as the work needed to be taken up upon a much more extensive scale." It called attention to the fact that no state money has ever been spent on Mad River, and that unless something was done, there is a possibility that many acres of valuable land upon which state and county taxes are now being paid will be swept into the ocean." The article went on to say:

"The principal point of danger to which Mr. Kehoe's attention was drawn was the low place on the Robert Foster ranch of which Peter Damgaard is the renter, which is known as 'the old bed of Mad river.' At this point there is always danger of the river breaking over, and if it should do so, it would follow the old water course and run into the bay, doing untold damage to the rich lands of Arcata bottom. Considerable work has been done at this point in years past, but almost every winter the same danger threatens, making it necessary to be constantly spending money upon it."

"The protective work done along the south bank of Mad river in the past has been most effective, and at the same time simple- rock, willow brush, and boxes filled with rock being used principally. Very little piling, concrete or wire cable work have been put in, yet a number of the rock and willow dykes with willow trees growing up in them, have attained a degree of permanency which could well be imitated on Eel River, where a large part of state money was spent on work which failed to stand the first raise of river. (AU, Jan.7, 1911, pg.4).

Mr. Turner was one of the property owners who has spent considerable money in protective work, and in December completed a piece of work a quarter a mile in length on his lower ranch, which cost him about \$2500. Mr. Turner had expended about \$8000 in protective work in years past, and had also assisted in other work at points above his property. The other property owners with the help of the county also expended "a like sum," and it was clear that landowners felt strongly that the state should step in and "render some aid upon the proposition that the Lord helps those who help themselves." (AU, Jan.7, 1911).

The property owners along Mad River felt they were entitled to state protection, especially the property owners had done so much for themselves. Mr. Kehoe agreed to interview Governor Johnson on the matter, and if he were to sign a bill for an appropriation without having the property owners put up a like amount, Mr. Kehoe would ask for an

appropriation of from \$20,000 to \$25,000. If the Governor does make this restriction, the bill would be introduced for \$15,000 or less. Senator Cutten had also agreed to take up the bill in the Senate if it passed the Assembly. (AU, Jan.7, 1911, pg.4).

Dec.31, 1913-Jan.2, 1914 Rain-on-snow "High Water Causes Some Damage."

Once again, rain-on-snow resulted in heavy flooding. The bulkhead at the Sheppard place (Brk 6) was damaged as flood waters undermined it. Reports of high tides could be found all up and down the coast as high storm surges coupled with El Nino resulted in considerable damage to coastal areas (Scalici, 1993).

"Mad River was true to name Wednesday afternoon and Thursday of last week, (December 31-January 1) and the long downpour of warm rain, augmented with a heavy supply of snow on the mountain rages sent the river out of its banks, in the lower section, causing considerable damage to ranches and river banks."

"The bulkhead at the Sheppard Place, which was put in more than 20 years ago, gave away under the strain and the water rushing across the ranches between there and the low lands adjacent to the Mad River slough, carried away yards of fencing, and washed some fields bare, while in teh immediate vicinity of the break, much drift was strwen over the ground." The extensive piece of rip-rap work put in on lower Mad river by William Turner 2 years ago, was damaged considerably by settling, though it is still there, for a foundation for future work. Between the fish camp and the famous Bull Moose Camp the water went over the bank and piled up an enormous lot of drift and logs, completely blocking the road for traffic." (AU, Jan.8, 1914).

Piles of drift afforded crews of men much material to work with, rolling out the logs and drift on the county road on lower Mad River and repairing the break at the Sheppard place. (AU, Jan.8, 1914).

The levee put in near the Canal school house the previous autumn to protect the county road, stood the test, and no water came over the bank at that point. The rip-rap put in recently at the Glasson place stood the test, and was not damaged. The entire reclaimed section about the head of the Mad river slough was under water until Friday (January 2), and while a few haad of stock was drowned, no other damage was reported. All the bridges across Mad river survived the storm (AU, Jan.8, 1914).

In Blue Lake, it was said that "Mad River reached its highest mark in 20 years at least and many believe its highest level since the founding of Blue Lake around 2 p.m. on December 31, but during the night it started to drop"..There was still considerable snow in the

mountains. Along the river, no fences or temporary structures were left standing, but the danger was not considerably heavy." (HS, Jan.1, 1914).

On February 26, 1914, an article appeared in the *Union* suggesting that county and state money be appropriated to repair the damage to the banks of Mad River. The following are excerpts of that article.

"MAD RIVER LAND OWNERS SHOULD GET BUSY. For several years past it has been evident that unless something is done in the way of protective work along the banks of Mad river to continue the flood waters and to prevent cutting, in a number of places, considerable damage could ensue, and the action of old Mad river during recent high water, the largest in many years, has proved the correctness of this conclusion. At the Sheppard place above the lower Mad River road bridge, the river went through in heavy volume and the bottom ranches for a mile or more were covered with water for several days. Fences were washed away, drift wood deposited and considerable damage was done to both the ranches and the county wagon road. The river bank was also cut badly in several places and on the William Turner ranch, near the mouth of the river, considerable damage was done making it necessary for Mr. Turner to get out with a crew of men, and with bags of sand, brush, and trees tied with wire cables, combat the destructive effect of the swift current which he was successful in doing." (AU, Feb.26, 1914).

The *Union* writer talked with Supervisor Rasmus Anderson, who had also been interviewed by several of the interested property owners, and Mr. Anderson stated that he would take the issue up at the next meeting of the Board to see if the county could not help the property owners in raising the money to do the work. If it would be possible for the county to join in with the property owners on the 'dollar for dollar' basis, it would take \$2.00 from the state treasury, for every \$1.00 put in by the property owners. The county was interested in two ways, one in helping to protect valuable ranches upon which taxes are being paid, and the other to protect the county wagon roads, which were more or less injured every time the river overflowed. (AU, Feb.26, 1914).

Work to Fix Flood Damage: Summer, 1914

This last flood resulted in the onset of more bank stabilization work on the river along reach 4. The money for this work was put up by the State of California, the County of Humboldt and the individual ranchers and owners, both those living along the banks, whose property is in danger from cutting, and those living further away, whose places are liable to damage from the river leaving the banks and flowing over the bottom lands into the bay, as it did the previous winter (AU, Sept.3, 1914). By the summer, rip-rap work on Mad River was progressing rapidly. The following article was published in the *Arcata Union* on September 3, 1914.

"For some weeks past crews of men with a number of teams have been at work at several points on Mad river putting in substantial rip rap work where the high water of last winter did considerable damage and threatened to do more the coming winter. The first work done on the lower river was along the upper part of the William Turner ranch opposite Tyee City where the angry waters of last winter undermined the protective work done some years ago, and took out quite a section of the bank. The destructive work at this point was prevented during the high water by some quick emergency work on the part of Mr. Turner and crew, and bags of sand, trees, etc., were thrown in the breach to prevent further washing."

"Considerable work had been previously done at this point by the county and Mr. Turner, and the present job, when completed, should certainly afford ample protection. Henry Biddings with a crew of men has been busy laying brush along the curve commencing at a point several hundred yards above where the bad break occurred and ending some distance below it. A heavy mat of large spruce limbs and other brush has been laid along the bank reaching well out into the stream, and upon this brush heavy rock will be laid. The brush work at this point was completed the latter part of last week, and the crew was transferred to the Andrew Olson place above the Carson railroad bridge where a similar piece of work, also under Mr. Biddings, has been in progress. The old landing a short distance below the Carson bridge where several half rotted spiles stood, was also was a danger point, and the wood work was blown out with dynamite and a small piece of rip rap work done here."

"Chris Kjer has taken the contract for getting out the rock, which will be obtained from the old Hannah quarry across Mad river. It is from this quarry that the rock for the Seal Rock Lighthouse was obtained some years ago, and an immense quantity of waste rock was quarried and left on the ground. Most of it is too large to load on wagons, and Mr. Kjer will blast into suitable sizes for handling, and will load the large ones on the wagons with hand winches."

"The rock will commence to move in a few days, the brush work having practically been completed and by winter time the worst places on the bank will be in pretty good shape. Ben Chaffey, with a crew, has also been doing some necessary work along the Sheppard place where the river over flowed last winter, and a more detailed mention of this piece of work will be made in a later issue."

"The money for this work is being put up by the State of California, the County of Humboldt and the individual ranchers and owners, both those living along the banks, whose property is in danger from cutting, and those living further away, whose places are liable to damage from the river leaving the banks and flowing over the bottom lands into the bay, as it did last winter. Some years ago, \$10,000 was appropriated for the protection work on Mad river with the understanding that the state money could be drawn out 'dollar for dollar' when the property owners started a fund. Supervisor Anderson also agreed to have the county put up a dollar for every one the property owners raised, which makes \$4.00 to be expended from three sources for every \$1.00 the property owners themselves put up. Sufficient money was raised in this manner to successfully prosecute the work as outlined and there still remains a substantial sum in the State treasury for further work." (AU, Sept.3, 1914).

The town of Blue Lake was continuing to expand and on May 2, 1914, a foot bridge across Mad river from Blue Lake was built by the citizens of Blue Lake. "It will be quite an accommodation to the people of West End wishing to come here at any time."

In March, 1915, minor flooding was reported but little damage occurred. On October 9, 1915, Blue Lake was dry and water levels were low in tank (SBF vol.68, pg.23).

1917 - 1925, Drought and the Onset of Bed Lowering

With drought conditions, recruitment of sediments into the project reaches was reduced, since the large flood events transport sediments. Although a few minor floods were reported during this period, it appears that the river bed reached its highest level and would soon start degrading. In late February, 1917, the Mad River was 2 feet lower than in 1915. Mad River was high but no damage was reported. (SBF vol. 82, pg. 285).

In November, 1920, the recent raise in the river cut out a bar at the mouth, making a deep channel, which, it was said, "permitted the fish to come in at almost any stage of the tide and allowed an extreme runout" (AU, Nov.4, 1920). This event, and probably others to follow, flushed lower Mad River of the small sediments that had been transported in years past.

The third week of February, 1921, brought a minor flood which caused heavy damage to the Northern Redwood Lumber Company at Korbel. The bridges at Riverside and Canyon Creek were carried away, as were bridges near the mill. (AU, Feb.20, 1921).

High water was reported on February 20, 1922 and "drift was coming down fast," many big logs were seen. (AU, Mar.2, 1922).

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